

## ACCESSORIES AND BODY, CAB

### Audio, Navigation And Anti-Theft - Repair - All I3 Models - i3

## RADIO, AUDIO AMPLIFIER, HEADUNIT

### 65 12... INSTALL THE CORRECT NAVIGATION MAP (AFTER REPLACING THE HEAD UNIT AS FROM 07/2015)

Install the correct navigation map depending on the validity of the customer subscription after having replaced the head unit for vehicles with a production date as from 07/2015.

*Different cases:*

Customer subscription is **still valid** :

- Install the most recent navigation map.

Customer subscription has **expired** :

- Check when the customer subscription expired\*.
- Install the navigation map applicable on the expiry date.

The customer subscription has **expired**. **After the expiry** of his/her subscription, the customer **purchased a newer version of the navigation map** ("One Time Update"):

- Check which navigation map was installed most recently.
- Install this navigation map

*\* The information required to determine the term of the customer subscription is available in the following path:*

#### BMW Aftersales Information Research (AIR)

- - Navigation map

The following table is displayed in the "Navigation map" menu:

Installed map (Status with date)	Enabling code (Subscription)	Free update	Update subject to a charge
In this field the currently installed map with year specification is displayed. (E.g. navigation map Europe 2015)	Displayed in this field is: <ul style="list-style-type: none"><li>• Validity of the subscription (E.g. valid until 31.10.2017)</li><li>• or an enabling code for "One Time Update"</li></ul>	Displayed in this field is: <ul style="list-style-type: none"><li>• During a valid subscription of the current, free enabling code</li><li>• The last functional, free enabling code is shown if the subscription or "One time update" has expired</li></ul>	Displayed in this field is: <ul style="list-style-type: none"><li>• The field is empty during a valid subscription</li><li>• The next available, most recent enabling code subject to a charge if the subscription or "one time update" has expired</li></ul>

### 65 12 220 REMOVE AND INSTALL (REPLACE) THE SATELLITE RADIO (SDARS), (US VERSION FROM 09/2009 ONLY)

Necessary preliminary tasks:

- Remove **HEADUNIT**

When replacing, please observe:

Note SID number (1) of the removed device.

**NOTE:** The SID number (1) can be found on the label of the housing. Location may be different, depending on the equipment manufacturer.

Note SID number (1) of the new device in the same way.

Input the enabling code obtained via BMW.



**Fig. 1: Identifying SID Number**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **PROGRAMMING/ENCODING**.

**NOTE:** Please contact Sirius. Use the SID number to cancel current device and register new one.

## 65 12 315 REMOVING AND INSTALLING (REPLACING) HU-H)

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed **prior to starting work** :

De-energize the **HIGH-VOLTAGE SYSTEM**.

Observe **SAFETY INFORMATION** for handling hybrid cars.

**Attention!**

Risk of damage!

There is a hard disk installed in the headunit.

Carry out mechanical work on the headunit and adjacent components with care.

Avoid subjecting the headunit to vibration/shocks.

**Attention!**



**NOTE:** Comply with notes on HANDLING OPTICAL FIBRES .

Necessary preliminary tasks:

- Remove REAR SEAT
- Clamp off BATTERY EARTH LEAD .

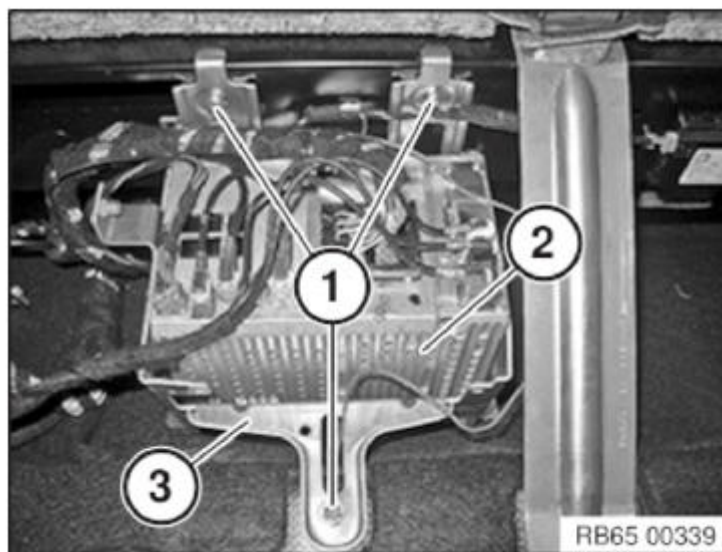
Release screws (1).

Unlock and disconnect all plug connections on headunit (2).

Remove headunit (2) with holder (3) upwards.

*Installation note:*

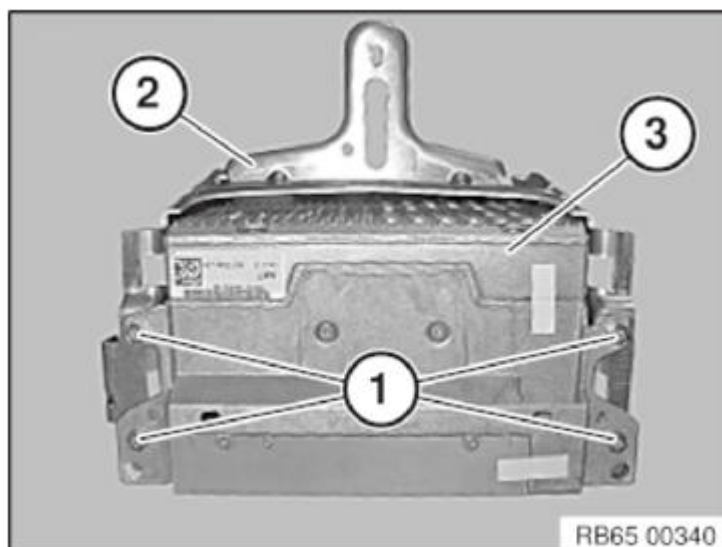
Remember ground cable on two screws.



**Fig. 2: Identifying Headunit, Plug Connections, Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Remove holder (2) from headunit (3).



**Only for US models with satellite radio:**

When replacing the headunit, additional work is required!

- Refer to **REPLACING SATELLITE TUNER, AS OF 09/2009**.

**Replacement:**

Carry out **PROGRAMMING/ENCODING** .

**ON VEHICLES WITH A PRODUCTION DATE AS FROM 07/2015, INSTALL THE CORRECT NAVIGATION MAP.**

**Importing the Service history:**

- Maintenance and Pre-Delivery Check
- Service history

**65 12 320 REMOVING AND INSTALLING (REPLACING) HEADUNIT BASIS**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed **prior to starting work** :

De-energize the **HIGH-VOLTAGE SYSTEM** .

Observe **SAFETY INFORMATION** for handling hybrid cars.

**Attention!**

Risk of damage!

There is a hard disk installed in the headunit.

Carry out mechanical work on the headunit and adjacent components with care.

Avoid subjecting the headunit to vibration/shocks.

**Attention!**

Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

**NOTE:** Comply with notes on **HANDLING OPTICAL FIBRES** .

**Necessary preliminary tasks:**

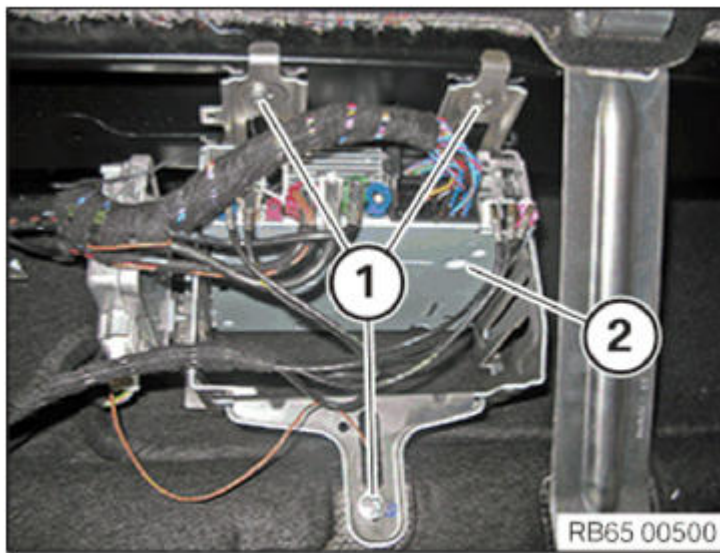
- Remove **REAR SEAT**
- Clamp off **BATTERY EARTH LEAD** .

Release screws (1).

Unlock and disconnect all plug connections on headunit (2).

*Installation note:*

Remember ground cable on two screws.

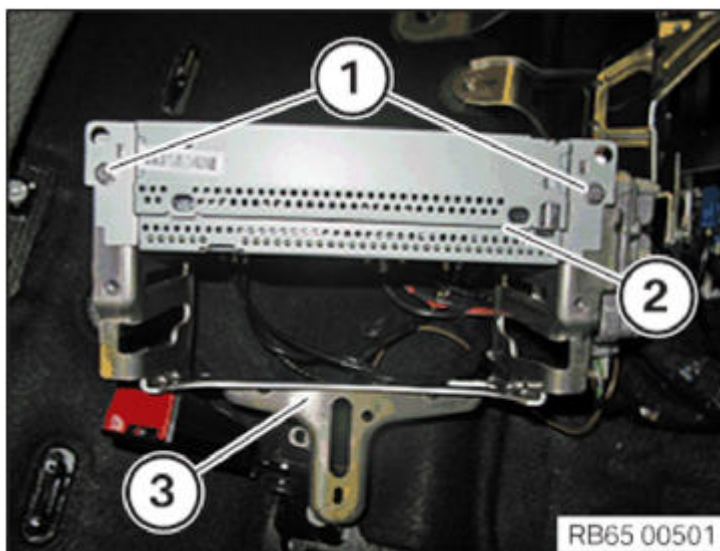


**Fig. 4: Identifying Headunit And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Turn headunit (2) over.

Release screws (1).

Remove headunit (2) from holder (3).



**Fig. 5: Identifying Headunit, Holder And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Only for US models with satellite radio:**

When replacing the headunit, additional work is required!

- Refer to [REPLACING SATELLITE TUNER, AS OF 09/2009](#).

**Replacement:**

Carry out [PROGRAMMING/ENCODING](#) .

**Importing the Service history:**

- Maintenance and Pre-Delivery Check
- Service history

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed **prior to starting work** :

De-energize the **HIGH-VOLTAGE SYSTEM** .

Observe **SAFETY INFORMATION** for handling hybrid cars.

Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

**NOTE:** Comply with notes on **HANDLING OPTICAL FIBRES** .

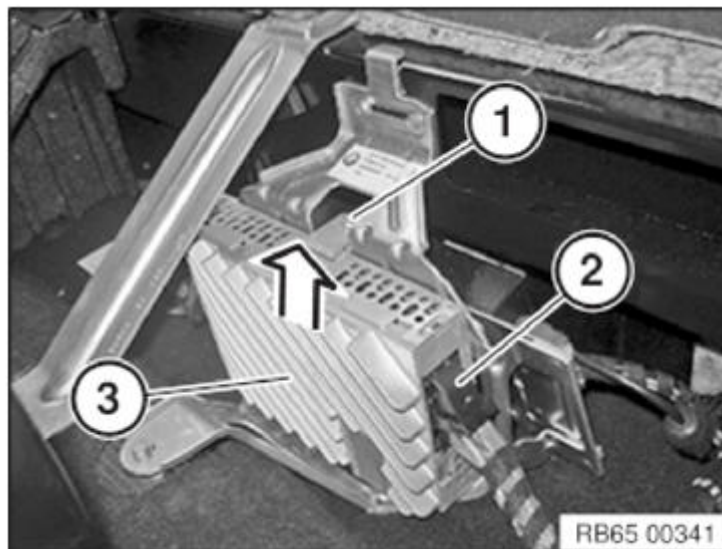
**Necessary preliminary tasks:**

- Disconnect **BATTERY EARTH LEAD**
- Remove **REAR SEAT**

Release screw (1).

Unfasten plug connection (2) and disconnect.

Remove amplifier (3) in direction of arrow.



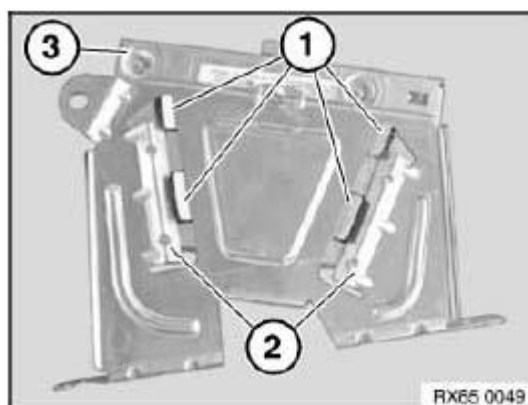
**Fig. 6: Removing Amplifier**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Lugs (1) must be correctly slid into guide (2).

Check that amplifier (3) is securely seated.



## Replacement:

In Harman Kardon version, perform VEHICLE PROGRAMMING AND ENCODING .

## 65 12 355 REMOVING AND INSTALLING/REPLACING FAN

*Necessary preliminary tasks:*

- Remove REAR SEAT

Unfasten plug connection (1) and disconnect.

Unlock catch (2).

Remove fan (3) in direction of arrow.

*Installation note:*

Make sure fan (3) is seated correctly.

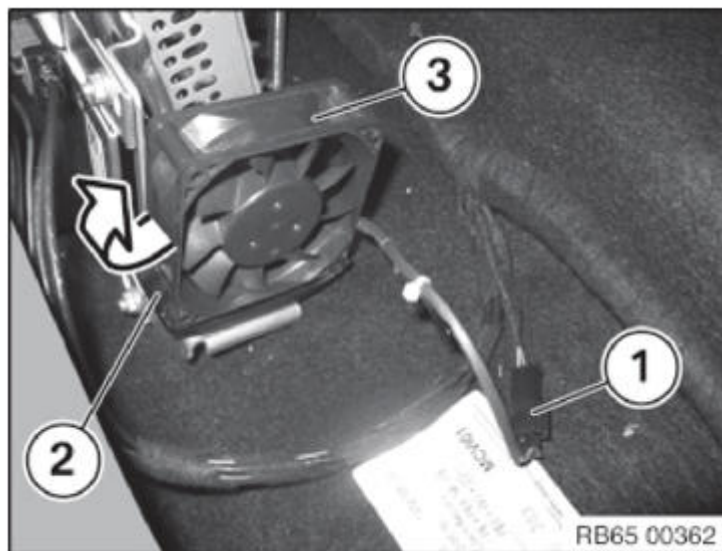


Fig. 8: Removing Fan

Courtesy of BMW OF NORTH AMERICA, INC.

## SPEAKER AND COVER

## 65 13 320 REMOVING AND INSTALLING/REPLACING LEFT BASS SPEAKER

*Necessary preliminary tasks:*

- Remove FOOTWELL TRIM PANEL ON LEFT A-PILLAR
- Remove TRIM PANEL FOR PEDAL MECHANISM

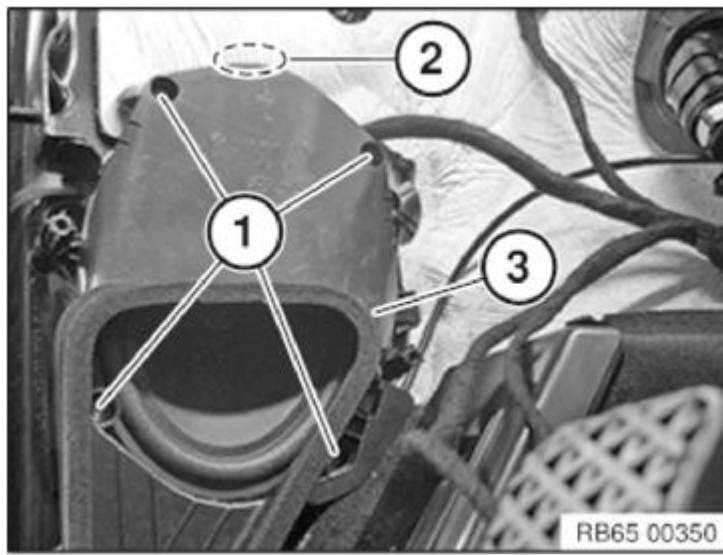
Release screws (1).

Unlock catch (2).

Remove sound guiding (3) with central bass speaker.

Unlock associated plug connection and disconnect.





**Fig. 9: Identifying Sound Guiding, Catch And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**65 13 080 REMOVING AND INSTALLING/REPLACING REAR TWEETER (IN DOOR TRIM PANEL)**

*Necessary preliminary tasks:*

- Remove **REAR DOOR TRIM PANEL**

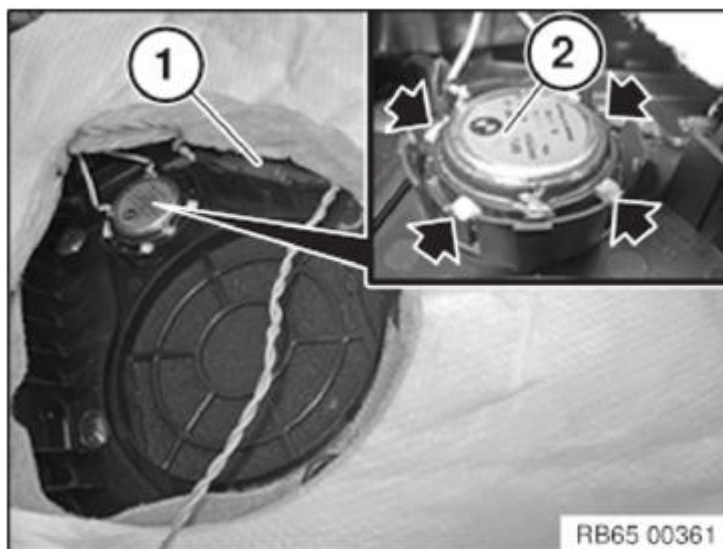
Unclip resistor (1).

Unlock latches at marked points.

Feed out tweeter (2).

*Installation note:*

Latch mechanisms must not be damaged Make sure tweeter (2) is securely seated.



**Fig. 10: Locating Tweeter Latch Mechanisms**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**65 13 322 REMOVING AND INSTALLING/REPLACING RIGHT BASS SPEAKER**

*Necessary preliminary tasks:*

- Remove **FOOTWELL TRIM PANEL ON RIGHT A-PILLAR**
- Remove **PASSENGER'S SIDE FOOTWELL TRIM PANEL**

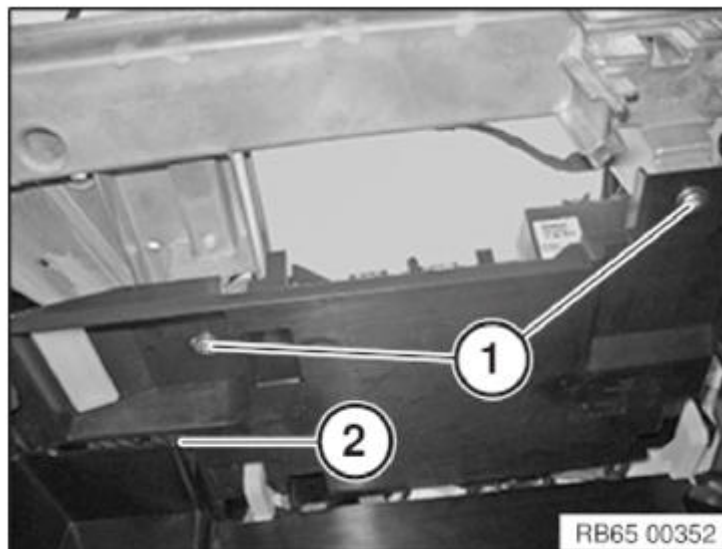
Release screws (1).



**Fig. 11: Identifying Right Bass Speaker Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Disengage power distribution box (2) from hinges and put to one side.



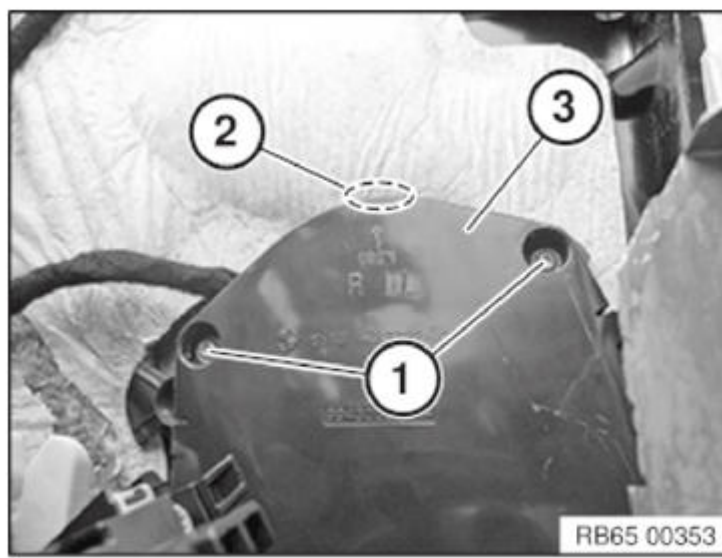
**Fig. 12: Identifying Power Distribution Box And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Unlock catch (2).

Remove sound guiding (3) with central bass speaker.

Unlock associated plug connection and disconnect.



**Fig. 13: Identifying Sound Guiding, Catch And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**65 13 050 REMOVING AND INSTALLING/REPLACING SPEAKER (A-PILLAR TRIM PANEL)**

*Necessary preliminary tasks:*

- Remove **TRIM PANEL FOR ROOF PILLAR**

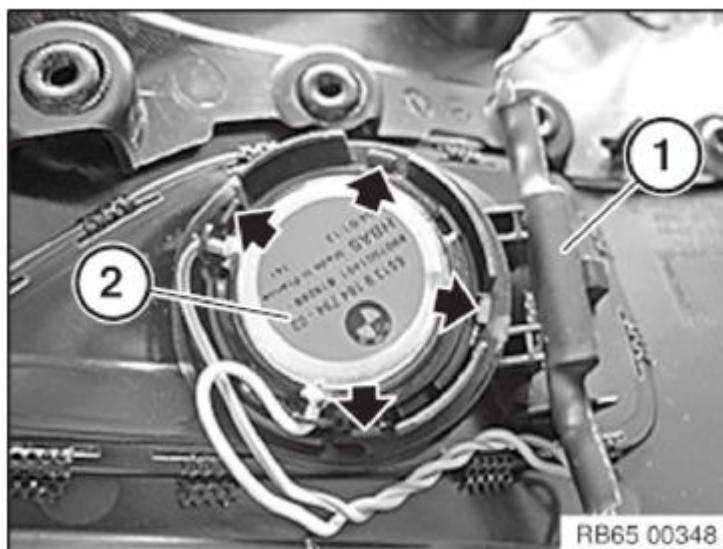
Unclip resistor (1).

Unlock latches at marked points.

Remove tweeter (2).

*Installation note:*

Latch mechanisms must not be damaged



**Fig. 14: Locating Tweeter Latch Mechanisms**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**65 13 090 REMOVING AND INSTALLING/REPLACING SPEAKER (MID-RANGE SPEAKER IN REAR DOOR)**

*Necessary preliminary tasks:*

- Remove **REAR DOOR TRIM PANEL**

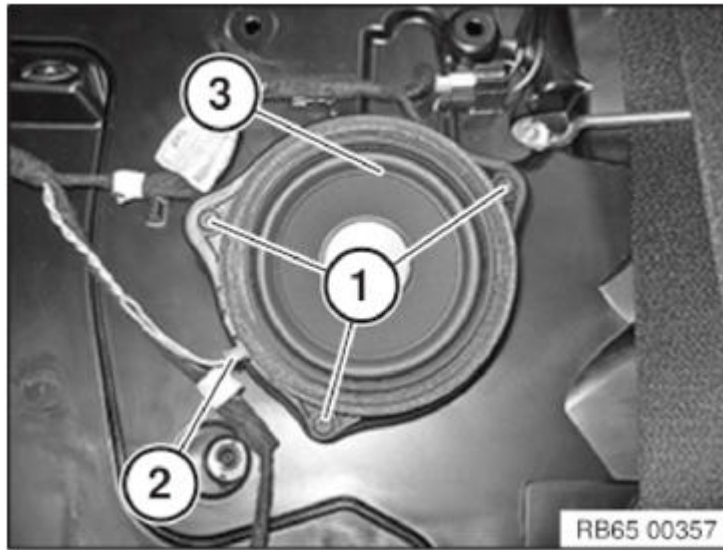


Release screws (1).

Tightening torque [65 13 3AZ](#) .

Unfasten plug connection (2) and disconnect.

Remove mid-range speaker (3) from inner door panel.



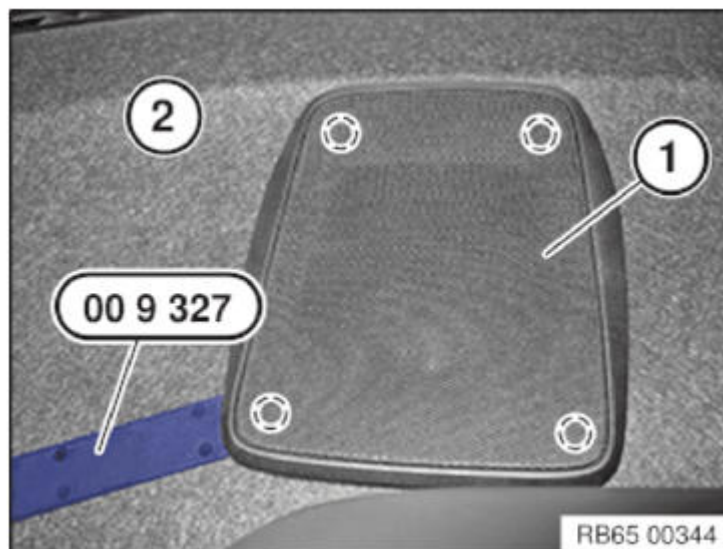
**Fig. 15: Identifying Mid-Range Speaker, Plug Connection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**65 13 060 REMOVING AND INSTALLING/REPLACING SPEAKER (MID-RANGE SPEAKER, IN INSTRUMENT PANEL)**

Special tools required:

- [00 9 327](#)

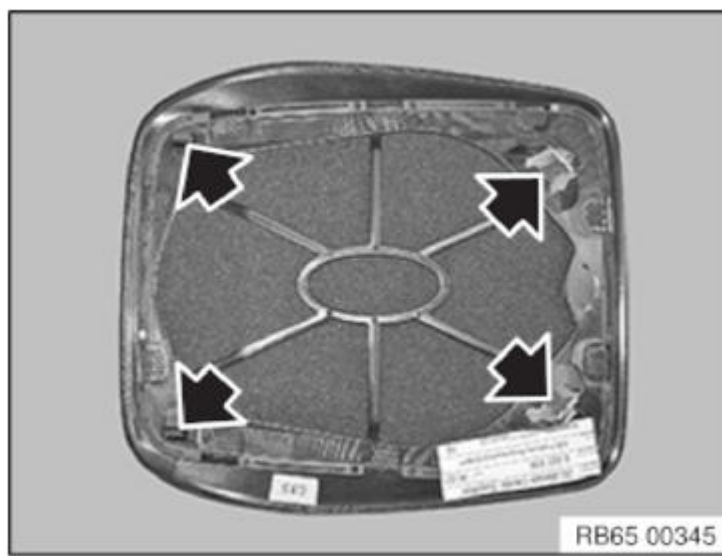
Unclip trim (1) with special tool [00 9 327](#) from latch mechanisms and remove upwards.



**Fig. 16: Unclipping Trim With Special Tool (00 9 327)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

Retaining lugs and clamps at marked points must not be damaged.



**Fig. 17: Locating Trim Retaining Lugs And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

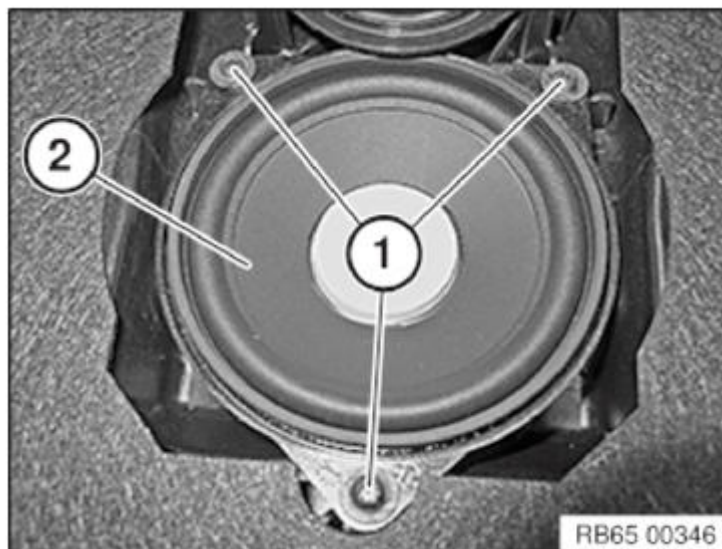
Release screws (1).

Tightening torque [65 13 04AZ](#) .

Remove mid-range speaker (2) upwards from dashboard.

Disconnect plug connections underneath.

Remove mid-range speaker (2).



**Fig. 18: Identifying Mid-Range Speaker And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **65 13 062 REMOVING AND INSTALLING/REPLACING SPEAKER (TWEETER, IN DASHBOARD)**

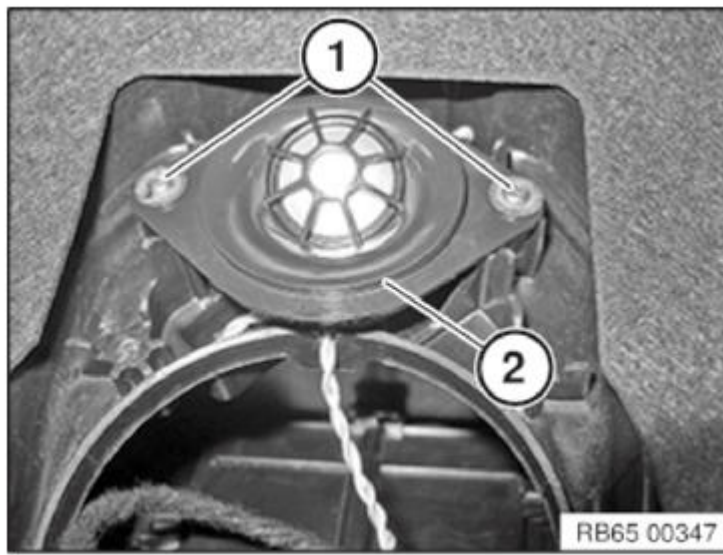
*Necessary preliminary tasks:*

- Remove [MID-RANGE SPEAKER](#)

Release screws (1).

Tightening torque [65 13 05AZ](#) .

Remove tweeter (2) with resistor upwards out of dashboard.



**Fig. 19: Identifying Tweeter And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**65 13 070 REMOVING AND INSTALLING/REPLACING SPEAKERS (MID-RANGE SPEAKER, FRONT DOOR LEFT AND RIGHT)**

*Necessary preliminary tasks:*

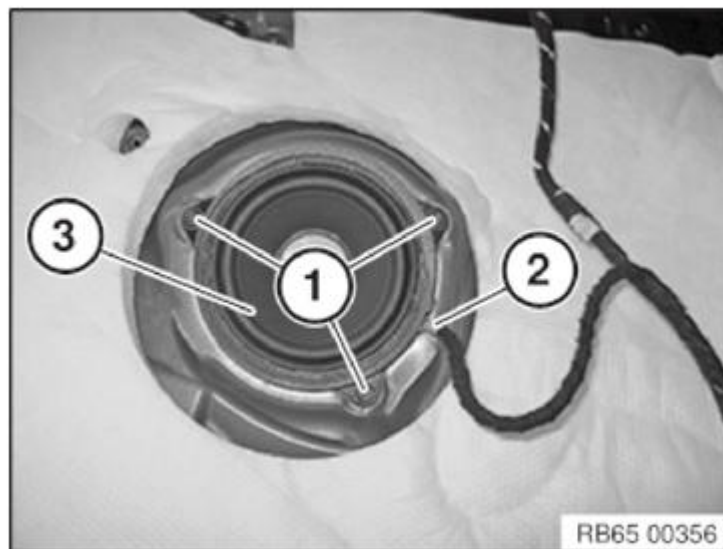
- Remove front **DOOR TRIM PANEL**

Release screws (1).

Tightening torque **65 13 1AZ** .

Unfasten plug connection (2) and disconnect.

Remove speaker (3) from inner door panel.



**Fig. 20: Identifying Inner Door Panel Speaker, Plug Connection And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**AERIAL, INTERFERENCE SUPPRESSION FILTER**

**65 20 090 REMOVING AND INSTALLING/RENEWING AERIAL AMPLIFIER (AERIAL DIVERSITY)**

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

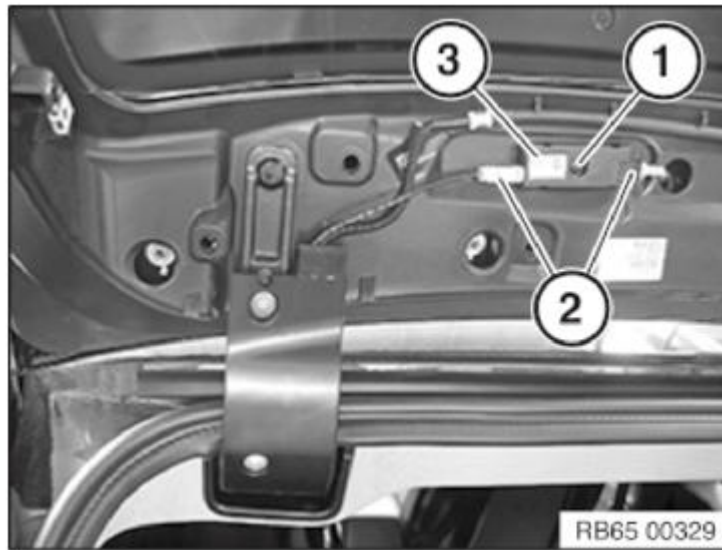
*Necessary preliminary tasks:*

- Remove **COVER FOR REAR WINDOW FRAME AT TOP**

Release screw (1).

Unlock plug connections (2) and disconnect.

Remove aerial amplifier (3).



**Fig. 21: Identifying Aerial Amplifier, Plug Connections And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **65 20 035 REMOVING AND INSTALLING/RENEWING ROOF AERIAL**

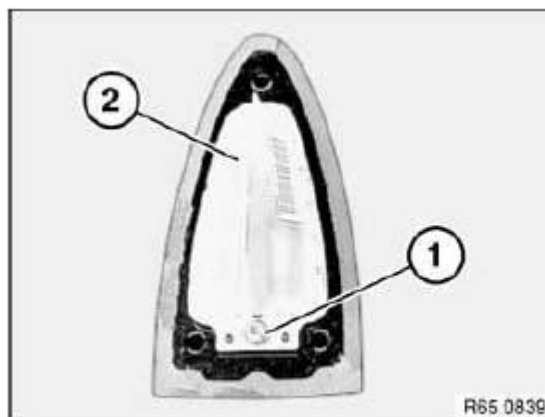
**Necessary preliminary tasks:**

- Detach **EMPTY HOUSING** for roof-mounted aerial

**NOTE:** Diagram similar.

Release screw (1).

Remove roof-mounted aerial (2) by maneuvering upwards.



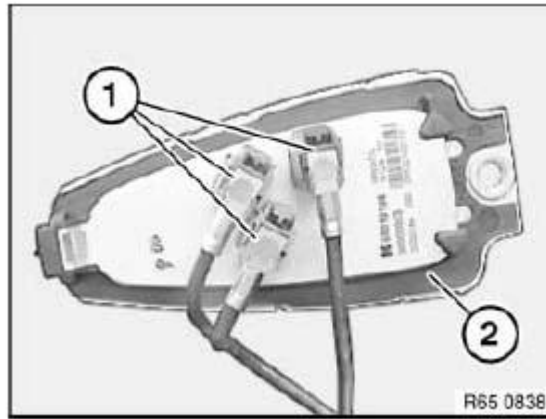
**Fig. 22: Identifying Roof Mounted Aerial And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1).

Remove aerial (2).

*Installation note:*

Do not mix up aerial/antenna connections (1).



**Fig. 23: Identifying Aerial And Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 35 980 REMOVING AND INSTALLING/REPLACING AERIAL FOR COMFORT ACCESS ON LEFT (OR RIGHT)**

**Necessary preliminary tasks:**

- Remove **REAR DOOR TRIM PANEL**

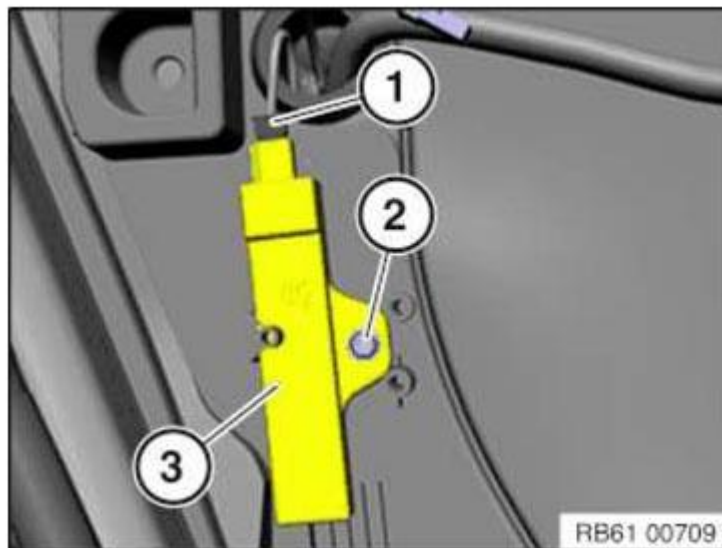
Disconnect plug connection (1).

Release screw (2).

Remove aerial for Comfort Access (3).

*Installation note:*

Ensure that aerial for Comfort Access (3) is correctly seated.



**Fig. 24: Identifying Comfort Access Aerial, Plug Connection And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **65 20 150 REMOVING AND INSTALLING/REPLACING BACK-UP AERIAL**

*Necessary preliminary tasks:*

- Remove **INSTRUMENT PANEL TRIM**

Release screw (1).

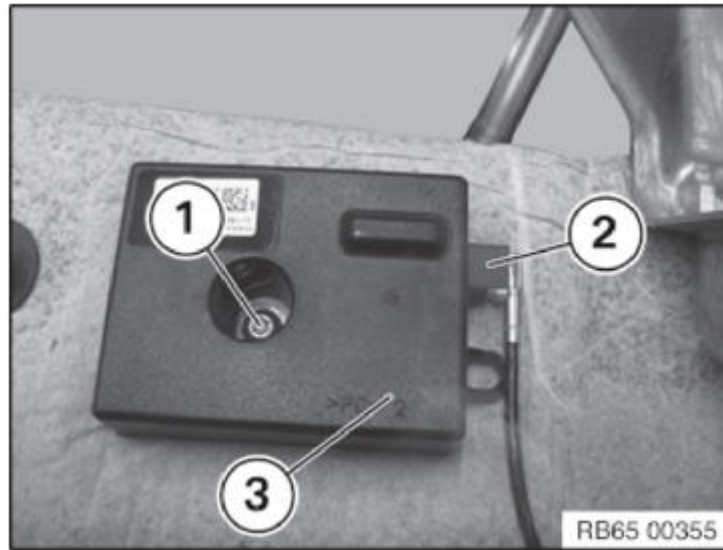


Unfasten plug connection (2) and disconnect.

Remove backup aerial (3).

*Installation note:*

Position back-up aerial (3) so that positioning pin on back engages in associated bore hole.



**Fig. 25: Identifying Back-Up Aerial, Plug Connection And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 35 975 REMOVING AND INSTALLING/REPLACING BUMPER AERIAL FOR COMFORT ACCESS**

Necessary preliminary tasks:

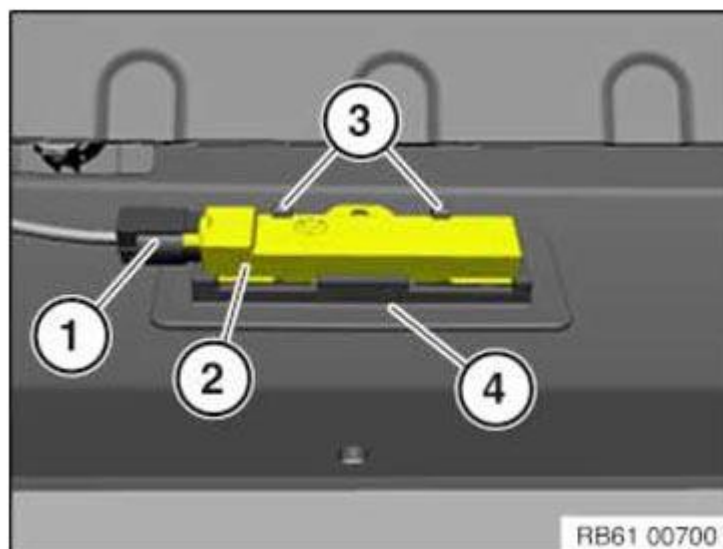
- Remove **REAR UNDERBODY PANELLING**

Disconnect plug connection (1).

Release bumper aerial for Comfort Access (2) on latch mechanism (3) and remove from holder (4).

*Installation note:*

Ensure that bumper aerial for Comfort Access (2) is correctly seated in holder (4).



**Fig. 26: Identifying Bumper Aerial For Comfort Access, Latch Mechanism, Plug Connection And Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 65 20 030 REMOVING AND INSTALLING/REPLACING EMPTY HOUSING FOR ROOF-MOUNTED AERIAL

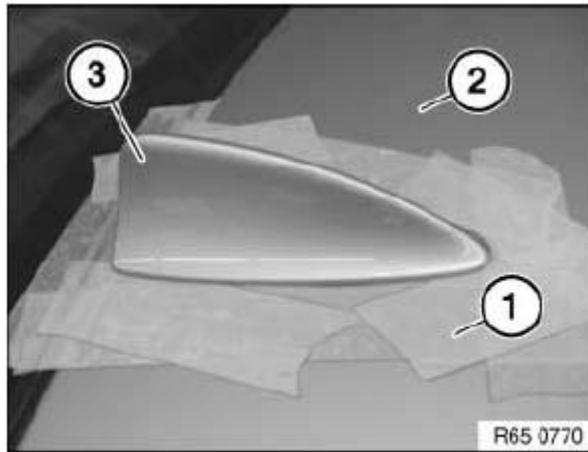
Note to customer:

**IMPORTANT:** In order to guarantee a permanent connection and adhesive hardening:  
After bonding the empty housing for the roof-mounted aerial, wait 24 hours before driving the vehicle through a car wash.

**NOTE:** Clean roof.

Mask roof (2) around empty housing for roof-mounted aerial (3) with yellow plastic adhesive tape (1). To do so, slide plastic adhesive tape under empty housing (3) slightly.

Cut through the adhesive bead (e.g. scalpel) and remove the empty housing for the roof-mounted aerial (3).



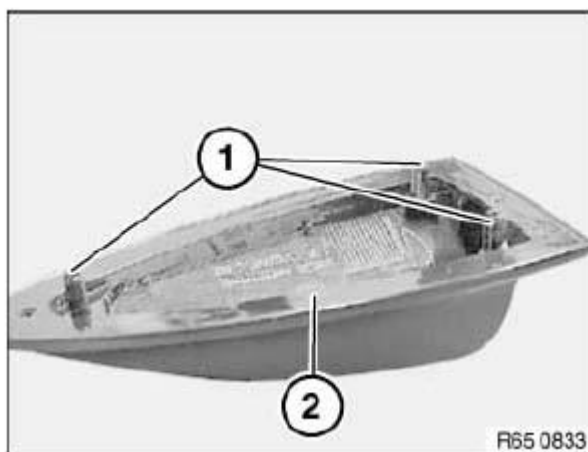
**Fig. 27: Identifying Roof-Mounted Aerial Housing And Yellow Plastic Adhesive Tape**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Installation:

Empty housing for roof-mounted aerial is secured with window glass adhesive. All preparatory operations correspond to the **WINDOW BONDING NOTES**.

**NOTE:** Replace empty housing for roof-mounted aerial if centering pins (1) on empty housing are damaged.

Bonding surface (2) must be clean and free from grease.



**Fig. 28: Identifying Centering Pins And Bonding Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

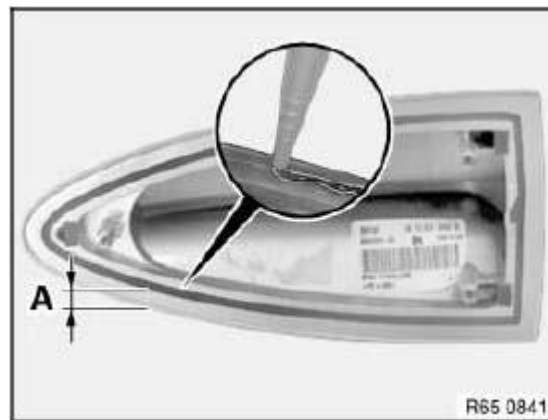
Apply trace of adhesive bead all round outer contour as follows.

Distance between adhesive bead and edge of aerial housing:

A. 6.5 mm  $\hat{A}\pm 1$  mm

Start and end of bead trace must have an overlap length of max. 10 mm.

**IMPORTANT:** To prevent the adhesive from leaking, the adhesive bead diameter must not exceed 2.5 mm to 3.5 mm.



**Fig. 29: Checking Distance Between Adhesive Bead And Aerial Housing Edge**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Attach the empty housing coated with adhesive by hand. To spread the adhesive better, move the housing back and forth horizontally slightly when pressing down.

Secure empty housing if necessary with adhesive tape and press down uniformly.

After bonding, leave vehicle to stand for at least 3 hours at room temperature.

### **65 20 350 REMOVING AND INSTALLING/REPLACING INTERFERENCE SUPPRESSION FILTER**

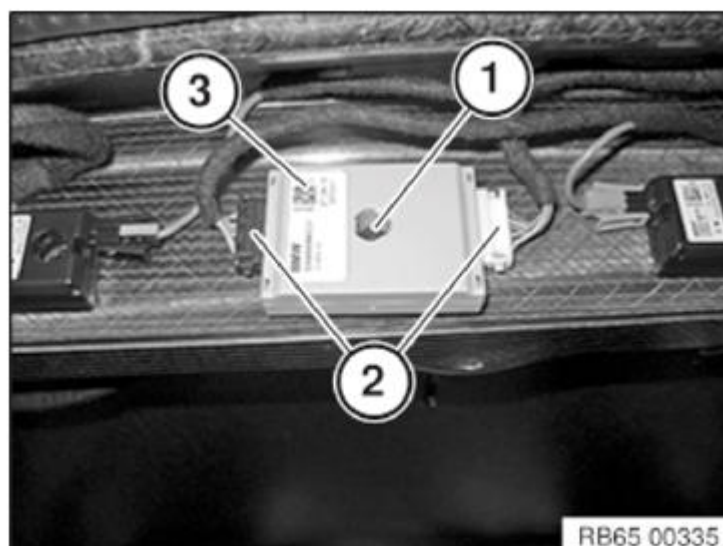
*Necessary preliminary tasks:*

- Lower **HEADLINING IN REAR AREA**

Release screw (1).

Unlock plug connections (2) and disconnect.

Remove interference suppression filter (3).

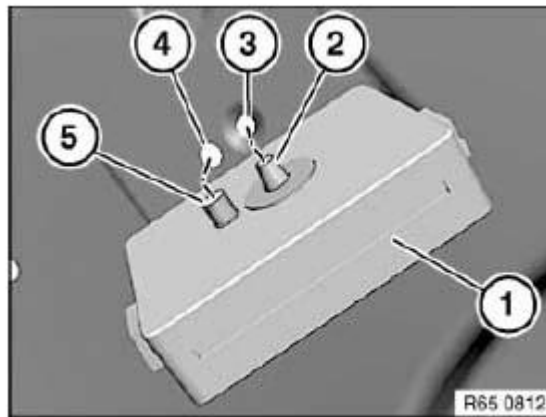




**Fig. 30: Identifying Interference Suppression Filter, Plug Connections And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Fit interference suppression filter (1) so that screw (2) engages thread (3) and locating pin (4) engages in bore hole (5).



**Fig. 31: Identifying Suppression Filter, Screws, Engages Thread, Bore Hole And Locating Pin**  
Courtesy of BMW OF NORTH AMERICA, INC.

**61 35 953 REMOVING AND INSTALLING/REPLACING INTERIOR AERIAL FOR COMFORT ACCESS (FRONT STORAGE COMPARTMENT)**

**Necessary preliminary tasks:**

- Remove **DECORATIVE TRIM ON CENTER CONSOLE**

Disconnect plug connection (1).

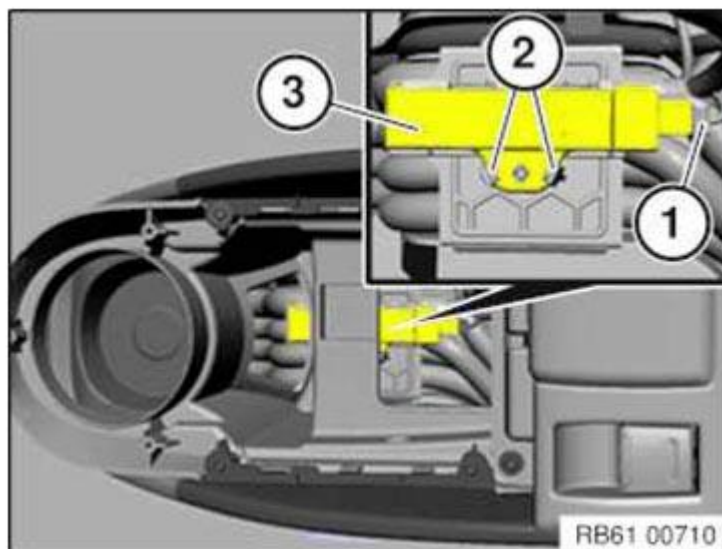
Release catches (2).

Remove interior aerial (3) from holder (4).

*Installation note:*

Make sure interior aerial (3) is correctly fitted.

Make sure plug connection (1) is correctly seated.



**Fig. 32: Identifying Interior Aerial, Catches, Plug Connection And Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 61 35 954 REMOVING AND INSTALLING/REPLACING INTERIOR AERIAL FOR COMFORT ACCESS SYSTEM (REAR CENTER CONSOLE)

### Necessary preliminary tasks:

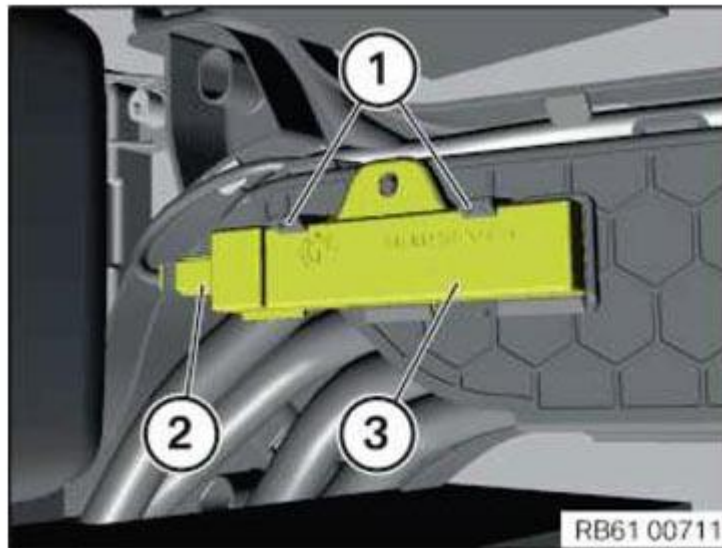
- Remove **REAR CENTER CONSOLE TRIM**

Unfasten plug connection (2) and disconnect.

Release latch mechanisms (1) and remove interior aerial (3).

*Installation note:*

Make sure plug connection (2) and interior aerial (3) are correctly seated.



**Fig. 33: Identifying Interior Aerial, Latch Mechanisms And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

## REAR WINDOW AERIAL, TV AMPLIFIER, WAVE TRAP

### 65 24 100 REMOVING AND INSTALLING/REPLACING AERIAL

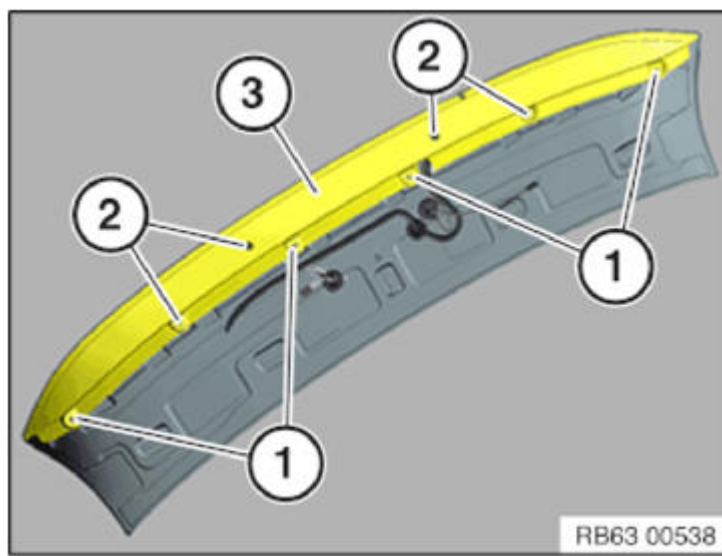
### Necessary preliminary tasks:

- Remove **REAR SPOILER**

Release expanding rivet (1).

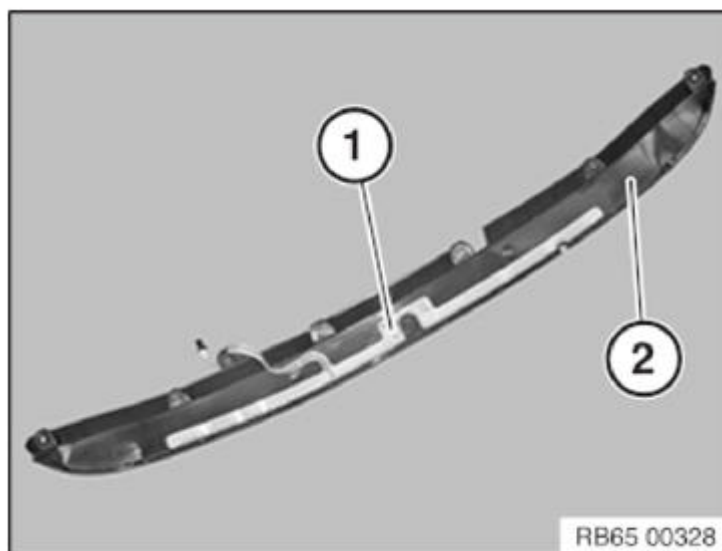
Unfasten screws (2).

Remove trim (3) from rear spoiler.



**Fig. 34: Identifying Trim, Expanding Rivets And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove aerial (1) from trim (2).



**Fig. 35: Identifying Aerial And Trim**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **65 24 040 REMOVING AND INSTALLING/REPLACING LEFT WAVE TRAP**

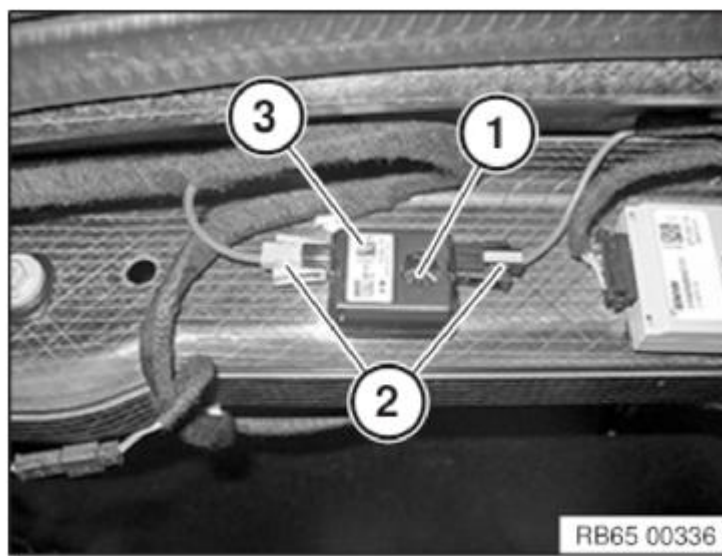
*Necessary preliminary tasks:*

- Lower **HEADLINING IN REAR AREA**

Release screw (1).

Unlock plug connections (2) and disconnect.

Remove wave trap (3).



**Fig. 36: Identifying Wave Trap, Plug Connections And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **65 24 040 REMOVING AND INSTALLING/REPLACING RIGHT WAVE TRAP**

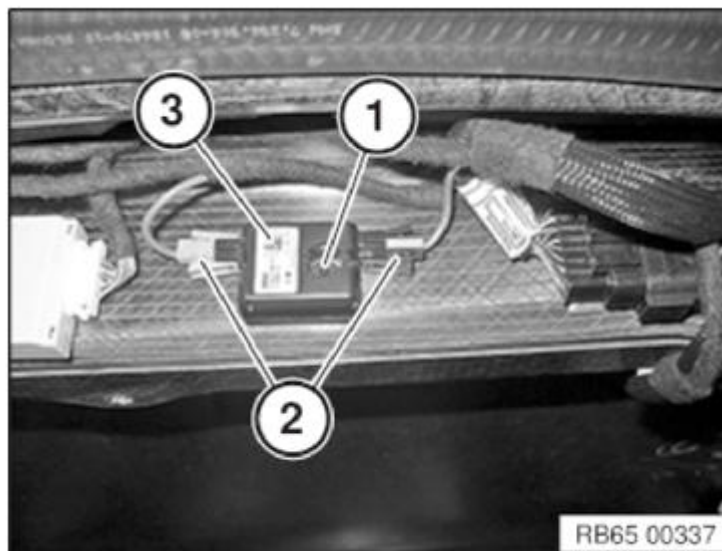
*Necessary preliminary tasks:*

- Lower **HEADLINING IN REAR AREA**

Release screw (1).

Unlock plug connections (2) and disconnect.

Remove wave trap (3).



**Fig. 37: Identifying Wave Trap, Plug Connections And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **VIDEO AND TV SETS, CENTRAL INFORMATION DISPLAY (CID)**

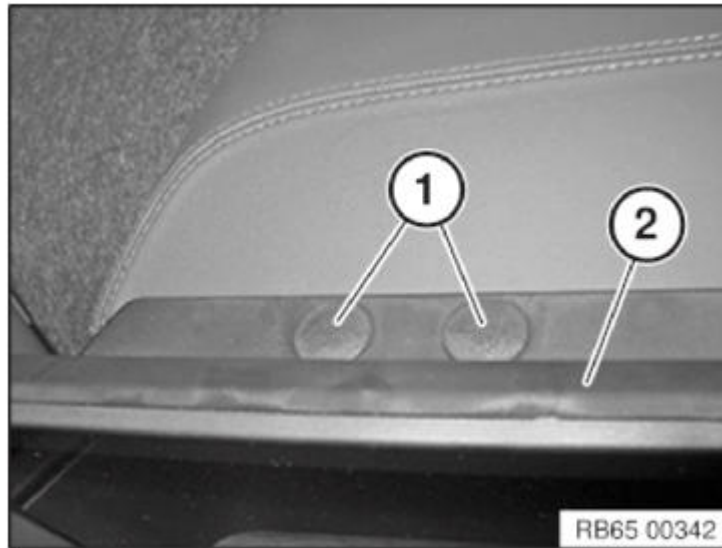
### **65 50 057 REMOVING AND INSTALLING/REPLACING CENTRAL INFORMATION DISPLAY (CID)**

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

Lift off covers (1).

Release screws underneath.

Remove CID (2) towards top.

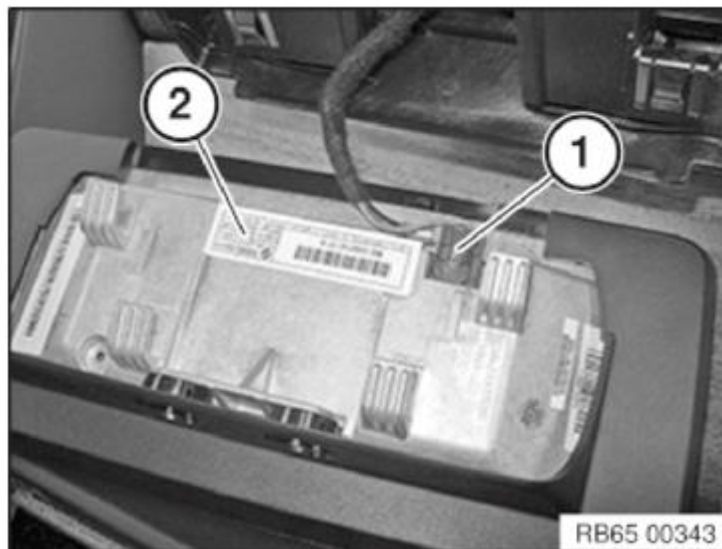


**Fig. 38: Identifying Covers And CID**

Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

Remove CID (2).



**Fig. 39: Identifying Plug Connection And CID**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING** .

**NOTE:** In the case of replacement of 6.5" central information display in vehicles with production date up to 07/2013 Entry Head Unit must be updated.

## **ANTI-THEFT ALARM SYSTEM**

### **65 75 055 REMOVING AND INSTALLING/REPLACING EMERGENCY POWER SIREN WITH TILT SENSOR**

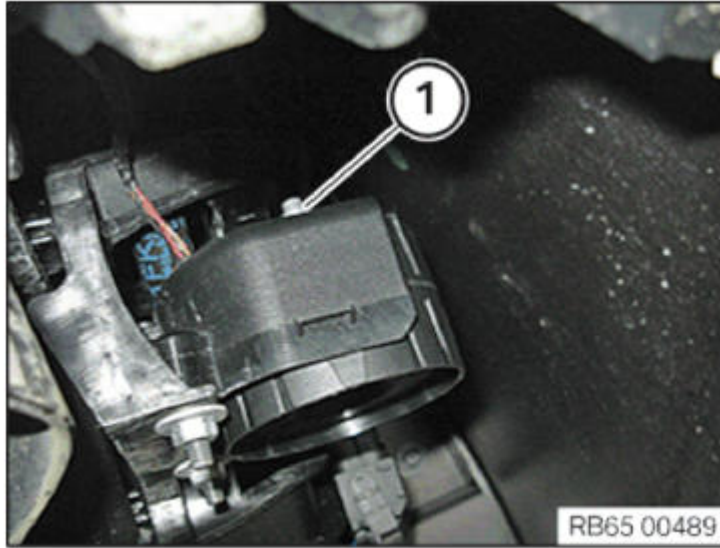
*Necessary preliminary tasks:*



- Remove FRONT (REAR SECTION) LEFT WHEEL ARCH COVER

**Removal:**

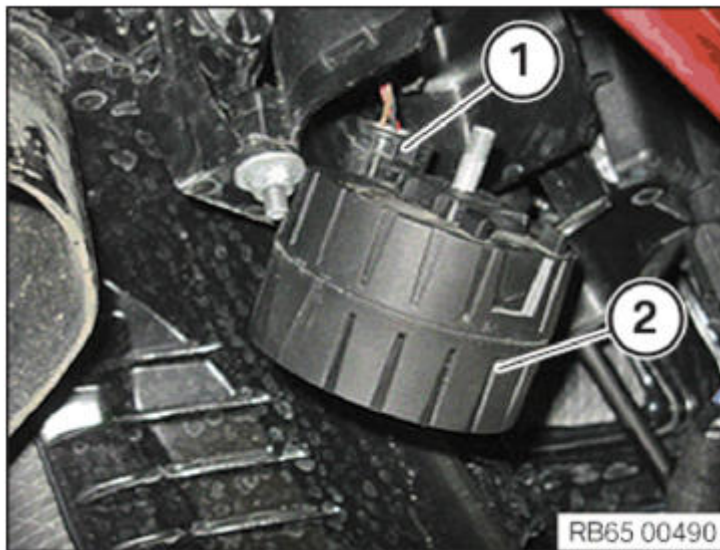
Slacken nut (1).



**Fig. 40: Identifying Emergency Power Siren Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect the connector (1).

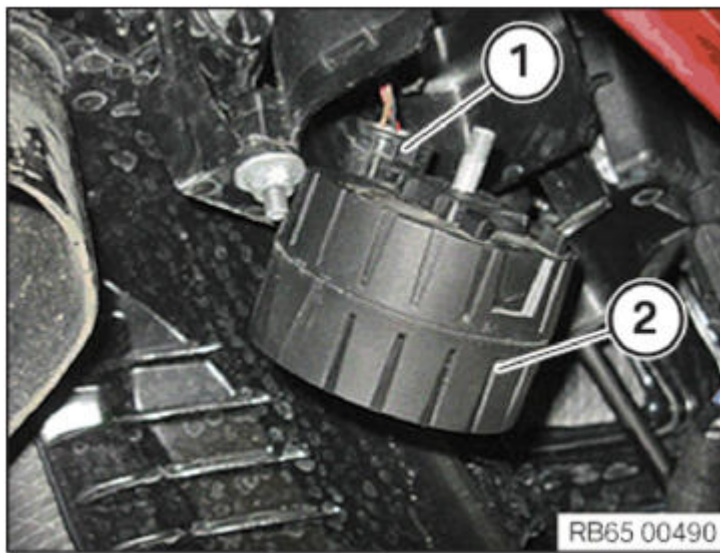
Remove emergency power siren with tilt sensor (2).



**Fig. 41: Identifying Emergency Power Siren Connector And Tilt Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

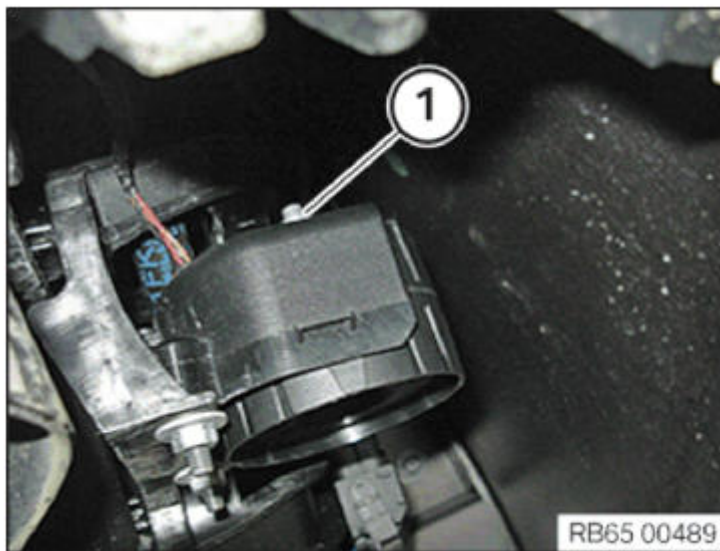
**Installation:**

Join connector (1) to emergency power siren with tilt sensor (2) and connect.



**Fig. 42: Identifying Emergency Power Siren Connector And Tilt Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten nut (1).



**Fig. 43: Identifying Emergency Power Siren Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Required reworking:*

- Mount **FRONT (REAR SECTION) LEFT WHEEL ARCH COVER**

**Replacement:**

Carry out **VEHICLE PROGRAMMING/ENCODING** .

## **AIRBAG CONTROL UNITS, AIRBAG SENSORS**

### **65 77 750 REMOVING AND INSTALLING (REPLACING) DRIVER'S SEAT SENSOR**

**WARNING:** Note **AIRBAG SAFETY REGULATIONS** !

Incorrect handling can activate airbag and cause injury.

**Necessary preliminary tasks:**

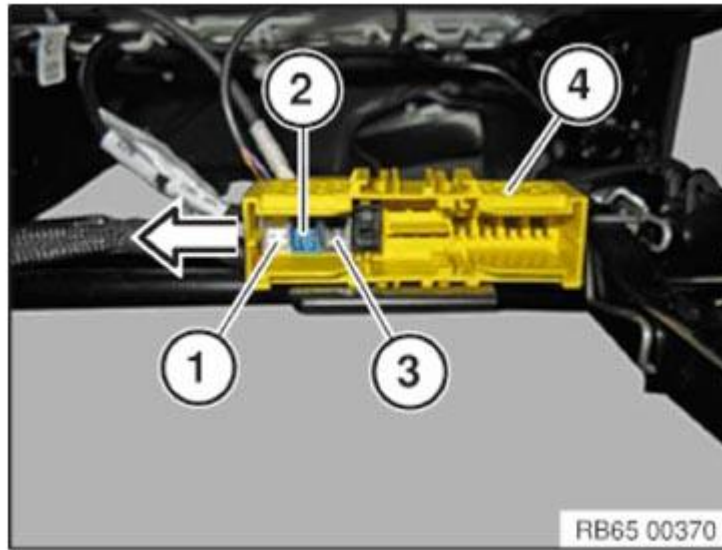
- Remove **FRONT SEAT** .

Unlock connector housing (1 to 3) and pull out of connector housing (4) in direction of arrow.

*Installation note:*

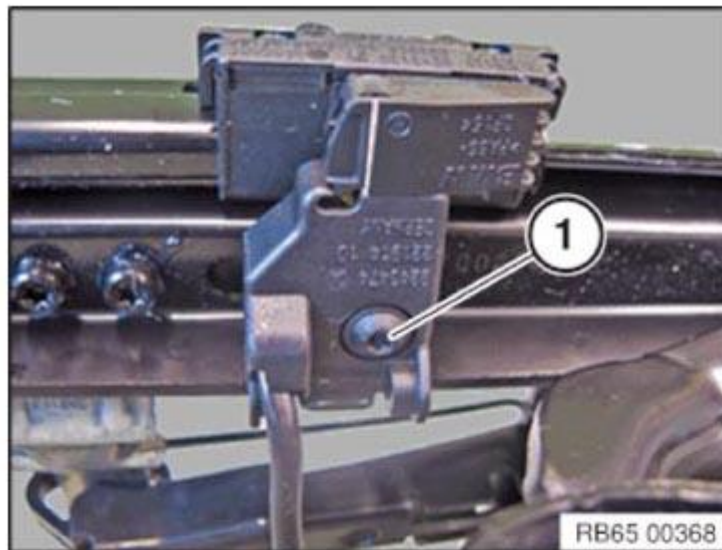
Connectors are encoded against incorrect assembly.

Make sure installation sequence of connector housing (1 to 3) is correct.



**Fig. 44: Unlocking Connector Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).



**Fig. 45: Identifying Front Seat Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

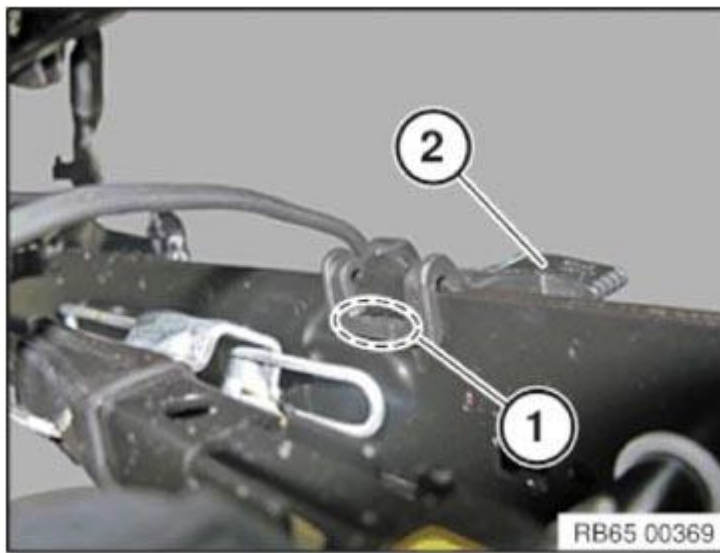
Release latch mechanism (1) in marked area.

Remove sensor (2).

*Installation note:*

Make sure sensor (2) is correctly fitted.





**Fig. 46: Identifying Sensor And Latch Mechanism**

Courtesy of BMW OF NORTH AMERICA, INC.

**65 77 755 REMOVING AND INSTALLING (REPLACING) FRONT PASSENGER SEAT SENSOR**

**WARNING:** Note **AIRBAG SAFETY REGULATIONS !**

Incorrect handling can activate airbag and cause injury.

**Necessary preliminary tasks:**

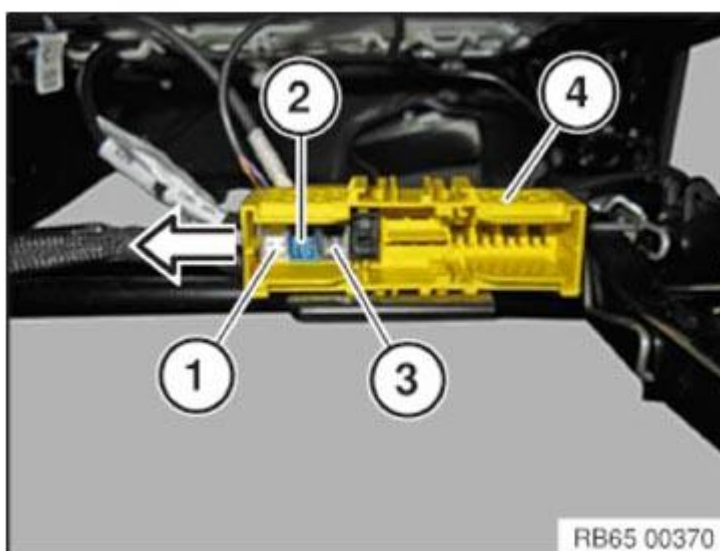
- Remove **FRONT SEAT**

Unlock connector housing (1 to 3) and pull out of connector housing (4) in direction of arrow.

*Installation note:*

Connectors are encoded against incorrect assembly.

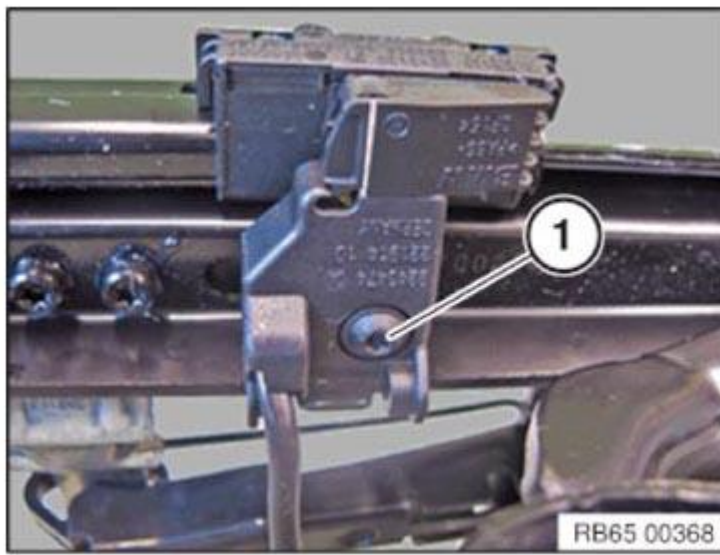
Make sure installation sequence of connector housing (1 to 3) is correct.



**Fig. 47: Unlocking Connector Housing**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).



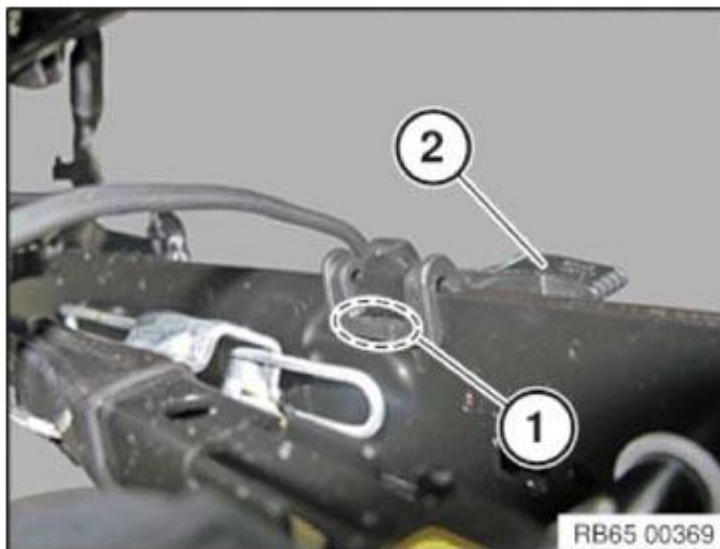
**Fig. 48: Identifying Front Seat Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release latch mechanism (1) in marked area.

Remove sensor (2).

*Installation note:*

Make sure sensor (2) is correctly fitted.



**Fig. 49: Identifying Sensor And Latch Mechanism**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **65 77 580 REMOVING AND INSTALLING (REPLACING) FRONT SEAT POSITION SENSOR ON LEFT OR RIGHT**

**WARNING:** Note **AIRBAG SAFETY REGULATIONS !**

Incorrect handling can activate airbag and cause injury.

**Necessary preliminary tasks:**

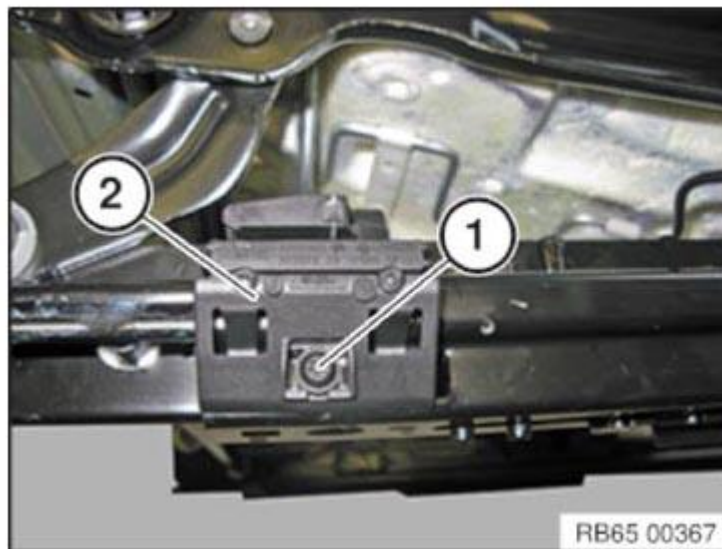
- Remove front seat. See **REMOVING FRONT SEAT, DRIVER'S SIDE** or **REMOVING FRONT SEAT, PASSENGER'S SIDE** .

Release screw (1).

Take off position sensor (2).

*Installation note:*

Make sure position sensor (2) is correctly fitted.



**Fig. 50: Identifying Position Sensor Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

### **65 77 720 REMOVING AND INSTALLING (REPLACING) LEFT/RIGHT B-PILLAR SENSOR**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed **prior to starting work** :

De-energize the **HIGH-VOLTAGE SYSTEM** .

Observe **SAFETY INFORMATION** for handling hybrid cars.

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)** .

**WARNING:** Observe **AIRBAG SAFETY REGULATIONS** !

Incorrect handling can activate airbag and cause injury.

*Necessary preliminary tasks:*

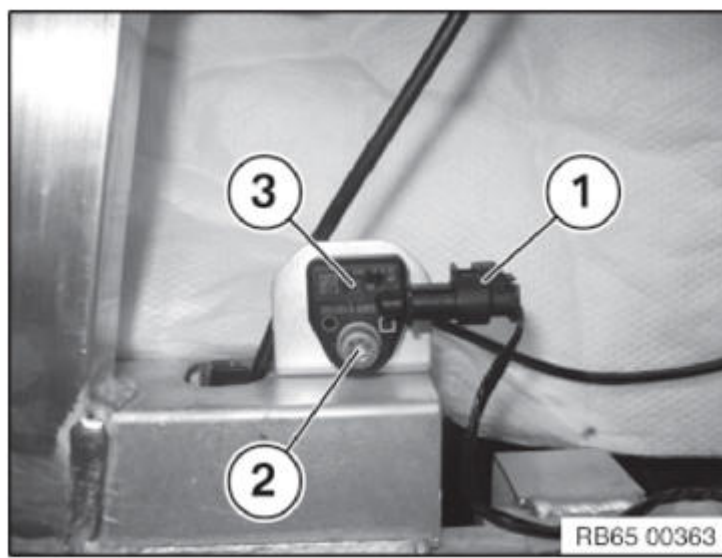
- Disconnect **NEGATIVE BATTERY LEAD**
- Remove REAR DOOR OUTER SKIN

Unfasten plug connection (1) and disconnect.

Release screw (2).

Tightening torque **65 77 3AZ** .

Remove sensor (3).



**Fig. 51: Identifying Sensor, Plug Connection And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

**65 77 740 REMOVING AND INSTALLING (REPLACING) LEFT/RIGHT FRONT DOOR SENSOR (US VERSION)**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed **prior to starting work** :

De-energize the **HIGH-VOLTAGE SYSTEM** .

Observe **SAFETY INFORMATION** for handling hybrid cars.

**WARNING:** Note **AIRBAG SAFETY REGULATIONS** !

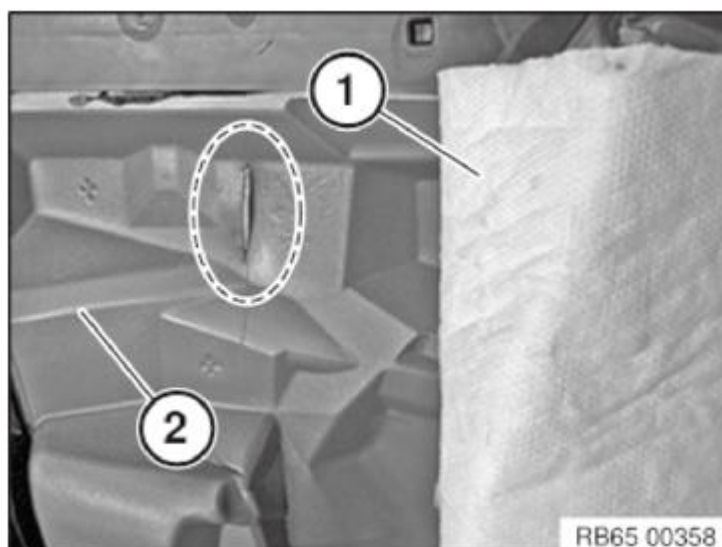
Incorrect handling can activate airbag and cause injury.

**Necessary preliminary tasks:**

- Remove **LEFT FRONT DOOR TRIM PANEL**
- Disconnect **BATTERY EARTH LEAD**

Fold down insulating mat (1) as shown.

Cut sound insulation (2) in marked area.

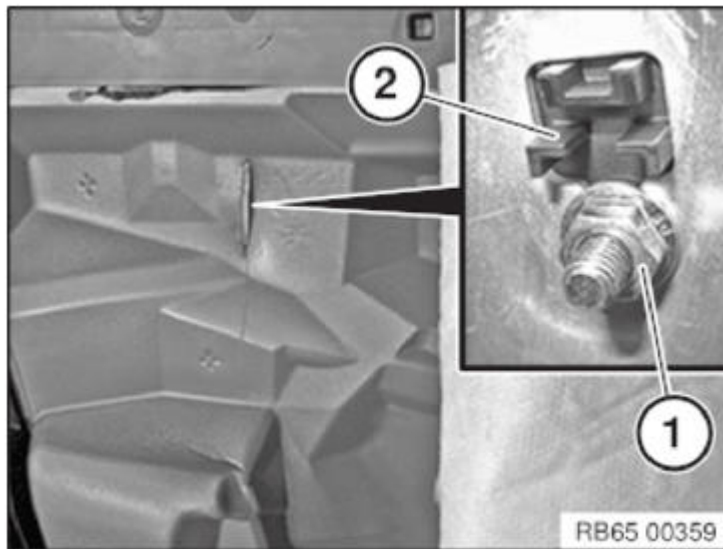


**Fig. 52: Identifying Insulating Mat And Sound Insulation Cutting Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque **65 77 4AZ** .

Remove sensor (2).



**Fig. 53: Identifying Sensor And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **65 77 016 REMOVING AND INSTALLING/REPLACING AIRBAG CONTROL UNIT**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed **prior to starting work** :

De-energize the **HIGH-VOLTAGE SYSTEM** .

Observe **SAFETY INFORMATION** for handling hybrid cars.

**WARNING:** Observe **AIRBAG SAFETY REGULATIONS** !

Incorrect handling can activate airbag and cause injury.

**Attention!**

Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

**Necessary preliminary tasks:**

- Disconnect **BATTERY EARTH LEAD**
- Remove **CENTER CONSOLE** .

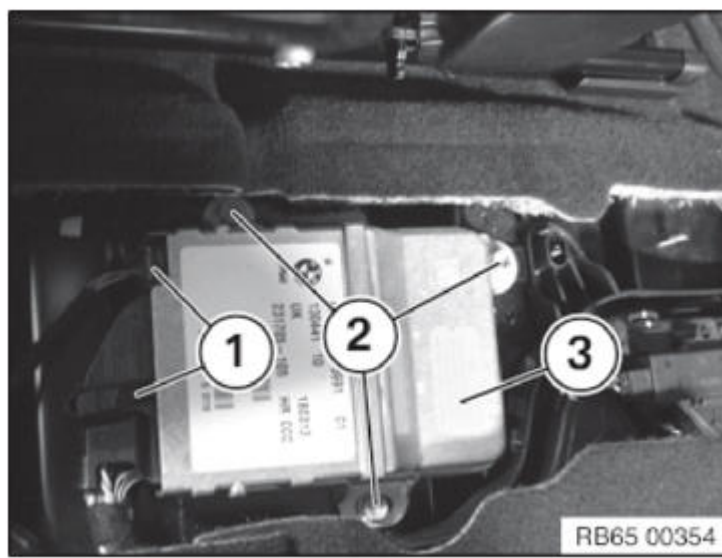
**Removal:**

Unlock plug connections (1) and disconnect.

Unfasten screws (2).

Remove airbag control unit (3).





**Fig. 54: Identifying Airbag Control Unit, Plug Connections And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

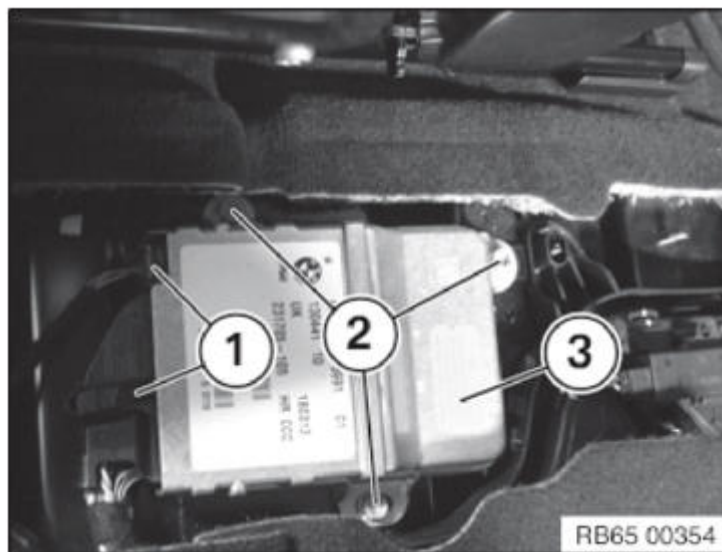
**Installation:**

Install the airbag control unit (3).

Tighten down screws (2).

Tightening torque **65 77 1AZ** .

Connect and lock the plug connections (1).



**Fig. 55: Identifying Airbag Control Unit, Plug Connections And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Required reworking:**

- Install **CENTER CONSOLE**
- Connect **BATTERY EARTH LEAD**
- Run the service function to adjust the sensors for the driving dynamics as follows:
  - Chassis and suspension
  - Traction control system
  - Adjustment of the driving dynamics sensors

**Replacement:**

Carry out PROGRAMMING/ENCODING .

## 65 77 532 REMOVING AND INSTALLING/REPLACING FRONT LEFT SENSOR (US VERSION ONLY)

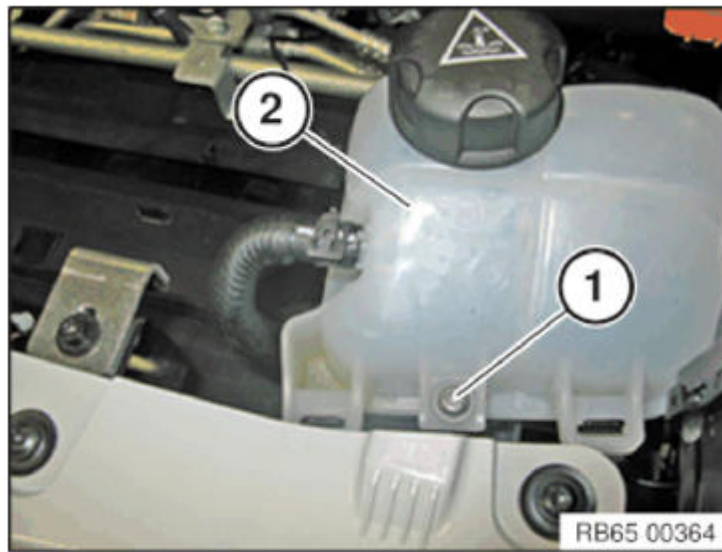
**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work :  
De-energize the HIGH-VOLTAGE SYSTEM .  
Observe SAFETY INFORMATION for handling hybrid cars.

*Necessary preliminary tasks:*

- Disconnect BATTERY EARTH LEAD
- Remove FRONT LUGGAGE COMPARTMENT WELL

Release screw (1).

Remove expansion tank for coolant (2) and put to one side.



**Fig. 56: Identifying Coolant Expansion Tank And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

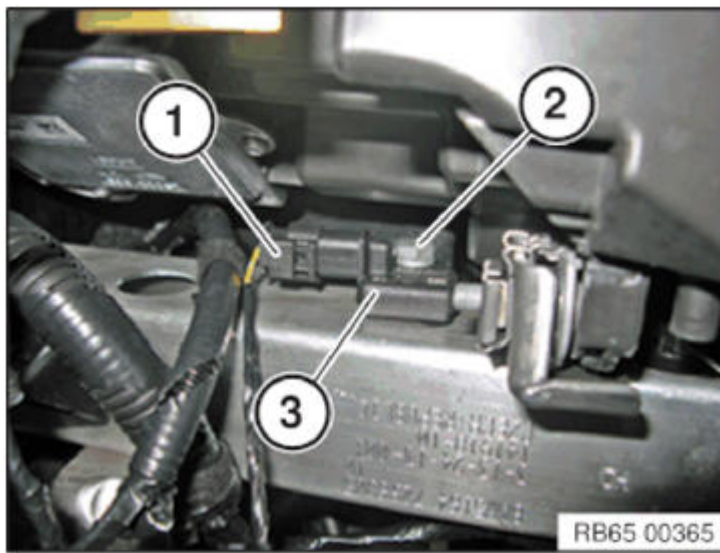
Release screw (2).

Tightening torque 65 77 2AZ .

Remove sensor (3).

*Installation note:*

Make sure sensor (3) is in correct installation position.



**Fig. 57: Identifying Sensor, Plug Connection And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**65 77 534 REMOVING AND INSTALLING/REPLACING FRONT RIGHT SENSOR (US VERSION ONLY)**

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work :  
 De-energize the **HIGH-VOLTAGE SYSTEM** .  
 Observe **SAFETY INFORMATION** for handling hybrid cars.

*Necessary preliminary tasks:*

- Disconnect **BATTERY EARTH LEAD**
- Remove **FRONT LUGGAGE COMPARTMENT WELL**

Release screw (1).

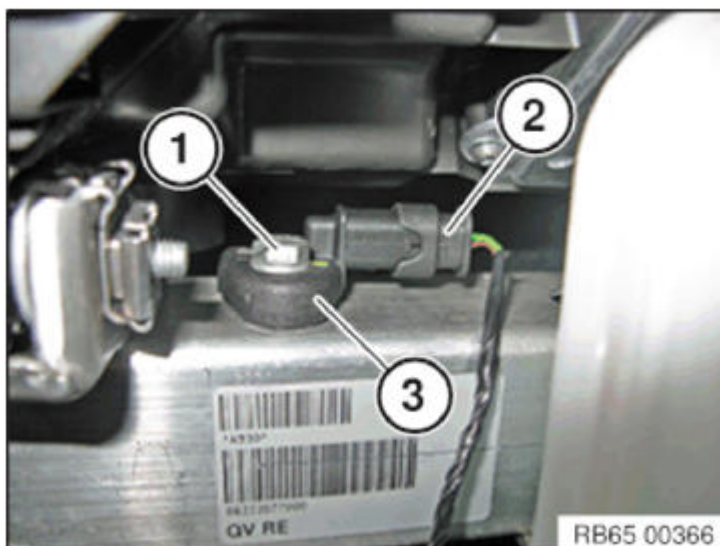
Tightening torque **65 77 2AZ** .

Unfasten plug connection (2) and disconnect.

Remove sensor (3).

*Installation note:*

Make sure sensor (3) is in correct installation position.





## **65 77 610 REPLACING SEAT OCCUPANCY MAT (CIS) FOR FRONT PASSENGER SEAT OCCUPANCY DETECTOR**

**WARNING:** US and Canadian version of the front passenger seat (with CIS mat):  
The CIS mat is bonded to the entire surface of the facing and can only be removed in conjunction with the padding from the seat cover.  
If CIS mat or padding is defective, both parts may only be replaced together.  
Full functional capability can only be guaranteed with original BMW spare parts.  
After installation, the CIS mat must be enabled using the **BMW PROGRAMMING SYSTEM** .

Operation is described in:

Replacing **UPHOLSTERY FOR FRONT PASSENGER SEAT** .

## **ON-BOARD COMPUTER, OUTSIDE TEMPERATURE SENSOR**

### **65 81 060 REMOVING AND INSTALLING/REPLACING OUTSIDE TEMPERATURE SENSOR**

- Partially removing **FRONT RIGHT WHEEL ARCH COVER**

Unfasten plug connection (1) and disconnect.

Pull ambient temperature sensor (2) out of fixture (3).

Remove the outside temperature sensor (2).



**Fig. 59: Identifying Outside Temperature Sensor, Plug Connection And Fixture**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **CENTRAL DISPLAY AND OPERATING UNIT**

### **65 82 300 REMOVING AND REFITTING (REPLACING) TOUCHBOX**

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

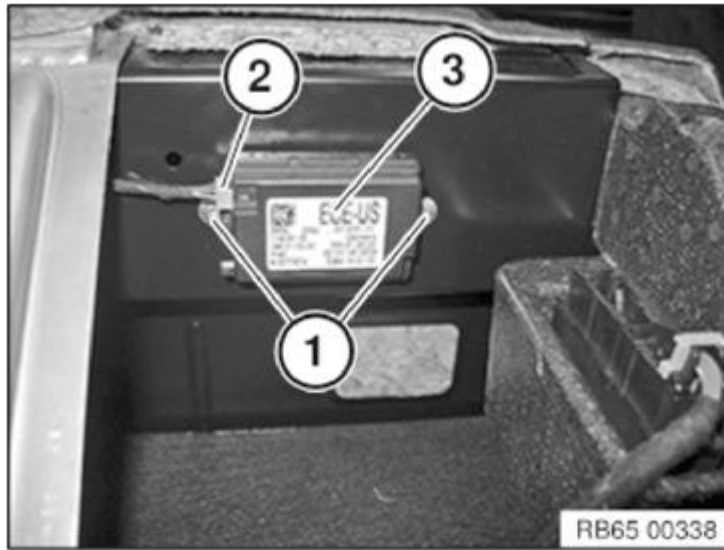
Necessary preliminary tasks:

- Remove REAR SEAT

Release screws (1).

Unfasten plug connection (2) and disconnect.

Remove touchbox (3).



**Fig. 60: Identifying Touchbox, Plug Connection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out VEHICLE PROGRAMMING AND ENCODING.

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[Back To Article](#)

## ACCESSORIES AND BODY, CAB

Audio, Navigation And Anti-Theft - Special Tools - All I3 Models - i3

### AUDIO, NAVIGATION AND INFORMATION SYSTEMS

#### 2405335 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP

**NOTE:** Diagnosis of the aerial input on the head unit

##### Storage Location

C121

I116

##### SI number

02 12 14 (171)



**Fig. 1: Identifying Adapter Cable (2405335).**

Courtesy of BMW OF NORTH AMERICA, INC.

#### 651150 ADAPTER CABLE AM

**NOTE:** (V adapter cable, 42-pin) For measuring electrical variables on 42-pin plug connection on high fidelity and Top HiFi amplifier

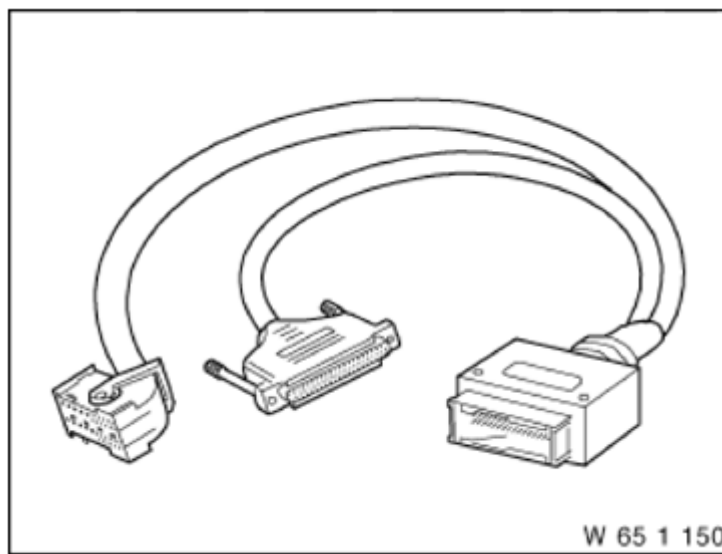
##### Storage Location

M207

I101

##### SI number

02 02 98 (308)



**Fig. 2: Identifying Adapter Cable (651150)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2405263 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Diagnosis of aerial line

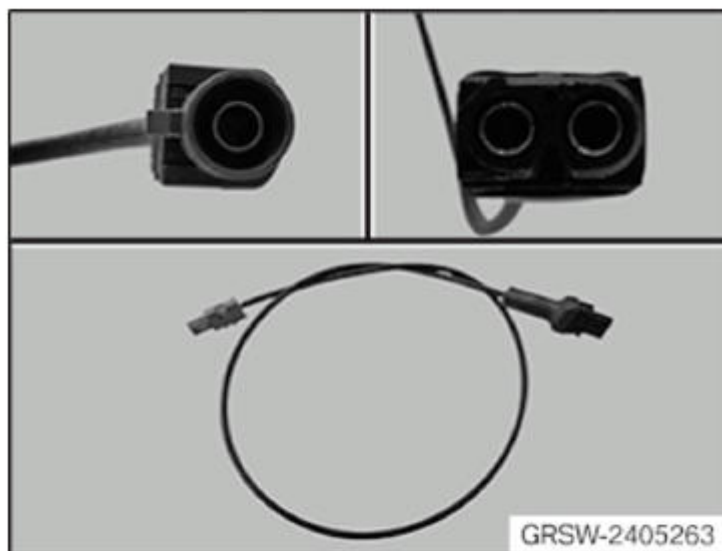
**Storage Location**

C120

I115

**SI number**

02 12 14 (171)



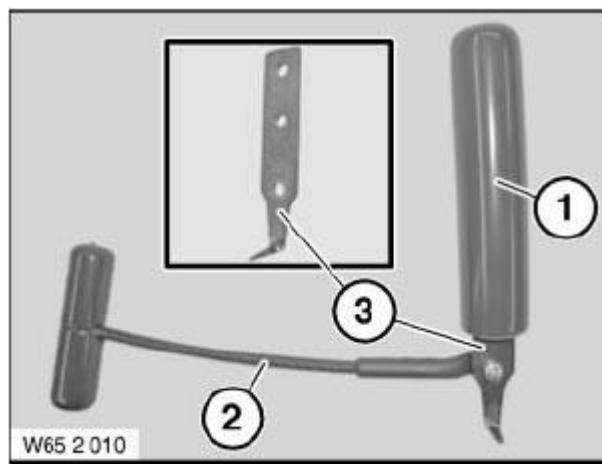
**Fig. 3: Identifying Adapter Cable (2405263)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**652013 BLADE AM**

**NOTE:** (Special blade) Replaced by **65 2 014 (0 496 531)**

**SI number**

01 22 04 (147)



**Fig. 4: Identifying Blade (652013).**

Courtesy of BMW OF NORTH AMERICA, INC.

**652014 BLADE AM**

SI number

01 15 08 (475)



**Fig. 5: Identifying Blade (652014).**

Courtesy of BMW OF NORTH AMERICA, INC.

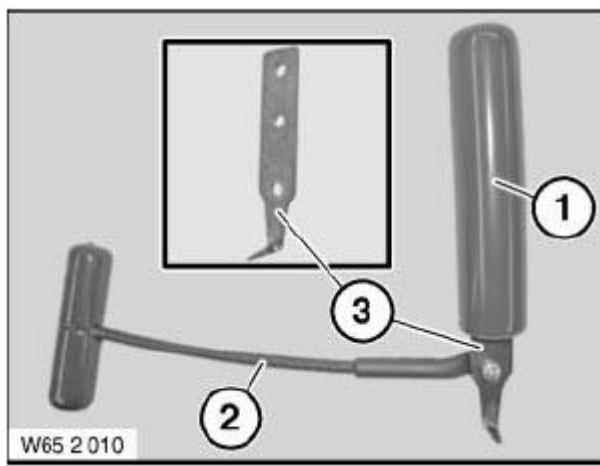
**652012 HANDLE AM**

**NOTE:** (Pull handle) Remaining inventories will be sold off and then only available as part of complete tool set 652010 = 0494968.

SI number

01 16 04 (127)





**Fig. 6: Identifying Handle (652012).**

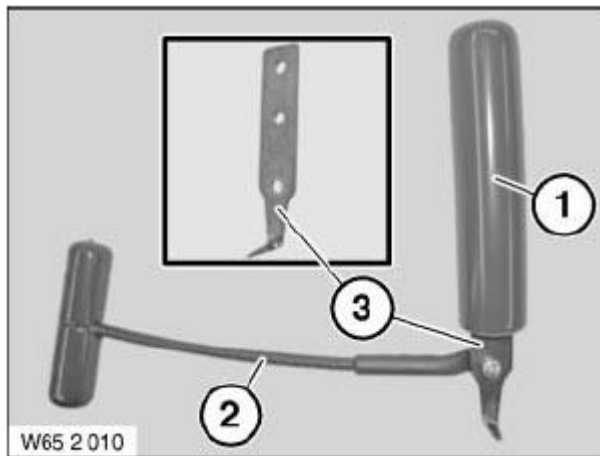
Courtesy of BMW OF NORTH AMERICA, INC.

**652011 HANDLE AM**

**NOTE:** (Draw knife with plastic sleeve) Remaining inventories will be sold off and then only available as part of complete tool set 652010 = 0494968.

**SI number**

01 16 04 (127)



**Fig. 7: Identifying Handle (652011).**

Courtesy of BMW OF NORTH AMERICA, INC.

**652010 KNIFE AM**

**NOTE:** (Cutting knife set for roof-mounted aerial (empty housing)) special tool for manual operation only. 65 2 011 Drawing knife with plastic sleeve; 65 2 012 Pull handle with plastic sleeve, 65 2 013. Special blade is replaced by **65 2 014** Special blade

**Storage Location**

Individual

**SI number**

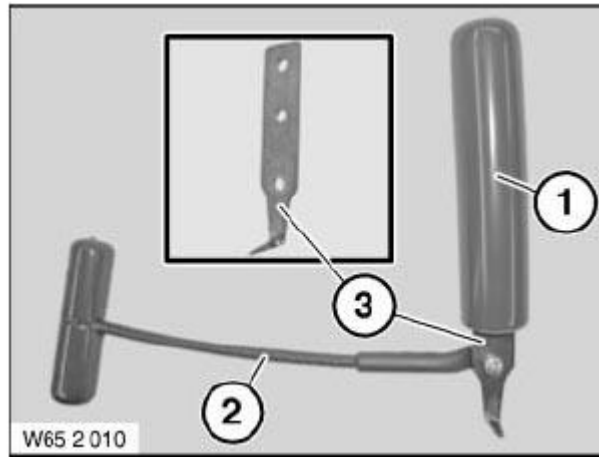
01 15 08 (475)

Consisting of:

2 = **0495112** Handle

**NOTE:** (Pull handle) Remaining inventories will be sold off and then only available as part of complete tool set 652010 = 0494968.

1 = 0495113 Handle



**Fig. 8: Identifying Knife (652010)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** (Draw knife with plastic sleeve) Remaining inventories will be sold off and then only available as part of complete tool set 652010 = 0494968.

3 = 0495114 Blade

**NOTE:** (Special blade) Replaced by [65 2 014](#) (0 496 531)

4 = 0496531 Blade

**NOTE:** (Special blade) Replaced by special tool [65 2 013](#) since 08/2008.

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## ACCESSORIES AND BODY, CAB

## Audio, Navigation And Information Systems - Tightening Torques - All I3 Models - i3

## CONTROL OF AIRBAG DEPLOYMENT

## 65 77 CONTROL OF AIRBAG DEPLOYMENT

## TIGHTENING TORQUE SPECIFICATION - CONTROL OF AIRBAG DEPLOYMENT

Å	Type	Thread	Tightening specifications	Dimension
1AZ Airbag control unit	F01/F02/F03/F04/F06/F07/F10/F11/F12/F13/F18/F20/F21/F22/F23/F30/F31/F32/F33/F34/F35/F36/F45/F46/F48/F49/F80/F82/F83/F87/	Å	Å	2.5 Nm
	I01/I12	Å	Å	8 Nm
2AZ Acceleration sensor, front (Airbag front sensor)	F01/F02/F04/F07	M6x35	Replace screws	8 Nm
	F06/F10/F11/F12/F13/F25/F26	M6x35	Replace screws	9 Nm
	F22/F23/F30/F31/F32/F33/F34/F36/F45/F46/F48/F49/F54/F55/F56/F57/F60/F80/F82/F83/F87/	M6x20	Replace screws	9 Nm
	I01/I12	M6x30	Replace screws	8.6 Nm
3AZ Sensor, B-pillar	F01/F02/F03/F04/F07	Å	Replace screws	8 Nm
	F06/F10/F11/F18/F12/F13/F20/F21/F22/F23/F25/F26/F30/F31/F32/F33/F34/F35/F36/F45/F46/F48/F49/F54/F55/F56/F57/F60/F80/F82/F83/F87	Å	Replace screws	9 Nm
	I01/I12	Å	Replace screws	8.8 Nm
4AZ Front door sensor	F01/F02/F04/F07	Å	Replace screws	8 Nm
	F10/F11/F18	Å	Replace screws	9 Nm
	F06/F12/F13/F25/F26/F22/F23/F30/F31/F32/F33/F34/F36/F45/F46/F48/F49/F54/F55/F56/F57/F60/F80/F82/F83/F87/I01/I12/	Å	Replace nut	9 Nm
5AZ Central sensor	F01/F02/F03/F04/F07/F10/F11/F18	Å	Replace hexagon nuts	8 Nm

## SPEAKERS

## 65 13 SPEAKERS

## TIGHTENING TORQUE SPECIFICATION - SPEAKERS

Å	Type	Thread	Tightening specifications	Dimension
1AZ Mid-range speaker to front door	I01	Å	Å	2 Nm
	I12	Å	Å	2.5 Nm
2AZ Bass speaker to adapter	I01	Å	Å	2.3 Nm
	I12	Å	Å	2.5 Nm
3AZ Mid-range speaker to rear door	I01	Å	Å	1.8 Nm
4AZ Mid-range speaker in trim panel dashboard	I01/I12	Å	Å	1.8 Nm
5AZ Tweeter in trim panel dashboard	I01/I12	Å	Å	1.8 Nm

## ACCESSORIES & BODY, CAB

### BMW Operating Fluids

#### 1.0 ADHESIVES/SEALANTS FOR GLASS

Sikaflex 255 Adhesive is a single component polyurethane with a minimum curing time of 4 hours at 72°F/22°C and 38% relative humidity.

The windshield or rear window must be installed within 10 minutes of applying the adhesive or a skin will form on the adhesive's surface and reduce the adhesive effectiveness.

Sikaflex 255, BMW Part No. 81 22 9 407 497 Cold Kit, or

Sika Ultrafast, BMW Part No. 83 19 9 407 714 in conjunction with Heater, BMW Part No. 83 19 9 407 820.

#### 2.0 OTHER FLUIDS

Cleaning E53 black glossy exterior ornamental trim please use Meguiar's Mirror Glaze Number 9 Professional Swirl Remover 2.0

Glass treatment, all models: Aquapel® Glass Treatment, BMW Part No. 83 19 9 408 523.

#### 3.0 CONTACT CEMENT

A powerful adhesive for leather and leatherette, rubber moldings, felt linings, insulating materials, convertible top adhesive, etc.

(former BMW Part No. 81 22 9 407 524)

3M 1357 High Performance Contact Adhesive

#### 4.0 INSTANT ADHESIVE FOR RUBBER, METAL AND PLASTIC SURFACES

Applications: Rubber profiles on windows, doors, bumpers (soft and hard rubber), seals, inner covers, buttons and controls (plastic/plastic, plastic/steel), circuit elements (electronics), rear lights, turn indicators, ornamental strips and moldings.

(former BMW Part No. 81 22 9 407 143)

3M Part No. 8155

Loctite Part No. 49450

#### 5.0 LOCTITE 380

Black cyanacrylate adhesive for joining metals, but also rubber, PVC etc.

Particularly recommended for attaching rubber door seals on the BMW 5 Series (E34).

(former BMW Part No. 81 22 9 407 394)

3M Part No. 8155

Würth Part No. 893 4103

Loctite Part No. 38050

## **6.0 GLASS ADHESIVE**

BMW Part No. 81 22 9 407 497.

## **7.0 PREMIUM LEATHER CARE KIT**

BMW Part No. 81 11 024 455.

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[Back To Article](#)

**ACCESSORIES AND BODY, CAB**  
**Body - Special Tools - All I3 Models - i3**

**BODY**

**2357464 BLADE AM**

In conjunction with: [83302357309](#)

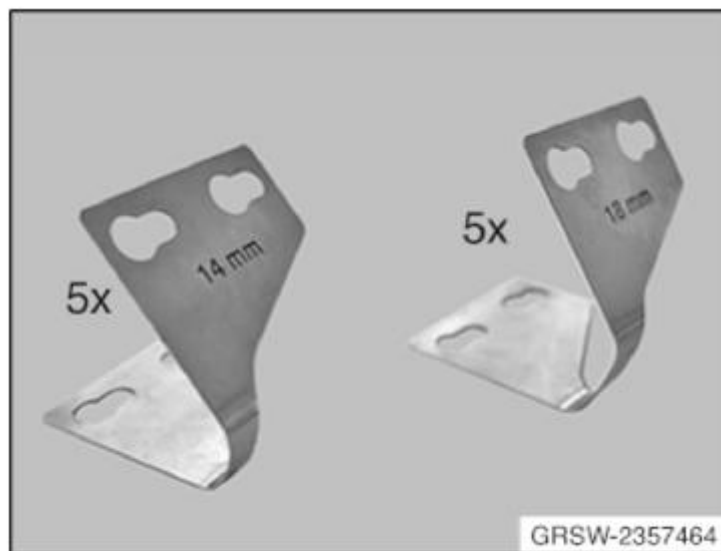
**NOTE:** Replacement blades for angle scraper Applies to: BMW i Aftersales Carbon Full

**Storage Location**

Individual

**SI number**

01 27 13 (996)



**Fig. 1: Identifying Blade (2357464)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355747 CABLE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Full

**Storage Location**

Individual

**SI number**

01 10 13 (940)



**Fig. 2: Identifying Cable (2355747)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355218 DEVICE MINIMUM SET: MECHANICAL TOOLS AM**

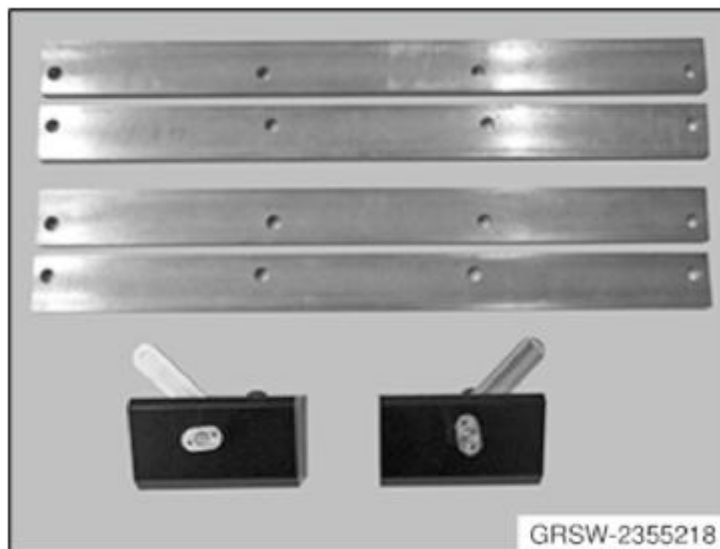
**NOTE:** For aligning the Drive module Applies to: BMW i Aftersales Carbon Full

**Storage Location**

Individual

**SI number**

01 32 13 (004)



**Fig. 3: Identifying Device (2355218)**

Courtesy of BMW OF NORTH AMERICA, INC.

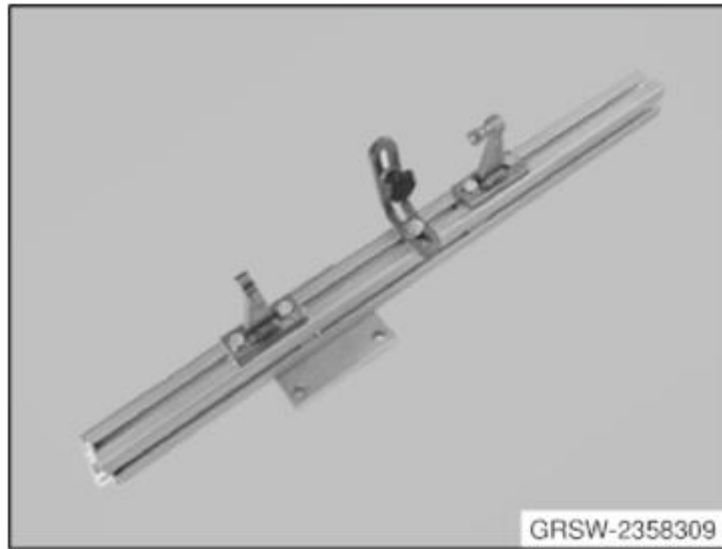
**2358309 FIXTURE AM**

**NOTE:** Fixture for door on engine mounting bracket, valid for: BMW i Aftersales Basic

**Storage Location**

Individual

**SI number**



**Fig. 4: Identifying Fixture (2358309)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355746 GAUGE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Applies to: BMW i Aftersales CFRP Full set consisting of 3 gauges

**2355745 GAUGE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Applies to: BMW i Aftersales Carbon Full

**Storage Location**

Individual

**SI number**

01 08 13 (938)

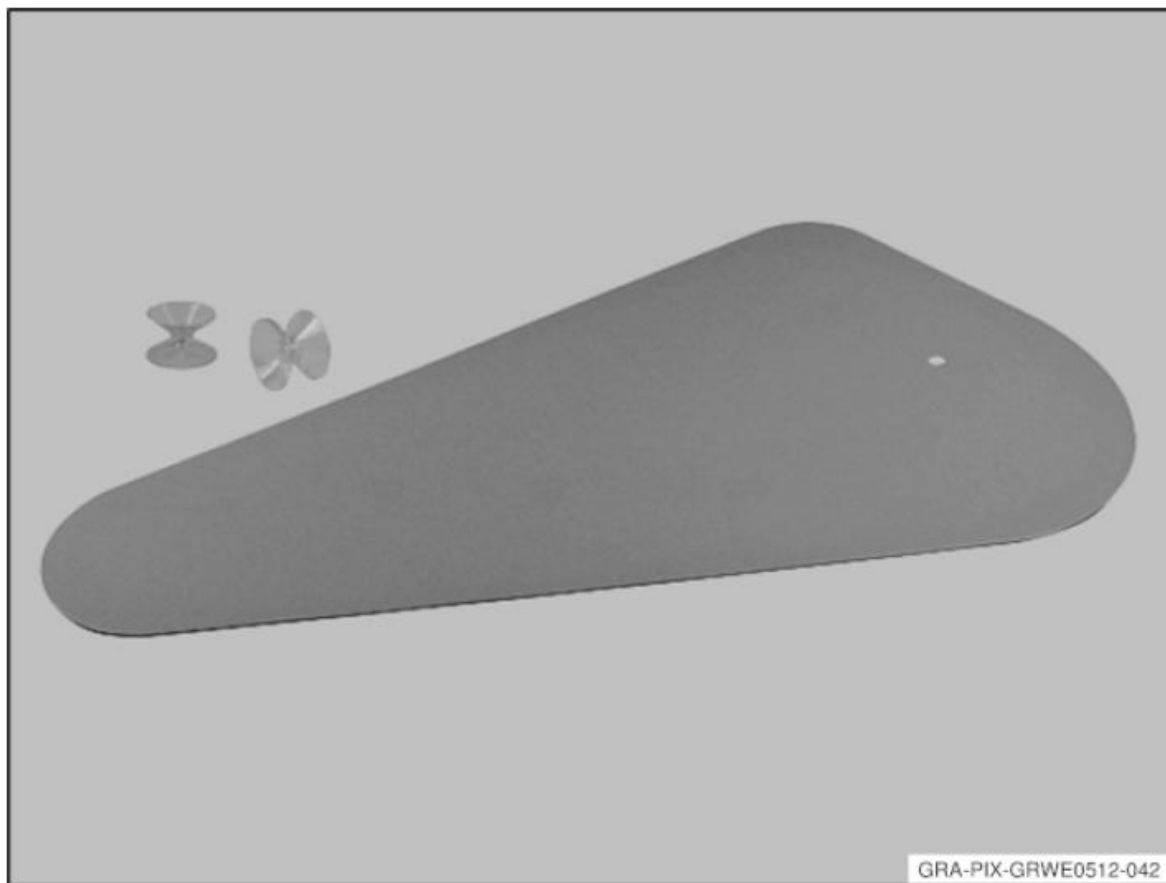
Consisting of:

1 = **2355746** Gauge

**NOTE:** Applies to: BMW i Aftersales CFRP Full set consisting of 3 gauges



**2337983 GUARD AM**



[Fig. 6: Identifying Guard \(2337983\)](#)

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Additional information and data stored in project 1030.

**Storage Location**

Individual

**SI number**

05 09 12 (853)

**2352494 HEXAGON SOCKET MINIMUM SET: MECHANICAL TOOLS**

**NOTE:** For adjusting the door outer skin Applies to: BMW i Aftersales.

**Storage Location**

A74

**SI number**

01 25 13 (994)



**Fig. 7: Identifying Hexagon Socket (2352494)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2357465 HOOK WRENCH MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** For adjusting the door outer skin I01 Applies to: BMW i Aftersales.

**Storage Location**

C35

**SI number**

01 25 13 (994)



**Fig. 8: Identifying Hook Wrench (2357465)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356945 MEASUREMENT AID MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic (only for Japan) measuring aid (laser) for measuring the vehicle height. In conjunction with 83 30 2 356 943.

**Storage Location**

Individual

**SI number**





**Fig. 9: Identifying Measurement Aid (2356945)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2211265 MEASURING DEVICE AM**

**NOTE:** The infrared thermometer is used for checking the three-stage drying process of the 2-pack metallic filler.

**Storage Location**

individual



**Fig. 10: Identifying Measuring Device (2211265)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355540 PLIERS MECHANICAL TOOL**

**NOTE:** For fixing CFRP components/FZ 60 Applies to: BMW i Aftersales Carbon Full

**SI number**

05 07 13 (002)



**Fig. 11: Identifying Pliers (2355540)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356860 PLIERS MINIMUM SET: MECHANICAL TOOLS AM**

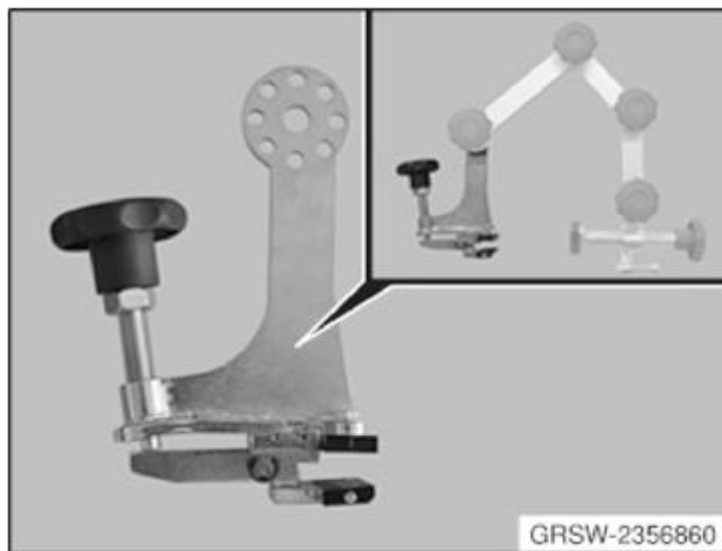
**NOTE:** Roof pliers Applies to: BMW i Aftersales Carbon Full

**Storage Location**

Individual

**SI number**

01 28 13 (997)



**Fig. 12: Identifying Pliers (2356860)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355479 PLIERS MECHANICAL TOOL**

**NOTE:** For fixing CFRP components/MT 70 Applies to: BMW i Aftersales Carbon Full

**SI number**

05 07 13 (002)



**Fig. 13: Identifying Pliers (2355479)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2155739 RIVETING TOOL SET AM**



**Fig. 14: Identifying Riveting Tool Set (2155739)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** For setting blind rivet nuts and blind rivet screws.

**SI number**

05 05 08 (504)

**2357309 SCRAPER MINIMUM SET: MECHANICAL TOOLS AM**

In conjunction with: [83302357309](#)

**NOTE:** Angle scraper Applies to: BMW i Aftersales CFK Full Spare blades for angle scraper 83 30 2 357 464

**Storage Location**

Individual

**SI number**

01 27 13 (996)



**Fig. 15: Identifying Scraper (2357309)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2408752 SOCKET NUT MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** To adjust the door outer skin I01 after production date 01/2016

**Storage Location**

B35

**SI number**

01 59 15 (355)



**Fig. 16: Identifying Socket Nut (2408752)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2358919 TOOL AM**

**Storage Location**

Individual

SI number

01 02 14 (069)



**Fig. 17: Identifying Tool (2358919)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2358918 TOOL AM**

**NOTE: Driver for M14 threaded inserts**

Storage Location

Individual

SI number

01 02 14 (069)



**Fig. 18: Identifying Tool (2358918)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2285061 TOOL SET AM**

**NOTE: Tool set for M5 threaded insert**

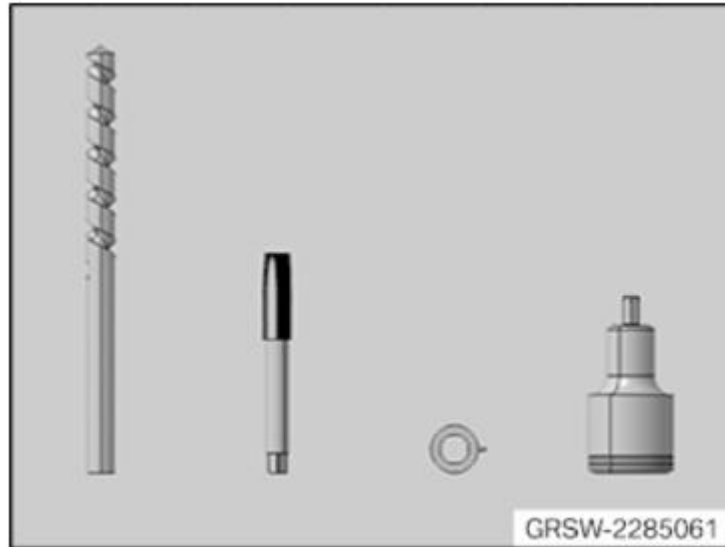
Storage Location



Individual

SI number

01 02 14 (069)



**Fig. 19: Identifying Tool Set (2285061)**

Courtesy of BMW OF NORTH AMERICA, INC.

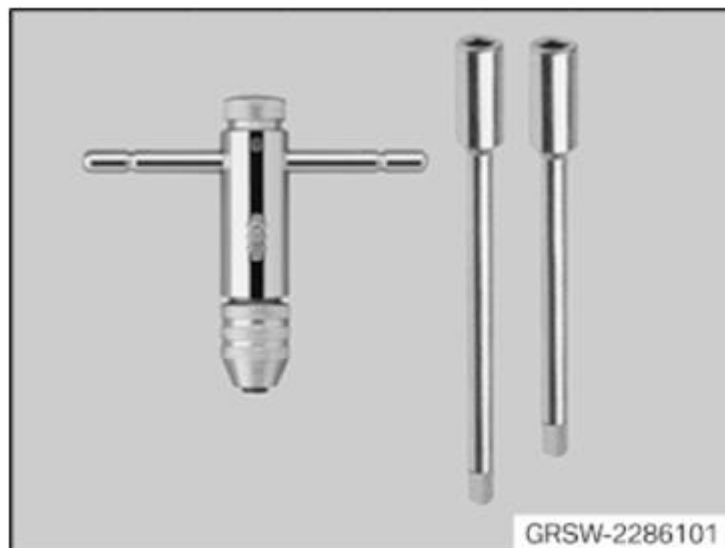
**2286101 TOOL SET AM**

Storage Location

Individual

SI number

01 02 14 (069)



**Fig. 20: Identifying Tool Set (2286101)**

Courtesy of BMW OF NORTH AMERICA, INC.

**0402559 USE AM**

**NOTE:** for aluminum thread repair on the N52-magnesium crankcase

SI number

08 01 05 (177)



**Fig. 21: Identifying Use (0402559).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356943 WRENCH MINIMUM SET: MECHANICAL TOOLS AM**

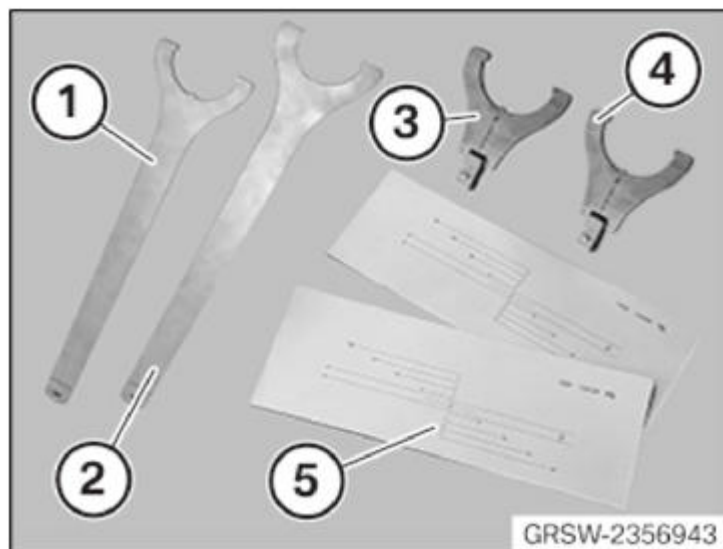
**NOTE:** Applies to: BMW i Aftersales Basic (for Japan only) To adjust height of dampers for MCV Japan chassis and suspension I01. In conjunction with 83302356945. Contents: 4 hook wrenches, 2 of which are the longer version and 2 for torque wrench 2 magnet foils with measuring grid

**Storage Location**

Individual

**SI number**

01 20 13 (986)



**Fig. 22: Identifying Wrench (2356943)**

Courtesy of BMW OF NORTH AMERICA, INC.

**ACCESSORIES AND BODY, CAB****Body - Tightening Torques - All I3 Models - i3****DRIVE MODULE****41 11 DRIVE MODULE****TIGHTENING TORQUE SPECIFICATION - DRIVE MODULE**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Strut, horizontal to drive module	I01	Screw, M10	Â	56 Nm
	I01	Screw, M8	Â	28 Nm
2AZ Cross member, rear to drive module	I01	M10 screw	Â	56 Nm
3AZ Drive module to body	I01	M12 screw	Â	108 Nm
4AZ Rear end strut to drive module	I01	M10 screw	Renew screw. Jointing torque Angle of rotation	56 Nm 90 Â°
	I01	Screw, M8	Â	28 Nm
5AZ Dome strut to cast spring strut dome/bulkhead	I01	M10 screw	Â	56 Nm
6AZ Grounding cable to blind rivet nut	I01	M8	Â	15 Nm
7AZ Grounding cable to blind rivet nut	I01/I12	M10	Â	17 Nm
8AZ Reinforcement of side member to side member	I01	M6 thread cutting	Â	4 Nm
9AZ Reinforcement of side member to side member/strut brace	I01	M12x1.5	Â	100 Nm
10AZ Strut brace to side member	I01	M12x1.5	Â	100 Nm
11AZ Side sill reinforcement to Drive module	I01	M12x1.5x23	Renew screw.	108 Nm

**ENGINE COMPARTMENT LID****41 61 ENGINE COMPARTMENT LID****TIGHTENING TORQUE SPECIFICATION - ENGINE COMPARTMENT LID**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Engine compartment lid to hinge	I01	M8	Â	18.5 Nm
	I12	M8	Â	19.0 Nm
2AZ Hinge to body	I01	M8	Â	18.5 Nm
	I12	M6	Â	8 Nm
3AZ Adjusting plate to hinge	I12	M6	Â	4 Nm

**FRONT DOOR****41 51 FRONT DOOR****TIGHTENING TORQUE SPECIFICATION - FRONT DOOR**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Screw for hinge halves	I01	M8x1 screw	Replace screw	28.5 Nm
2AZ Door hinge to front door	I01	M10 screw	Â	40 Nm
3AZ Door hinge to body	I01	Screw with taper M12	Â	82 Nm

⌘	Type	Thread	Tightening specifications	Dimension
4AZ Side impact protection on front door	I01	M8 screw	Replace screw	19 Nm

## REAR DOOR

### 41 52 REAR DOOR

#### TIGHTENING TORQUE SPECIFICATION - REAR DOOR

⌘	Type	Thread	Tightening specifications	Dimension
1AZ Screw for hinge halves	I01	M8 x 24	Replace screw	28.5 Nm
2AZ Door hinge to rear door	I01	M10 x 28	⌘	40 Nm
3AZ Door hinge to body	I01	M12 x 36	⌘	82 Nm

## REAR LID

### 41 62 REAR LID

#### TIGHTENING TORQUE SPECIFICATION - REAR LID

⌘	Type	Thread	Tightening specifications	Dimension
1AZ Tailgate to tailgate hinge	I01	M8	⌘	20 Nm
	I12	Oval-head screw M6	⌘	8 Nm
2AZ Tailgate hinge to body	I01	M8	⌘	18.5 Nm
	I12	M8 screw	⌘	19 Nm
3AZ Grounding strap to body	I01	M5	⌘	2 Nm
	I12	M5	⌘	4.5 Nm
4AZ Opening aid to tailgate	I12	M5 screw	⌘	4.5 Nm

## ROOF

### 41 31 ROOF

#### TIGHTENING TORQUE SPECIFICATION - ROOF

⌘	Type	Thread	Tightening specifications	Dimension
1AZ Roof frame on convertible top bow	I01	M6	⌘	3.5 Nm

## SIDE PANELS

### 41 35 SIDE PANELS

#### TIGHTENING TORQUE SPECIFICATION - SIDE PANELS

⌘	Type	Thread	Tightening specifications	Dimension
1AZ Front side panel to module carrier, and to bracket	I01	Hexagon screw for thermoplastic material	⌘	2 Nm
2AZ Rear side panel to bracket, front and to bracket, side	I01	Hexagon screw and screw TS5 x 20 for thermoplastic material	⌘	2 Nm
3AZ Rear side panel to wheel arch cover	I01	Hexagon screw for thermoplastic material	⌘	3 Nm
4AZ Module carrier, to connection, top and to carrier support,	I01	STEMS M6 x 20	⌘	3.5 Nm
5AZ Bracket to side frame and to deformation element	I01	Screw/nut M5	⌘	5 Nm



## ACCESSORIES AND BODY, CAB

### Body Equipment - Repair - All I3 Models - i3

## GENERAL INFORMATION

### 51 00... NOTES ON COMPONENT BONDING WITH ADHESIVE TAPE

Unless specified otherwise in individual or component-specific instructions, the following notes apply.

Follow [REPAIR INSTRUCTIONS FOR BONDED GASKETS](#) for rubber seals.

#### 1. General notes

- Bonding at room and object temperature of  $>+18\text{ }^{\circ}\text{C}$ .
- Newly painted parts may only be bonded after a drying time of at least 24 hours.
- Optimal bonding/attachment to the background surface is achieved after approx. 48 hours. Components must not be exposed to mechanical strain beforehand (car wash, strength test, etc.).
- Do not touch bonding area.
- It is not the length of time that pressure is applied but rather the force of pressure applied that is crucial.
- Detaching the adhesive tape after pressing destroys the adhesive layer.

#### 2. Auxiliary materials and tools

- CLEANING AGENT R1 OR CLEANING AGENT R2
- [SIKA ACTIVATOR 205](#)
- Fluff-free cleaning cloths
- Pressure roller

#### 3. Preparations

- Remove all adhesive residue or clean new part thoroughly
- Clean the areas to be bonded immediately before bonding to remove silicone and grease residues.
- Treat bonding on glass or painted surfaces with Sika Aktivator 205.

**NOTE:**        **Observe ventilation time  $\geq 1$  minute.**

#### 4. Bonding

##### 4.1 Components without preassembled adhesive tape

- Pull off liner\* from adhesive tape
- Position adhesive tape on component and stick on
- Press down adhesive tape over entire adhesive area
- Continue with Point 4.2

\* Liner is the protective film on the adhesive tape.

##### 4.2 Components with pre-fitted adhesive tape

- Pull off liner\* from adhesive side (if adhesive area is large, do not pull off liner completely)
- Align component in correct position on vehicle
- Press down component over entire adhesive area

Minimum contact pressure  $\geq 15\text{ N/cm}^2$  (firm thumb pressure reaches approx.  $35\text{ N/cm}^2$  .)

\* Liner is the protective film on the adhesive tape.

### 51 00... NOTES ON INSTALLATION OF RUBBER WINDOW SEALS

#### 1. Work safety when handling lubricant G14



- Wear safety goggles, protective gloves and if necessary an apron.
- Do not eat, drink or smoke in the area of processing/application
- Ensure rooms are well ventilated.
- Keep away from heat and ignition sources
- In event of skin contact: Wash areas of skin affected with soap and water immediately, change work clothing which has been fouled with lubricant immediately (keep spare work clothing in reserve)
- In event of eye contact: Rinse eyes immediately with plenty of water and seek medical advice

## 2. General notes

- Only use the BMW-approved lubricant for installation
- Application only at room and object temperatures between 18 and 25 °C
- Lubricant dries at different rates depending on the quantity, temperature and ventilation and becomes sticky
- Lubricant can only be used for fitting and not for fault elimination (e.g. grating)
- Newly painted parts may only be brought into contact with the lubricant after cooling
- Optimal bonding to the surface is achieved after approx. 48 h. The rubber window seal must not be exposed to mechanical strain beforehand. (car wash, strength test, etc.).

**IMPORTANT:** To avoid groaning noises, do not use soapy water (low-surface-tension water with washing-up liquid) or lubricant containing silicone.

## 3. Auxiliary materials and tools

- CLEANING AGENT R1 OR CLEANING AGENT R2 , cleaning cloth, plastic scraper, needle
- **LUBRICANT G14**

## 4. Preparations

- Heat and remove anti-friction agent residues with a hot air blower or clean new part thoroughly
- Immediately prior to fitting, clean the work area in order to remove silicone and grease residues

**NOTE:** Air drying time approx. 1 min:

## 5. Assembly

- Apply a thin coating of lubricant to the rear side of the rubber window seal only
- Perform fitting within 30 min of applying lubricant
- Lubricant dries after fitting and becomes sticky

## 51 00... OVERVIEW OF CONSUMABLES

Designation, repair instructions	Designation	Part number	Remarks
Cleaning agent R2	Cleaning agent R2	83 19 0 417 324	500 ml
Lubricants G14	Lubricants G14	83 23 2 360 412	900 ml/ <b>NOTES</b>
Sika Activator 205	Aktivator 205	83 19 0 030 155	250 ml
Â	Â	Â	Â
Yellow plastic adhesive tape	Adhesive tape	83 19 9 410 979	A = 66 mm; B = 50 mm
Double-sided adhesive tape	Adhesive tape	54 11 2 290 978	L = 50 mm/W = 12 mm
Masking tape	Masking tape	81 22 9 400 181	L = 50 mm/ W = 19 mm
Masking tape	Masking tape	81 22 9 400 388	L = 50 mm/ W = 30 mm
Â	Â	Â	Â
Eraser disk	Scotch Brite eraser disk	51 91 0 402 946	with shaft

Designation, repair instructions	Designation	Part number	Remarks
Cutting cord	Cutting cord	81 43 2 344 272	<u>NOTES</u>
Adhesive set K6	Adhesive set K6	83 19 2 317 925	Â
Window glass adhesive	Window glass adhesive, cold, 1 hour	83 19 2 289 286	Â
Profile rubber adhesive	Â	83 19 2 232 322	Â
Set of felt pads	Set of felt pads	51 45 2 353 024	Â

## 51 11... INSTALLING/REPLACING NUMBER PLATE (WITHOUT NUMBER PLATE BASEPLATE)

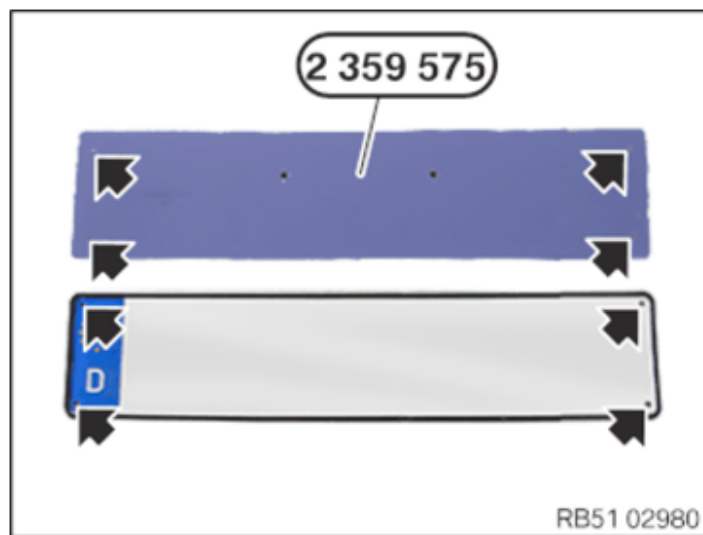
### Special tools required:

- 2 359 575

Place template 2 359 575 on number plate and center.

Mark and drill/punch drilled holes on number plate.

Deburr bore holes on the number plate.



**Fig. 1: Locating Bore Holes On Number Plate**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Place template 2 359 575 on bumper panel and align over the marks (1).

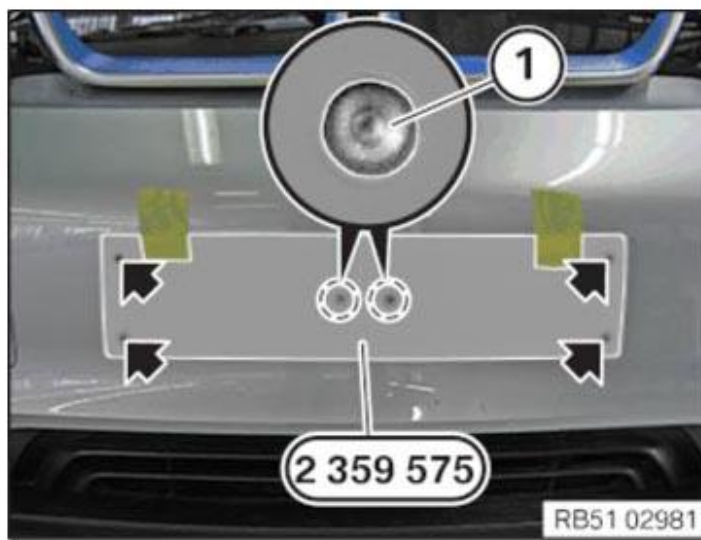
Align template horizontally.

Mark drilled holes on bumper panel.

Remove template.

**IMPORTANT: Do not pre-drill!**

Mount number plate to bumper panel using number plate screws and the corresponding protective caps.



**Fig. 2: Placing Template (2 359 575) On Bumper Panel**

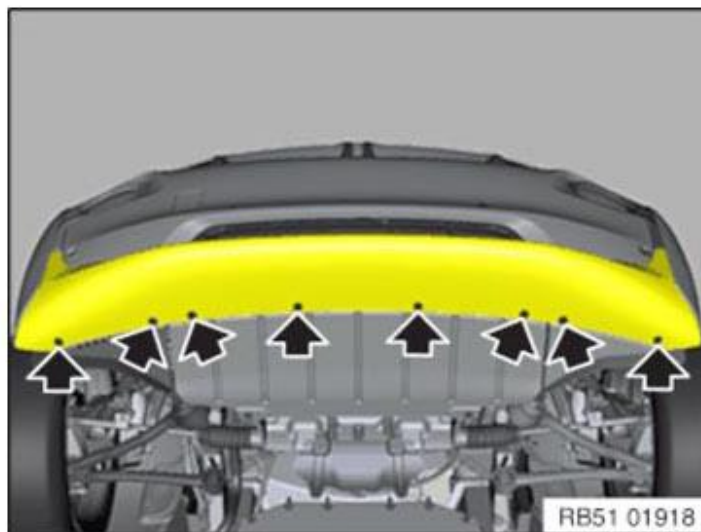
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 11 156 REMOVING AND INSTALLING FRONT BUMPER PANEL**

Necessary preliminary tasks:

- Remove **FRONT WHEEL ARCH COVER (FRONT SECTION)** left/right

Release screws.

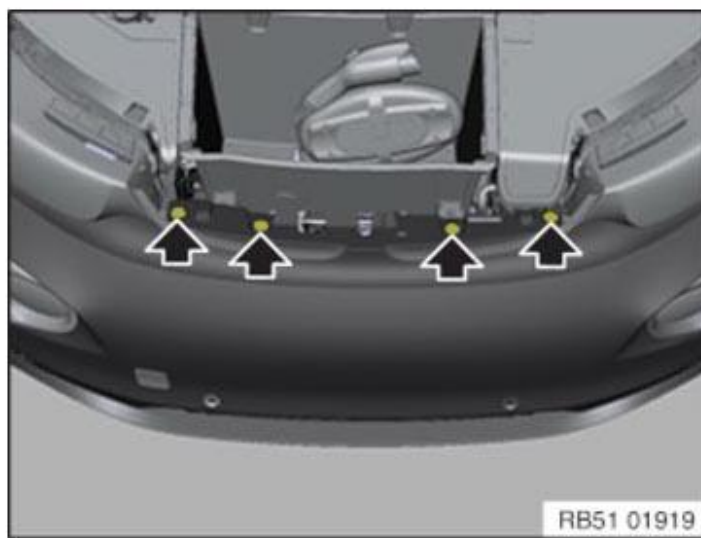


**Fig. 3: Locating Front Bumper Panel Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

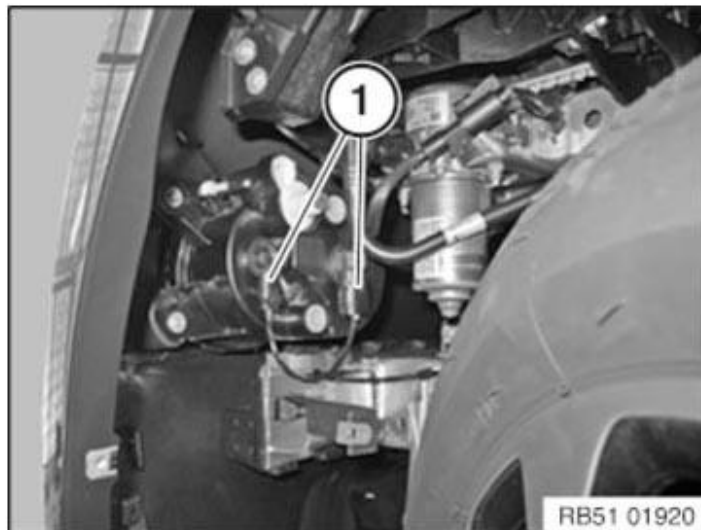
Tightening torque **51 11 1AZ** .



**Fig. 4: Locating Front Bumper Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug connections (1) and disconnect.

**NOTE:** Carry out work on the right side in the same way as for the left side illustrated here.

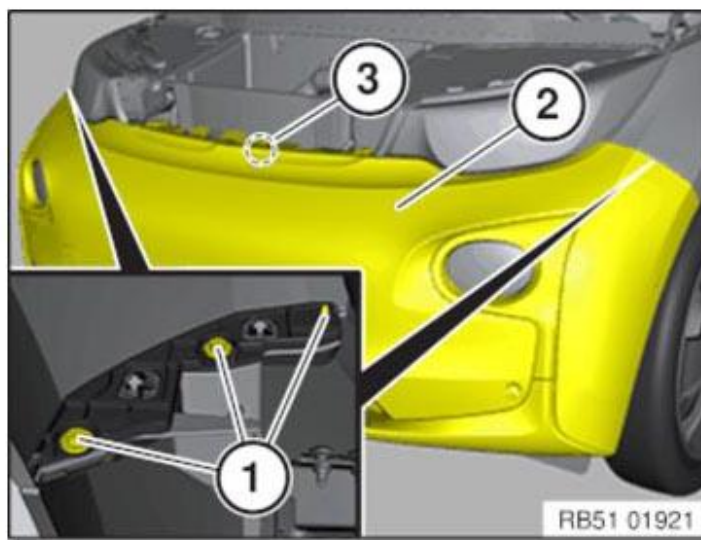


**Fig. 5: Identifying Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) on left/right.

Tightening torque [51 11 2AZ](#) .

**NOTE:** The following tasks must be carried out with a second person assisting:



**Fig. 6: Identifying Bumper Panel, Guide And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Lift bumper panel (2) over guide (3).

Remove bumper panel (2) towards front.

If necessary, unlock associated plug connections and disconnect.

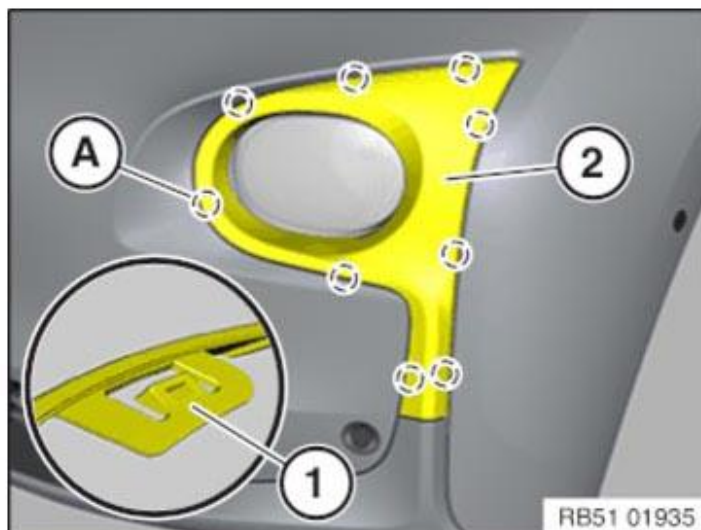
**51 11 164 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT BUMPER PANEL TRIM**

**Special tools required:**

- [2 298 505](#)

Unclip latch mechanisms (1) for trim (2) using special tool [2 298 505](#) .

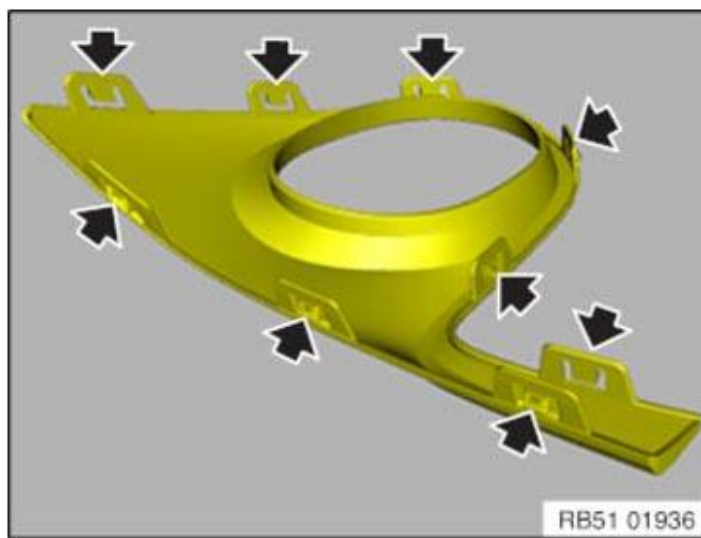
**NOTE:** Begin by releasing the latch mechanisms (1) in area (A).



**Fig. 7: Identifying Latch Mechanisms And Trim**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Latch mechanisms must not be damaged or missing.



**Fig. 8: Checking Latch Mechanisms For Damaged Or Missing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 11 770 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT DEFORMATION ELEMENT FOR FRONT BUMPER PANEL**

**Necessary preliminary tasks:**

- Remove **SUPPORT FOR TOP FRONT BUMPER PANEL**

Unclip cable clip (1).

Release screw (2).

Tightening torque **51 11 4AZ** .

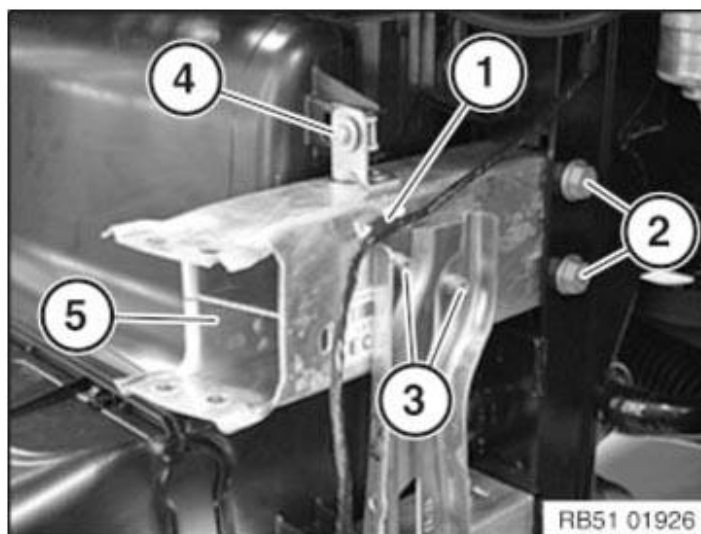
Release screws (3).

Tightening torque **51 11 7AZ** .

Release screw (4).

Tightening torque **51 64 8AZ** .

Pull out deformation element (5) towards front.



**Fig. 9: Identifying Deformation Element, Cable Clip And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

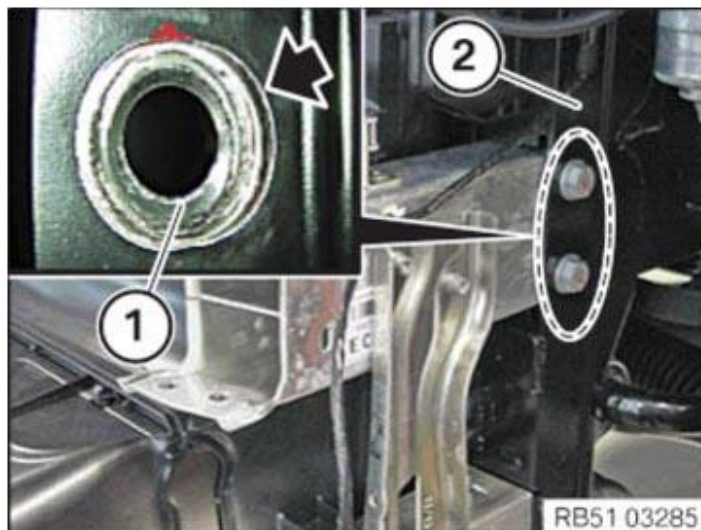
*Installation note:*



Check ATTACHMENT POINTS (1) on side member (2).

Grind off any burr at attachment points (1).

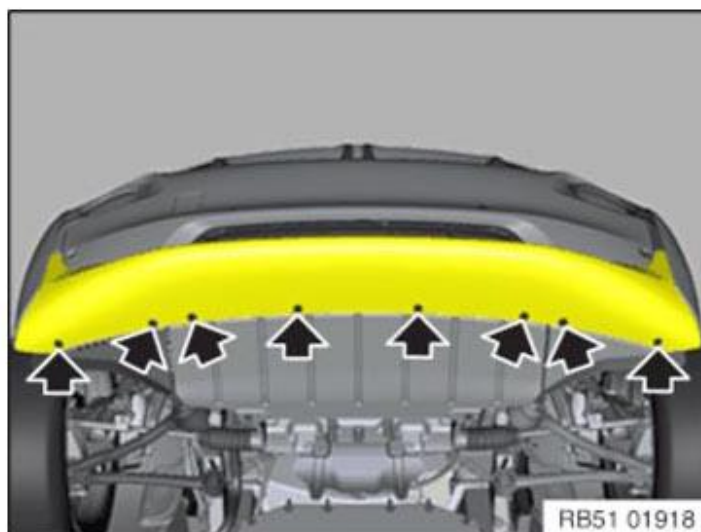
Apply primer at bare metallic points and touch up with paint pen.



**Fig. 10: Identifying Attachment Points And Side Member**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 11 141 REMOVING AND INSTALLING/REPLACING LOWER SECTION AT FRONT BUMPER PANEL**

Release screws.

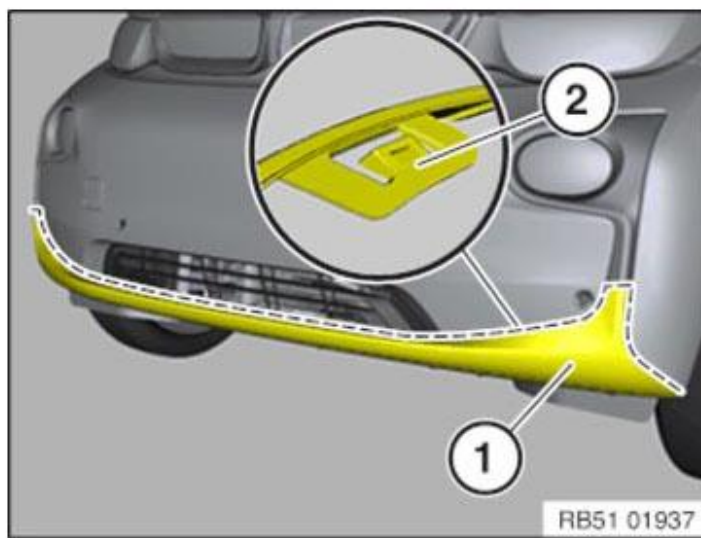


**Fig. 11: Locating Front Bumper Panel Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release bumper panel lower section (1) at latch mechanisms (2) and feed out.

*Installation note:*

Catches (2) must not be damaged or missing.



**Fig. 12: Identifying Bumper Panel Lower Section And Catches**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 11 180 REMOVING AND INSTALLING/REPLACING ORNAMENTAL GRILLE FOR BUMPER PANEL (CENTER)**

**Necessary preliminary tasks:**

- Remove **LOWER SECTION OF BUMPER TRIM AT FRONT**

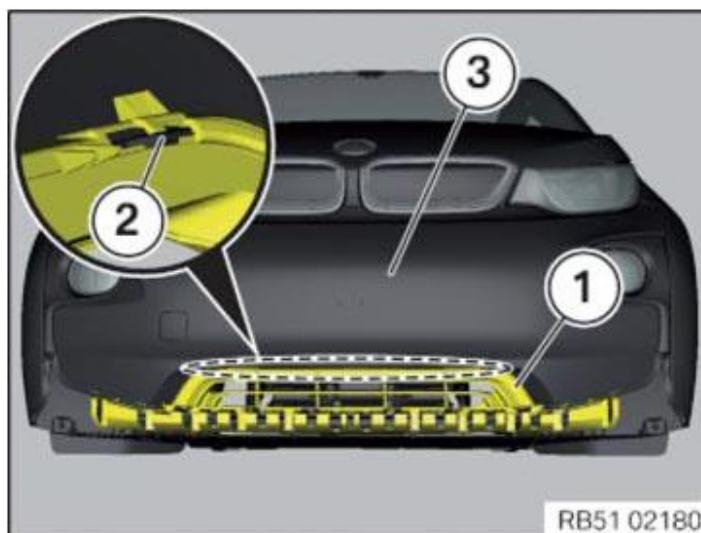
Release ornamental grille (1) from latch mechanisms (2) toward the rear.

If necessary, detach hose for headlight cleaning system from ornamental grille (1).

Feed out and remove ornamental grille (1) from bumper panel (3).

*Installation note:*

Latch mechanisms (2) must not be damaged or missing.



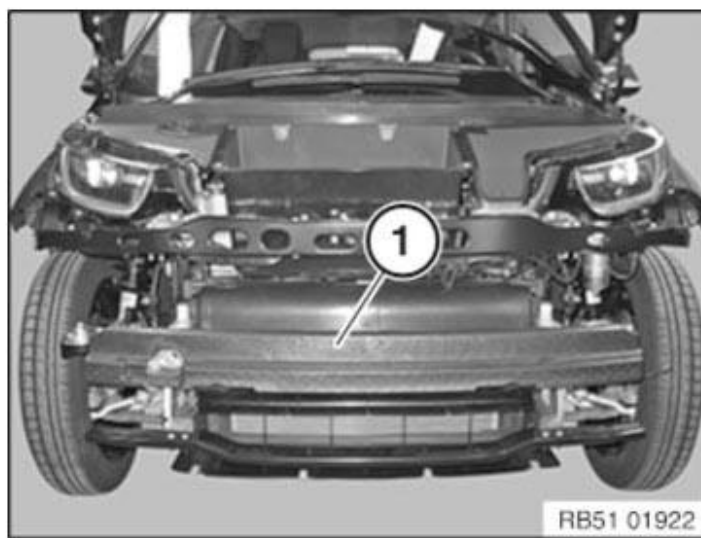
**Fig. 13: Identifying Ornamental Grille, Bumper Panel And Latch Mechanisms**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 11 050 REMOVING AND INSTALLING/REPLACING SUPPORT FOR FRONT BUMPER PANEL**

**Necessary preliminary tasks:**

- Remove front **BUMPER PANEL**
- Remove the **FANFARE HORN**

Remove impact absorber (1).

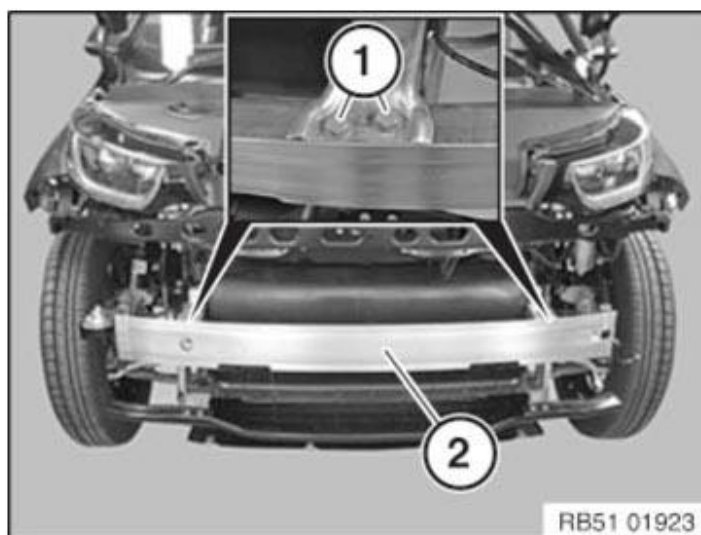


**Fig. 14: Identifying Impact Absorber**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque **51 11 3AZ** .

Remove support (2).



**Fig. 15: Identifying Front Bumper Support And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

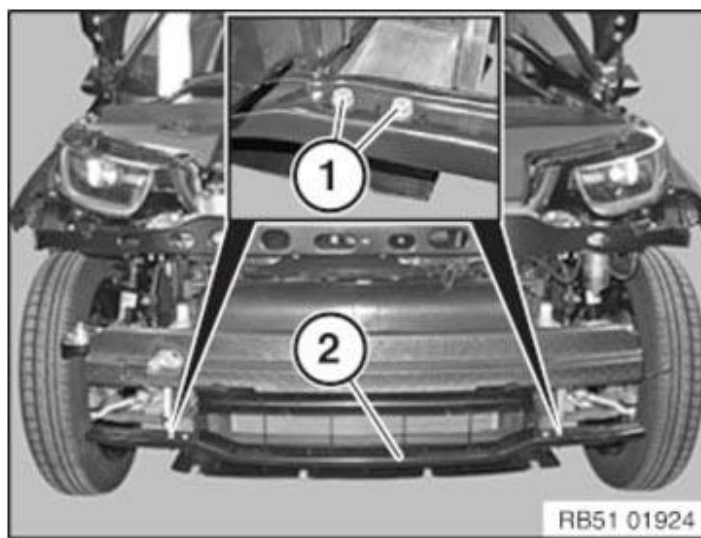
**51 11 060 REMOVING AND INSTALLING/REPLACING SUPPORT FOR FRONT LOWER BUMPER PANEL**

**Necessary preliminary tasks:**

- Remove front **BUMPER PANEL**

Release screws (1) and remove support (2).

Tightening torque **51 11 5AZ** .



**Fig. 16: Identifying Front Bumper Support And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 11 158 REPLACING BASE PLATE FOR NUMBER/LICENSE PLATE**

Only use the individual number plate baseplate.

The installation of other license plate baseplates is not permissible.

The number plate must be precisely mounted on the number plate baseplate.

If a number plate baseplate is not offered for the corresponding national-market version, the number plate must be screwed directly onto the bumper using a drilling template.

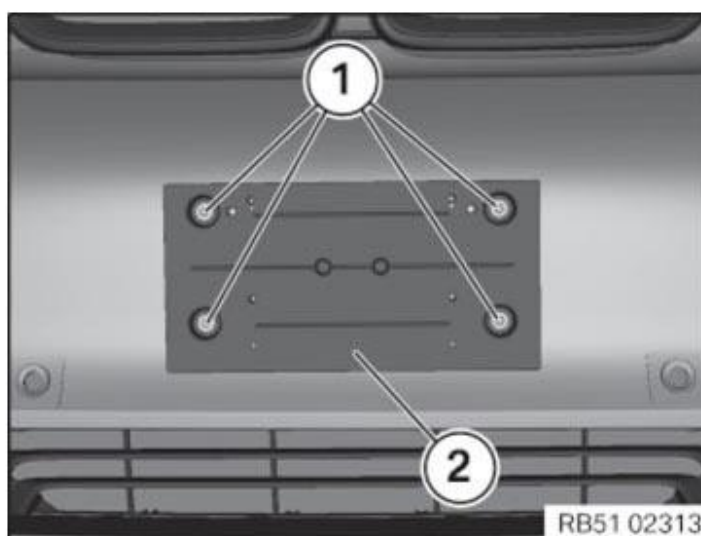
Incorrect assembly leads to a malfunction of the sensors of the driver assist systems.

**NOTE:** Schematic diagram is example of I01 Japan national-market version.

Release screws (1).

Tightening torque [51 11 8AZ](#) .

Remove holder (2) towards front.



**Fig. 17: Identifying Holder And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**If replacing bumper:**

Drill out marks (1) on bumper to 10 mm.

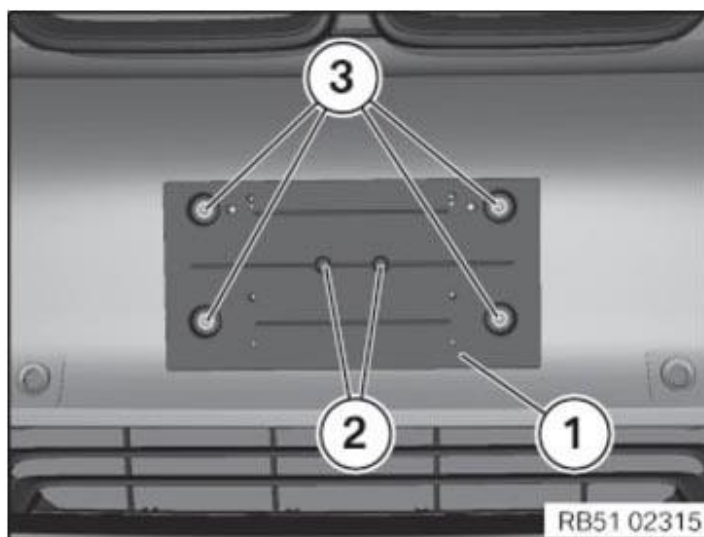


**Fig. 18: Identifying Drilling Marks On Bumper**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Position support (1) with centering (2) on bumper.

Screw in screws (3).

Tightening torque **51 11 8AZ** .



**Fig. 19: Identifying Bumper Support And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 11 773 REPLACING FRONT LOWER LEFT OR RIGHT DEFORMATION ELEMENT**

**Necessary preliminary tasks:**

- Remove the **SUPPORT FOR THE FRONT BOTTOM BUMPER PANEL**

Release screw (1).

Tightening torque **51 11 6AZ** .

Unfasten screws (2).

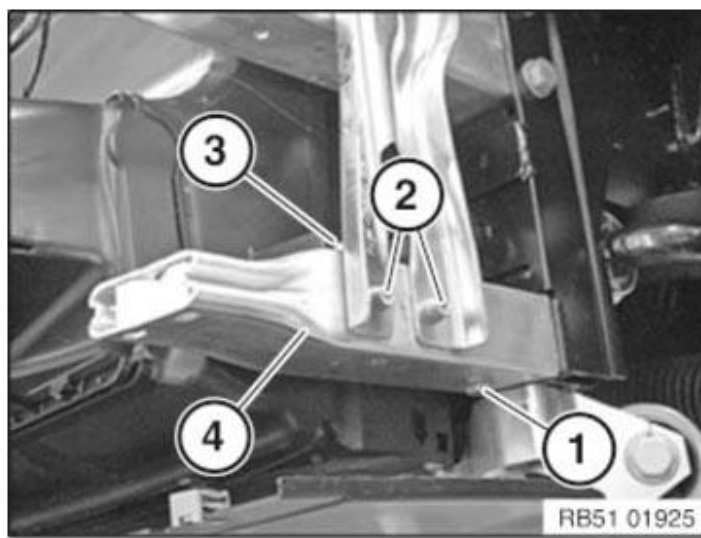
Tightening torque **51 11 7AZ** .

Release screw (3).

Tightening torque **51 64 8AZ** .

Remove deformation element (4).





**Fig. 20: Identifying Deformation Element And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## REAR BUMPER

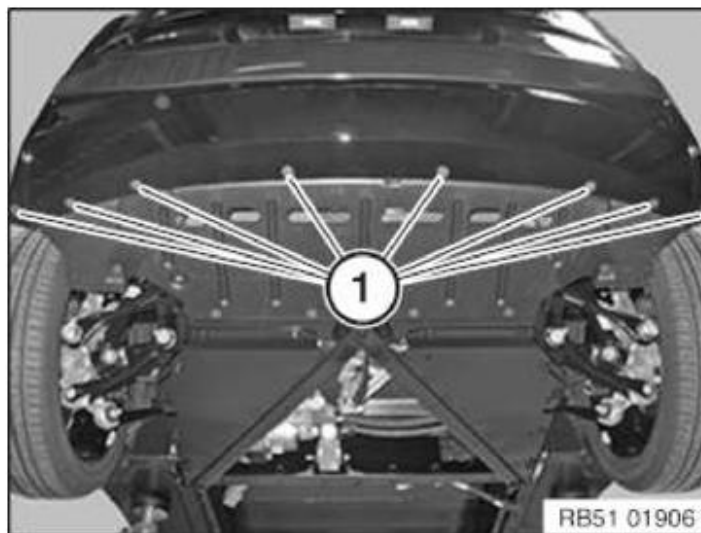
### 51 12 156 REMOVING AND INSTALLING (REPLACING) REAR BUMPER PANEL

Necessary preliminary tasks:

- Remove **LICENSE PLATE LIGHTS**
- Remove **NUMBER PLATE** or **NUMBER PLATE BASEPLATE**.

Release screws (1).

Tightening torque **51 12 3AZ** .

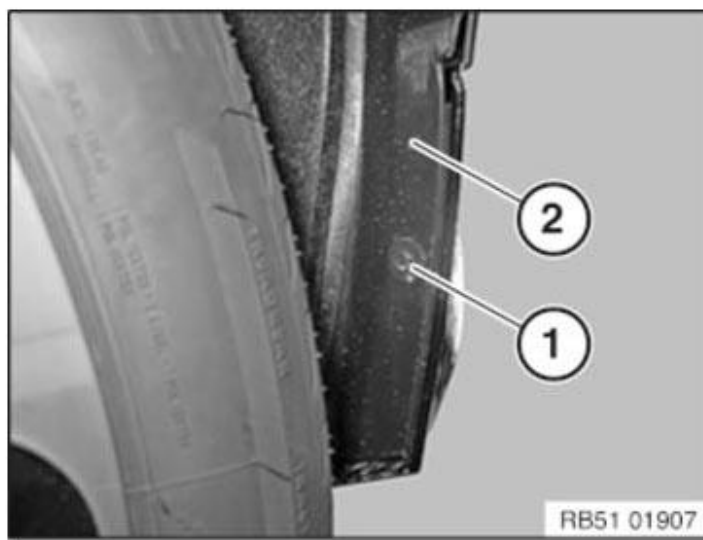


**Fig. 21: Identifying Rear Bumper Panel Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) on wheel arch cover (2) on left/right.

Tightening torque **51 12 2AZ** .





**Fig. 22: Identifying Wheel Arch Cover And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

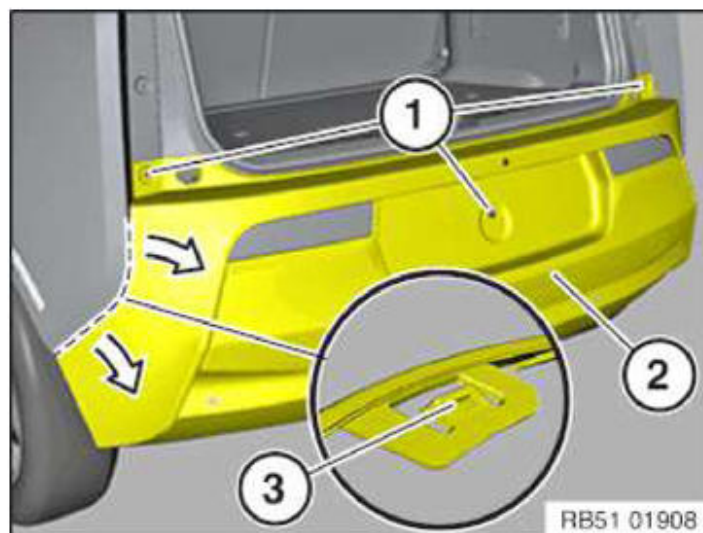
Tightening torque [51 12 1AZ](#) .

**NOTE:** The following tasks must be carried out with a second person assisting:

Release left/right latch mechanisms (3) from inside and unclip bumper panel (2) outwards.

Disconnect corresponding plug connections and remove bumper panel (2).

*Installation note:*



**Fig. 23: Releasing Left/Right Latch Mechanisms From Inside And Unclip Bumper Panel Outwards**

Courtesy of BMW OF NORTH AMERICA, INC.

Latch mechanisms (3) must be properly fed into corresponding holder.

Adjustment, see BODY GAP DIMENSION .

**Replacement:**

- Remount rear lights. See [REMOVING AND INSTALLING/REPLACING LEFT REAR LIGHT \(BUMPER PANEL\)](#) or [REMOVING AND INSTALLING/REPLACING RIGHT REAR LIGHT \(BUMPER PANEL\)](#)
- Remount [CAMERA](#)
- Change over the [COVER ON THE BUMPER TRIM PANEL](#)

**On replacement with PDC version:**

Unlock latch mechanisms (1) in direction of arrow.

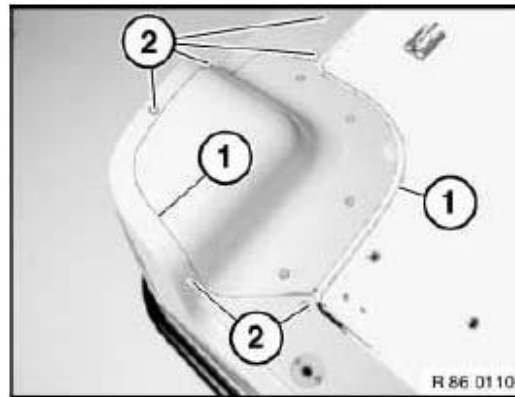
Pull ultrasonic sensor (2) out of bracket (3).

*Installation note:*

Before installation of ultrasonic sensor (2) on wiring harness, clean plug connection!

Retaining hooks of ultrasonic sensor (2) must engage exactly in mountings (1).

Make sure rubber ring is correctly fitted on ultrasonic sensor (2).



**Fig. 24: Unlocking Latch Mechanisms**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 12 080 REMOVING AND INSTALLING/REPLACING COVER ON REAR BUMPER PANEL**

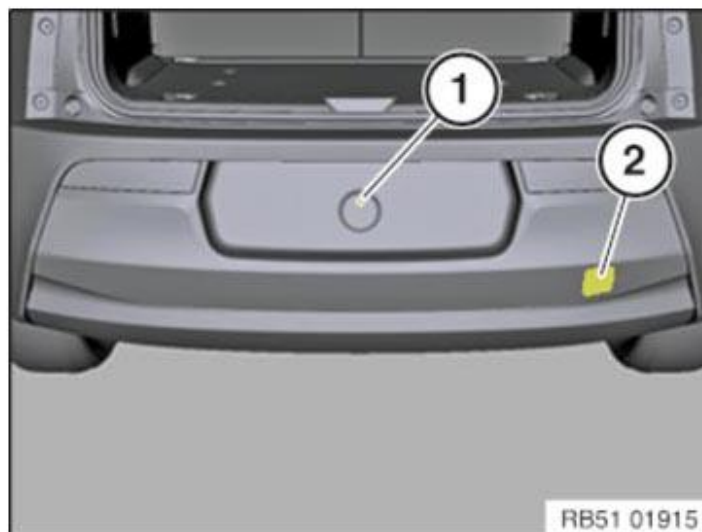
**Special tools required:**

- [2 298 505](#)

Release screw (1).

Tightening torque [51 12 1AZ](#) .

Unclip towing eye (2) from cover.



**Fig. 25: Identifying Towing Eye And Screw**

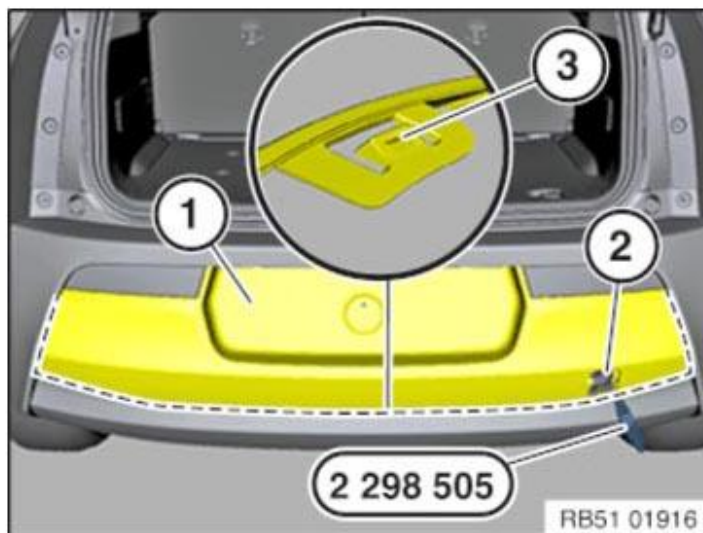
Courtesy of BMW OF NORTH AMERICA, INC.

Pull trim (1) on towing eye opening (2) slightly towards rear.

Insert special tool [2 298 505](#) between trim (1) and bumper panel as shown and release latch mechanisms (3).

First release latch mechanisms (3) at the bottom, then at the side.

Remove cover (1).



**Fig. 26: Inserting Special Tool (2 298 505) Between Trim And Bumper Panel**  
Courtesy of BMW OF NORTH AMERICA, INC.

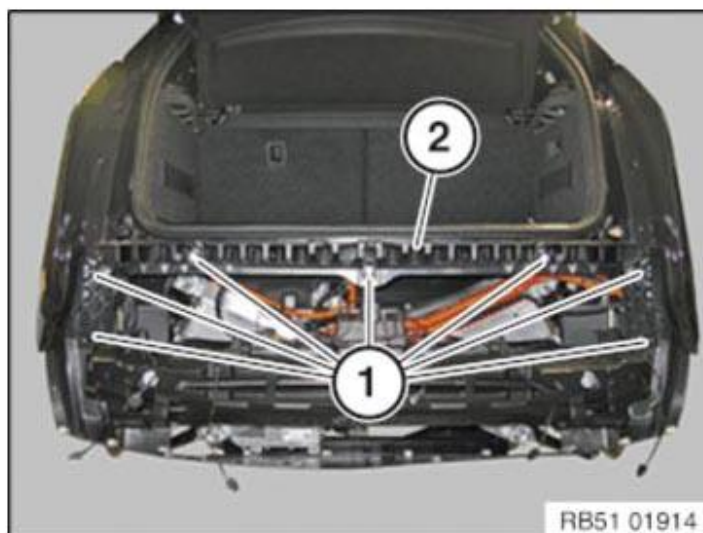
### **51 12 825 REMOVING AND INSTALLING/REPLACING GUIDE FOR REAR CENTER BUMPER**

Necessary preliminary tasks:

- Remove SUPPORT FOR BUMPER PANEL

Release screws (1) and remove guide (2).

Tightening torque 51 12 2AZ .



**Fig. 27: Identifying Guide And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

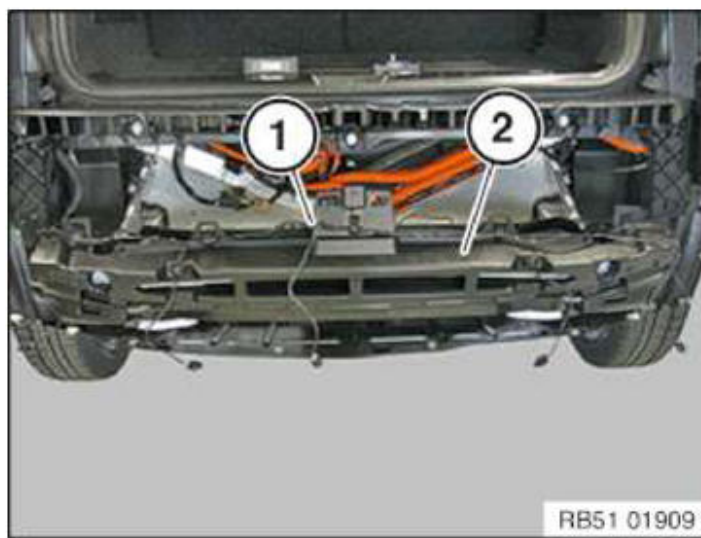
### **51 12 050 REMOVING AND INSTALLING/REPLACING SUPPORT FOR REAR BUMPER PANEL**

Necessary preliminary tasks:

- Remove BUMPER PANEL

Feed out wiring harness (1).

Unclip holder (2) from support.

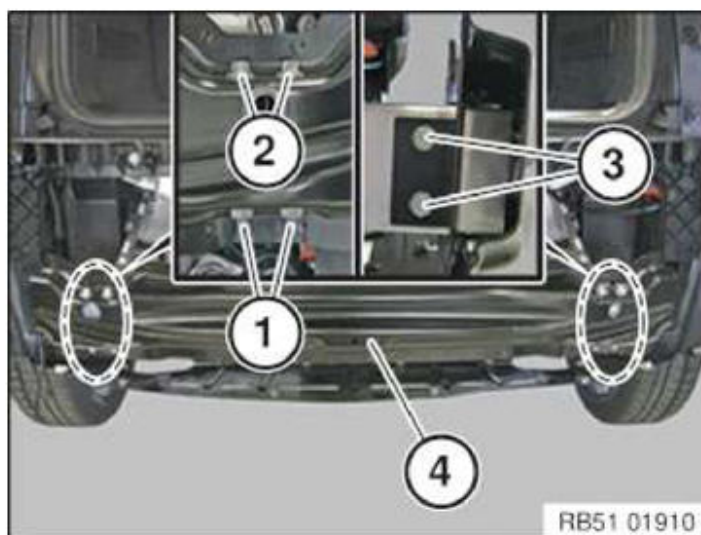


**Fig. 28: Identifying Wiring Harness And Holder**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release nuts (1) and remove screws (2).

Release screws (3) and remove support (4).

Tightening torque **51 12 5AZ** .



**Fig. 29: Identifying Rear Bumper Support, Nuts And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 12 812 REPLACING LEFT (RIGHT) DEFORMATION ELEMENT**

**Necessary preliminary tasks:**

- Remove **SUPPORT FOR BUMPER PANEL**
- Remove **REAR WHEEL**

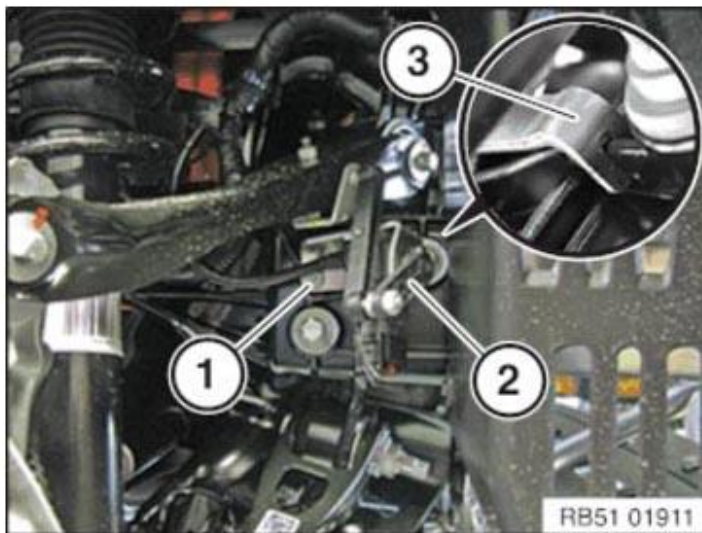
**Left side:**

Release screw (1) and allow sensor (2) to hang downwards.

*Installation note:*

Ensure that the holder (3) is correctly positioned.

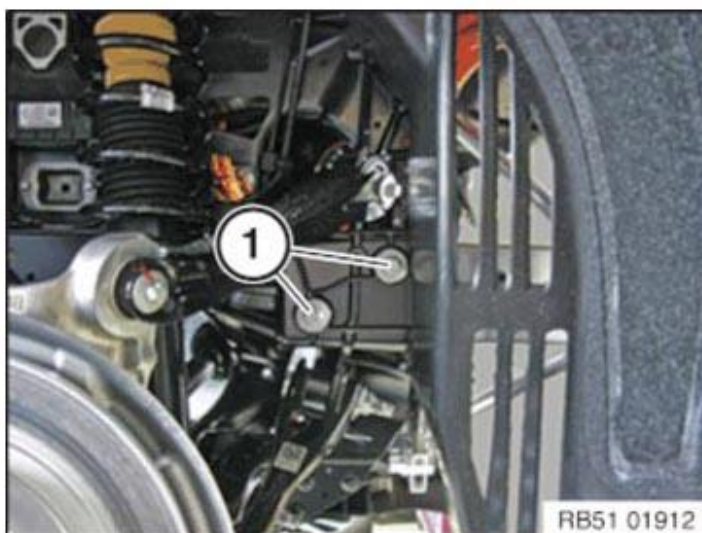




**Fig. 30: Identifying Holder, Screw And Allow Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

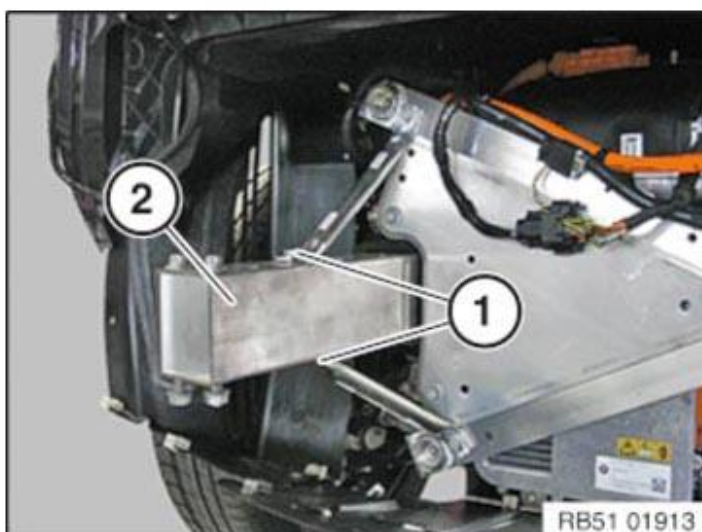
Tightening torque [51 12 6AZ](#) .



**Fig. 31: Identifying Rear Bumper Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and pull out deformation element (2).

Tightening torque [51 12 7AZ](#) .



**51 12 812 REPLACING LEFT DEFORMATION ELEMENT (VERSION WITH RANGE EXTENDER)**

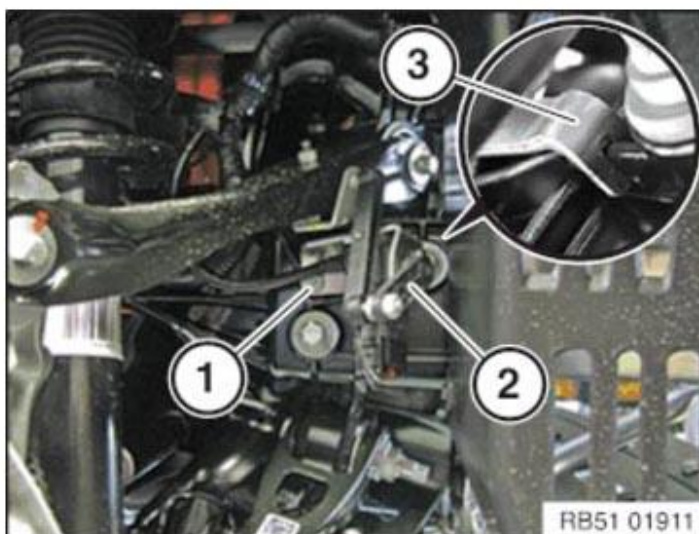
Necessary preliminary tasks:

- Remove **SERVICE CAP**
- Remove **SUPPORT FOR BUMPER PANEL**
- Remove **REAR WHEEL**

Release screw (1) and allow sensor (2) to hang downwards.

*Installation note:*

Ensure that the holder (3) is correctly positioned.

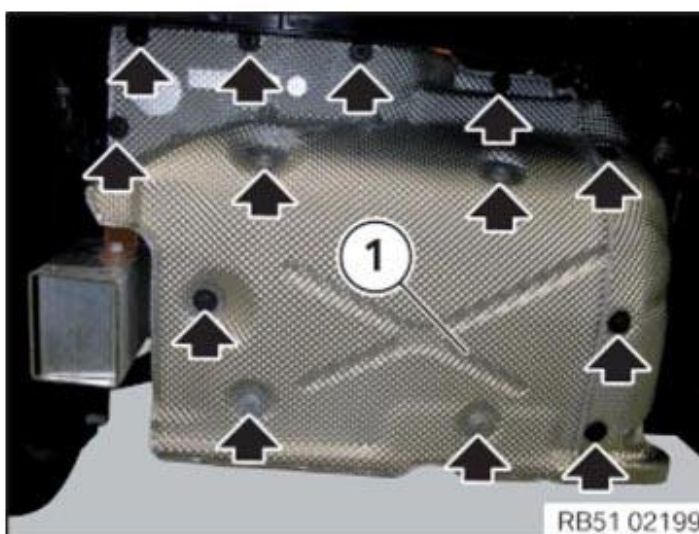


**Fig. 33: Identifying Holder, Screw And Allow Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove screws and nuts.

Tightening torque **18 32 5AZ** and **18 32 6AZ**.

Remove heat shield (1).



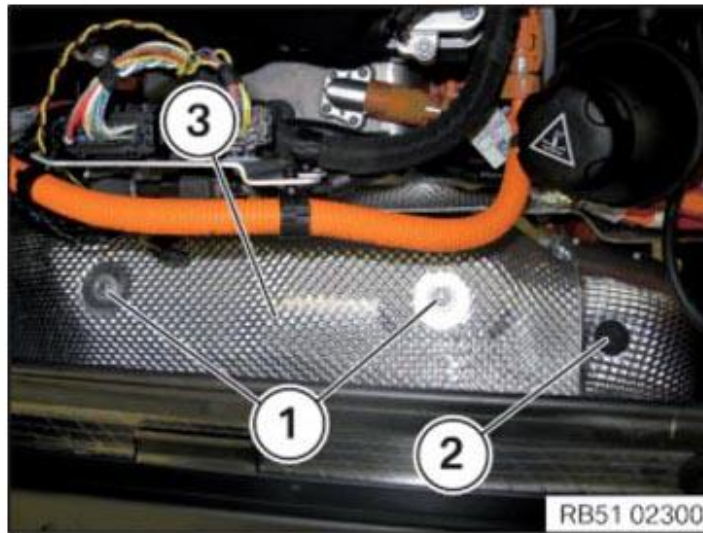
**Fig. 34: Locating Heat Shield Screws And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release nuts (1) and screw (2).



Tightening torque [18 32 5AZ](#) and [18 32 6AZ](#) .

Feed out heat shield (3) downwards.



**Fig. 35: Identifying Heat Shield, Screws And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Support exhaust system.

Release screws (1).

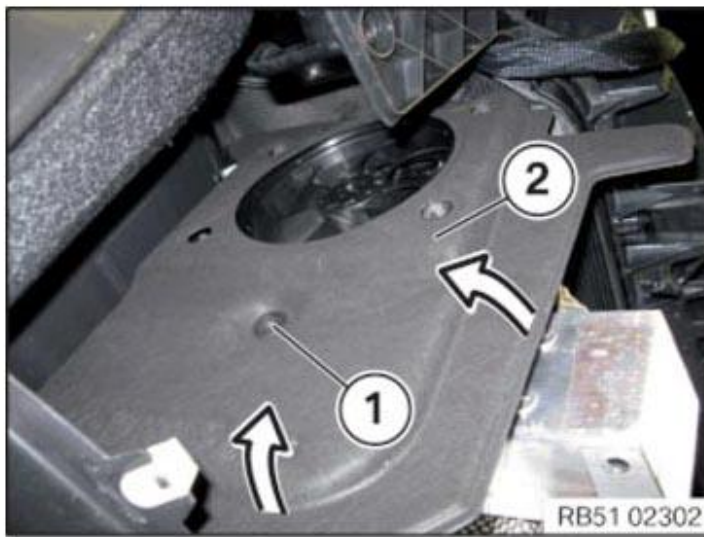
Tightening torque [18 20 1AZ](#) .



**Fig. 36: Identifying Exhaust System Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Fold up insulation (2) in bottom area.

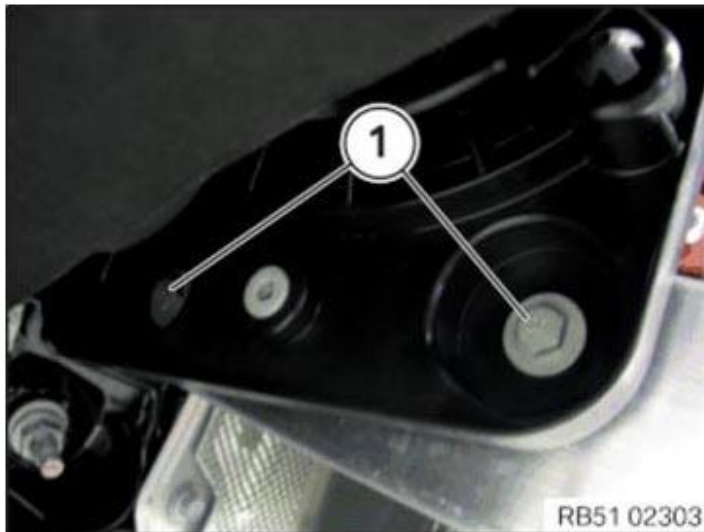


**Fig. 37: Folding Up Insulation**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [17 42 2AZ](#) .



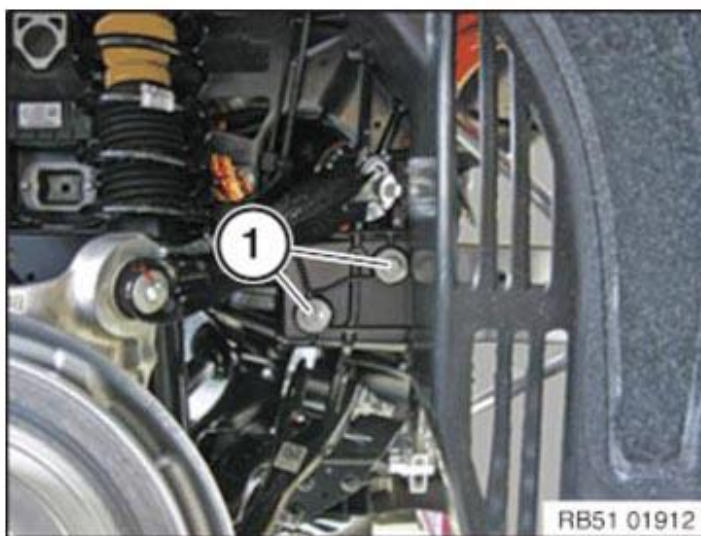
**Fig. 38: Identifying Electrical Fan Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [51 12 6AZ](#) .

Pull out deformation element.



**Fig. 39: Identifying Rear Bumper Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 12 812 REPLACING RIGHT DEFORMATION ELEMENT (VERSION WITH RANGE EXTENDER)**

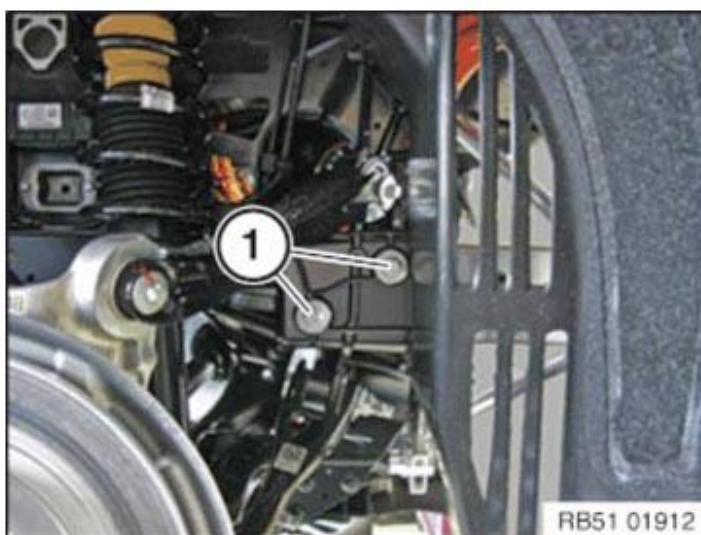
Necessary preliminary tasks:

- Remove **INTAKE SILENCER HOUSING**
- Remove **SUPPORT FOR BUMPER PANEL**
- Remove **REAR WHEEL**

Release screws (1).

Tightening torque **51 12 6AZ** .

Pull out deformation element.



**Fig. 40: Identifying Rear Bumper Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **TRIM, COVERS, HANDLE TRIM**

### **51 13... REMOVE, INSTALL/REPLACE C-PILLAR COVER**

Special tools required:

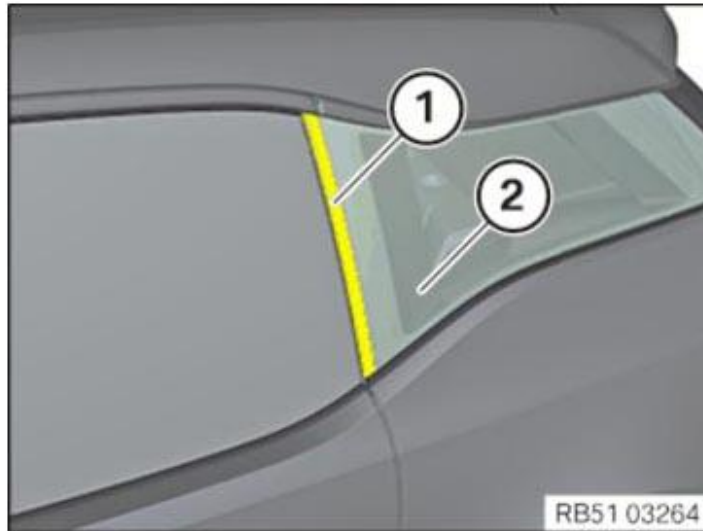
- **00 9 325**

**IMPORTANT:** The notes on **COMPONENT BONDING** with double-sided adhesive tape serve as the basis for this repair instruction and must be observed without fail.

**Removal:**

Mark position of the trim (1) with adhesive tape.

Heat cover (1) using a hot air blower and remove from side window (2) using special tool [00 9 325](#) .



**Fig. 41: Identifying Trim And Heat Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Clean the adhesive area.

Pull off liner\* of trim (1).

Align trim (1) to adhesive tape and bond on.

**Bonding with new fixed side window glass:**

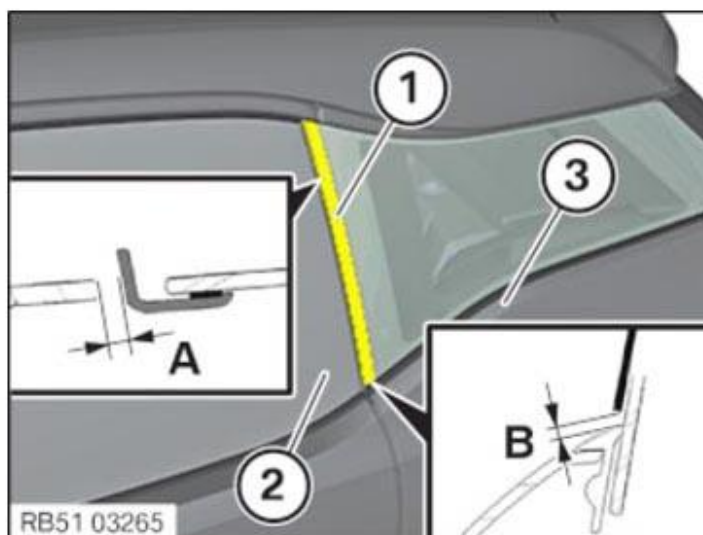
Bond trim (1) according to dimensions (A and B) to the door window glass (2) and to the side panel (3).

$A = 5 \hat{\text{A}} \pm 1 \text{ mm}$  (parallelism deviation maximum 2 mm)

$B = 3.5 \hat{\text{A}} \pm 2 \text{ mm}$

Apply thumb pressure force over entire bonding surface of cover (1).

\*Liner is the protective film on adhesive tape.



**Fig. 42: Identifying Trim Installation Dimensions To Door Window Glass And Side Panel**

Courtesy of BMW OF NORTH AMERICA, INC.



## 51 13 170 REMOVING AND INSTALLING (REPLACING) FRONT ROOF FRAME TRIM PANEL ON OUTER LEFT OR RIGHT

### Special tools required:

- [00 9 321](#)

### Necessary preliminary work:

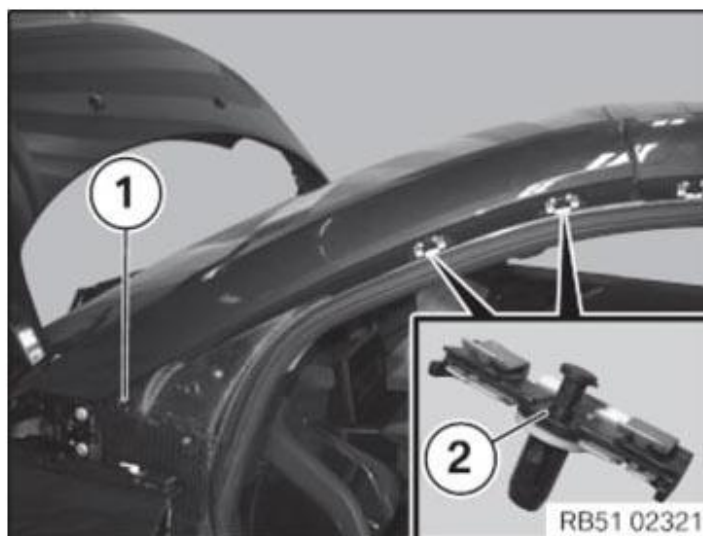
- Remove [TRIM STRIP FROM DRIP MOLDING](#)

Release screw (1).

Remove clamps (2).

*Installation note:*

Replace defective retainers (2).

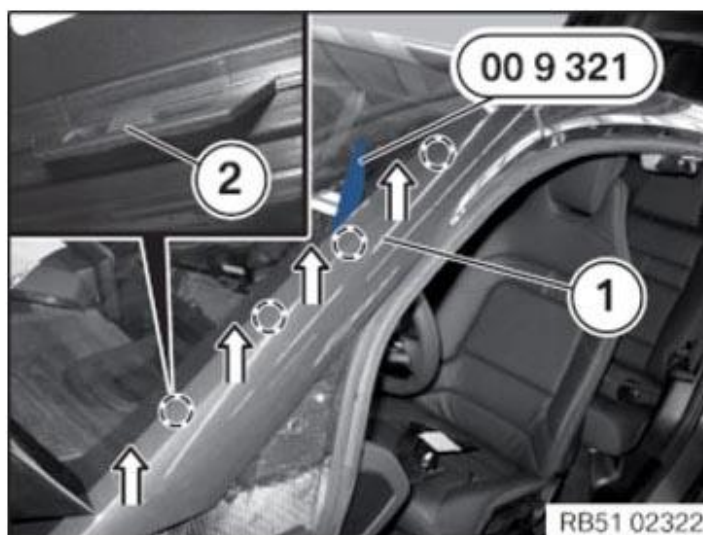


**Fig. 43: Identifying Defective Retainers, Clamps And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lever out roof frame trim panel (1) from latch mechanisms (2) in direction of arrow with special tool [00 9 321](#) and remove.

*Installation note:*

Latch mechanisms (2) must not be damaged.



**Fig. 44: Removing Roof Frame Trim Panel From Latch Mechanisms With Special Tool (00 9 321)**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 51 13 174 REMOVING AND INSTALLING (REPLACING) REAR OUTER ROOF FRAME TRIM PANEL REAR ON LEFT OR RIGHT

### Special tools required:

- [00 9 321](#)

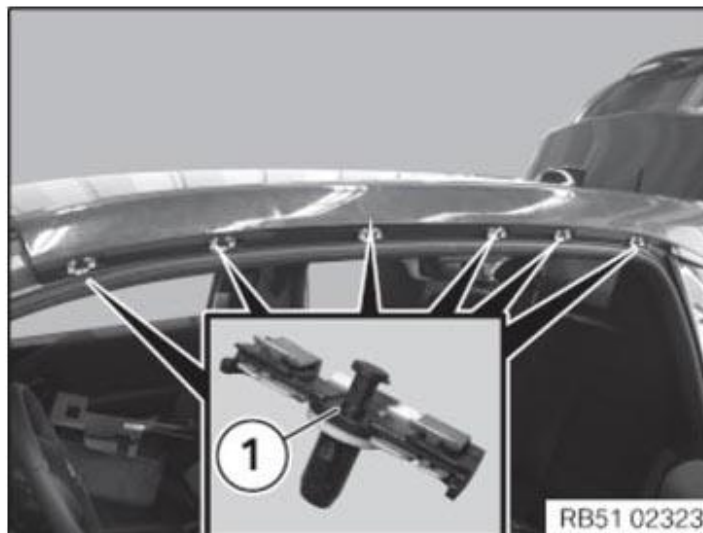
### Necessary preliminary tasks:

- Remove [FRONT OUTER ROOF FRAME TRIM PANEL](#)

Remove clamps (1).

*Installation note:*

Replace faulty clamps (1).



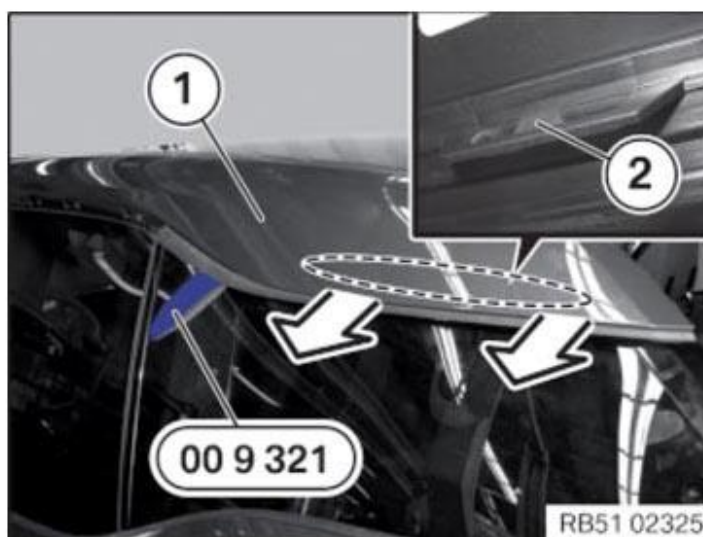
**Fig. 45: Identifying Rear Outer Roof Frame Trim Panel Clamps**

Courtesy of BMW OF NORTH AMERICA, INC.

Release roof frame trim panel (1) from latch mechanisms (2) in direction of arrow with special tool [00 9 321](#).

*Installation note:*

Latch mechanisms (2) must not be damaged.



**Fig. 46: Releasing Roof Frame Trim Panel From Latch Mechanisms With Special Tool (00 9 321)**

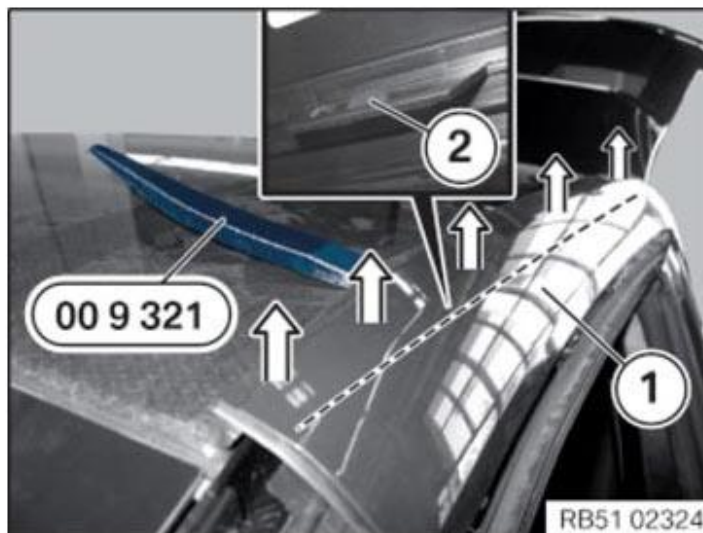
Courtesy of BMW OF NORTH AMERICA, INC.

Release roof frame trim panel (1) in marked area from latch mechanisms (2) in direction of arrow with special tool [00 9 321](#).

Remove roof frame trim panel (1).

*Installation note:*

Latch mechanisms (2) must not be damaged.



**Fig. 47: Releasing Roof Frame Trim Panel In Marked Area From Latch Mechanisms With Special Tool (00 9 321)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **51 13 316 REMOVING AND INSTALLING OR REPLACING TRIM STRIP ON ROOF GUTTER AT LEFT OR RIGHT**

**Necessary preliminary tasks:**

- Remove **TRIM ON FRONT SIDE PANEL AT FRONT**

Open door at front and rear.

Release screws (1).

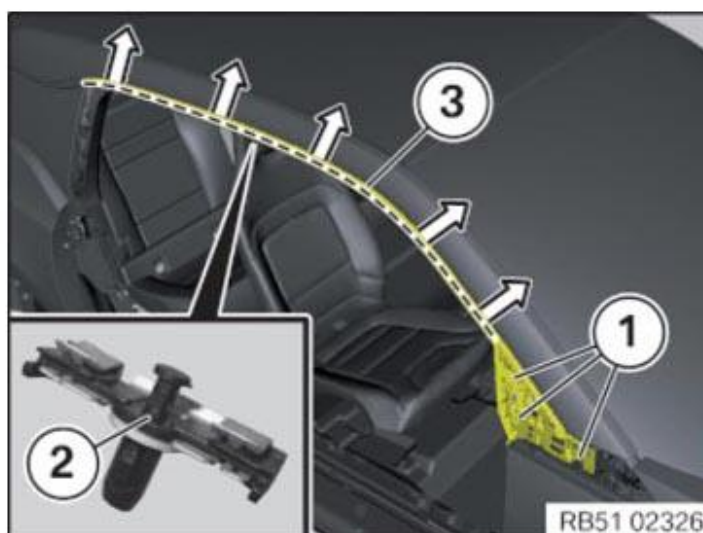
Tightening torque **51 13 1AZ**.

Pull trim strip (3) out of clamps (2) in direction of arrow beginning at the front.

*Installation note:*

To avoid noises and leaking, check clamps (2) for damage.

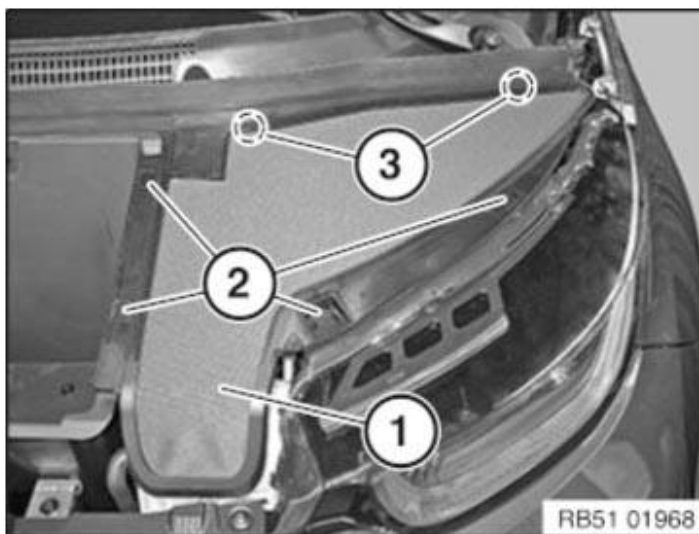
Replace faulty clamps (2).





**51 13... REMOVING AND INSTALLING/REPLACING COVER IN FRONT LEFT OR RIGHT LUGGAGE COMPARTMENT**

Release cover (1) from Dual Lock tape (2) and feed out towards front from guides (3).



**Fig. 49: Identifying Cover, Dual Lock Tape And Guides**  
Courtesy of BMW OF NORTH AMERICA, INC.

**51 13 095 REMOVING AND INSTALLING/REPLACING COVER ON FRONT SIDE WALL LEFT OR RIGHT**

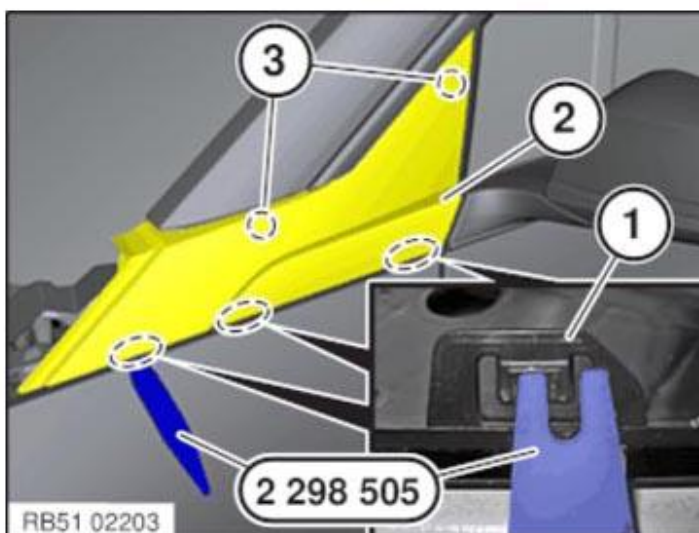
Special tools required:

- [2 298 505](#)

Place special tool [2 298 505](#) on latch mechanisms (1) as illustrated.

Pull cover (2) slightly outwards and remove latch mechanisms (1).

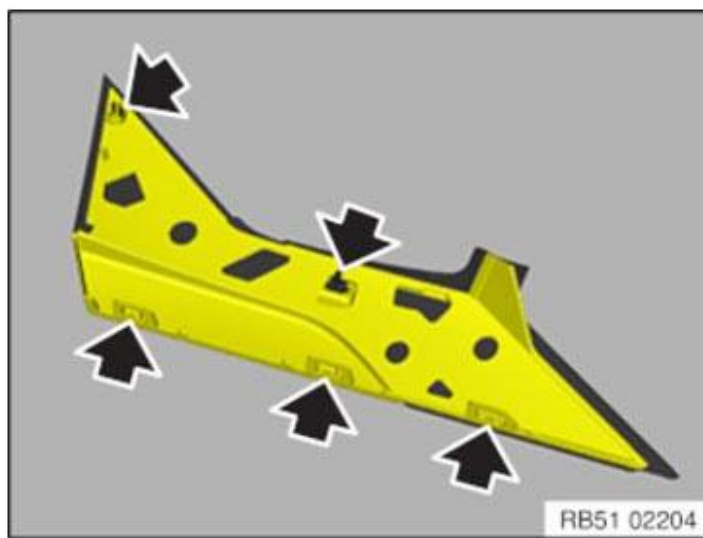
Release cover (2) from latch mechanisms (3) and remove.



**Fig. 50: Placing Special Tool (2 298 505) On Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Latch mechanisms must not be damaged or missing.



**Fig. 51: Checking Latch Mechanisms For Damaged Or Missing**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 13... REMOVING AND INSTALLING/REPLACING COVER ON LEFT OR RIGHT REAR ROOF PILLAR (D-PILLAR)**

#### **Special tools required:**

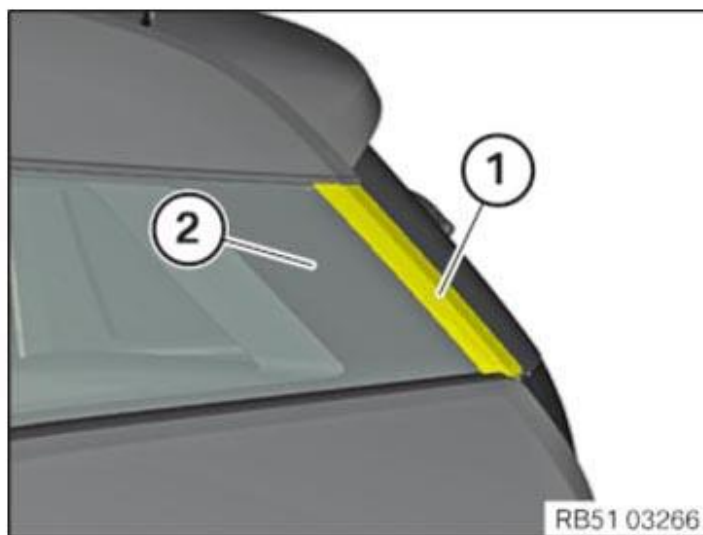
- [00 9 325](#)

IMPORTANT: The notes on [COMPONENT BONDING](#) with double-sided adhesive tape serve as the basis for this repair instruction and must be observed without fail.

#### **Removal:**

Mark position of the trim (1) with adhesive tape.

Preheat trim (1) by means of a hot air blower and release from the fixed side window glass (2) using special tool [00 9 325](#).



**Fig. 52: Identifying Trim And Fixed Side Window Glass**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### **Installation:**

Clean the adhesive area.

Pull off liner\* of trim (1).

Align trim (1) to adhesive tape and bond on.

**Bonding with new fixed side window glass:**

Position trim (1) and align to the edge of the roof frame trim panel (2).

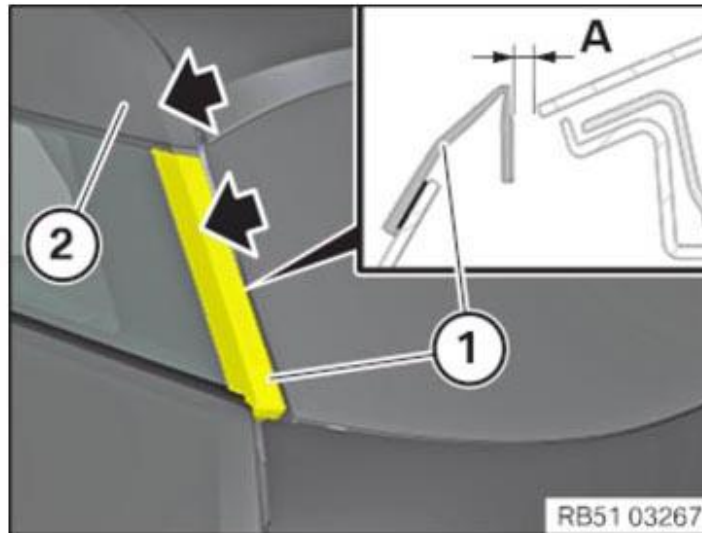
Trim (1) rests against the roof frame trim panel (2) in the upper section.

Bond trim (1) to rear window (2) according to dimension (A).

$A = 6 \pm 2$  mm (parallelism deviation maximum 1 mm)

Apply thumb pressure force over the entire bonding surface of the trim (1).

\*Liner is the protective film on adhesive tape.



**Fig. 53: Identifying Trim Installation Dimension To Rear Window**

Courtesy of BMW OF NORTH AMERICA, INC.

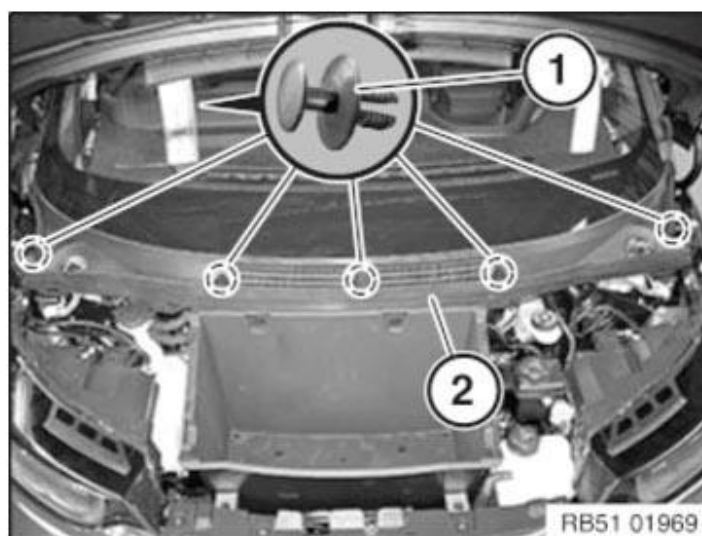
**51 13 116 REMOVING AND INSTALLING/REPLACING COWL PANEL COVER**

Necessary preliminary tasks:

- Remove **BOTH WINDSCREEN WIPER ARMS** .
- Remove **COVER IN FRONT LEFT/RIGHT LUGGAGE COMPARTMENT**

Release expanding rivet (1).

Lift out cover (2).

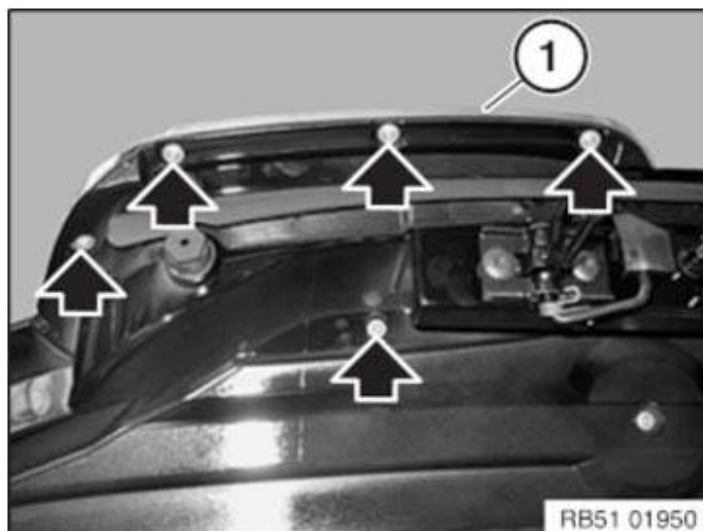


**Fig. 54: Identifying Cover And Expanding Rivet**

Courtesy of BMW OF NORTH AMERICA, INC.

## 51 13 001 REMOVING AND INSTALLING/REPLACING FRONT RADIATOR GRILLE, MIDDLE LEFT OR RIGHT

Release screws on front radiator grille (1).



**Fig. 55: Identifying Front Radiator Grille With Screws**

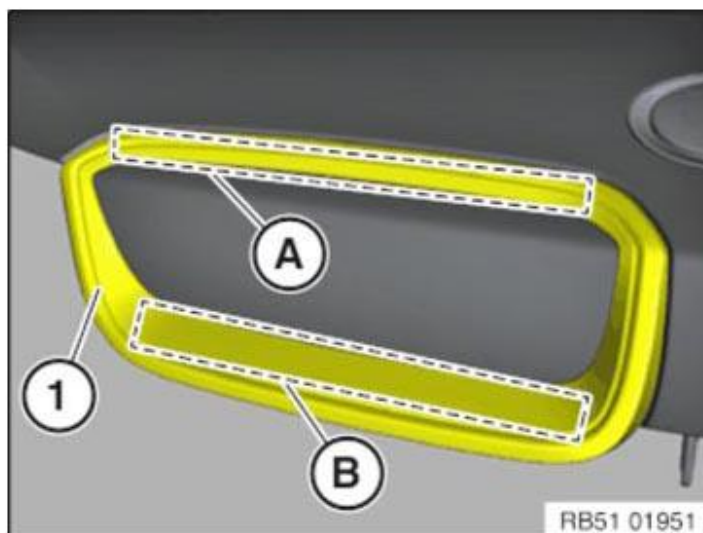
Courtesy of BMW OF NORTH AMERICA, INC.

Release front radiator grille (1) in area (A and B) from double-sided adhesive tape.

Remove front radiator grille (1).

*Installation note:*

Observe notes on [SECURING COMPONENTS](#) with adhesive tape.



**Fig. 56: Identifying Front Radiator Grille**

Courtesy of BMW OF NORTH AMERICA, INC.

## 51 13 183 REPLACE FRONT ROOF FRAME TRIM

Necessary preliminary tasks:

- Remove [LEFT AND RIGHT ROOF FRAME TRIM](#)

Trim on roof frame is fastened by double-sided adhesive tape and can be disassembled by means of Spider.

**Removal:**

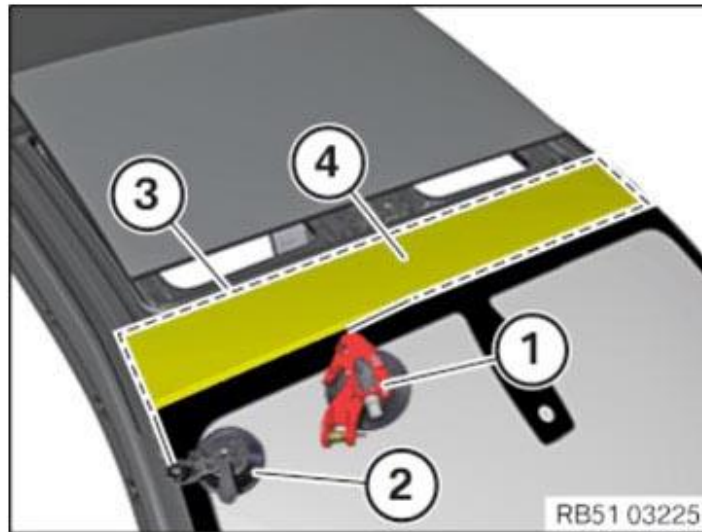
Open glass sunroof.

Attach fibre line removal device (1) and anchor suction cup (2) to the windscreen.

Feed in the line (3) underneath the trim (4) and the corresponding gasket.

Attach line (3) to anchor suction cup (2).

Wind up the line (3) on the fibre line removal device (1) and remove the trim (4) from the double-sided adhesive tape.



**Fig. 57: Identifying Device, Trim, Anchor Suction Cup And Line**  
Courtesy of BMW OF NORTH AMERICA, INC.

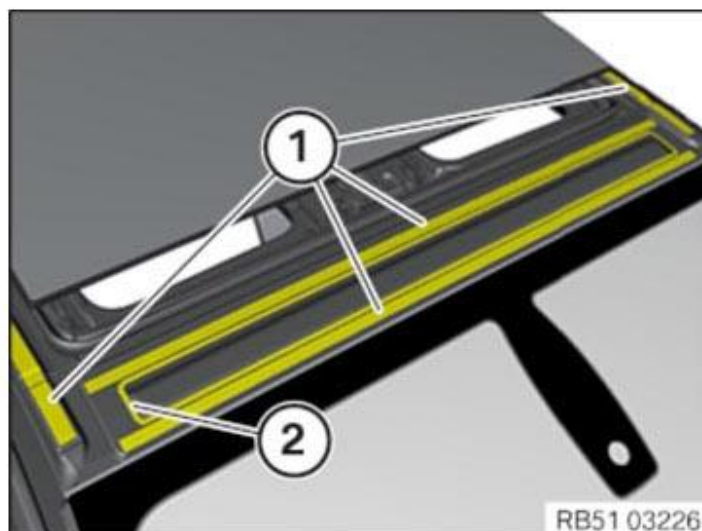
**Installation:**

Remove remnants of the double-sided adhesive tape (1) and of the sealant (2).

Clean adhesive area with CLEANING AGENT R2 .

Pre-treat adhesive area with SIKA AKTIVATOR 205 .

Comply with air drying time.



**Fig. 58: Identifying Double-Sided Adhesive Tape And Sealant**  
Courtesy of BMW OF NORTH AMERICA, INC.

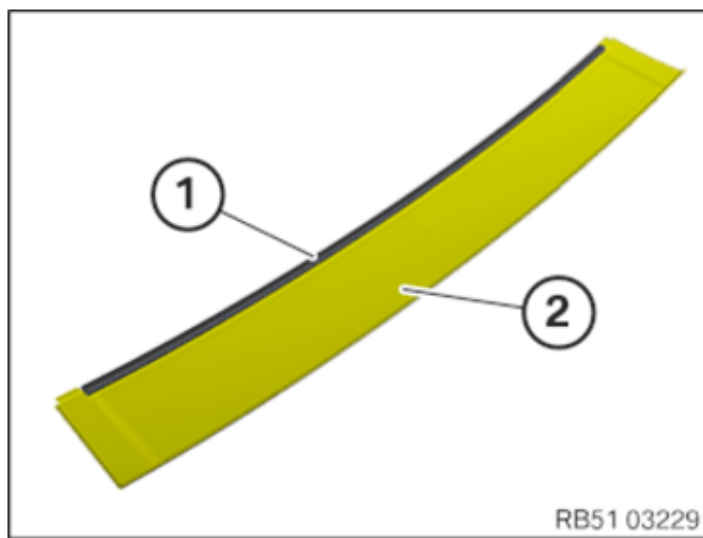
Make sure the gasket (1) is correctly seated on trim (2).

Clean adhesive area of trim (2) with CLEANING AGENT R2 .

Pre-treat adhesive area of trim (2) with SIKA AKTIVATOR 205 .

Comply with air drying time.





**Fig. 59: Identifying Gasket And Trim**

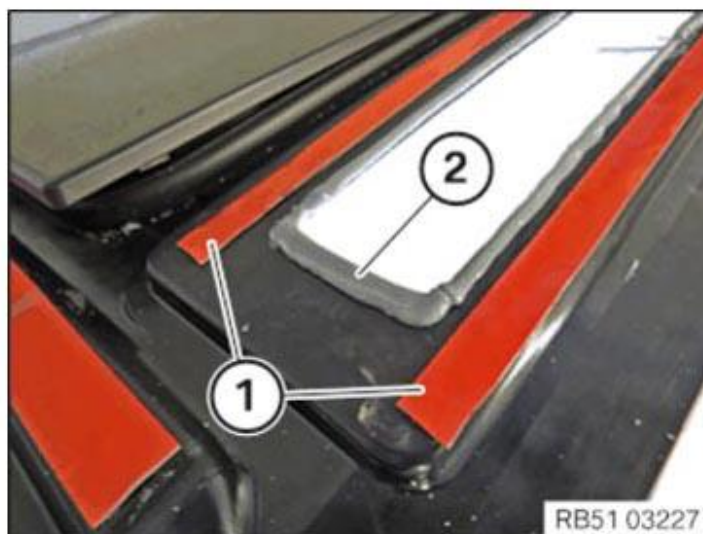
Courtesy of BMW OF NORTH AMERICA, INC.

Bond adhesive tape (1) to the outer edge on the roof frame and press down firmly.

IMPORTANT: Water ingress!

In order to prevent any water ingress, an **uninterrupted bead** (2) with SEALANT D2 needs to be installed around the aperture.

Install bead with  $\tilde{\text{A}} \sim 3$  mm in round forms around the aperture.

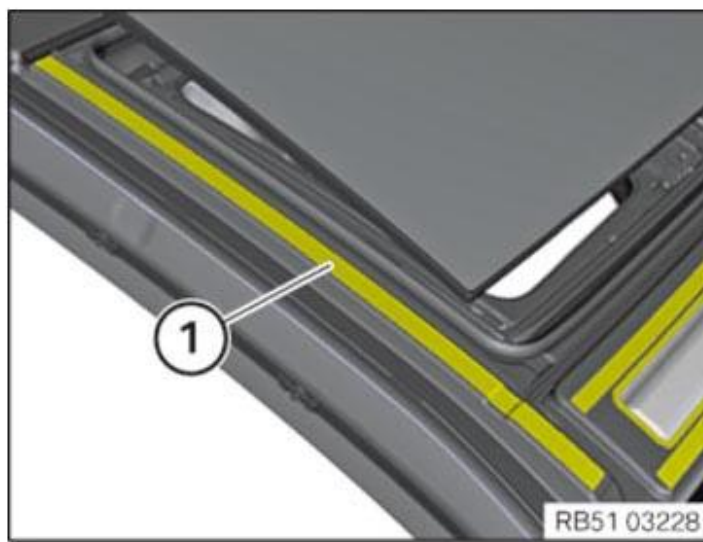


**Fig. 60: Identifying Uninterrupted Bead And Adhesive Tape**

Courtesy of BMW OF NORTH AMERICA, INC.

Bond adhesive tape (1) to the roof frame on the left and on the right side and press down firmly.

Remove protective film from all adhesive tapes.



**Fig. 61: Identifying Adhesive Tape Applying Area On Roof Frame**

Courtesy of BMW OF NORTH AMERICA, INC.

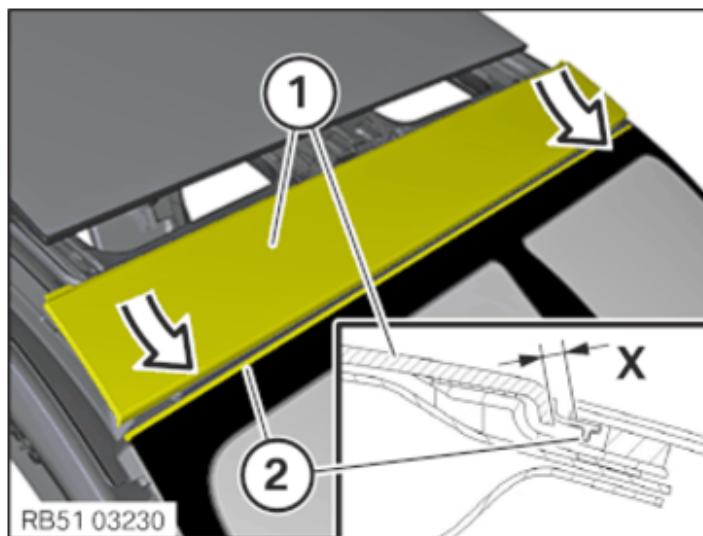
Align trim (1) evenly on left and right.

Insert trim (1) at an angle from the top and press against the gasket (2) of the windscreen.

Bond trim (1) in parallel to the windscreen and according to the dimension (x).

Gasket (2) needs to rest against the trim (1) evenly.

$x = 4 \hat{A} \pm 2 \text{ mm}$	Distance of trim (1) to windscreen
----------------------------------	------------------------------------



**Fig. 62: Inserting Trim At Angle**

Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Install **LEFT AND RIGHT ROOF FRAME TRIM**

**51 13 181 REPLACE LEFT OR RIGHT WINDOW ROOF FRAME TRIM**

**Necessary preliminary tasks:**

- Remove **REAR OUTER ROOF FRAME TRIM PANEL**

Trim on roof frame is fastened by double-sided adhesive tape and can be disassembled by means of Spider.

**Removal:**

Move glass sunroof to vent position.



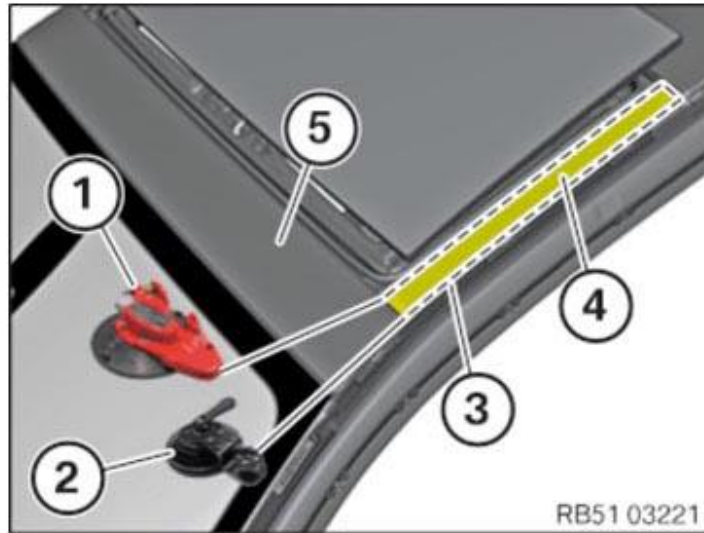
Attach fibre line removal device (1) and anchor suction cup (2) to the windscreen.

Feed in the line (3) underneath the trim (4) and the corresponding gasket.

Attach line (3) to anchor suction cup (2).

**NOTE:** The area where the line (3) slides over the trim (5) needs to be protected by means of a plastic adhesive tape.

Wind up the line (3) on the fibre line removal device (1) and remove the trim (4) from the double-sided adhesive tape.



**Fig. 63: Identifying Device, Line, Anchor Suction Cup And Trim**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Remove remnants of the double-sided adhesive tape (1).

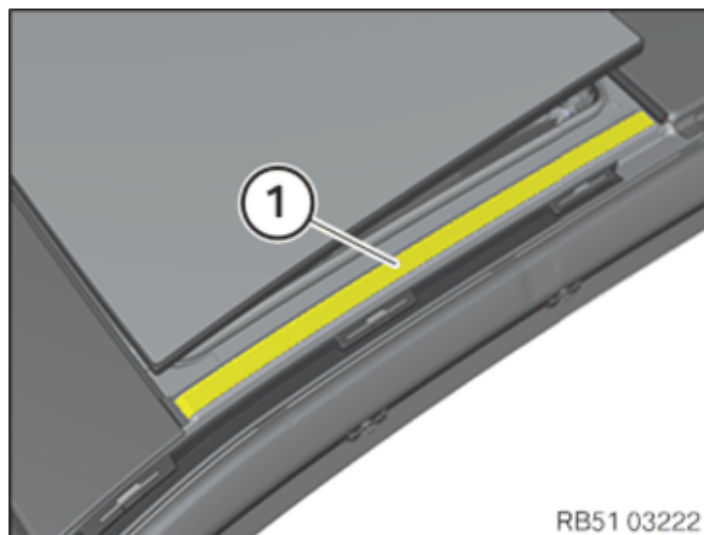
Clean adhesive area with CLEANING AGENT R2 .

Pre-treat adhesive area with SIKA AKTIVATOR 205 .

Comply with air drying time.

Cut new adhesive tape (1) if necessary.

Apply and press down new adhesive tape (1) on the roof outer skin.



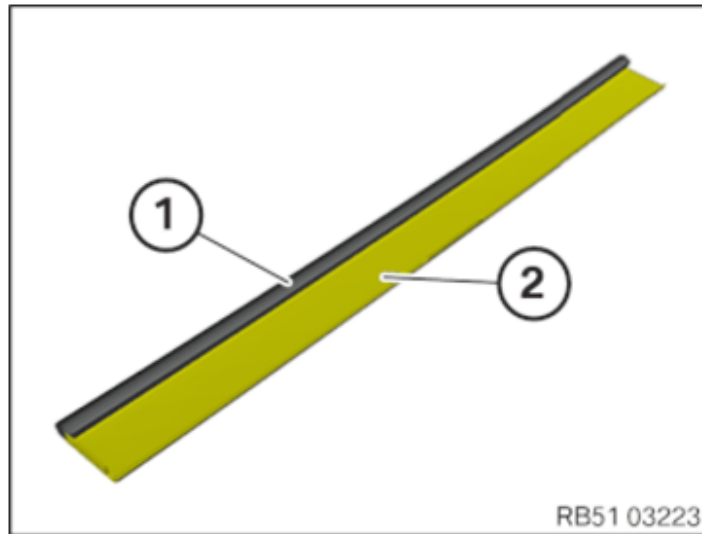
**Fig. 64: Identifying Adhesive Tape Applying Area On Roof Outer Skin**  
Courtesy of BMW OF NORTH AMERICA, INC.

Make sure the gasket (1) is correctly seated on trim (2).

Clean adhesive area of trim (2) with CLEANING AGENT R2 .

Pre-treat adhesive area of trim (2) with SIKA AKTIVATOR 205 .

Comply with air drying time.

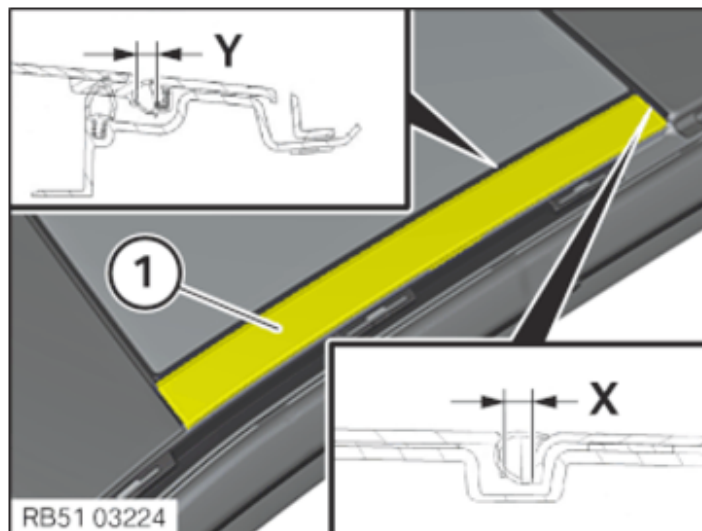


**Fig. 65: Identifying Gasket And Trim**

Courtesy of BMW OF NORTH AMERICA, INC.

Bond trim (1) in parallel to glass sunroof complying with the relative dimensions (X and Y).

$X = 7 \hat{A}\pm 2 \text{ mm}$	Distance of trim (1) to roof outer skin
$Y = 4.9 \hat{A}\pm 1 \text{ mm}$	Distance of trim (1) to glass sunroof



**Fig. 66: Checking Distance Of Trim To Roof Outer Skin**

Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

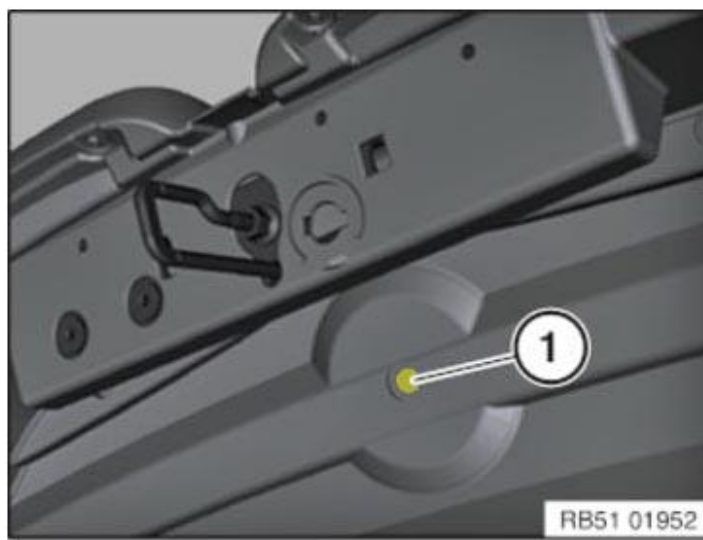
- Install **REAR OUTER ROOF FRAME TRIM PANEL**

## **BMW EMBLEMS, MODEL EMBLEMS**

### **51 14 000 REMOVING AND INSTALLING/REPLACING FRONT BMW BADGE**

Release screw (1).

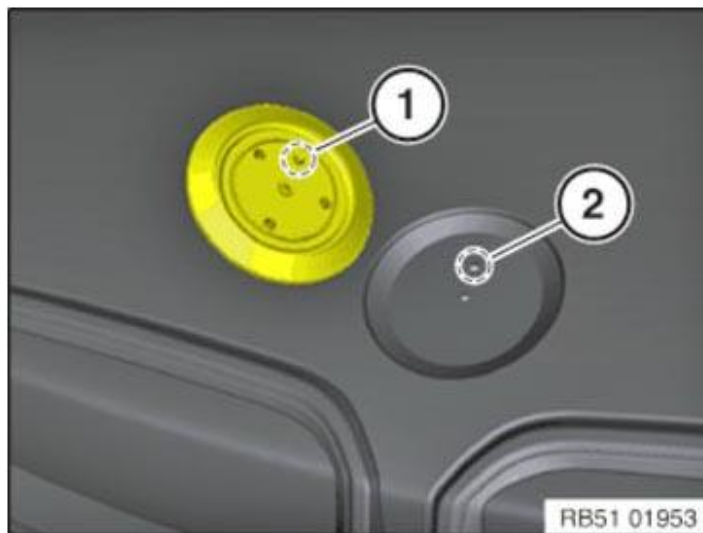
Remove plate from engine compartment lid.



**Fig. 67: Identifying Engine Compartment Lid Plate Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Guide pin (1) must be correctly seated in corresponding opening (2).



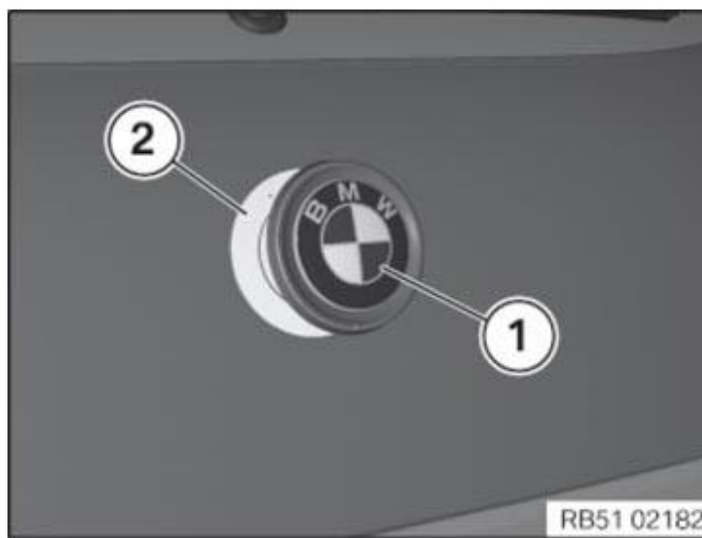
**Fig. 68: Identifying Corresponding Opening And Pin**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 14 010 REMOVING AND INSTALLING/REPLACING REAR BMW BADGE**

**Special tools required:**

- [00 9 322](#)

**IMPORTANT:** The notes on **COMPONENT BONDING** with double-sided adhesive tape serve as the basis for this repair instruction and must be observed without fail. When removing BMW badge (1), do not damage fixture (2).



**Fig. 69: Identifying BMW Badge And Fixture**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully heat BMW badge (1) with hot air blower and lever out with special tool [00 9 322](#).



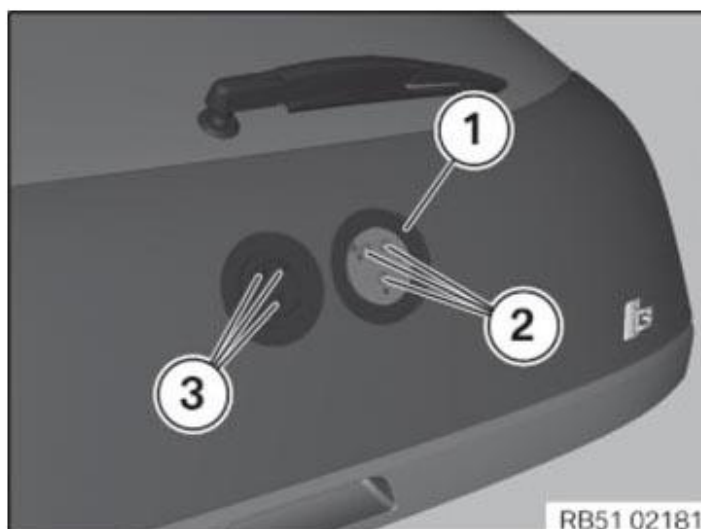
**Fig. 70: Removing BMW Badge Using Special Tool (00 9 322)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Pull liner\* off adhesive tape (1).

Position plate over guides (2 and 3) and press down firmly.

\* Liner is the protective film on a new plate.

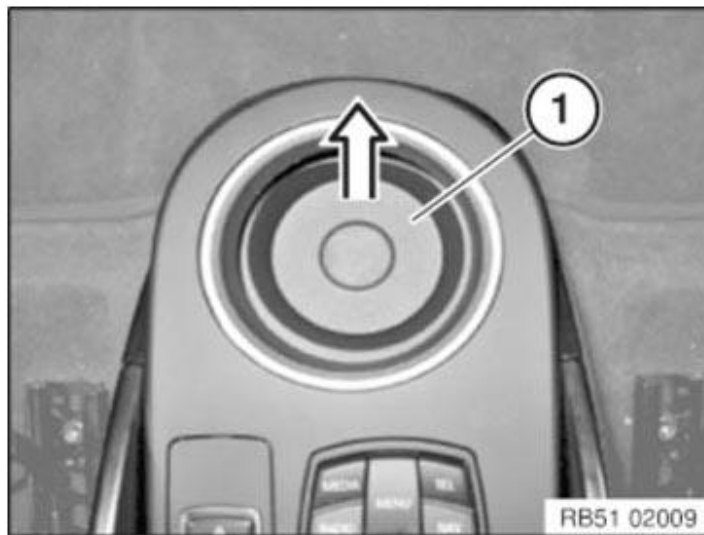


## **MIRRORS/COVERS/ASHTRAYS/SHELVES/TRAYS**

### **51 16 160 REMOVING AND INSTALLING (REPLACING) CENTER CONSOLE TRIM (FRONT)**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

Lever out trim (1) upwards.



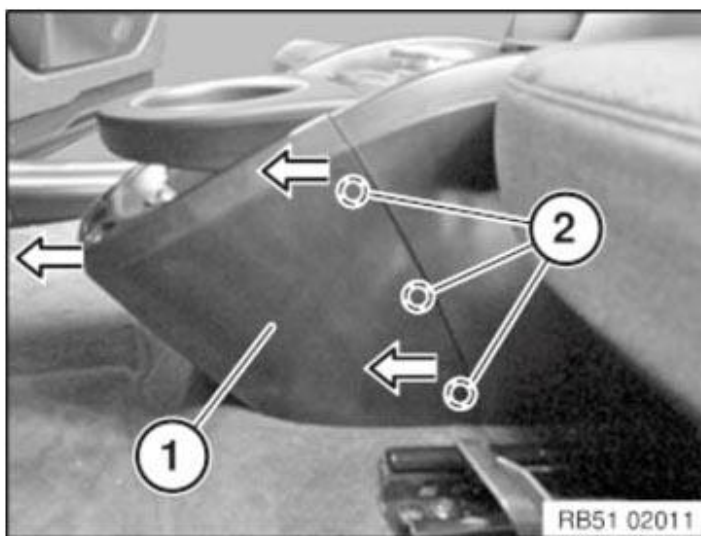
**Fig. 72: Removing Center Console Trim**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws.



**Fig. 73: Locating Center Console Trim Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

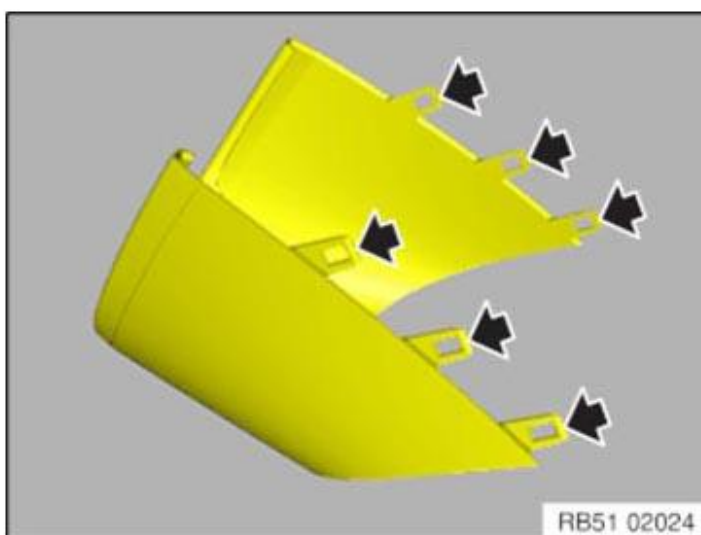
Release trim (1) in direction of arrow out of guides (2).



**Fig. 74: Releasing Trim Out Of Guides**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Guides must not be missing or damaged.



**Fig. 75: Locating Guides**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **51 16 145 REMOVING AND INSTALLING (REPLACING) DECORATIVE TRIM AT CENTER CONSOLE**

**Special tools required:**

- [00 9 327](#)

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

Release trim (1) from clamps (2) using special tool [00 9 327](#).

Lift trim (1) on front and pull out towards front.

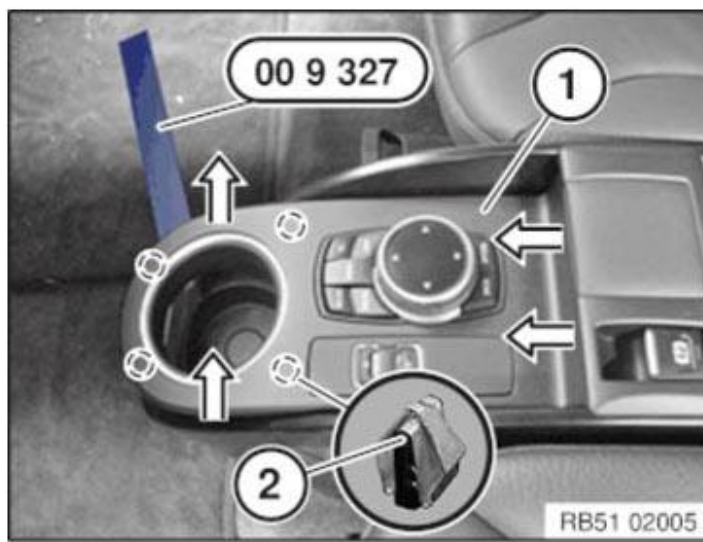
Unlock associated plug connections and disconnect.

Remove cover (1).

*Installation note:*

Replace faulty clamps (2).





**Fig. 76: Releasing Trim From Clamps Using Special Tool (00 9 327)**

Courtesy of BMW OF NORTH AMERICA, INC.

When replacing, remount the following parts depending on the version:

- **CENTER CONSOLE OPERATING UNIT**
- **CONTROLLER**

**61 31 401 REMOVING AND INSTALLING (REPLACING) ENGINE COMPARTMENT UNLOCKING SWITCH**

Special tools required:

- **64 1 020**

Remove engine compartment unlocking switch (1) from trim panel (2) by means of special tool **64 1 020**.

Unlock associated plug connection and disconnect.

*Installation note:*

Latching clamps on engine compartment unlocking switch (1) must not be damaged or missing.



**Fig. 77: Removing Engine Compartment Unlocking Switch From Trim Panel Using Special Tool (64 1 020)**

Courtesy of BMW OF NORTH AMERICA, INC.

**61 31 075 REMOVING AND INSTALLING (REPLACING) FUEL FILLER DOOR RELEASE SWITCH**

Special tools required:

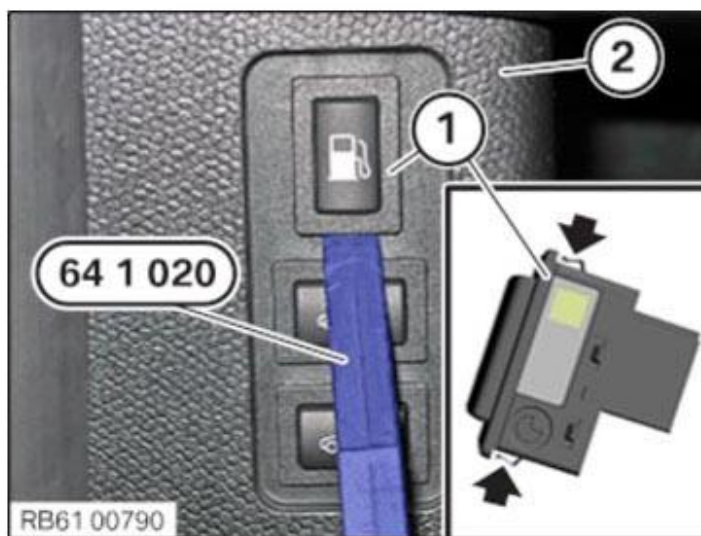
- **64 1 020**

Pry fuel filler door release switch (1) out of trim panel (2) with special tool [64 1 020](#) .

Unlock associated plug connection and disconnect.

*Installation note:*

Latch clamps on fuel filler door release switch (1) must not be damaged or missing.



**Fig. 78: Prying Fuel Filler Door Release Switch Out Of Trim Panel With Special Tool (64 1 020)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 31 083 REMOVING AND INSTALLING (REPLACING) TAILGATE RELEASE SWITCH**

**Special tools required:**

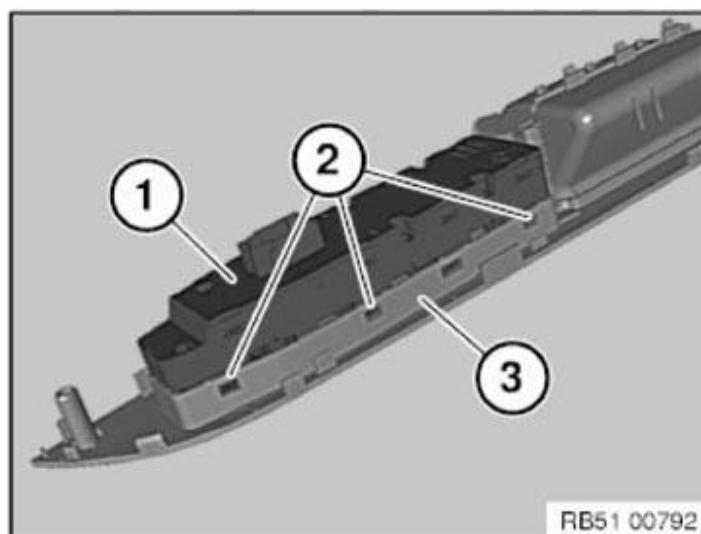
- [64 1 020](#)

Remove tailgate release switch (1) from trim panel (2) by means of special tool [64 1 020](#) .

Unlock associated plug connection and disconnect.

*Installation note:*

Latching clamps on tailgate release switch (1) must not be damaged or missing.



**Fig. 79: Removing Tailgate Release Switch From Trim Panel With Special Tool (64 1 020)**  
Courtesy of BMW OF NORTH AMERICA, INC.

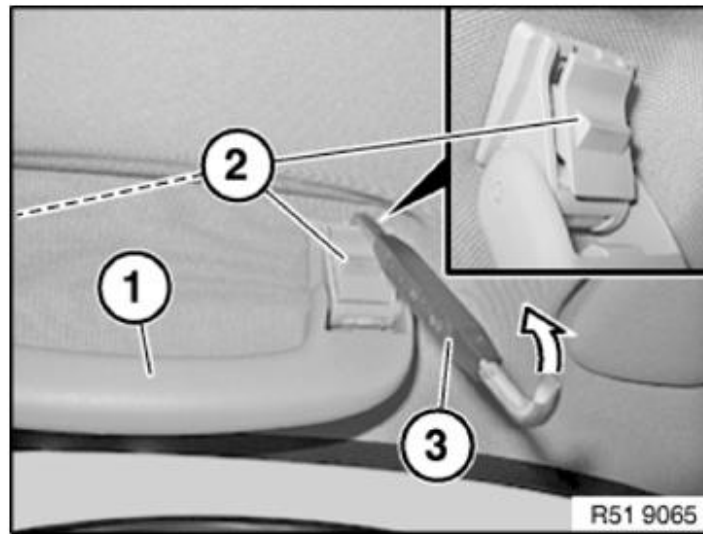
### **51 16 480 REMOVING AND INSTALLING OR REPLACING FRONT GRAB HANDLE**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

Fold grab handle (1) downwards.

Disengage and pull out locking wedge (2) with angle screwdriver (3), as shown.

Repeat procedure on rear locking wedge (2).

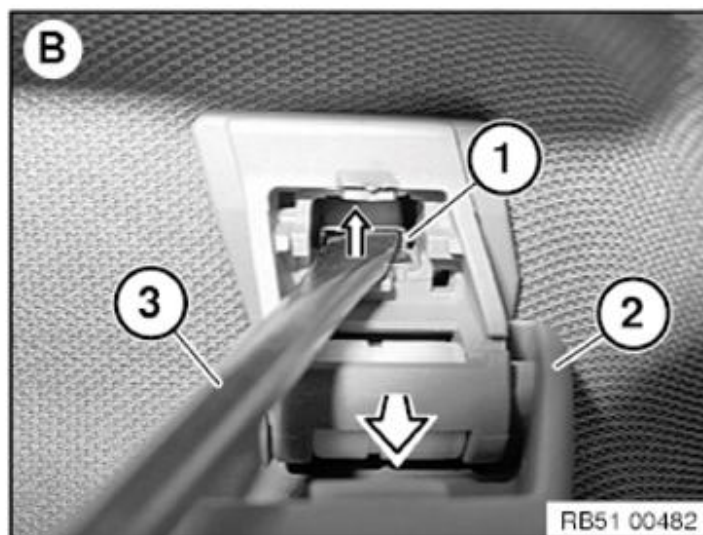


**Fig. 80: Disengaging Locking Wedge With Angle Screwdriver**

Courtesy of BMW OF NORTH AMERICA, INC.

Lightly pull grab handle (2) towards the inside by hand and hold under tension while releasing lower and upper tab (1) with screwdriver (3).

Remove grab handle (2) and place to side.

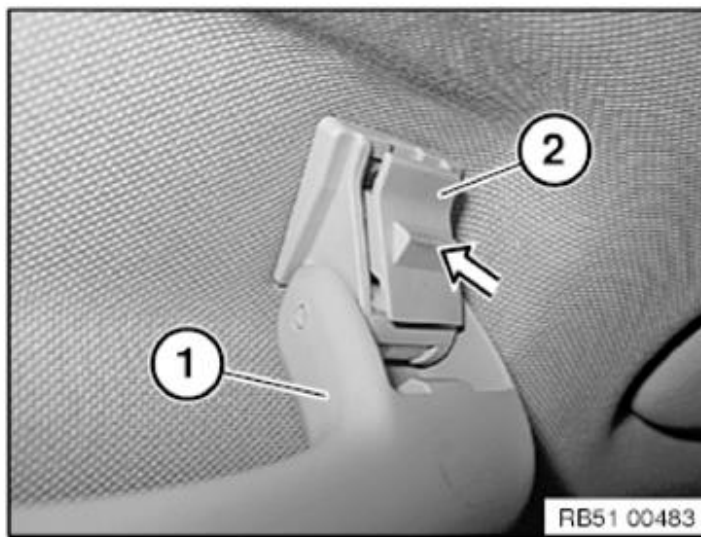


**Fig. 81: Pulling Grab Handle**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Only after grab handle (1) is snapped in correctly can locking wedges (2) be fully locked in position in grab handle (1).



**Fig. 82: Locating Grab Handle Locking Wedges**  
Courtesy of BMW OF NORTH AMERICA, INC.

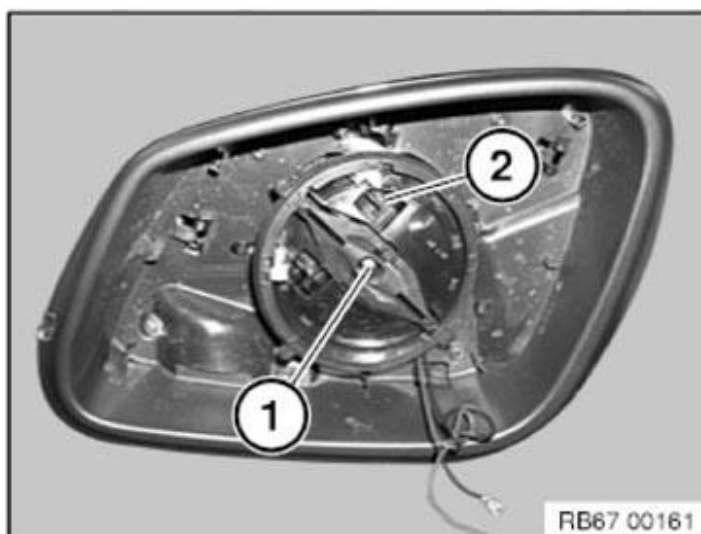
**51 16 045 REMOVING AND INSTALLING OR REPLACING RETAINING RING ON LEFT OR RIGHT EXTERIOR MIRROR**

**Necessary preliminary tasks:**

- Remove **PROTECTIVE CAP FROM EXTERIOR MIRROR**

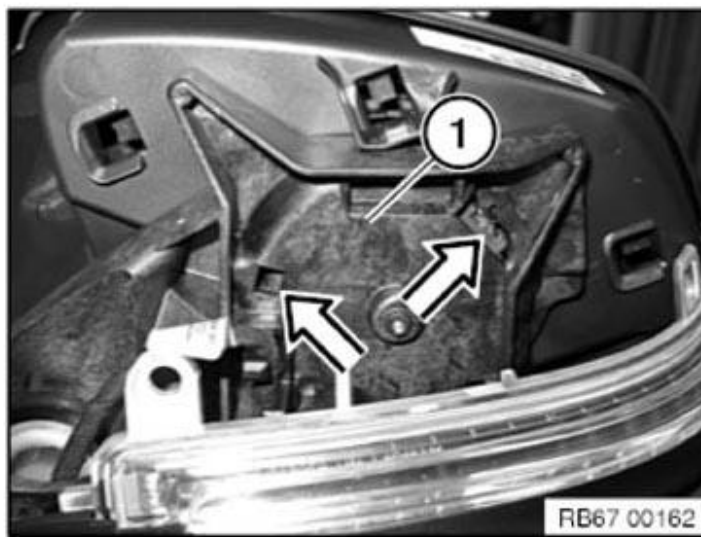
Release screw (1) on drive (2) for electrically adjustable exterior mirror.

Tightening torque **51 16 7AZ** .



**Fig. 83: Identifying Electrically Adjustable Exterior Mirror Screw And Drive**  
Courtesy of BMW OF NORTH AMERICA, INC.

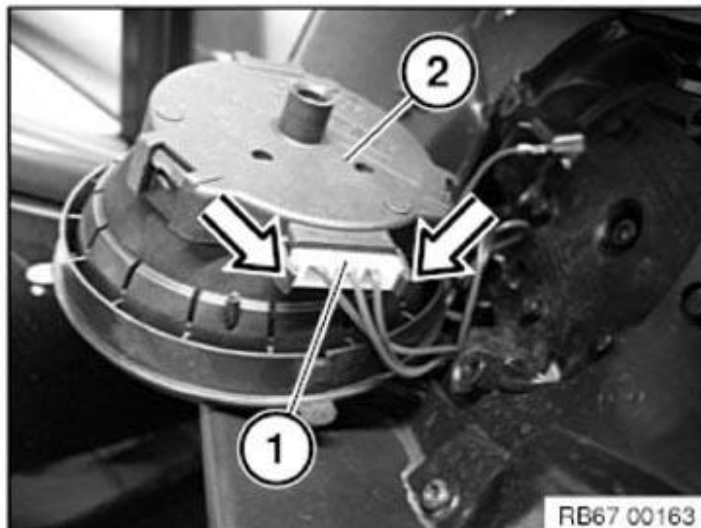
Unclip drive (1) from rear at marked points from mirror housing.



**Fig. 84: Removing Mirror Housing Drive**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully unlock and disconnect plug connection (1) at the marked points.

Remove electric motor (2).



**Fig. 85: Removing Electric Motor**  
Courtesy of BMW OF NORTH AMERICA, INC.

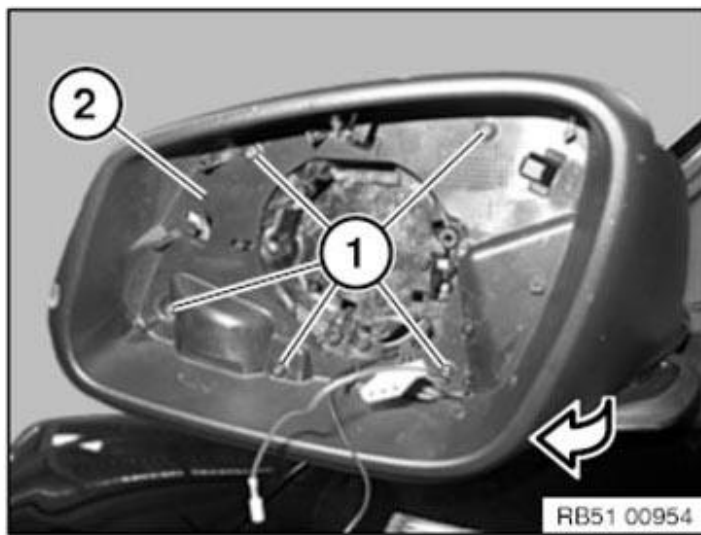
Fold exterior mirror forwards.

Release screws (1) from circlip (2).

Tightening torque **51 16 5AZ**.

Feed out retaining ring (2) in direction of arrow.

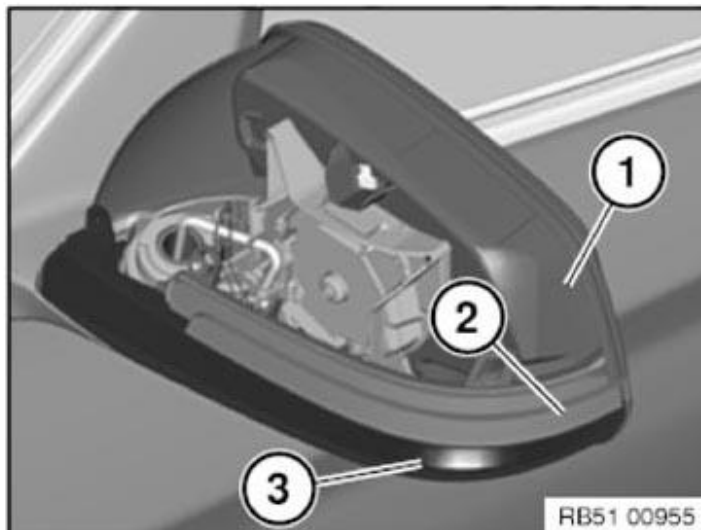




**Fig. 86: Removing Retaining Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure retaining ring (1) is correctly mounted on turn indicator (2) and housing (3).



**Fig. 87: Identifying Turn Indicator, Housing And Retaining Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 16 080 REMOVING AND INSTALLING OR REPLACING SUN VISOR AND LEFT OR RIGHT COUNTER SUPPORT**

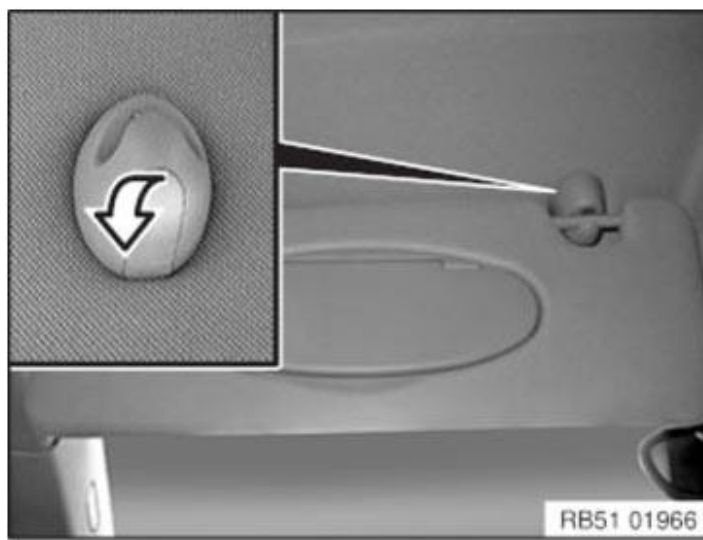
When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

Detach sun visor from counter support.

Open cover and release screw underneath.

Remove counter supports.

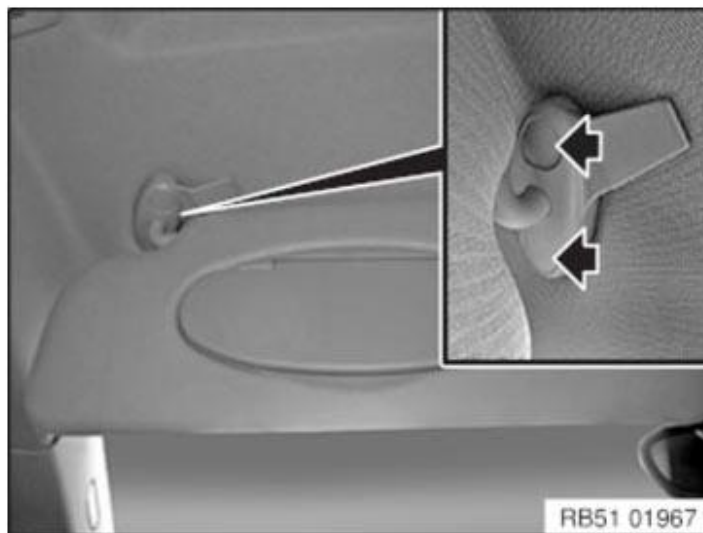




**Fig. 88: Opening Cover Of Screw Underneath**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Lever out covers and release screws underneath.

Remove sun visor, and if necessary, disconnect corresponding plug connection.



**Fig. 89: Locating Cover Of Screw Underneath**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **51 16... REMOVING AND INSTALLING TRIM FOR STORAGE COMPARTMENT**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work:

De-energize the **HIGH-VOLTAGE SYSTEM** .

Observe **SAFETY INFORMATION** for handling electric vehicles.

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

**Necessary preliminary tasks:**

- Disconnect **BATTERY EARTH LEAD**
- Remove **CENTER CONSOLE DECORATIVE TRIM**

Release screws (1).



**Fig. 90: Identifying Center Console Decorative Trim Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

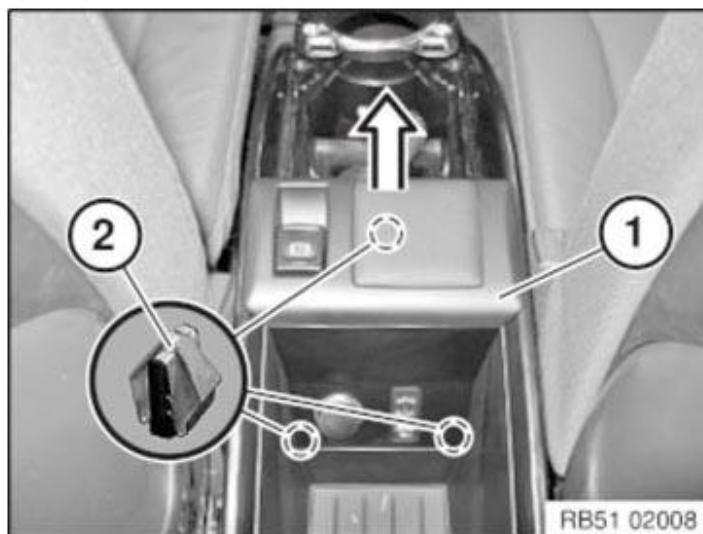
Feed trim (1) upwards out of clamps (2).

Unlock associated plug connections and disconnect.

Remove cover (1).

*Installation note:*

Replace faulty clamps (2).



**Fig. 91: Removing Center Console Decorative Trim**  
 Courtesy of BMW OF NORTH AMERICA, INC.

When replacing, remount the following parts depending on the version:

- 12 V POWER SOCKET
- USB AUDIO INTERFACE CONNECTING SOCKET
- EMF SWITCH

**51 16 345 REMOVING AND INSTALLING/REPLACING BUTTON FOR GLOVE BOX**

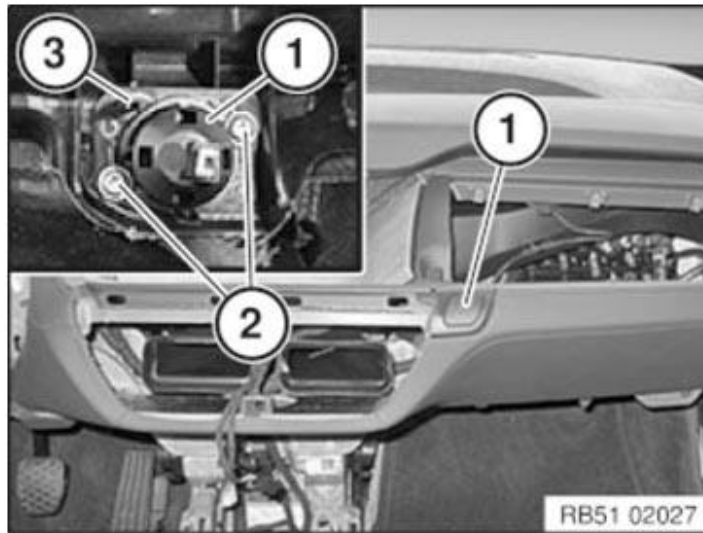
Necessary preliminary tasks:

- Remove RADIO AND A/C CONTROL PANEL
- Remove LOCKING CUP FOR GLOVE BOX

**NOTE:** Button (1) shown from behind for purposes of clarity.

Unfasten screws (2).

Remove supporting frame (3) towards rear and button (1) towards front.



**Fig. 92: Identifying Supporting Frame, Button And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 16 206 REMOVING AND INSTALLING/REPLACING CENTER ARMREST**

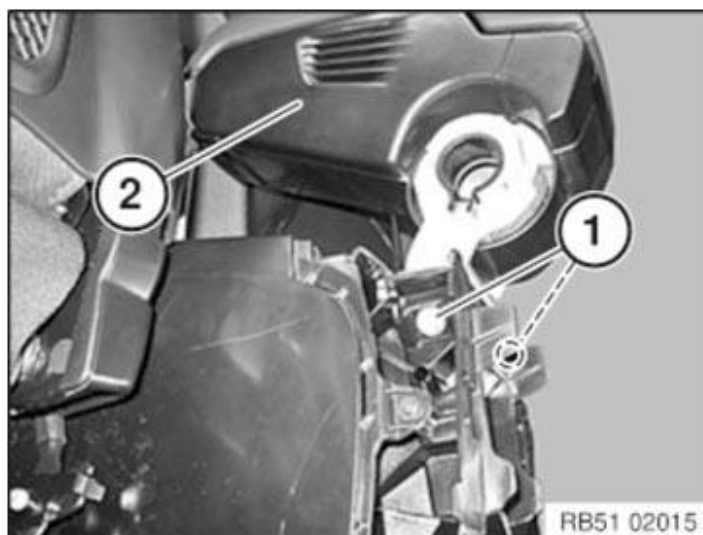
When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

**Necessary preliminary tasks:**

- Move both front seats forwards
- Remove **REAR CENTER CONSOLE TRIM**

Release screws (1).

Remove center armrest (2) upwards.



**Fig. 93: Identifying Center Armrest And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Modify **LID FOR CENTER ARMREST**

### **51 16 165 REMOVING AND INSTALLING/REPLACING COMPLETE CENTER CONSOLE**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

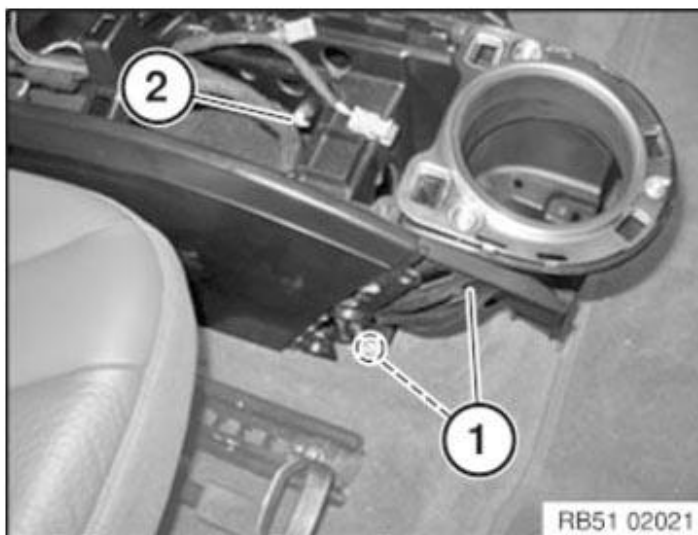
**Necessary preliminary tasks:**

- Remove **FRONT CENTER CONSOLE TRIM**
- Remove **REAR CENTER CONSOLE TRIM**
- Remove **COVER FOR STORAGE COMPARTMENT**

Unscrew nuts (1).

Tightening torque **51 16 8AZ** .

Unfasten cable strap (2).

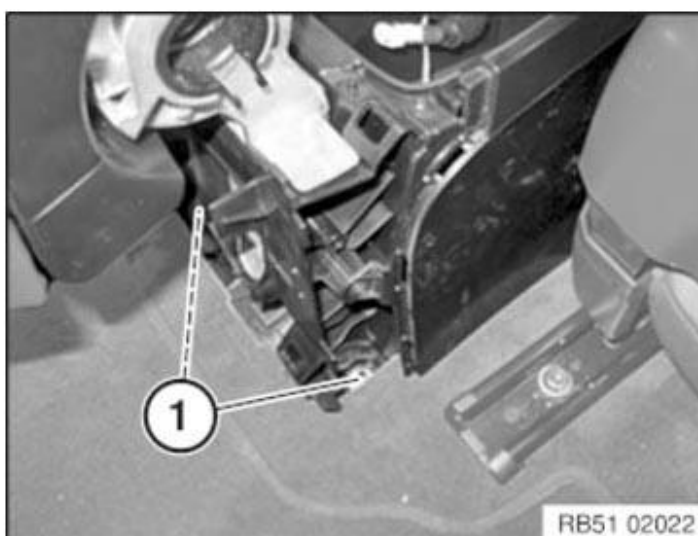


**Fig. 94: Identifying Cable Strap And Nuts**

Courtesy of BMW OF NORTH AMERICA, INC.

Unscrew nuts (1).

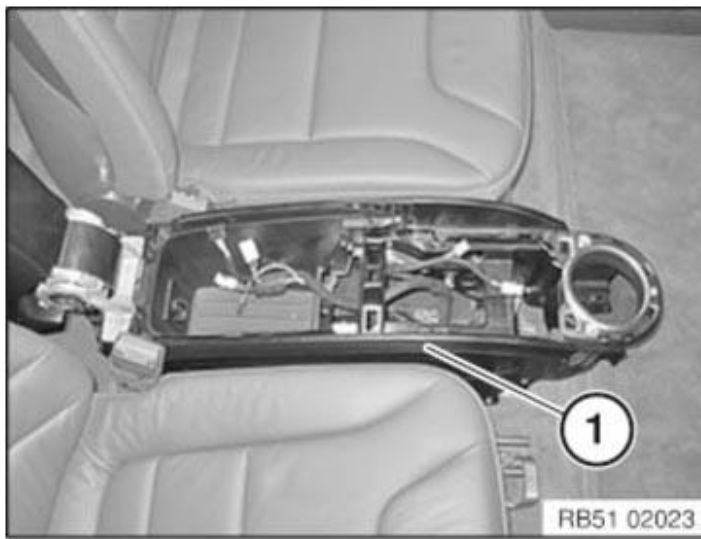
Tightening torque **51 16 8AZ** .



**Fig. 95: Identifying Complete Center Console Nuts**

Courtesy of BMW OF NORTH AMERICA, INC.

Lift out center console (1) upwards.



**Fig. 96: Identifying Center Console**

Courtesy of BMW OF NORTH AMERICA, INC.

When replacing, remount the following parts depending on the version:

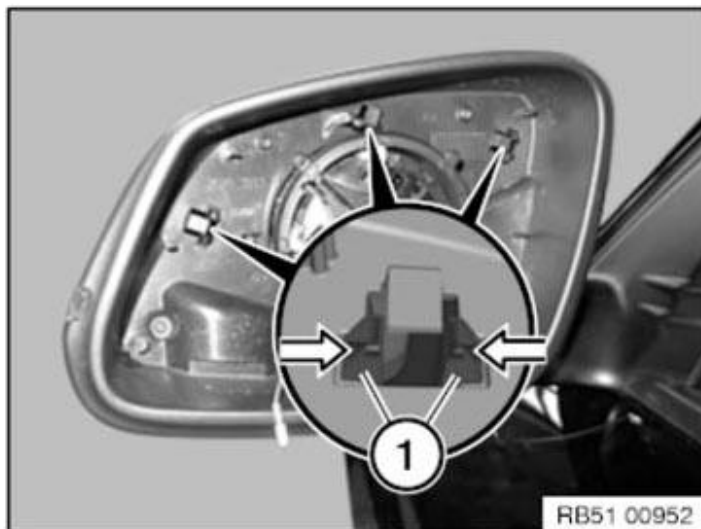
- **SIDE TRIMS ON CENTER CONSOLE**
- **CENTER ARMREST**
- **TRIM ON CUP HOLDER**

**51 16 041 REMOVING AND INSTALLING/REPLACING COVER CAP ON LEFT OR RIGHT EXTERIOR MIRROR**

Necessary preliminary tasks:

- Remove **MIRROR GLASS**

Press together latch mechanisms (1) and remove protective cap from the outside.

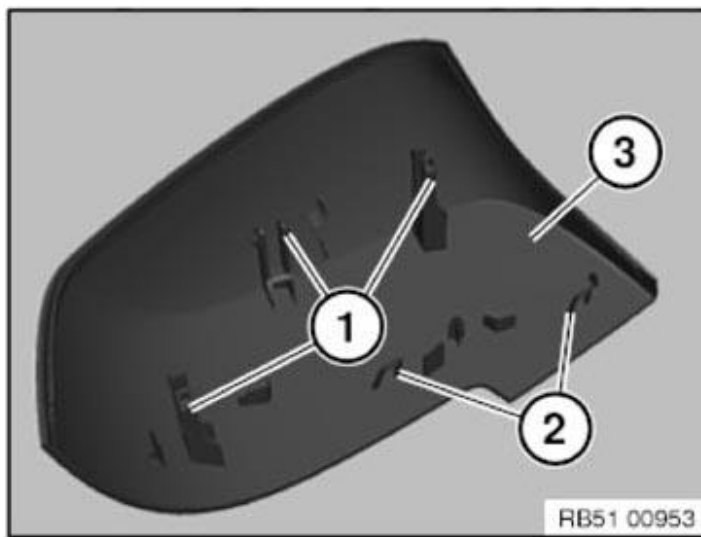


**Fig. 97: Pressing Latch Mechanisms**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Latch mechanisms (1) and guides (2) on protective cap (3) must not be damaged or missing.



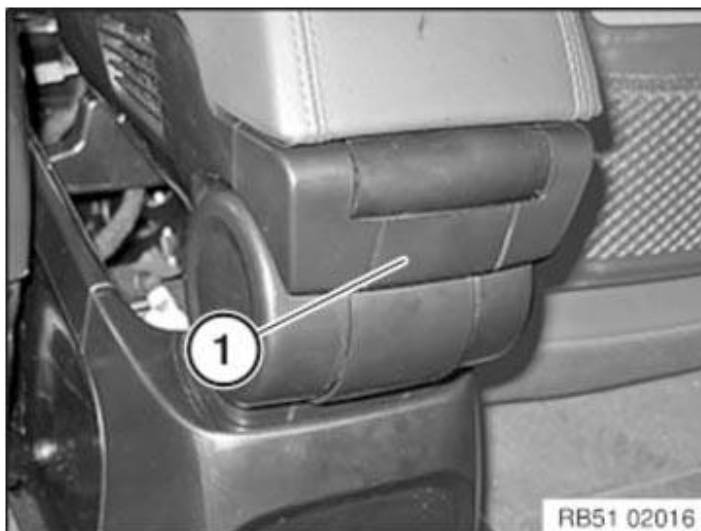
**Fig. 98: Identifying Latch Mechanisms, Guides And Protective Cap**

Courtesy of BMW OF NORTH AMERICA, INC.

### **51 16 196 REMOVING AND INSTALLING/REPLACING COVER FOR CENTER ARMREST**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

Unclip trim (1) towards rear and remove.



**Fig. 99: Identifying Trim**

Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Pull out screw and remove lid for center armrest.





**Fig. 100: Identifying Center Armrest Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 16... REMOVING AND INSTALLING/REPLACING COVER ON FRONT CUPHOLDER**

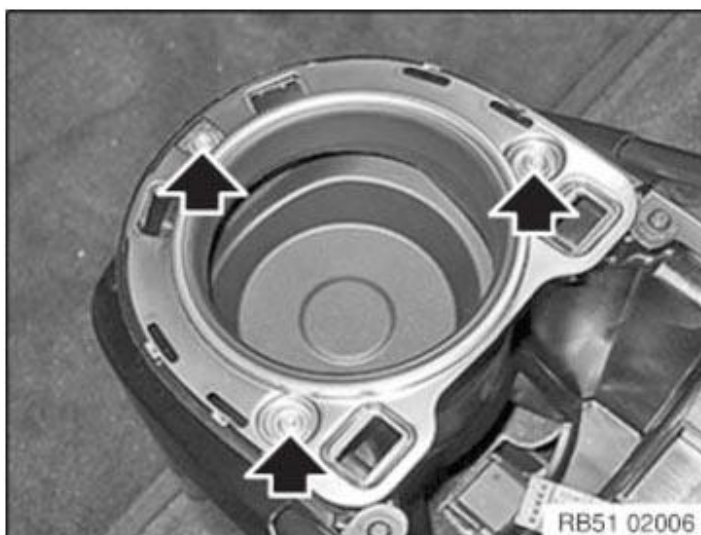
When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

**Necessary preliminary tasks:**

- Remove **CENTER CONSOLE DECORATIVE TRIM**

Release screws.

Remove trim on cup holder upwards.



**Fig. 101: Locating Cup Holder Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

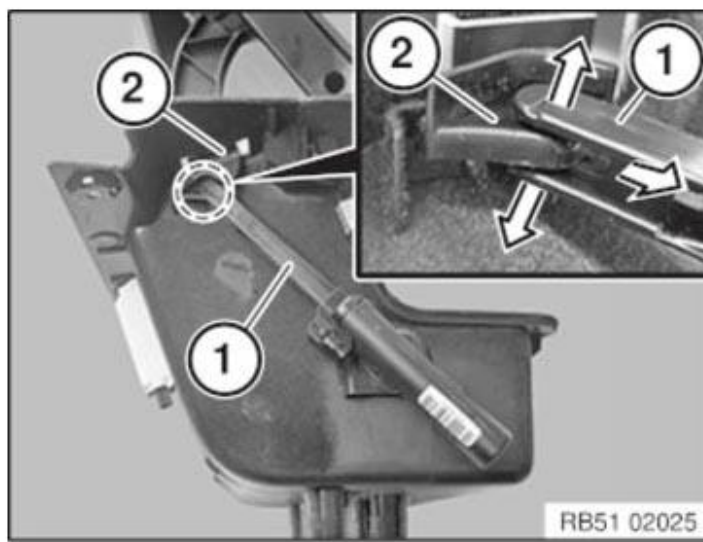
### **51 16 383 REMOVING AND INSTALLING/REPLACING DAMPER FOR GLOVE BOX**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

**Necessary preliminary tasks:**

- Remove **GLOVE BOX**

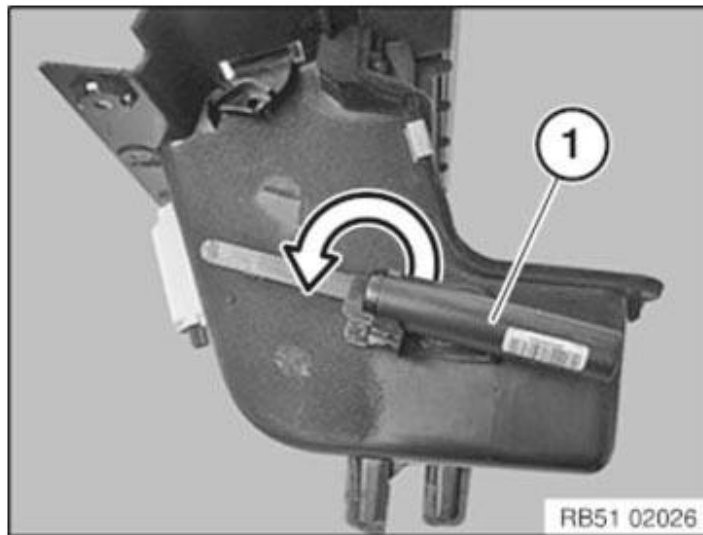
Unclip damper (1) from retaining bracket (2) and slide back in direction of arrow.



**Fig. 102: Unclipping Damper From Retaining Bracket**

Courtesy of BMW OF NORTH AMERICA, INC.

Turn damper (1) approx. 90° in direction of arrow and disconnect.



**Fig. 103: Turning Damper**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 16 040 REMOVING AND INSTALLING/REPLACING HOUSING ON LEFT OR RIGHT EXTERIOR MIRROR**

Necessary preliminary tasks:

- Remove **PROTECTIVE CAP ON EXTERIOR MIRROR**

Release screws (1).

Tightening torque **51 16 5AZ**.

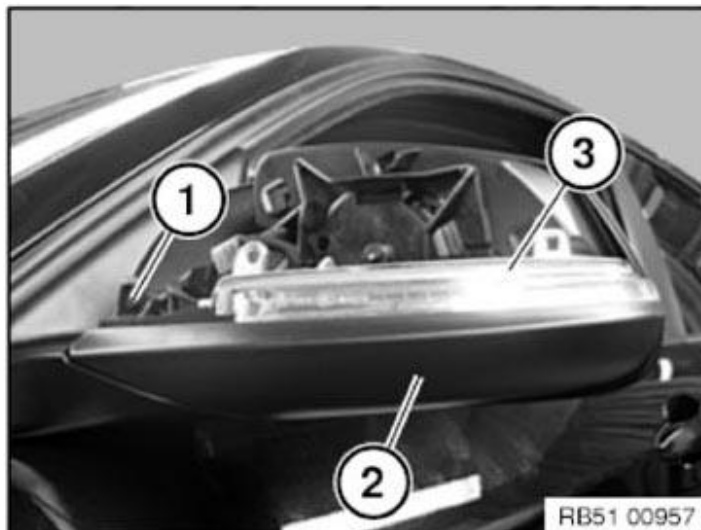


**Fig. 104: Identifying Exterior Mirror Housing Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Remove housing (2) carefully and disconnect plug connection at side repeater (3).

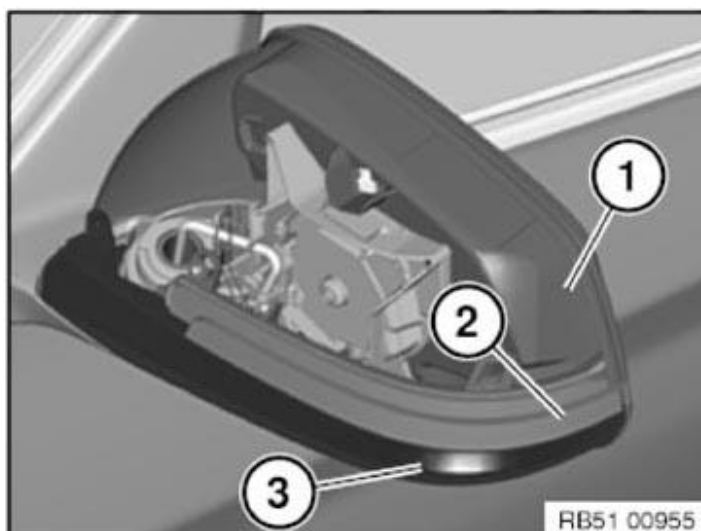


**Fig. 105: Identifying Housing, Side Repeater And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure retaining ring (1) is correctly mounted on side repeater (2) and housing (3).



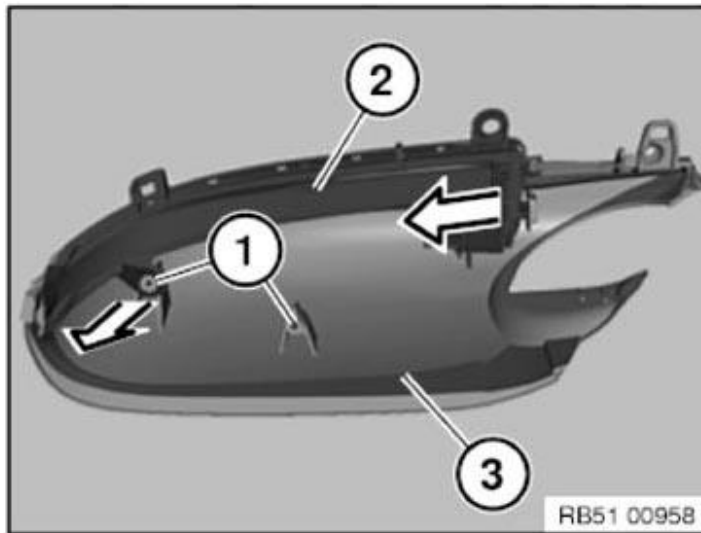
**Fig. 106: Identifying Turn Indicator, Housing And Retaining Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Screw holes (1) must not be damaged.

**Replacement:**

Feed side repeater (2) out of housing (3) in direction of arrow.



**Fig. 107: Removing Side Repeater Out Of Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

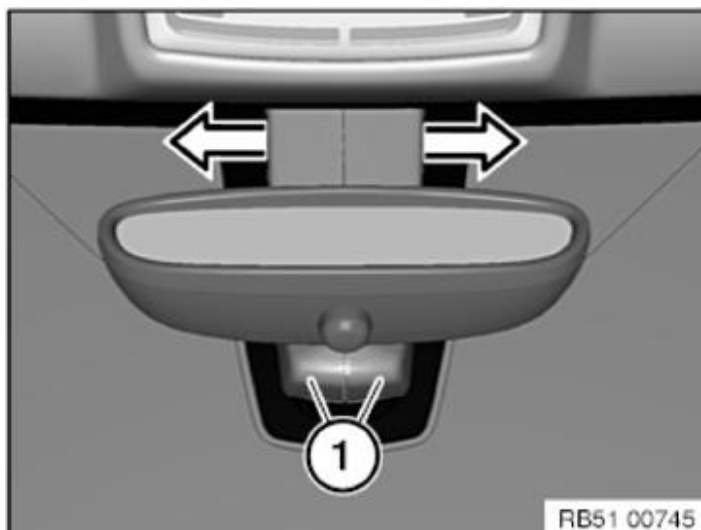
**51 16 063 REMOVING AND INSTALLING/REPLACING INTERIOR MIRROR (AS OF 07/2011)**

**IMPORTANT:** Work may only be carried out at a room/object temperature of 18... 28 °C.

If this can not be guaranteed (cold/hot countries), it is necessary to equalize the temperature of the windscreen, mirror base and inside mirror (e.g. vehicle left to stand indoors or in the shade for at least 30 minutes).

**IMPORTANT: To avoid windscreen breakage:**  
**IMPORTANT:** When removing mirror base, never turn or disengage towards front or rear.

Unclip end caps (1) in direction of arrow using a suitable tool and remove.

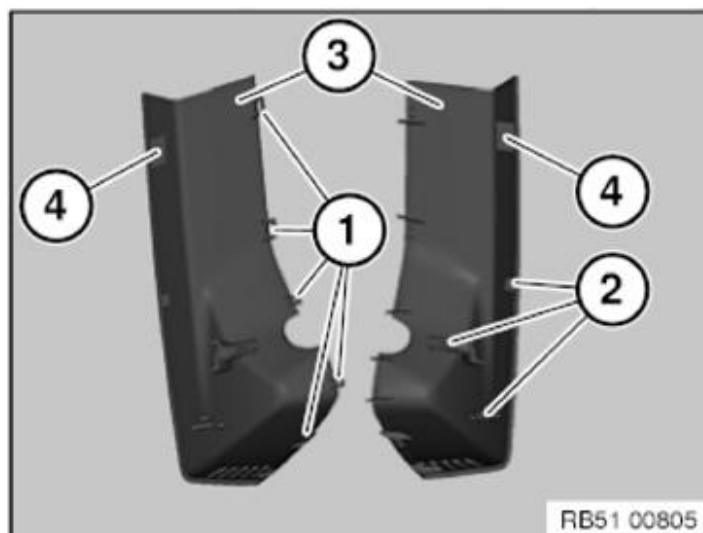


**Fig. 108: Removing Interior Mirror End Caps**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Latch mechanisms (1) and guides (2) on both end caps (3) must not be damaged.

For end caps (3) with tabs (4), the spacers must be bonded onto the tabs (4).



**Fig. 109: Identifying Interior Mirror Latch Mechanisms, Tabs And End Caps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Risk of damage!

IMPORTANT: When removing mirror base, never turn or disengage towards front or rear.

Interior mirror is held by clamp (3) and latch mechanism in area (A) on mirror base (2).

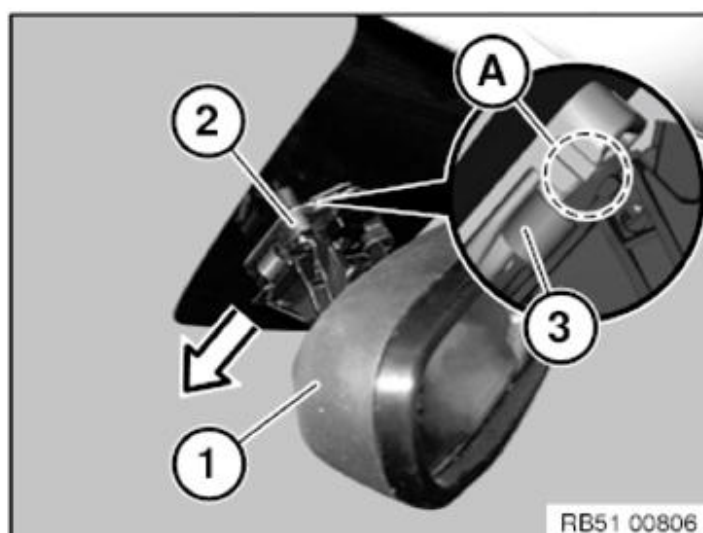
If necessary, disconnect plug connection on inside mirror (1).

Jerkily pull off inside mirror (1) parallel to windscreen from mirror socket (2).

*Installation note:*

Retaining clips (3) must not be bent or damaged.

Interior mirror (1) must engage correctly in mirror base (2) in area (A).



**Fig. 110: Pulling Off Inside Mirror Parallel To Windscreen From Mirror Socket**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with compass:**

Check compass function if replacing or after disconnecting inside mirror plug connection or battery.

If necessary, calibrate compass in interior rearview mirror.

**Version with high-beam assistant without KAFAS (camera-based driver support systems):**

Normalization or initialization is not necessary.

High-Beam Assistant is automatically aligned under the following conditions:

- Driving on a highway/ordinary road at night for approx. 50 km and
- Clearly visible road markings

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING** .

**51 16 063 REMOVING AND INSTALLING/REPLACING INTERIOR MIRROR (OVERVIEW)**

**IMPORTANT:** Interior mirrors with modified mirror base will be installed as of series launch F20 and for all subsequent series launches.

Observe new **REPAIR INSTRUCTIONS!**

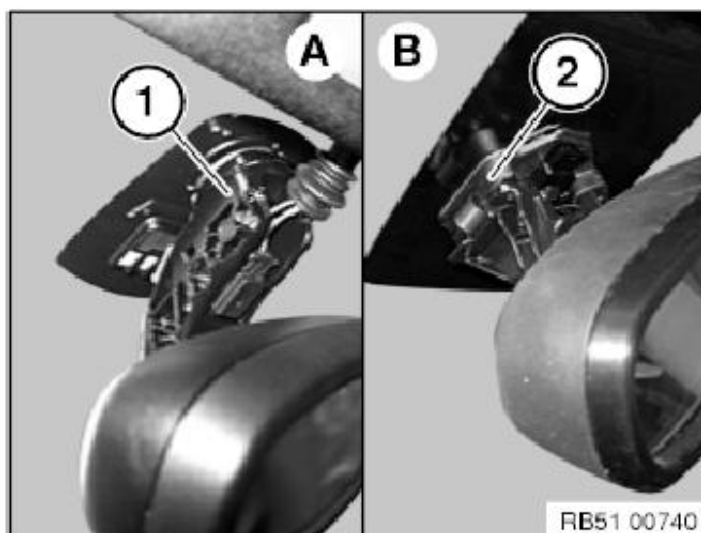
**Further introduction date:**

F01, F02, F03, F06, F07, F10, F11, F12, F13, F18	07/2012
F25	03/2012

**Distinguishing feature:**

- A. previous version, small mirror base (1) with round base plate on windscreen.
- B. new version, large mirror base (2) with square base plate on windscreen.

**NOTE:** Dismantling of mirror cap is identical on both versions.

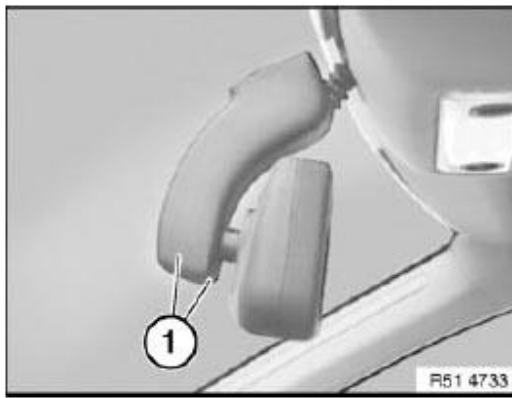


**Fig. 111: Identifying Mirror Base**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with mirror arm end cap:**

- Previous version.

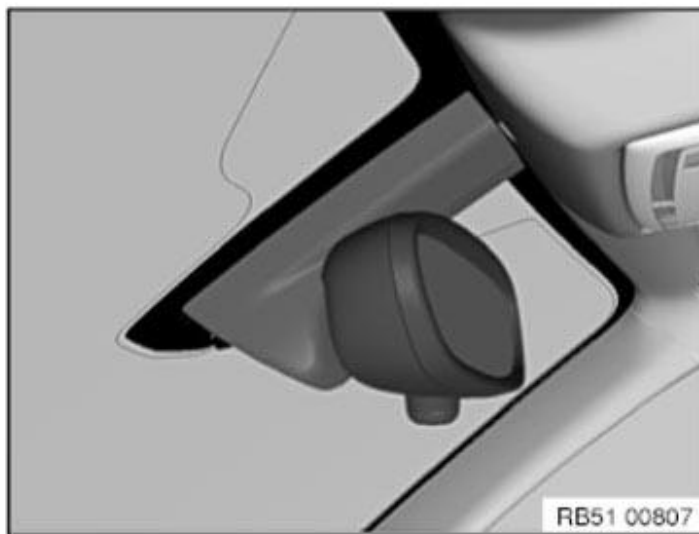




**Fig. 112: Identifying Mirror Arm End Caps - Previous Version**  
Courtesy of BMW OF NORTH AMERICA, INC.

Version with mirror arm end cap:

- **NEW VERSION.**



**Fig. 113: Identifying Mirror Arm End Cap - New Version**  
Courtesy of BMW OF NORTH AMERICA, INC.

Version with rain sensor:

- Previous version.
- **NEW VERSION.**

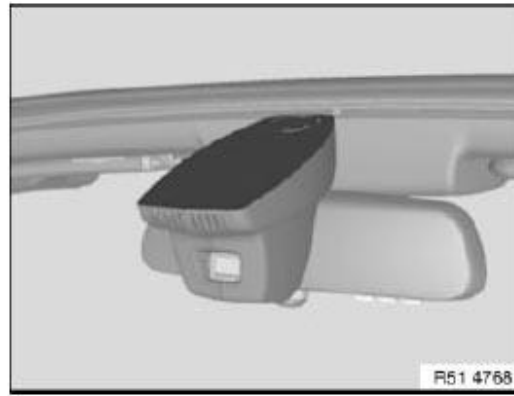


**Fig. 114: Identifying Rain Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

Version with Autobeam:

- Previous version.

- NEW VERSION.

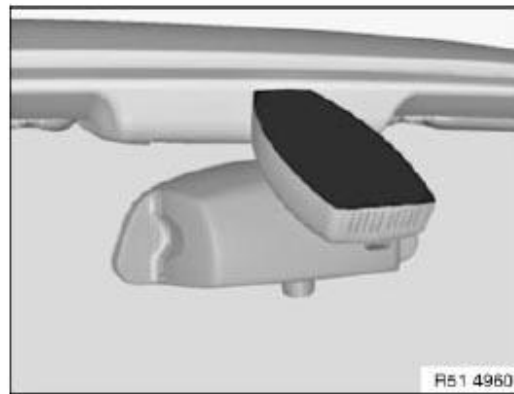


**Fig. 115: Identifying Autobeam**

Courtesy of BMW OF NORTH AMERICA, INC.

**Version with Toll interior mirror for Japan:**

- Previous version.
- NEW VERSION.



**Fig. 116: Identifying Toll Mirror For Japan**

Courtesy of BMW OF NORTH AMERICA, INC.

### **51 16 380 REMOVING AND INSTALLING/REPLACING LOCKING CUP FOR GLOVE BOX**

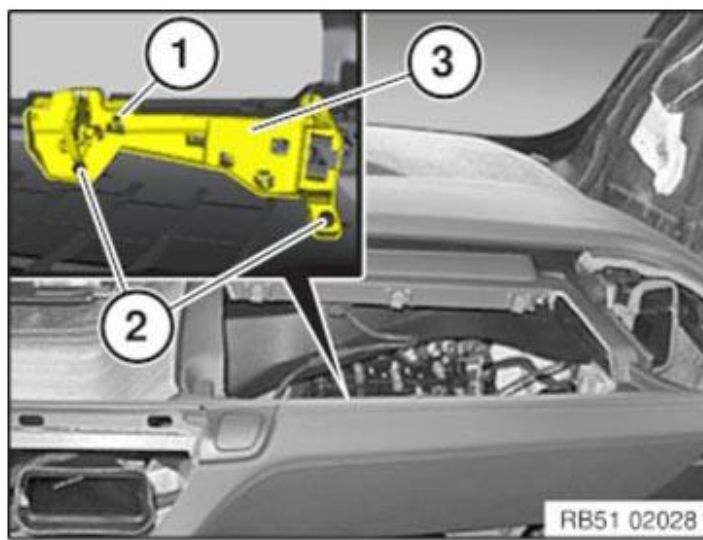
**Necessary preliminary tasks:**

- Remove GLOVE BOX

Release screw (1) from outside.

Release screws (2) from inside.

Remove locking cup (3) towards rear.



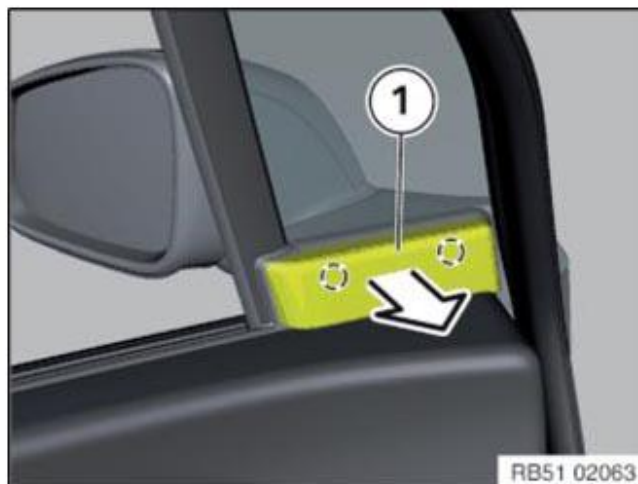
**Fig. 117: Identifying Locking Cup And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**51 16 001 REMOVING AND INSTALLING/REPLACING MIRROR ON LEFT OR RIGHT FRONT DOOR**

**Necessary preliminary tasks:**

- Remove FRONT DOOR OUTER SKIN

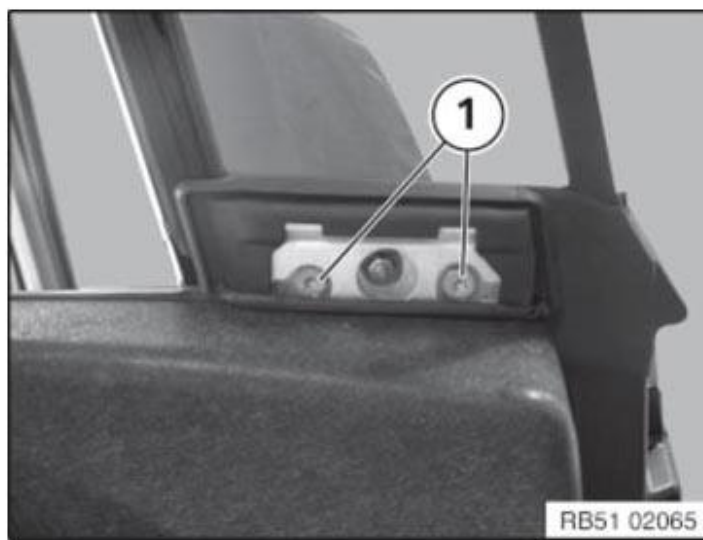
Lever out window frame cover (1) and remove.



**Fig. 118: Removing Window Frame Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque **51 16 1AZ**.



**Fig. 119: Identifying Front Door Mirror Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Secure mirror against falling off.

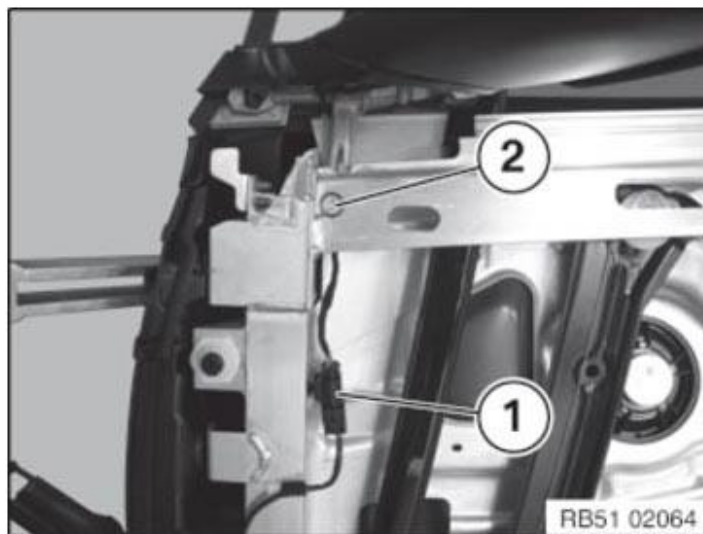
Unfasten plug connection (1) and disconnect.

Release screw (2) and remove exterior mirror.

Tightening torque **51 16 1AZ**.

*Installation note:*

Due to self-tapping screws, the tightening torque of the new rearview mirror increases by 2 Nm.

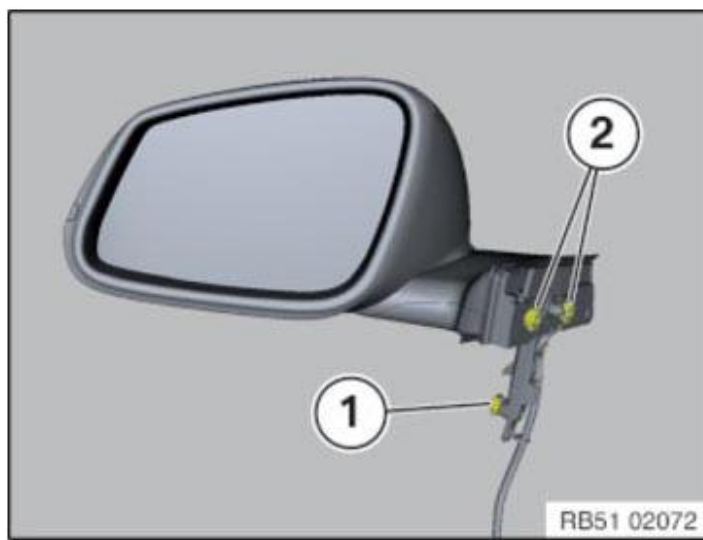


**Fig. 120: Identifying Exterior Mirror Plug Connection And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Shown removed here for purposes of clarity.

Position screw (1) then screws (2).



**Fig. 121: Identifying Exterior Mirror Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

When replacing, swap over the following parts:

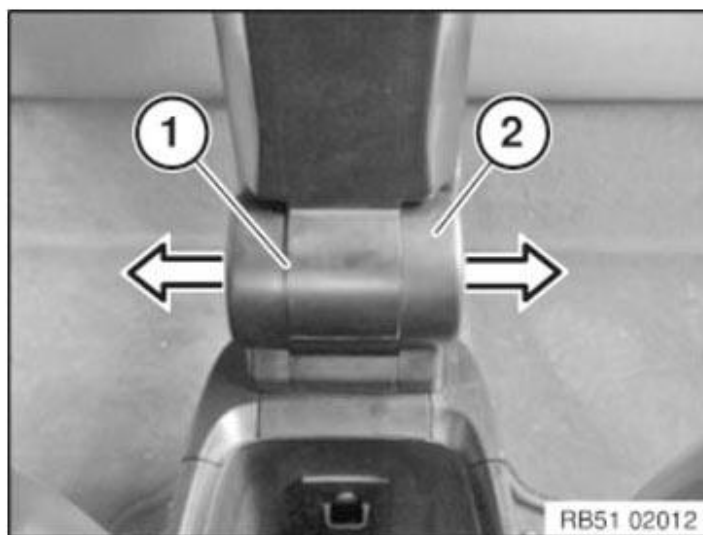
- MIRROR GLASS
- PROTECTIVE CAP

### **51 16 163 REMOVING AND INSTALLING/REPLACING REAR CENTER CONSOLE COVER**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

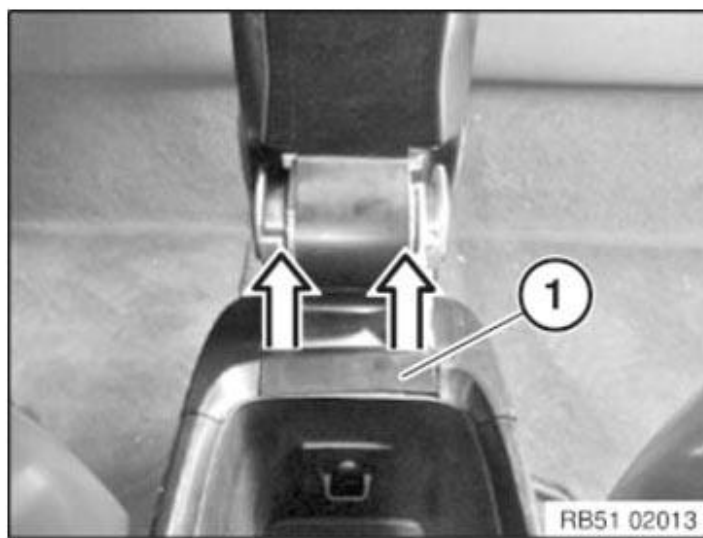
Fold up center armrest.

Unclip trims (1) and (2) in direction of arrow.



**Fig. 122: Unclipping Trims**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pry out cover (1) in direction of arrow.



**Fig. 123: Removing Cover**

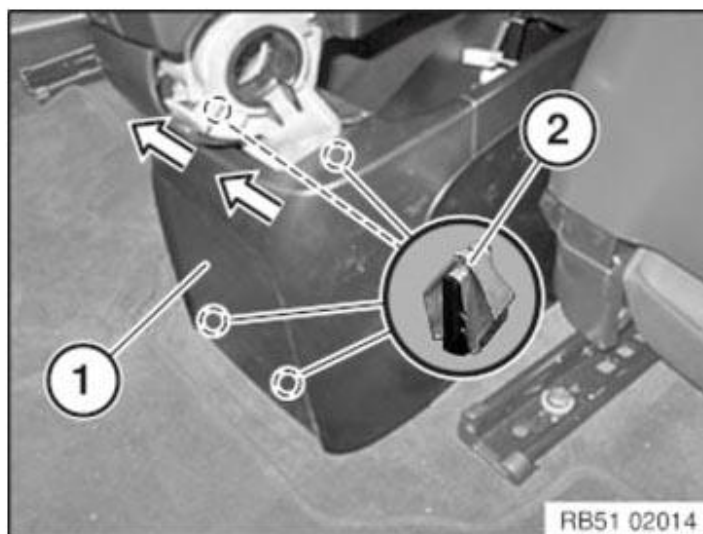
Courtesy of BMW OF NORTH AMERICA, INC.

Release trim (1) from clamp (2) in direction of arrow and remove.

*Installation note:*

Replace faulty clamps (2).

Corresponding mountings must not be missing or damaged.



**Fig. 124: Releasing Trim From Clamp**

Courtesy of BMW OF NORTH AMERICA, INC.

### **51 16 366 REMOVING AND INSTALLING/REPLACING RIGHT GLOVE BOX WITH HOUSING**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

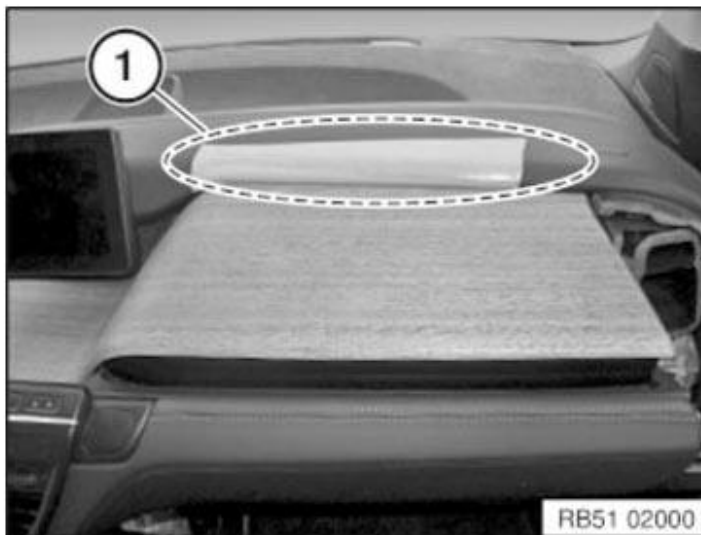
**Necessary preliminary tasks:**

- Remove **RIGHT FRESH AIR GRILLE**

IMPORTANT: Risk of damage!

Mask dashboard in area (1) above glove box.





**Fig. 125: Identifying Glove Box Mask Dashboard Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open glove box cover.

Lever out protective caps and release screws underneath.

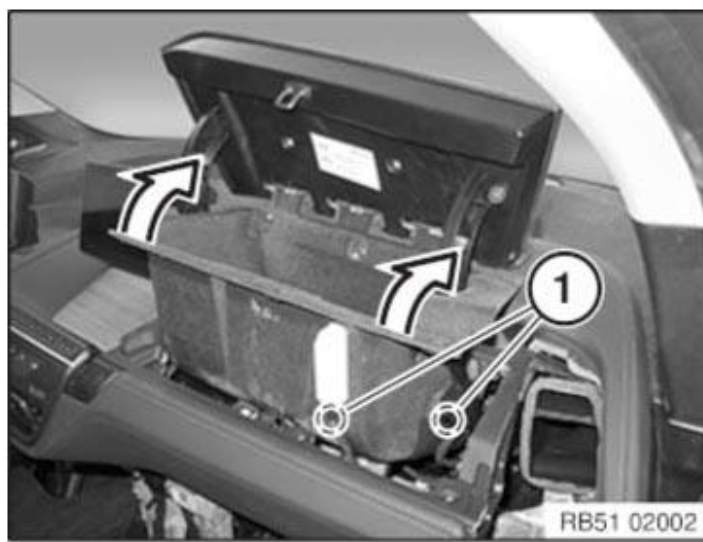


**Fig. 126: Locating Glove Box Cover Protective Caps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out glove box by approx. 10 cm.

Unlock plug connections (1) and disconnect.

Remove glove box in direction of arrow.



**Fig. 127: Removing Glove Box**

Courtesy of BMW OF NORTH AMERICA, INC.

When replacing, remount the following parts according to the equipment:

- **GLOVE BOX DAMPER**
- **COVER, GLOVE BOX**
- **GLOVEBOX LIGHT**

### **61 31 172 REMOVING AND INSTALLING/REPLACING SWITCH FOR ELECTROMECHANICAL PARKING BRAKE**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work:

Disconnect **HIGH-VOLTAGE SYSTEM FROM POWER** .

Observe **SAFETY INFORMATION** for handling electric vehicles.

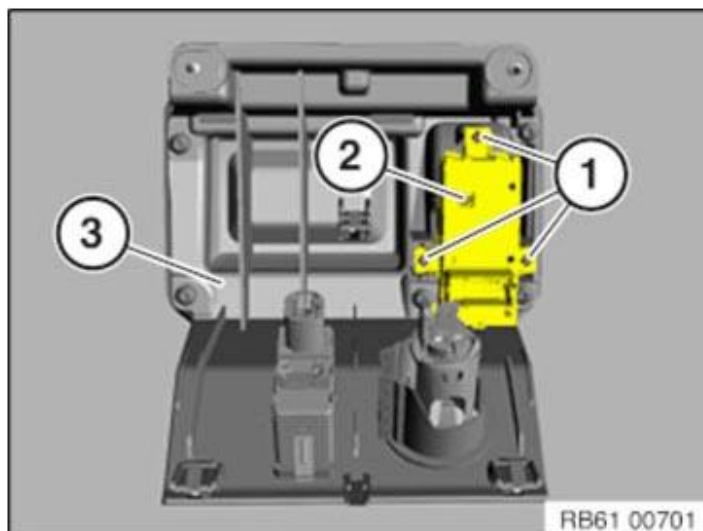
**Necessary preliminary tasks:**

- Disconnect **NEGATIVE BATTERY CABLE** (to avoid fault memory entries)
- Remove **COVER FOR STORAGE COMPARTMENT**

Release screws (1).

Tightening torque **61 31 2AZ** .

Remove switch for electromechanical parking brake (2) from cover for gear selector switch (3).



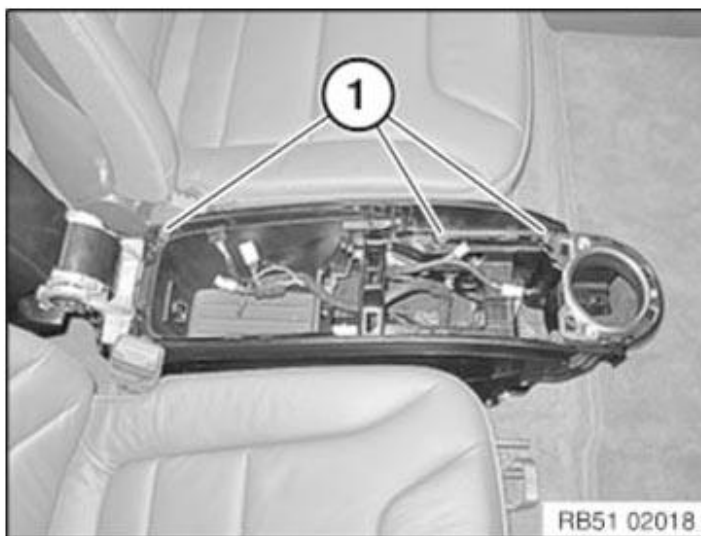
## **51 16... REMOVING AND INSTALLING/REPLACING TRIM ON CENTER CONSOLE AT SIDE LEFT OR RIGHT**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

### **Necessary preliminary tasks:**

- Remove **TRIM FOR STORAGE COMPARTMENT**
- Remove **CENTER CONSOLE COVER**
- Remove **REAR CENTER CONSOLE TRIM**

Release screws (1).



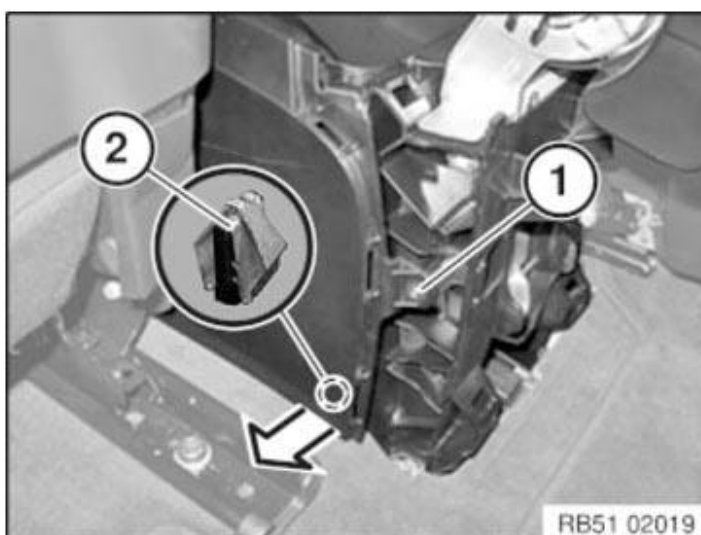
### **Fig. 129: Identifying Center Console Trim Screws** Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Lever trim out of clamps (2).

*Installation note:*

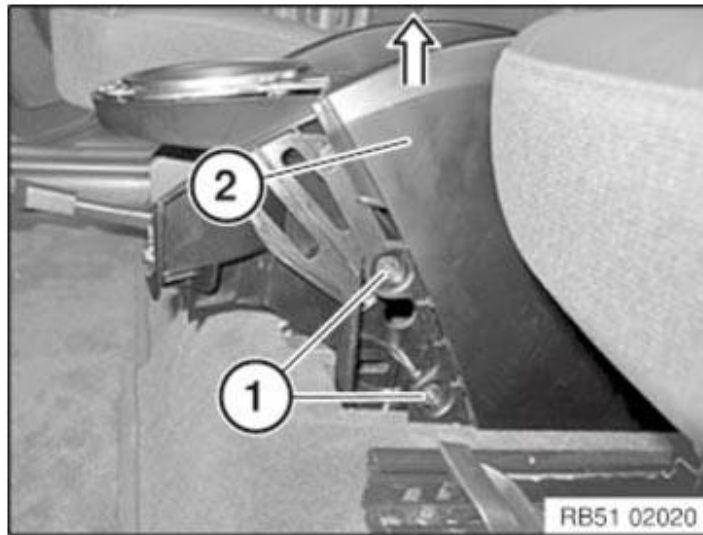
Replace defective clips (2).



### **Fig. 130: Removing Defective Clips** Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Pull out decorative trim (2) upwards.



**Fig. 131: Identifying Decorative Trim And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

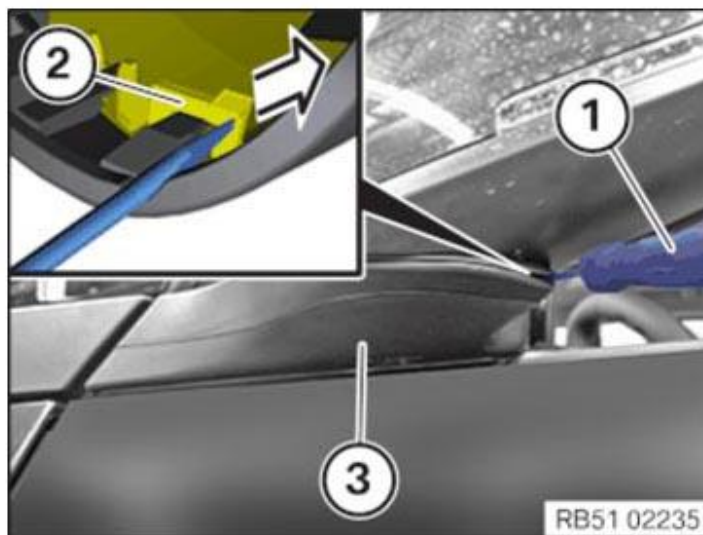
### **51 16... REMOVING AND INSTALLING/REPLACING TRIM ON LEFT OR RIGHT EXTERIOR MIRROR**

Fold in exterior mirror.

Insert suitable screwdriver (1) in groove between sealing lip and mirror base.

Release latch mechanism (2) with screwdriver (1).

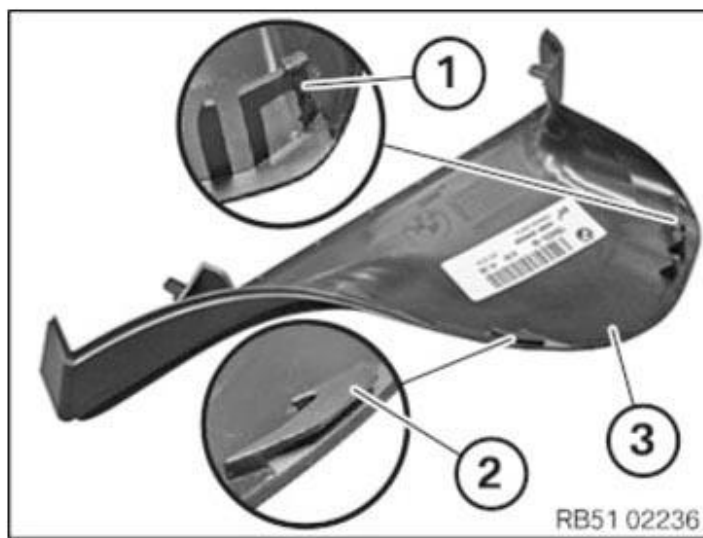
Slip off trim (3) downwards.



**Fig. 132: Releasing Latch Mechanism With Screwdriver**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Latch mechanism (1) and guide (2) on trim (3) must not be damaged or missing.



**Fig. 133: Identifying Latch Mechanism, Guide And Trim**

Courtesy of BMW OF NORTH AMERICA, INC.

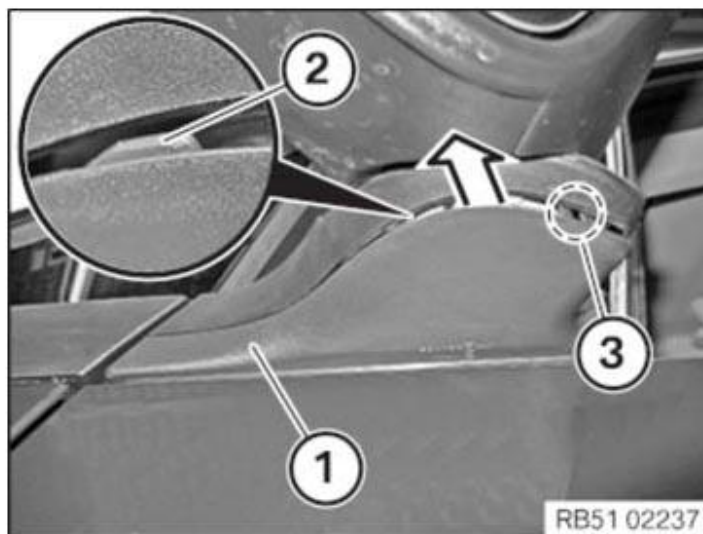
*Installation note:*

Slip on trim (1) upwards from below.

Slip on trim (1) with guide (2) first, then clip in latch mechanism in area (3).

Ensure guide (2) is correctly seated.

Ensure proper fit of latch mechanism in area (3).



**Fig. 134: Installing Guide**

Courtesy of BMW OF NORTH AMERICA, INC.

### **51 16 026 REPLACING MIRROR GLASS**

Special tools required:

- [2 298 505](#)

**WARNING:**

**Danger of injury!**  
 Move mirror glass with hand carefully and slowly.  
 If mirror glass is damaged:  
 Wear protective goggles and cut-proof gloves.  
 Danger of injury by flaking-off glass splinters.

**Attention!**

Risk of damage!



Bring exterior mirror to room temperature to prevent catches from breaking off.

**Attention!**

Risk of damage!

Secure mirror glass (1) against falling out.

Press mirror glass (1) at top by hand to full extent.

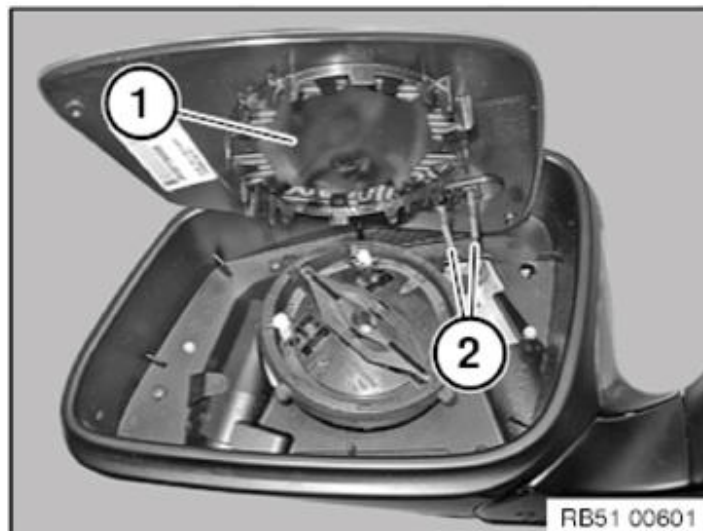
Unclip the mirror glass (1) with special tool [2 298 505](#) beginning on the bottom all the way around.



**Fig. 135: Unclipping Mirror Glass With Special Tool (2 298 505)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect associated plug connections (2).

Remove the mirror glass (1).



**Fig. 136: Identifying Mirror Glass And Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

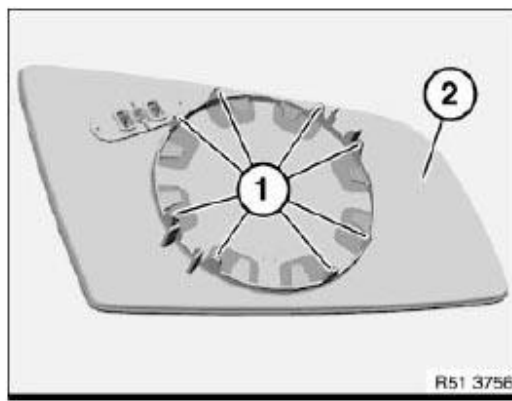
Retaining lugs (1) must not be damaged.

Fit the mirror glass (2) with the retaining lugs (1) flush on mirror adjustment drive and clip it into place.

Ensure correct locking.

Make sure mirror adjusting drive functions correctly.





**Fig. 137: Identifying Retaining Lugs And Mirror Glass**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **FRONT DOOR LOCKS, HANDLES, FITTINGS**

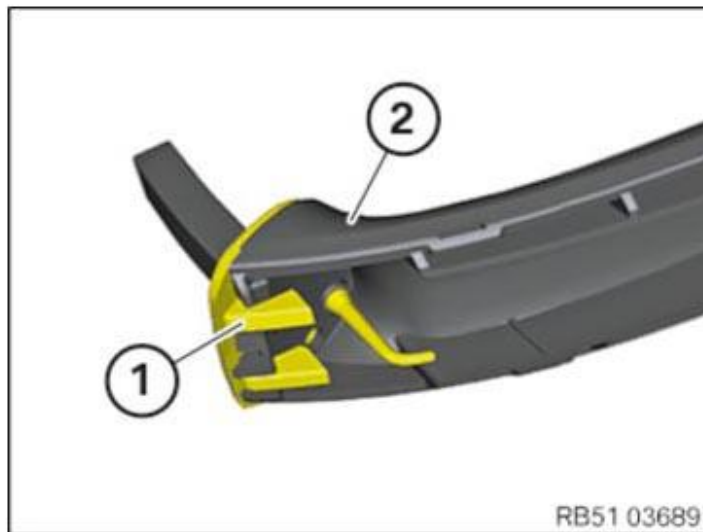
### **51 21 004 ADJUSTING FRONT LEFT OR RIGHT LOCK STRIKER**

**Operation is described in:**

ADJUSTING LEFT OR RIGHT FRONT DOOR .

### **51 21... ASSEMBLING THE OUTER DOOR HANDLE**

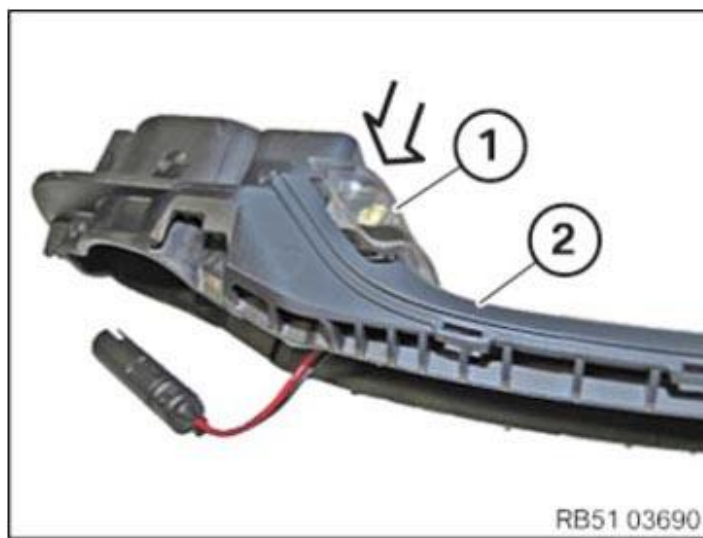
Insert gasket (1) in outer door handle (2).



**Fig. 138: Identifying Gasket And Outer Door Handle**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with light package:**

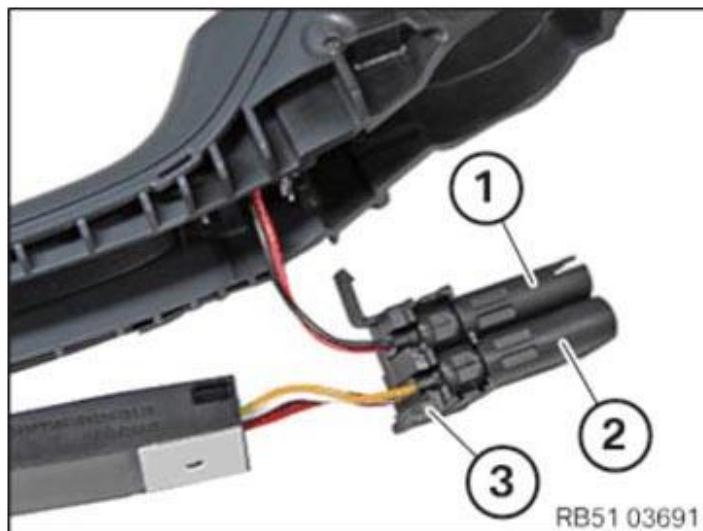
Feed in LED (1) in outer door handle (2) and lock.



**Fig. 139: Feeding LED In Outer Door Handle**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with light package/Comfort Access:**

Clip in connector (1) for LED and connector (2) for Comfort Access sensor in holder (3).

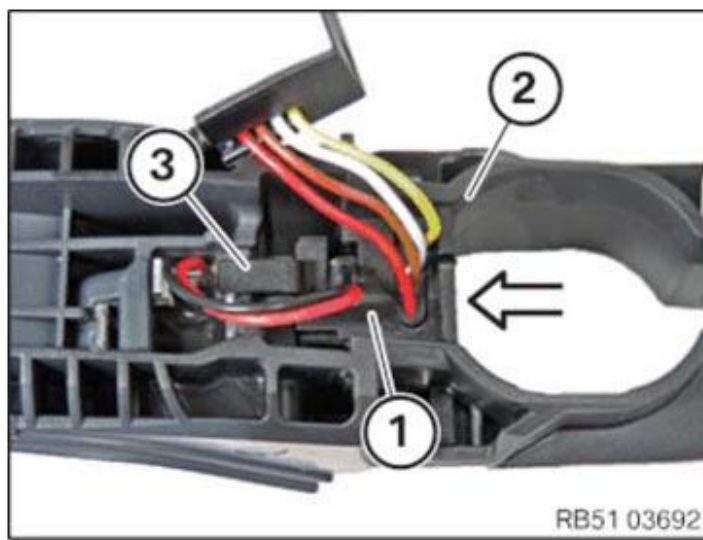


**Fig. 140: Identifying Holder And Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with light package/Comfort Access:**

Insert holder (1) in outer door handle (2) and lock.

Ensure latch mechanism (3) is correctly seated.



**Fig. 141: Inserting Holder In Outer Door Handle**  
 Courtesy of BMW OF NORTH AMERICA, INC.

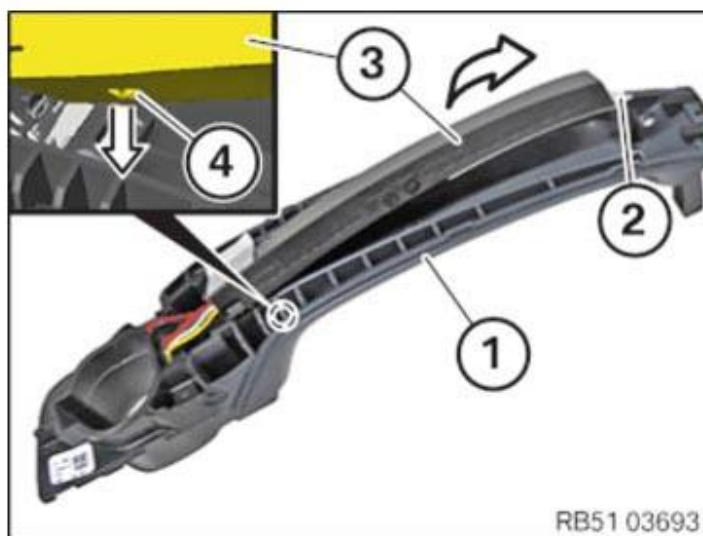
**Version with Comfort Access:**

Clean adhesive area in outer door handle (1) with cleaning agent R2.

Pull off protective film (2) from sensor (3).

Insert sensor (3) in outer door handle (1) and bond.

Guide (4) on sensor (3) must be inserted in the corresponding fixture on outer door handle (1).



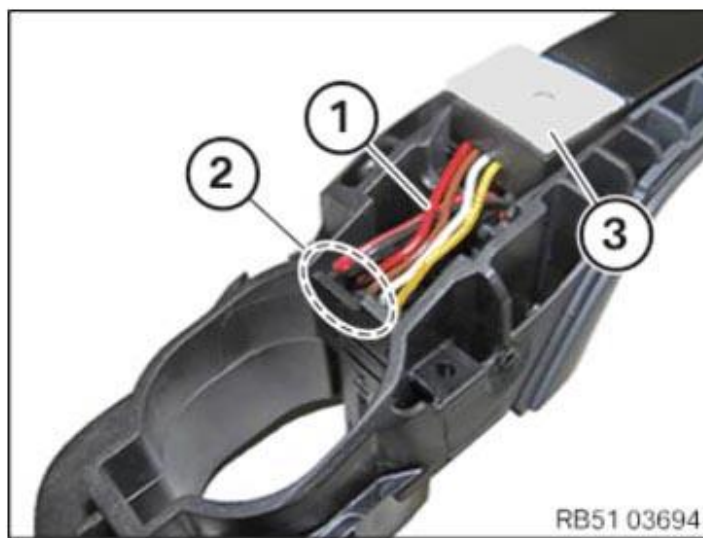
**Fig. 142: Pulling Off Protective Film From Sensor**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Version with light package/Comfort Access:**

Ensure correct cable routing (1).

Cables (1) must be in recess (2) and must not be trapped when assembled.

Pull off protective film (3).



**Fig. 143: Identifying Protective Film, Cable Routing And Cables**  
Courtesy of BMW OF NORTH AMERICA, INC.

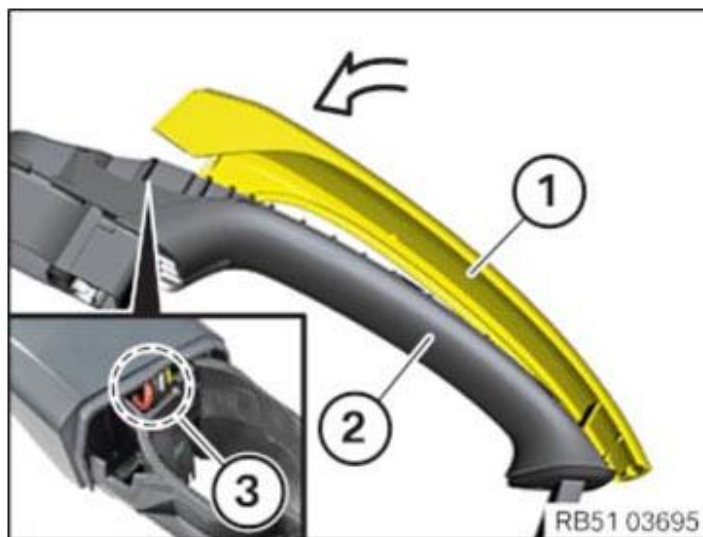
First attach cover (1) at front into outer door handle (2).

Clip cover (1) onto outer door handle (2).

**Version with light package/Comfort Access:**

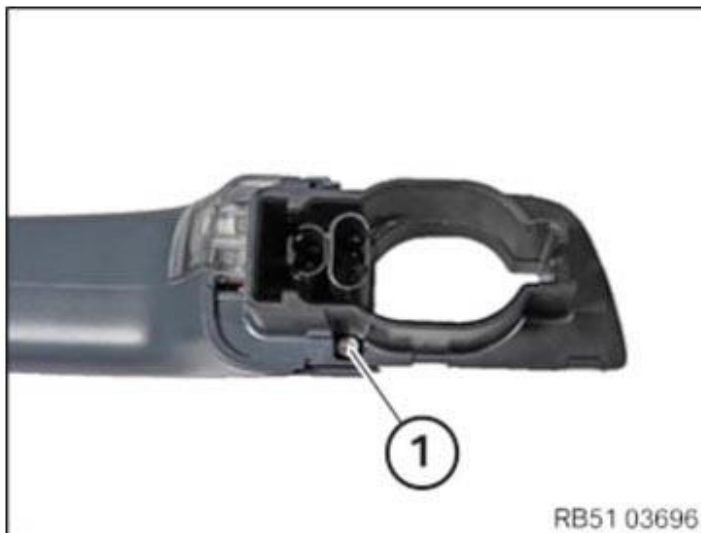
Ensure that cables are correctly seated in area (3).

The cables must not be trapped.



**Fig. 144: Attaching Cover At Front Outer Door Handle**  
Courtesy of BMW OF NORTH AMERICA, INC.

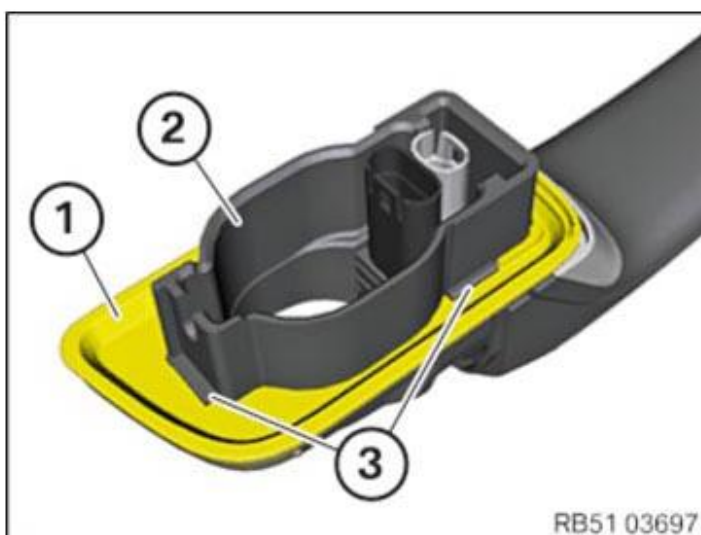
Tighten screw (1).



**Fig. 145: Identifying Door Handle Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

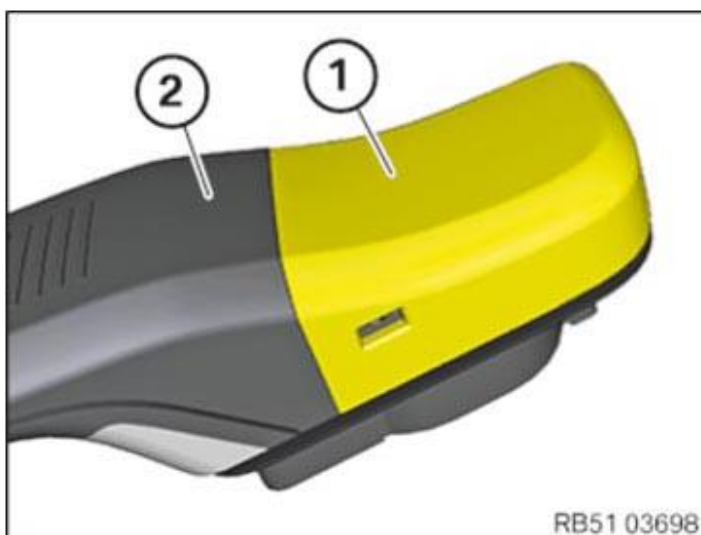
Connect gasket (1) to outer door handle (2).

Make sure gasket (1) is correctly seated in guides (3).



**Fig. 146: Identifying Outer Door Handle, Guides And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect protective cap (1) to outer door handle (2).



**51 21 300 REMOVING AND INSTALLING OR REPLACING WINDOW CAVITY COVER STRIP ON OUTSIDE OF LEFT OR RIGHT FRONT DOOR**

Special tools required:

- **00 9 324**

IMPORTANT: Disassembly of the weather strip is not possible without destroying it.

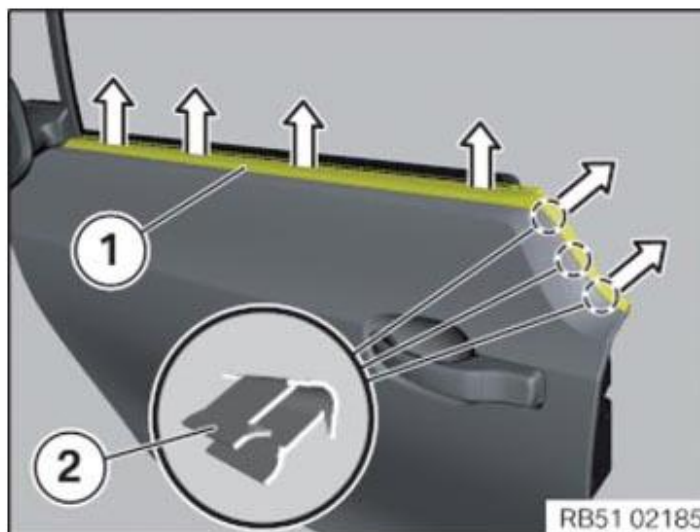
Weather strip must be replaced after removal.

Observe **PROCEDURE** for using special tool **00 9 324** .

The **NOTES ON INSTALLATION OF RUBBER WINDOW SEALS** serve as the basis for this repair instruction and must be observed without fail.

Lever out weather strip (1) with special tool **00 9 324** beginning from the back.

Remove any clamps (2) from door.

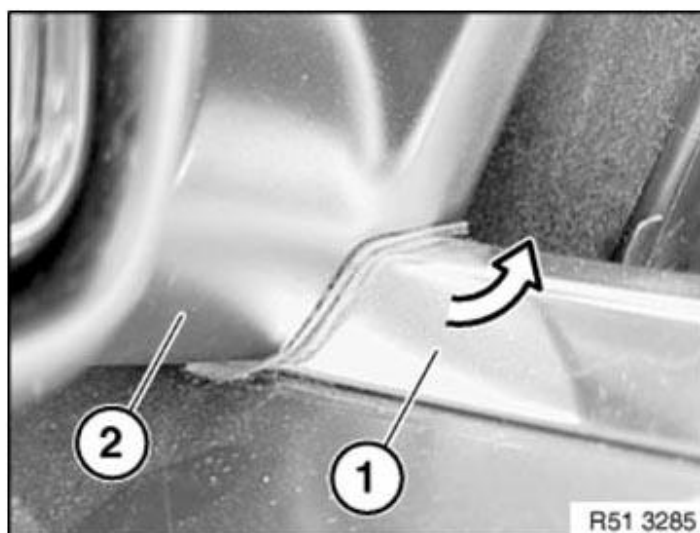


**Fig. 148: Removing Weather Strip With Special Tool (00 9 324)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out weather strip (1) from exterior mirror (2) in direction of arrow.

*Installation note:*

Moisten weather strip (1) before installation with the approved **LUBRICANT**.





**51 21 330 REMOVING AND INSTALLING/RENEWING WEATHER STRIP ON INNER FRONT DOOR**

**Necessary preliminary tasks:**

- Remove FRONT DOOR COVER ON INSIDE

Lever out window frame cover (1) and remove.



**Fig. 150: Removing Window Frame Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release clip (1).

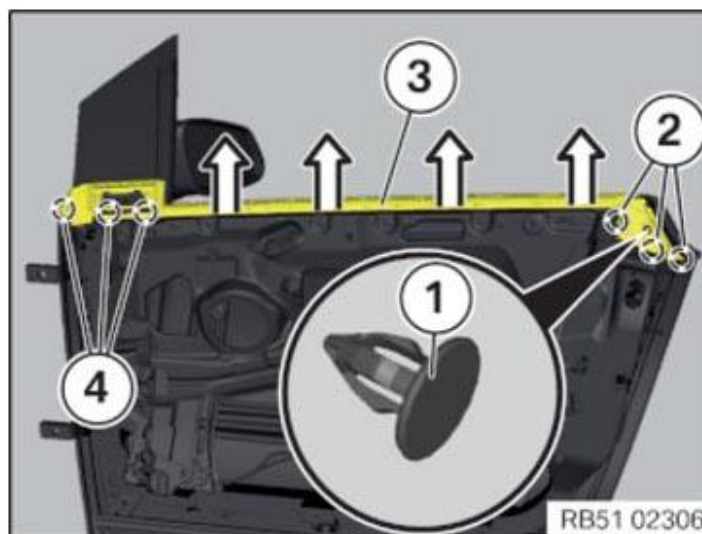
Release latch mechanisms (2) and (4).

Pull off weather strip (3) towards top.

***Installation note:***

Coat window cavity weather strip (1) with water before fitting.

Start with installation at front.



**Fig. 151: Pulling Off Weather Strip**  
Courtesy of BMW OF NORTH AMERICA, INC.

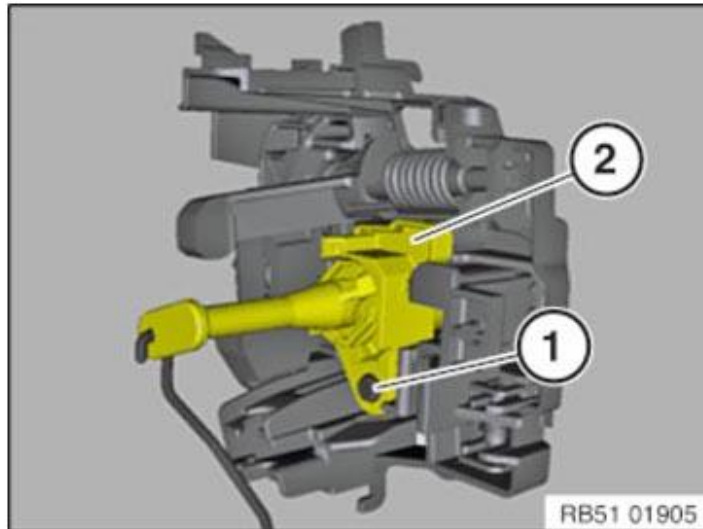
**51 21 140 REMOVING AND INSTALLING/REPLACING COMPLETE LOCK BARREL IN LEFT OR RIGHT FRONT DOOR**

**Necessary preliminary tasks:**

- Remove **CARRIER FOR OUTER DOOR HANDLE**

Release screw (1) and pull out lock barrel (2).

Tightening torque **51 21 6AZ** .

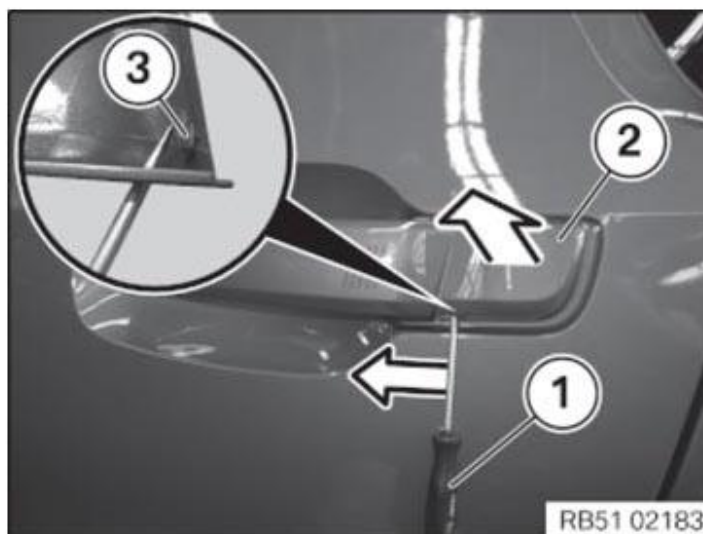


**Fig. 152: Identifying Lock Barrel And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

**51 21 180 REMOVING AND INSTALLING/REPLACING COVER ON OUTSIDE DOOR HANDLE**

Insert suitable screwdriver (1) in opening on cover (2).

Unlock retaining lug (3) towards front and remove cover (2) in direction of arrow.



**Fig. 153: Removing Outside Door Handle Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

**51 21 090 REMOVING AND INSTALLING/REPLACING DOOR LOCK IN LEFT OR RIGHT FRONT DOOR**

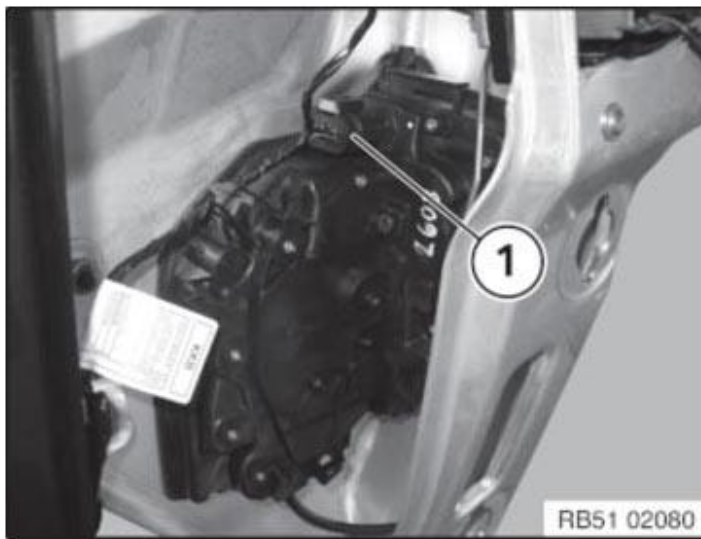
Special tools required:

- **51 2 190**

Necessary preliminary tasks:

- Remove INNER FRONT DOOR COVER
- Remove FRONT DOOR OUTER SKIN

Unfasten plug connection (1) and disconnect.

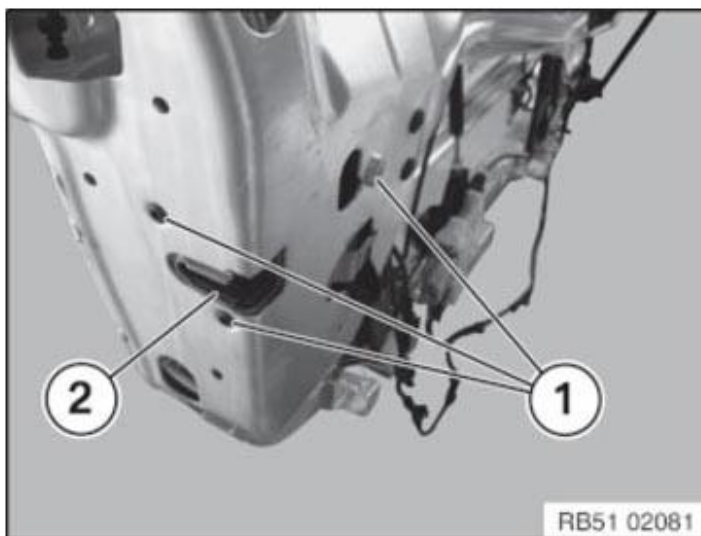


**Fig. 154: Identifying Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque **51 21 1AZ**.

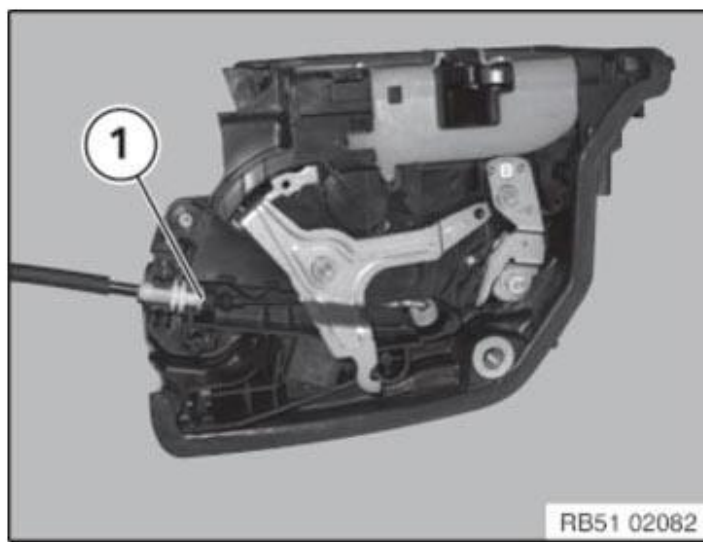
Remove door lock (2) inwards.



**Fig. 155: Identifying Door Lock And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement only:**

Detach cable (1) and remount.



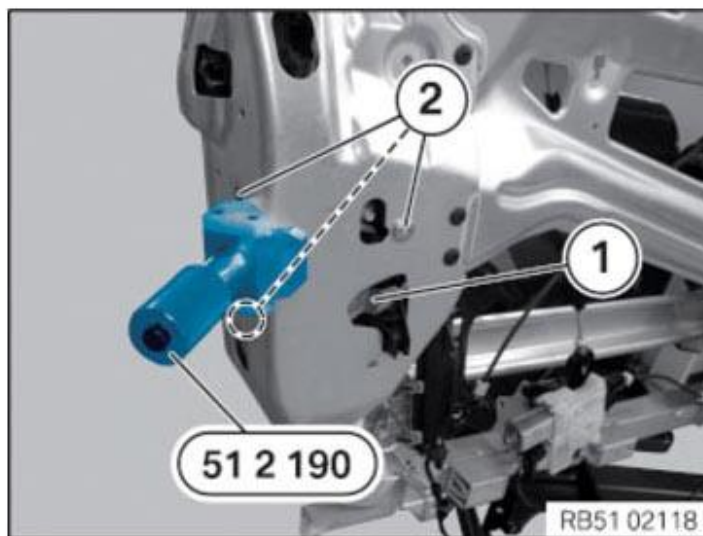
**Fig. 156: Identifying Cable**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Install door lock (1) and screw in screws (2) but do not tighten.

Slide special tool [51 2 190](#) into opened rotary striker until striker engages in first stage



**Fig. 157: Sliding Special Tool (51 2 190) Into Opened Rotary Striker**

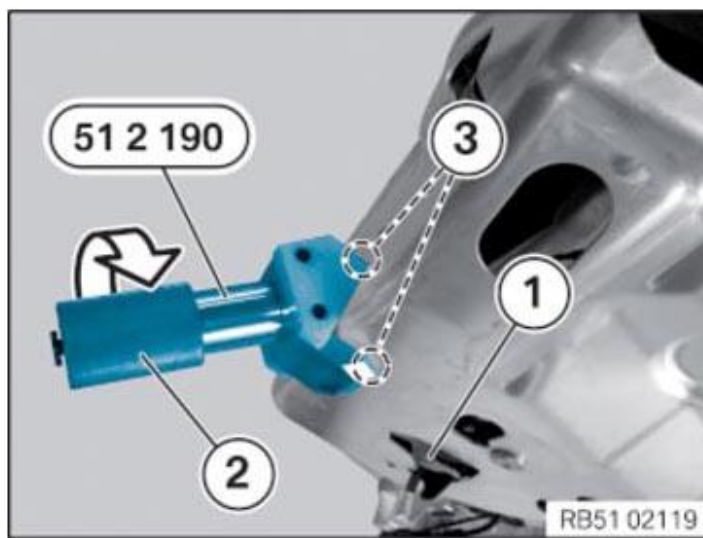
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Pre-tension door lock (1) with knurled screw (2) until special tool [51 2 190](#) just contacts corner points (3)

**IMPORTANT:** To tension door lock (1), it is only permitted to tighten knurled screw (2) by a further 1 to 1.5 turns (max.) (risk of damage).

Door lock seal must rest uniformly on inner door panel (water ingress).



**Fig. 158: Installing Door Lock With Knurled Screw Using Special Tool (51 2 190)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws of door lock (1).

Observe tightening sequence: bottom - top - inner.

Tightening torque **51 21 1AZ** .

**51 21 280 REMOVING AND INSTALLING/REPLACING DOOR STOP ON LEFT OR RIGHT FRONT DOOR**

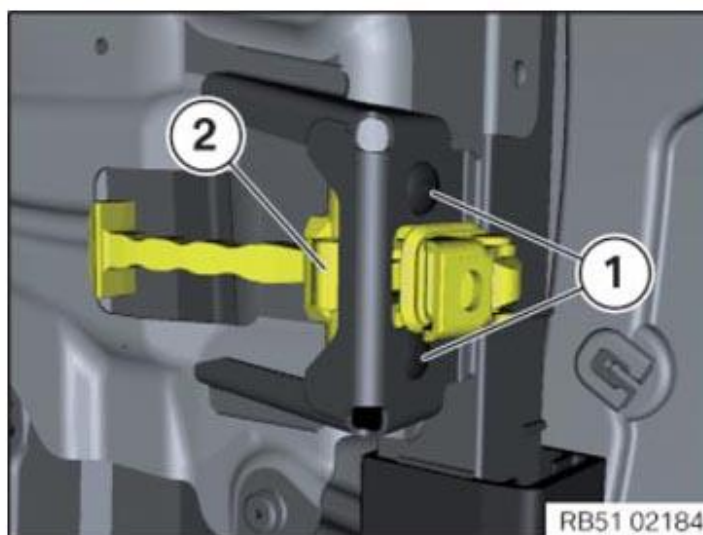
**Necessary preliminary tasks:**

- Remove FRONT DOOR INNER COVER

Release screws (1).

Tightening torque **51 21 4AZ** .

Feed out door stop (2) from door.

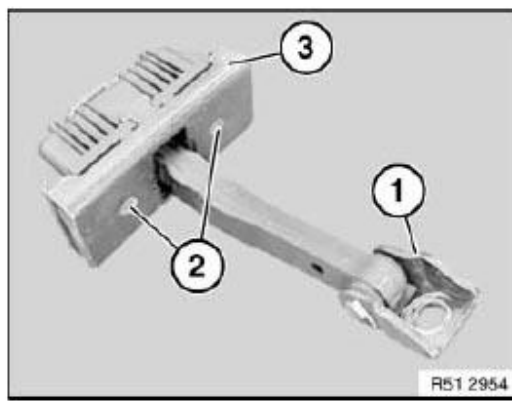


**Fig. 159: Identifying Door Stop And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Following parts of door retainer (3) must not be damaged:

1. Hinge
2. Thread



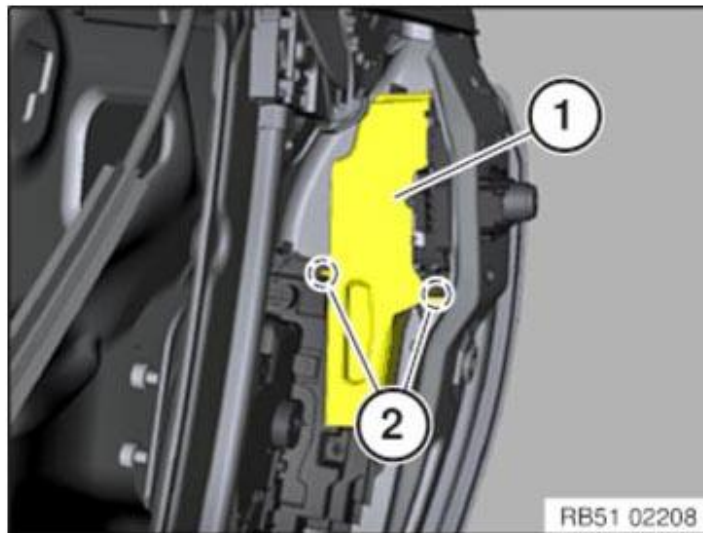
**Fig. 160: Identifying Door Retainer With Hinge And Thread**  
Courtesy of BMW OF NORTH AMERICA, INC.

**51 21 125 REMOVING AND INSTALLING/REPLACING SUPPORT FOR LEFT OR RIGHT OUTER DOOR HANDLE WITH LOCK BARREL**

**Necessary preliminary tasks:**

- Remove DOOR OUTER SKIN

Unclip cover (1) in area (2) and remove.

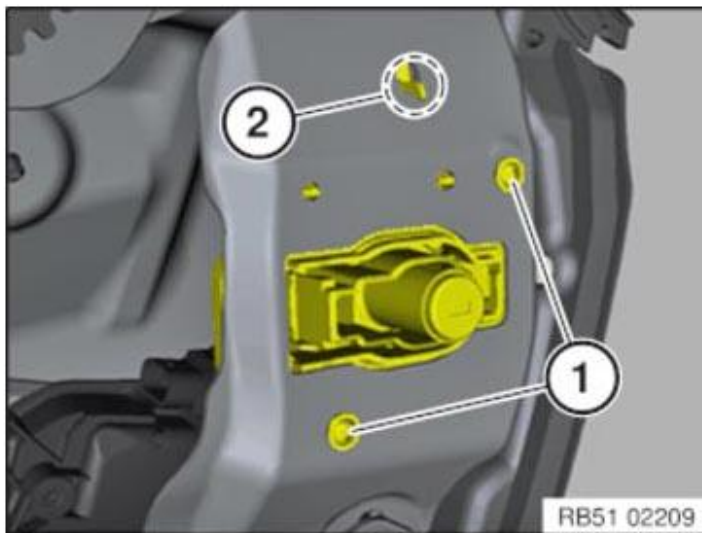


**Fig. 161: Identifying Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Detach support in area (2).

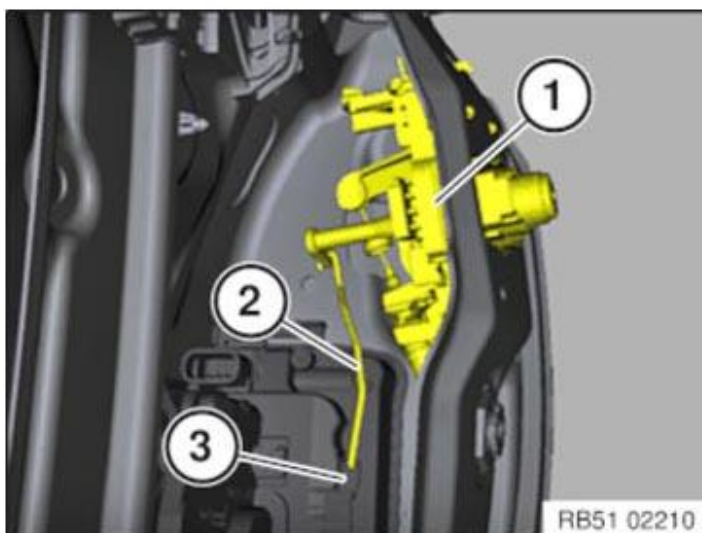




**Fig. 162: Identifying Outer Door Handle Support And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed out support (1) towards front.

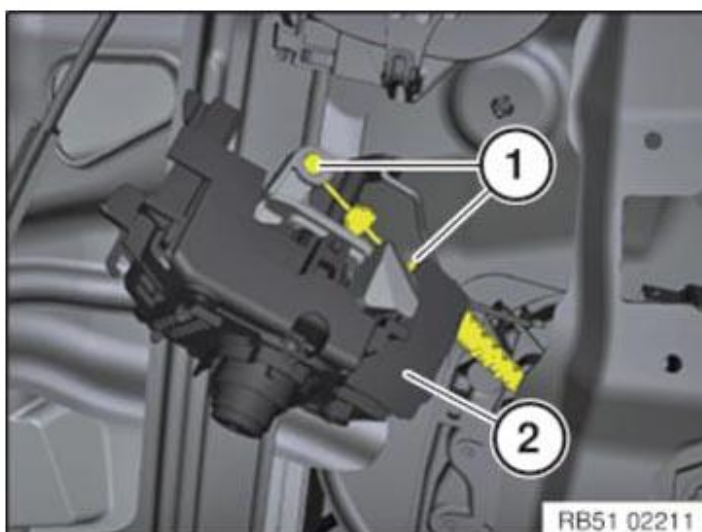
Detach locking lever (2) from door lock (3).



**Fig. 163: Identifying Locking Lever, Door Lock And Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect Bowden cable (1).

Remove support (2).

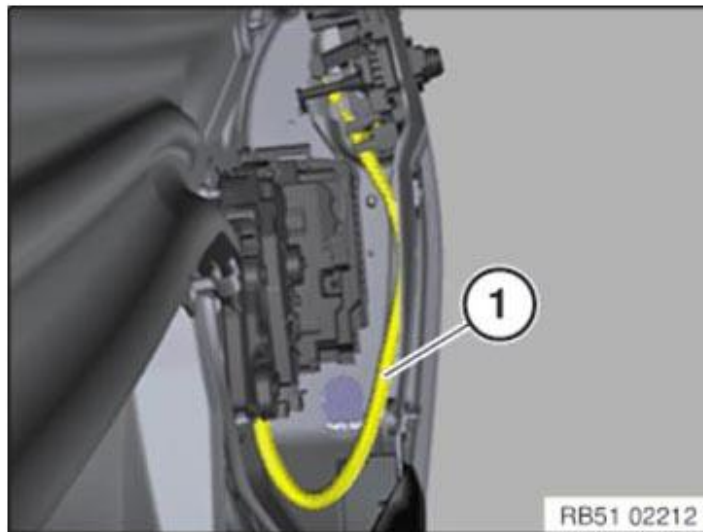


**Fig. 164: Identifying Bowden Cable And Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure Bowden cable (1) is in correct position.

Perform function check before completing the vehicle.



**Fig. 165: Identifying Bowden Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Remount **LOCK BARREL**.

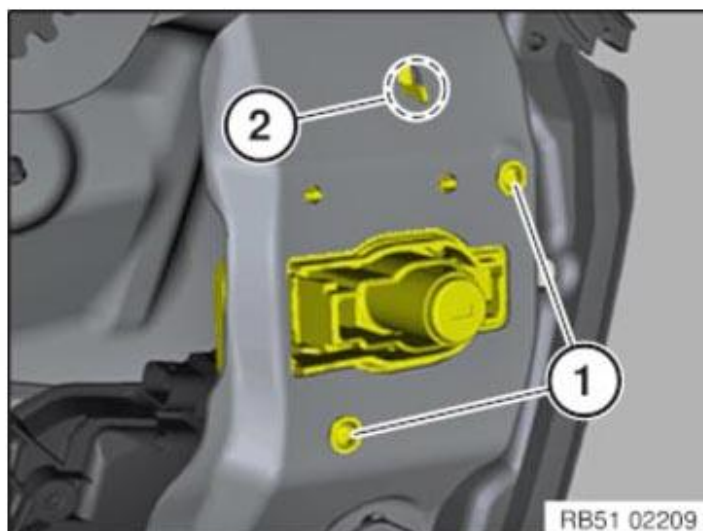
**51 21 126 REMOVING AND INSTALLING/REPLACING SUPPORT FOR LEFT OR RIGHT OUTER DOOR HANDLE WITHOUT LOCK BARREL**

**Necessary preliminary tasks:**

- Remove DOOR OUTER SKIN

Release screws (1).

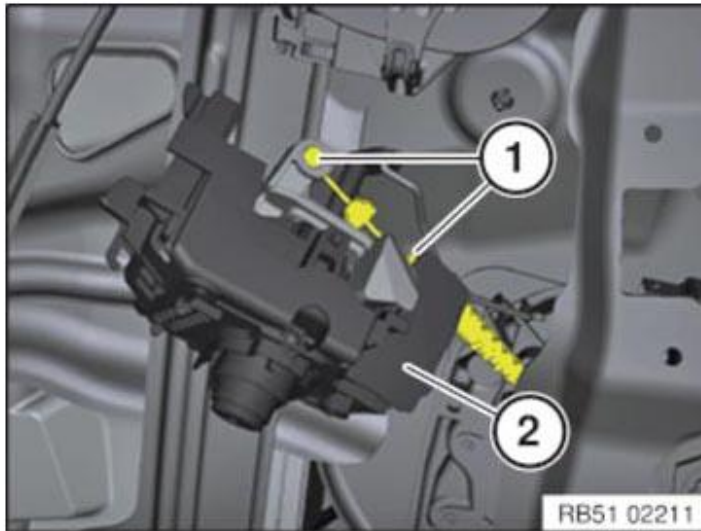
Detach support in area (2) and feed out of door.



**Fig. 166: Identifying Outer Door Handle Support And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect Bowden cable (1).

Remove support (2).

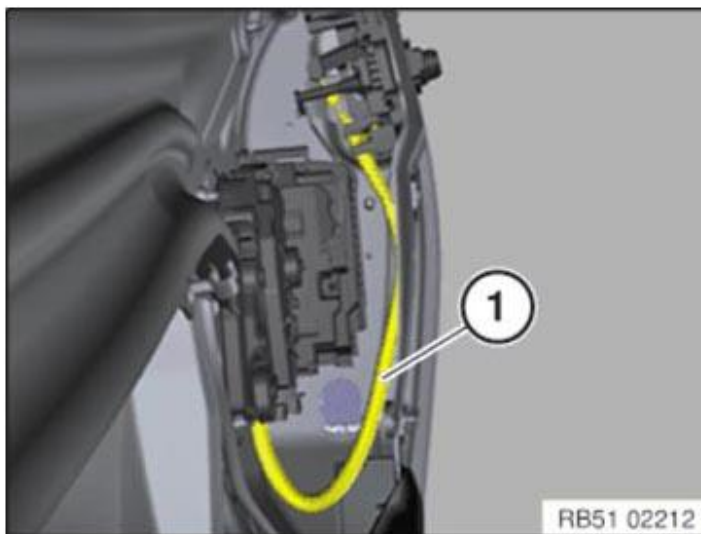


**Fig. 167: Identifying Bowden Cable And Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure Bowden cable (1) is in correct position.

Perform function check before completing the vehicle.



**Fig. 168: Identifying Bowden Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

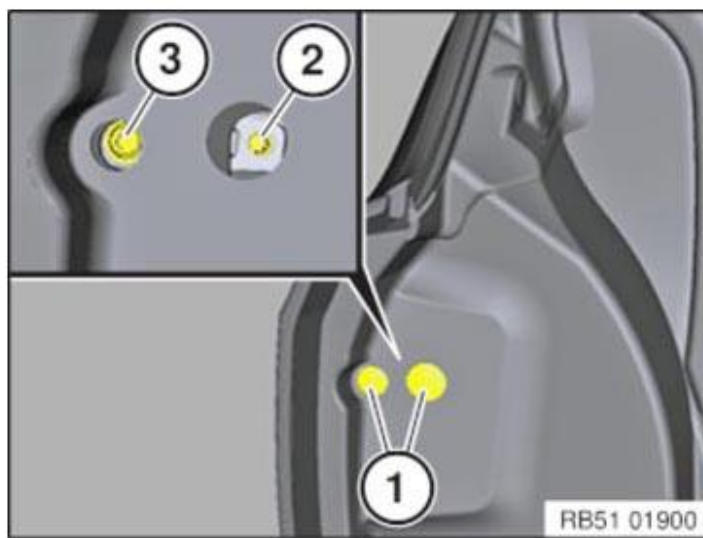
## **51 21 170 REMOVING AND INSTALLING/REPLACING THE OUTER DOOR HANDLE OF FRONT DOOR ON THE LEFT OR RIGHT**

### **Removal:**

Lever out caps (1).

**NOTE:** (2) Adjusting screw

(3) Mounting bolt for outer door handle

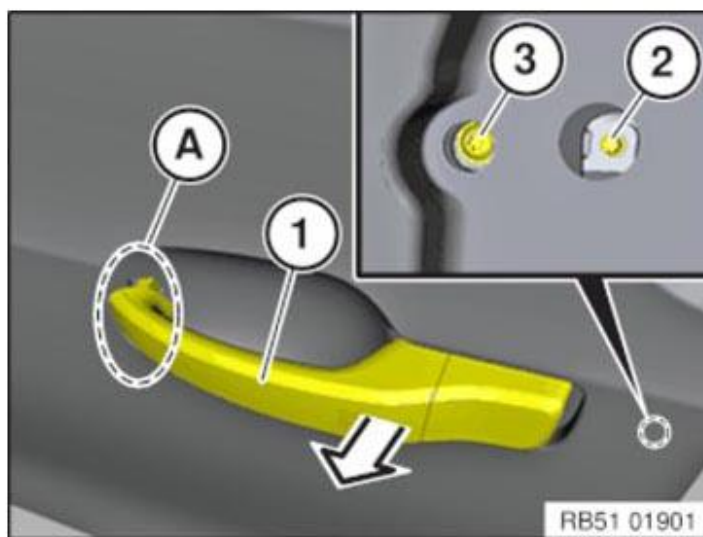


**Fig. 169: Identifying Outer Door Handle Mounting Bolt, Adjusting Screw And Caps**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Twist adjusting screw (2) until outer door handle (1) in area (A) protrudes the maximum distance outwards.

Release screw (3) by approx. 5 to 6 turns.

Pull out outer door handle (1) and disconnect corresponding plug connections.



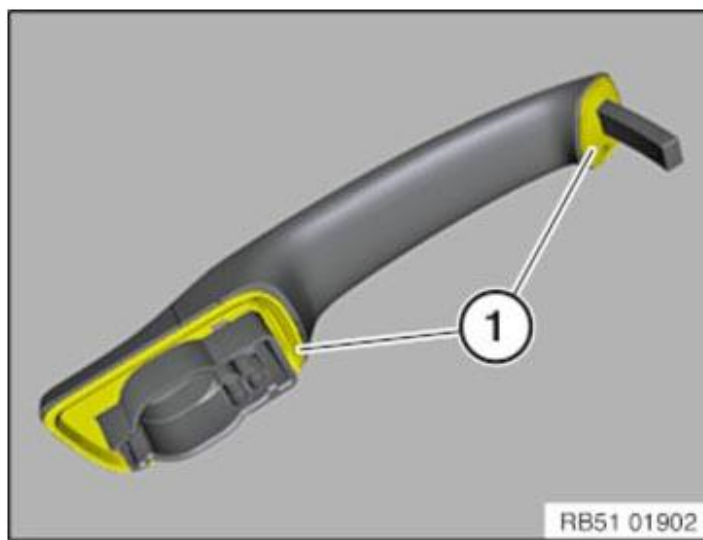
**Fig. 170: Pulling Out Outer Door Handle**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Paint new outer door handle and **ASSEMBLE**.

**Installation:**

**NOTE:** Gaskets (1) must not be damaged.



**Fig. 171: Identifying Gaskets**

Courtesy of BMW OF NORTH AMERICA, INC.

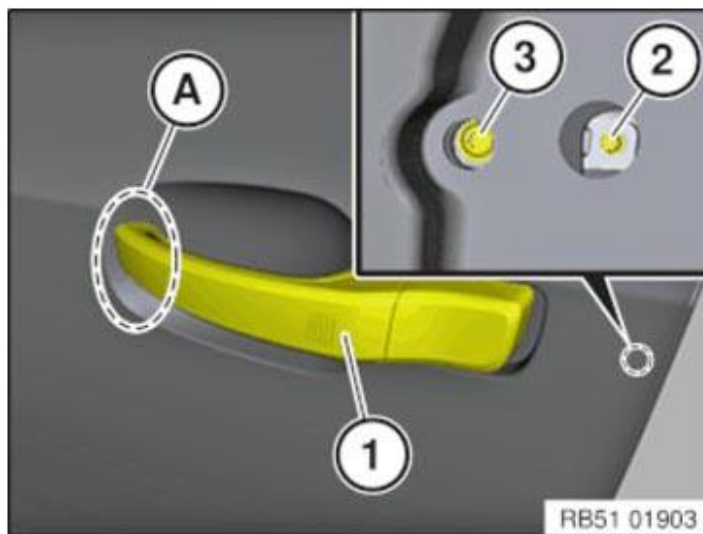
**NOTE:** Insert outer door handle (1) and fix with screws (3).

Tightening torque [51 21 7AZ](#) .

Twist adjusting screw (2) until outer door handle (1) in area (A) protrudes to the attachment on the outer skin.

Turn adjusting screw (2) a further 90° to bring the system into preload.

Carry out function check with door open.



**Fig. 172: Identifying Outer Door Handle, Adjusting Screw And Screws**

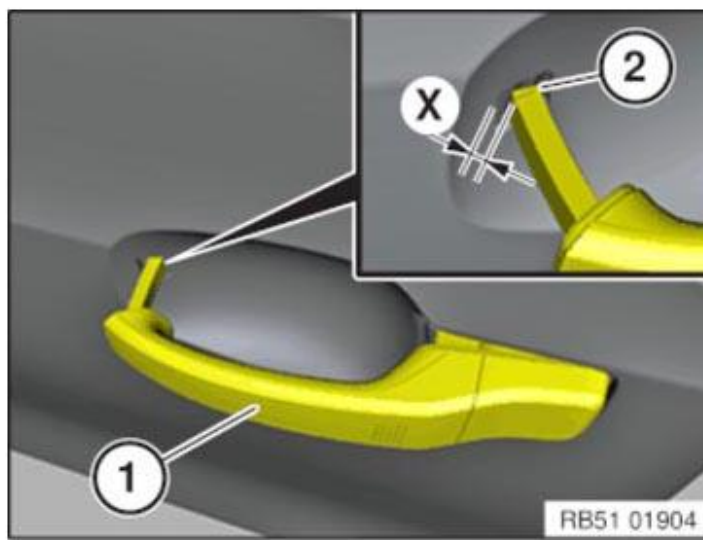
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** When operating the outer door handle (1) the mark (2) must be visible.

If the mark (2) is not visible, the preload too great. After locking, the doors can no longer be opened.

Mark (2) may have a maximum protrusion (X) of 3 mm to the door outer skin in the pulled position.





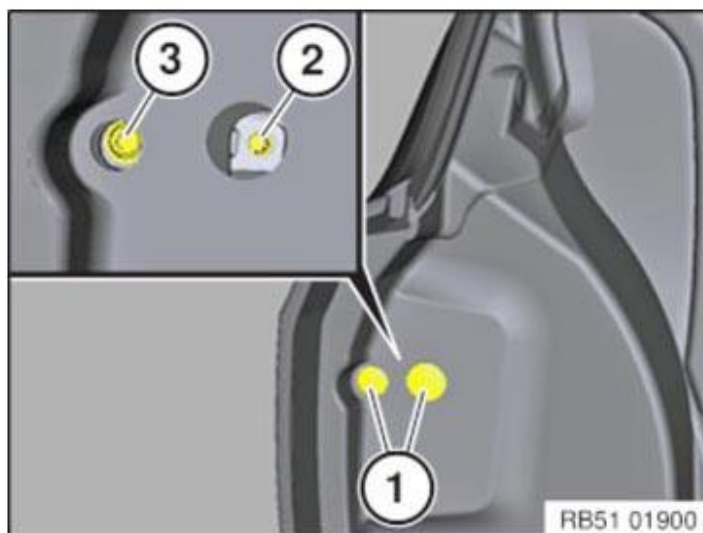
**Fig. 173: Checking Door Outer Skin Maximum Protrusion**

Courtesy of BMW OF NORTH AMERICA, INC.

Mount protective cap (1).

**NOTE:** (2) Adjusting screw

(3) Mounting bolt for outer door handle



**Fig. 174: Identifying Outer Door Handle Mounting Bolt, Adjusting Screw And Caps**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 21... REMOVING WEATHER STRIP WITH SPECIAL TOOL 00 9 324 AT FRONT OR REAR**

**Special tools required:**

- 00 9 318
- **00 9 324**

Open side window completely.

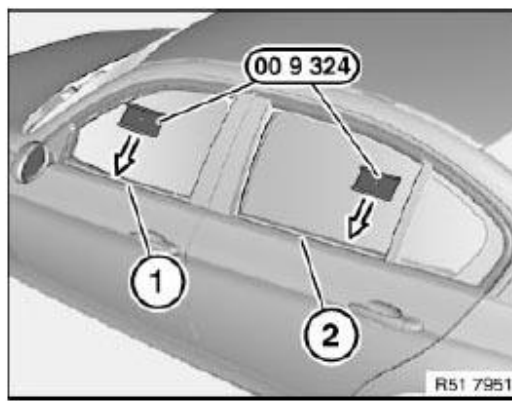
**Front door:**

Insert special tool **00 9 324** at front (at A-pillar) in window cavity (1) (TOP label pointing upwards).

**Rear door:**

Insert special tool **00 9 324** at rear (at C-pillar) in window cavity (2) (TOP label pointing upwards).





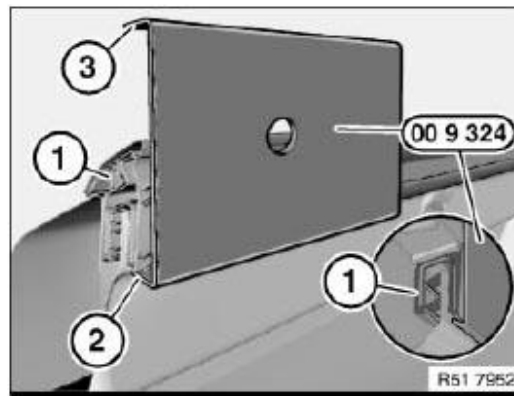
**Fig. 175: Inserting Special Tool (00 9 324) At Front And Rear Window Cavity**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** For purposes of clarity, graphic shows inner door panel and side window removed.

Special tool **00 9 324** must be correctly guided under weather strip (1).

2 Short leg, bottom

3 Long leg, top (TOP)

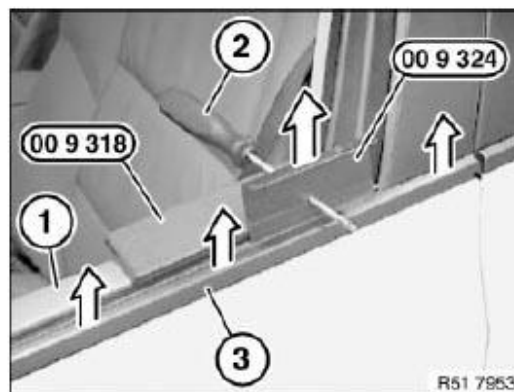


**Fig. 176: Installing Special Tool (00 9 324) Into Guided Under Weather Strip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Start at the front or rear, depending on the model.

Risk of damage!

**IMPORTANT:** Raise weather strip (3) no more than 5 mm in each levering operation, otherwise the strip will be bent.



**Fig. 177: Raising Weather Strip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Position special tool 00 9 318 on door trim panel (1).

Slide suitable tool (2) through hole of special tool [00 9 324](#) and in this way lever weather strip (3) in an upward direction by max. 5 mm.

Guide special tools [00 9 324](#) and 00 9 318 forward and backward step by step until weather strip (3) is fully removed.

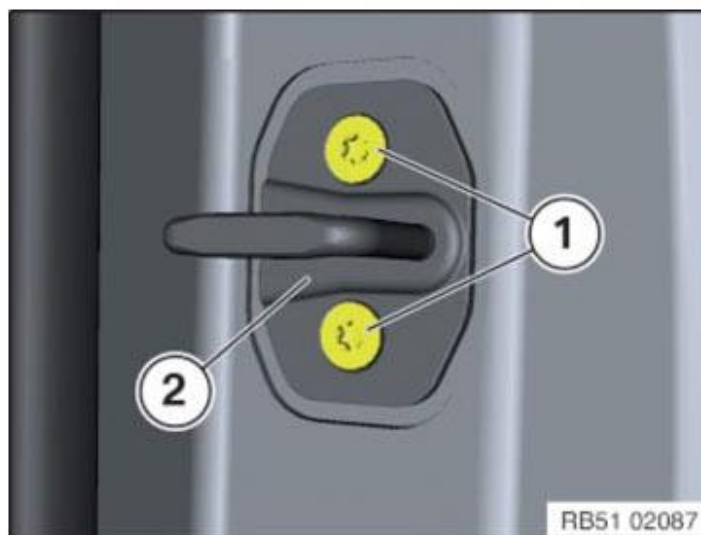
### **51 21 003 REPLACING DOOR DETENT (LOCK STRIKER), FRONT LEFT OR RIGHT**

Release screws (1) and remove door detent (2).

Tightening torque [51 21 2AZ](#) .

**After installation:**

Adjust [DOOR DETENT](#).



**Fig. 178: Identifying Door Detent And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

## **REAR DOOR LOCKS, HANDLES, FITTINGS**

### **51 22 004 ADJUSTING REAR LEFT OR RIGHT DOOR LOCK STRIKER**

**Operation is described in:**

ADJUST DOOR

### **51 22 405 REMOVING AND INSTALLING/REPLACING BOTTOM DOOR LOCK ON LEFT OR RIGHT**

**Necessary preliminary tasks:**

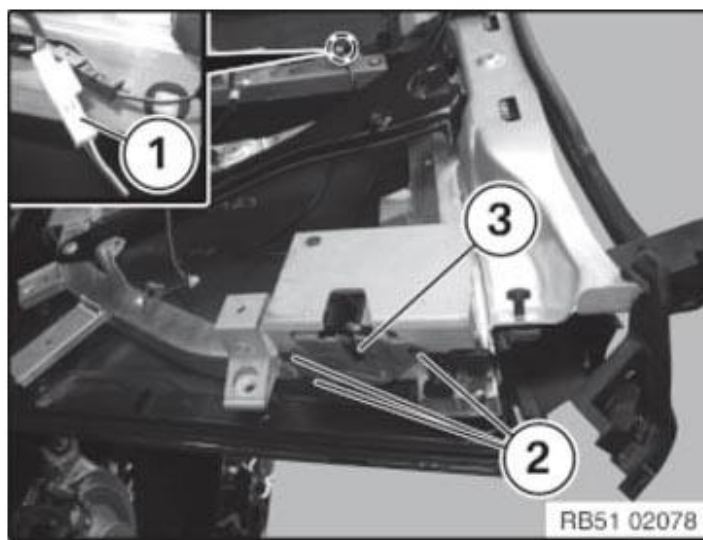
- Remove [INNER DOOR OPENER ON REAR DOOR](#)
- Remove INNER REAR DOOR COVER

Unlock plug connection (1) and disconnect.

Unfasten screws (2).

Tightening torque [51 22 2AZ](#) .

Remove door lock (3) downwards.

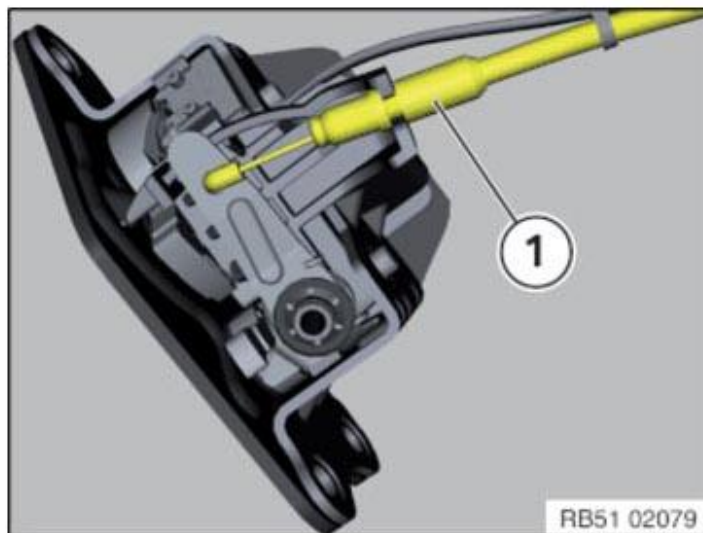


**Fig. 179: Identifying Door Lock, Plug Connection And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement only:**

Detach cable (1) and remount.



**Fig. 180: Identifying Cable**

Courtesy of BMW OF NORTH AMERICA, INC.

### **51 22 280 REMOVING AND INSTALLING/REPLACING DOOR STOP ON LEFT OR RIGHT REAR DOOR**

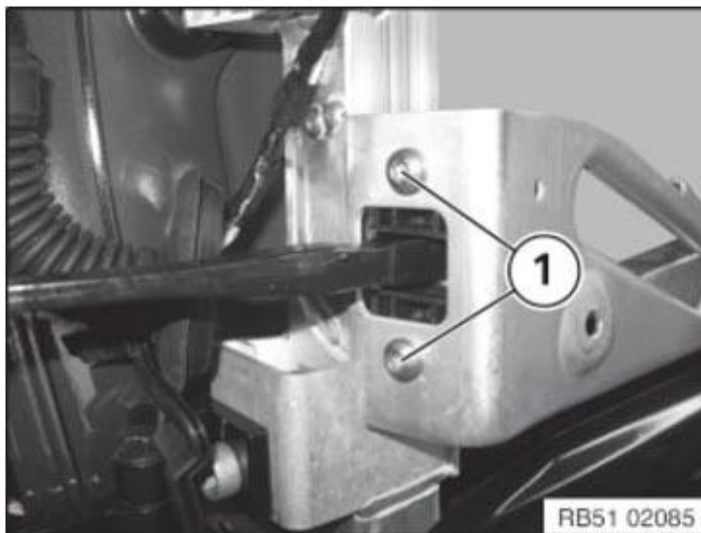
**Necessary preliminary tasks:**

- Remove INNER REAR DOOR COVER on left or right

Release screws (1).

Tightening torque [51 22 7AZ](#).

Remove door stop.



**Fig. 181: Identifying Door Stop Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

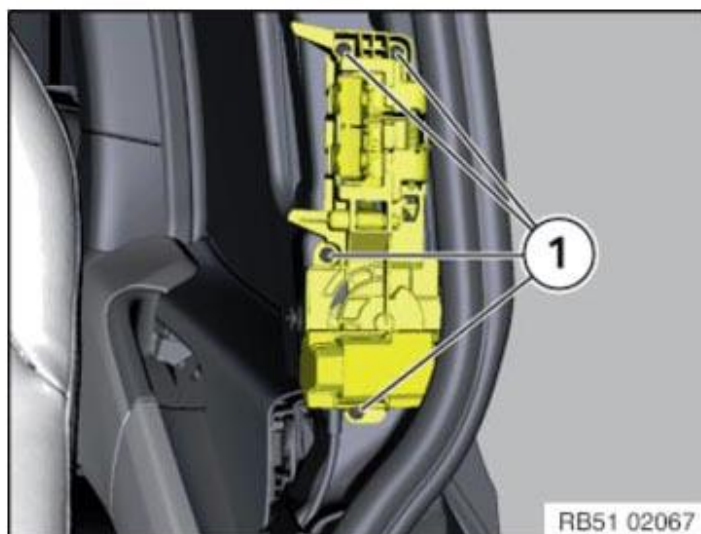
**51 22 225 REMOVING AND INSTALLING/REPLACING INSIDE DOOR OPENER OF REAR LEFT OR RIGHT DOOR**

Necessary preliminary tasks:

- Remove rear **ROOF PILLAR (B-PILLAR) TRIM PANEL**

Release screws (1).

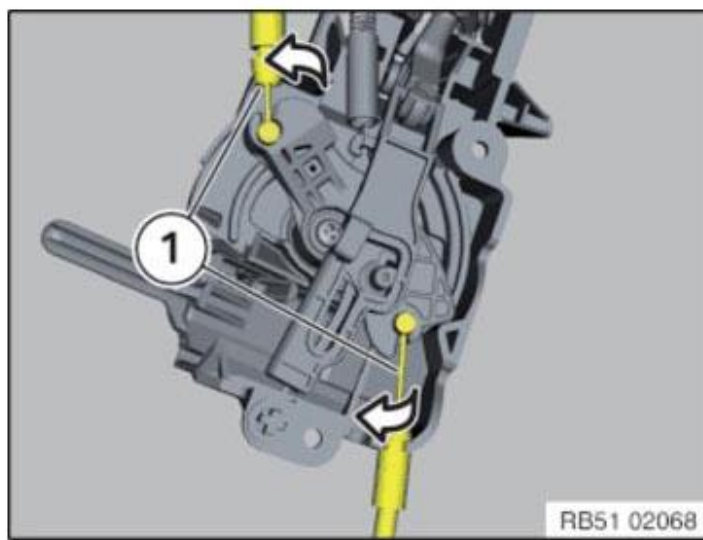
Tightening torque **51 22 5AZ**



**Fig. 182: Identifying Inside Door Opener Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Detach cables (1).



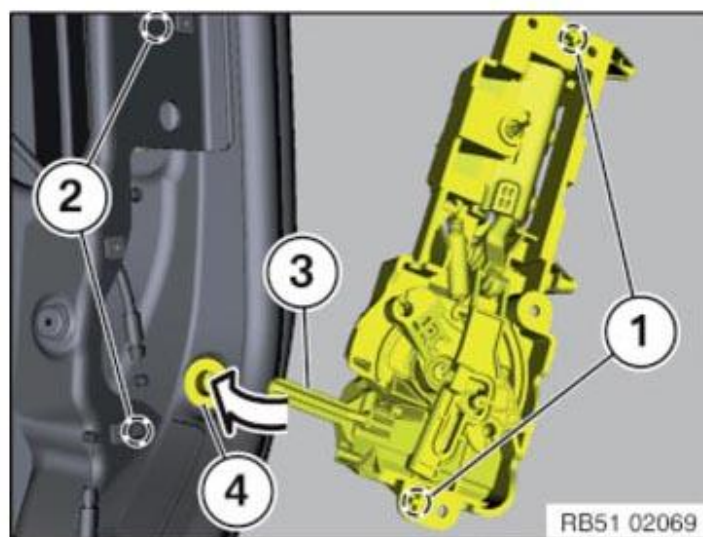
**Fig. 183: Detaching Cables**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Insert guides (1) into bore holes (2).

Insert pin (3) into grommet (4).



**Fig. 184: Inserting Pin Into Grommet**

Courtesy of BMW OF NORTH AMERICA, INC.

After installation, carry out function check with door open.

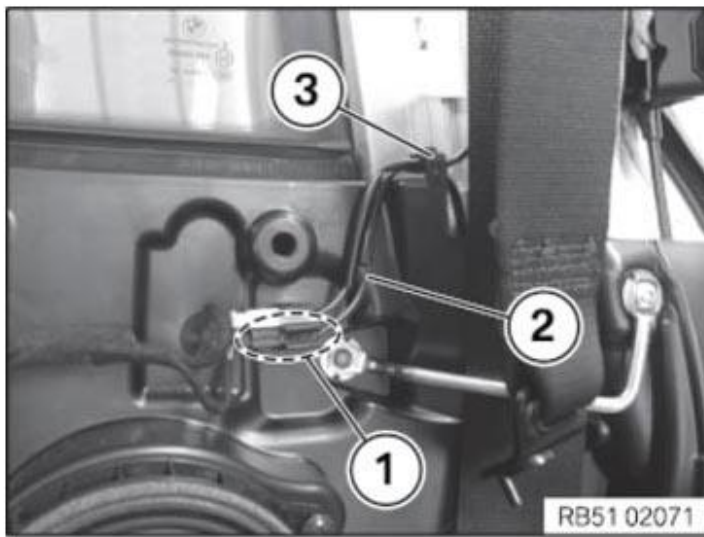
## **51 22 400 REMOVING AND INSTALLING/REPLACING TOP DOOR LOCK ON LEFT OR RIGHT**

**Necessary preliminary tasks:**

- Remove **REAR DOOR OPENER**
- Remove **REAR DOOR TRIM**

Unlock plug connection (1) and disconnect.

Detach cable (2) from bracket (3).



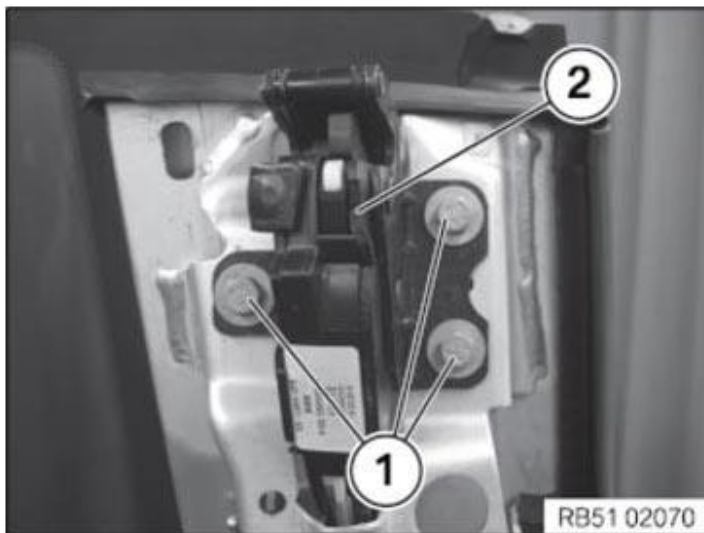
**Fig. 185: Identifying Cable, Bracket And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque **51 22 1AZ** .

Fully remove door lock (2) upwards.



**Fig. 186: Identifying Door Lock And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 22 001 REPLACING DOOR DETENT (LOCK STRIKER), REAR LEFT OR RIGHT**

**Bottom lock striker:**

Release screws (1).

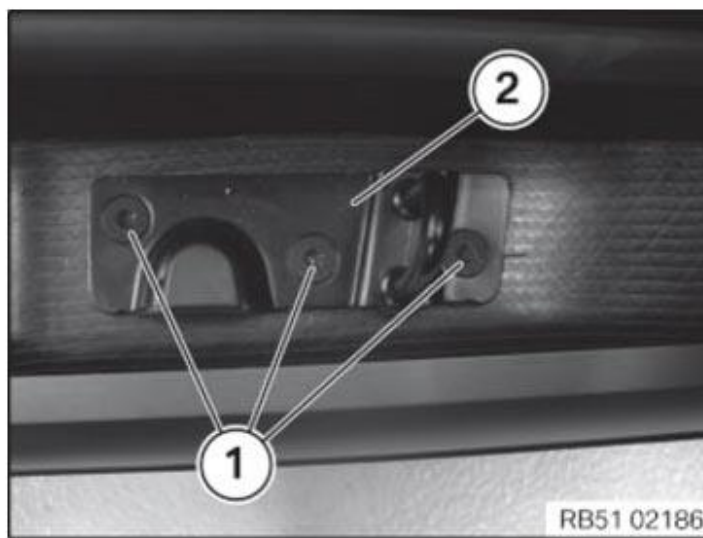
Remove lock striker (2).

Tightening torque **51 22 4AZ** .

**After installation:**

Adjust DOOR DETENT .

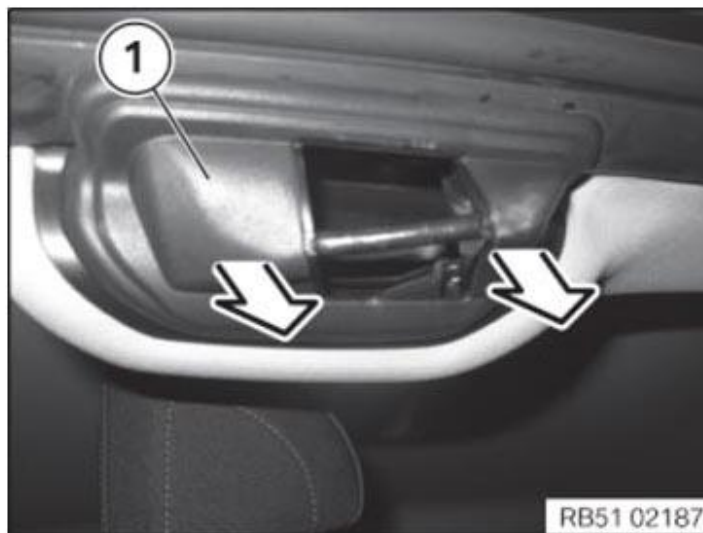




**Fig. 187: Identifying Lock Striker And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Top lock striker:**

Pull off cover (1) in direction of arrow.



**Fig. 188: Pulling Off Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

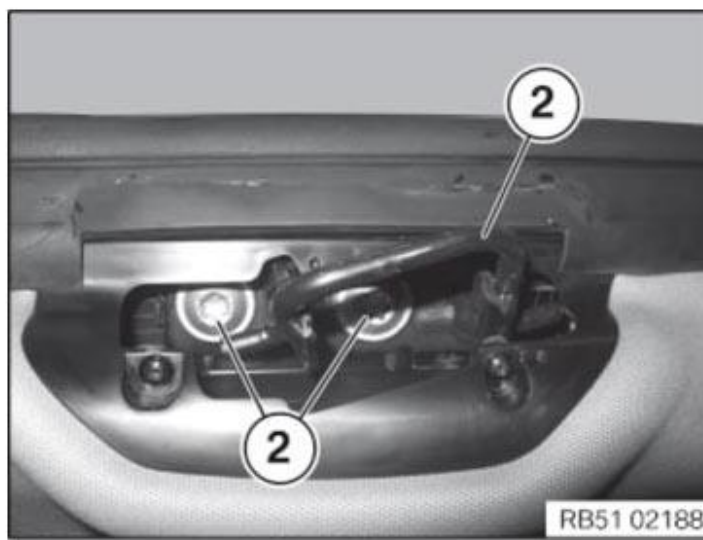
Release screws (1).

Remove lock striker (2).

Tightening torque **51 22 3AZ** .

**After installation:**

Adjust LOCK STRIKER .



**Fig. 189: Identifying Lock Striker And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## HOOD LATCH, LOCKS

### 51 23... ADJUSTING/REPLACING BUMP STOPS

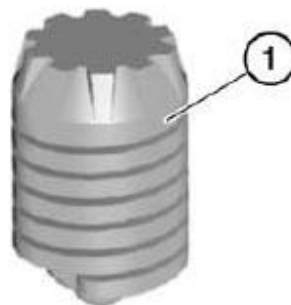
The graphics are schematic representations and are to be applied to the relevant vehicle type.

Prerequisite: Lid must be correctly adjusted.

#### Version 1:

Following parts must not be damaged:

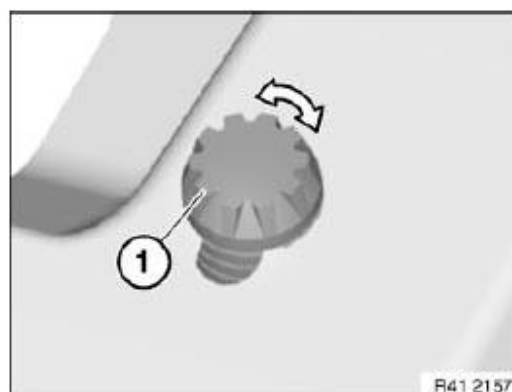
- (1) Bump stop



R41 2156

**Fig. 190: Identifying Bump Stop**  
Courtesy of BMW OF NORTH AMERICA, INC.

Adjust stop pad (1) to correct height by turning left or right.

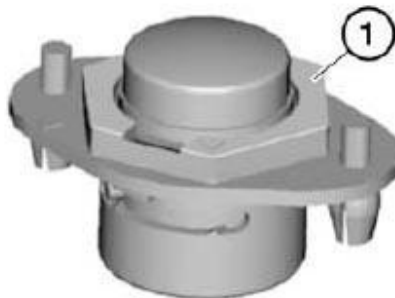


**Fig. 191: Adjusting Bump Stop**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version 2:**

Replace damaged stop pads:

- (1) Bump stop



R41 2146

**Fig. 192: Identifying Bump Stop**  
Courtesy of BMW OF NORTH AMERICA, INC.

Adjusting version 2:

Stop (1) 45° counter clockwise.

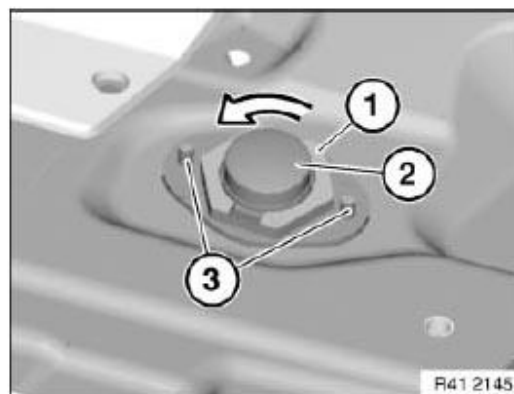
Pull stop pad (2) upwards.

Close lid slowly until it is at the same height as the side wall.

Open flap and turn stop (1) clockwise.

*Installation note:*

Press stop pad into panel and drive in expanding pins (3).

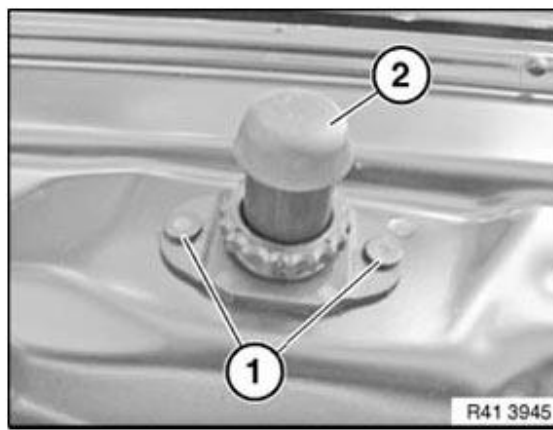


**Fig. 193: Turning Stop Clockwise**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version 3:**

Lever out expanding rivets (1).

Remove stop pad (2).



**Fig. 194: Identifying Stop Pad And Rivets**  
Courtesy of BMW OF NORTH AMERICA, INC.

Adjusting version 3:

Checking correct adjustment:

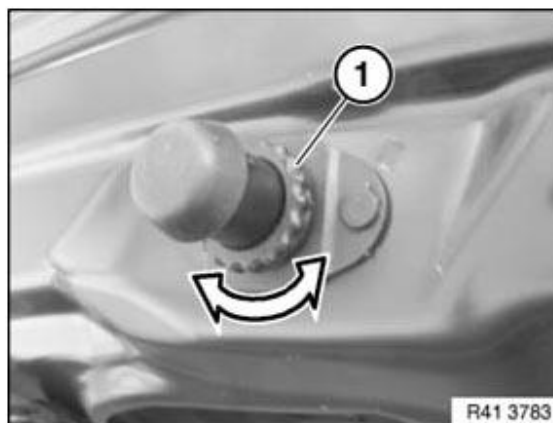
- Insert a strip of paper (normal writing paper) between stop pad and limit position on body.
- Close flap. Make sure that the paper strip remains between stop pad and limit position.
- The stop pad is correctly adjusted when the paper strip can be pulled out "with slight resistance".

**Adjustment procedures:**

Screw in stop pad until the paper strip can be easily pulled out.

Then unscrew stop pad until the paper strip cannot be pulled out any more.

Screw in stop pad until the paper strip can be pulled out with "slight" resistance.



**Fig. 195: Adjusting Stop Pad (Version 3)**  
Courtesy of BMW OF NORTH AMERICA, INC.

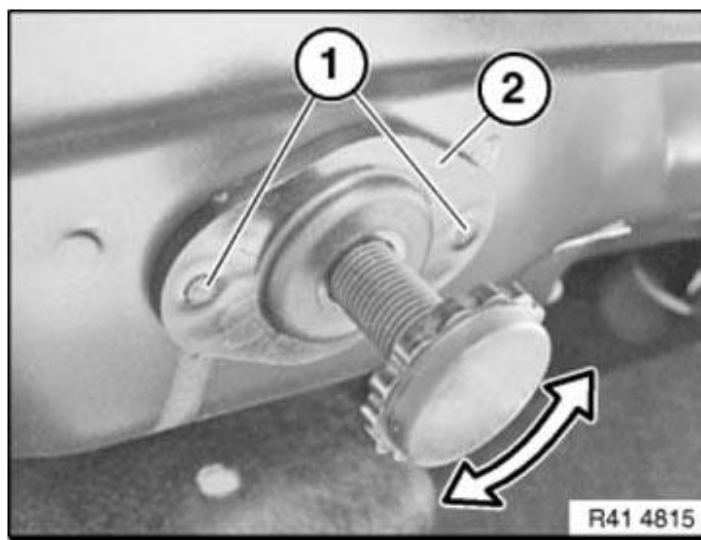
**Version 4:**

Lever out expanding rivets (1).

Remove stop pad (2).

Adjusting version 4:

Set stop pad to the correct height by turning to the left or right.



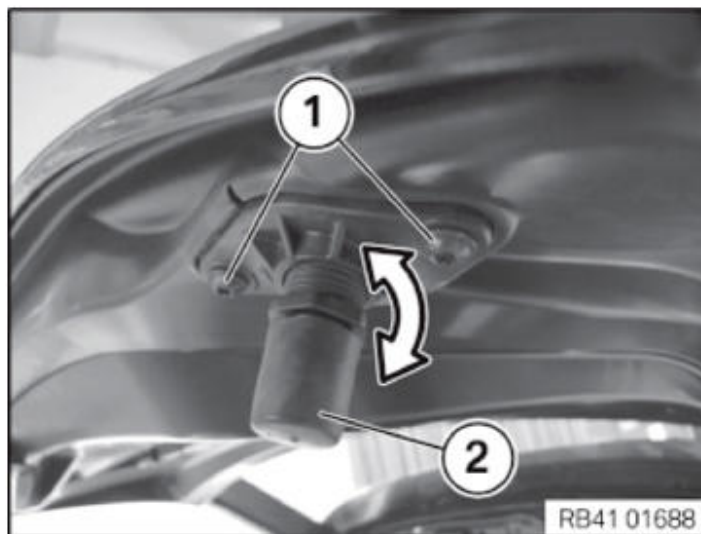
**Fig. 196: Adjusting Stop Pad (Version 4)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Version 5:**

Release screws (1) and remove stop pad (2).

Adjusting version 5:

Set stop pad to the correct height by turning to the left or right.



**Fig. 197: Adjusting Stop Pad (Version 5)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 23 130 ADJUSTING/REPLACING STRIKER ON HOOD/BONNET**

Operation is described in:

- Adjusting ENGINE COMPARTMENT LID

**51 23 160 REMOVING AND INSTALLING/REPLACING ENGINE COMPARTMENT LID RETAINING HOOK**

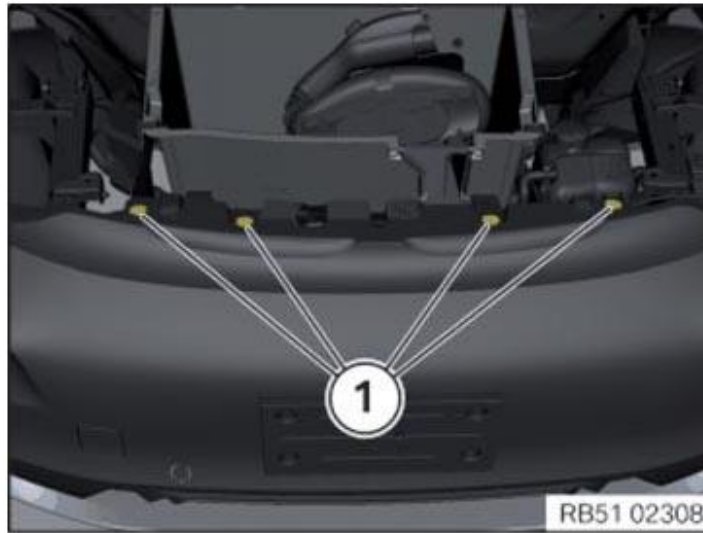
Necessary preliminary tasks:

- Remove **LUGGAGE COMPARTMENT WELL**

Release screws (1).

Slightly raise top bumper panel carefully.

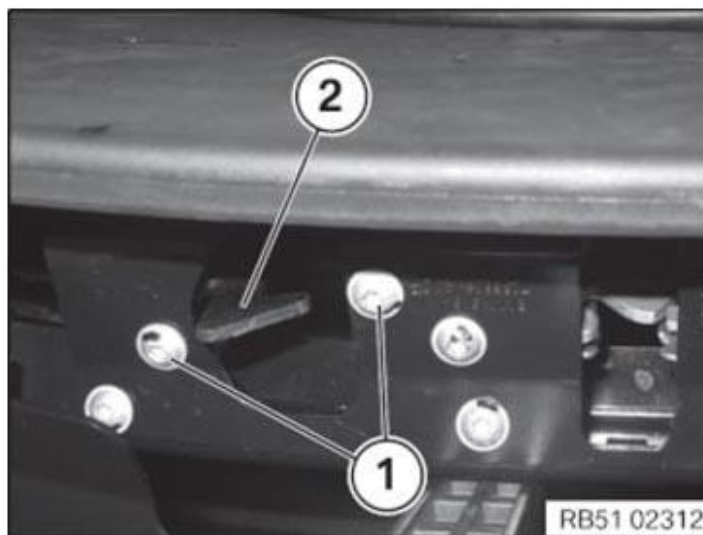
Tightening torque [51 11 1AZ](#) .



**Fig. 198: Identifying Top Bumper Panel Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and feed out retaining hook (2).

Tightening torque [51 23 2AZ](#) .



**Fig. 199: Identifying Retaining Hook And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 23 265 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT GAS PRESSURE SPRING FOR ENGINE COMPARTMENT LID**

**WARNING:** Danger of injury and damage!  
For the following tasks, you must take the appropriate measures to support the engine compartment lid.  
As an alternative, you can enlist the help of a second person to hold the engine compartment lid.

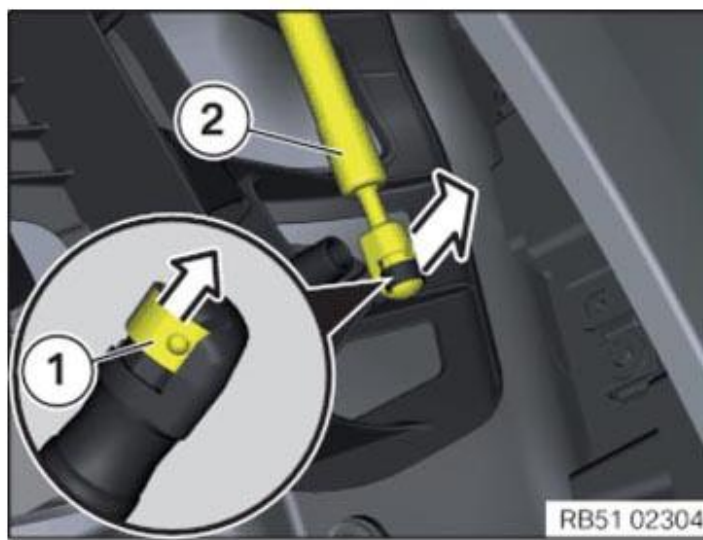
Necessary preliminary tasks:

- Remove [WHEEL ARCH COVER FRONT \(REAR SECTION\)](#).

Slide retaining spring (1) outwards.

Pull off gas pressure spring (1) from bottom ball head.

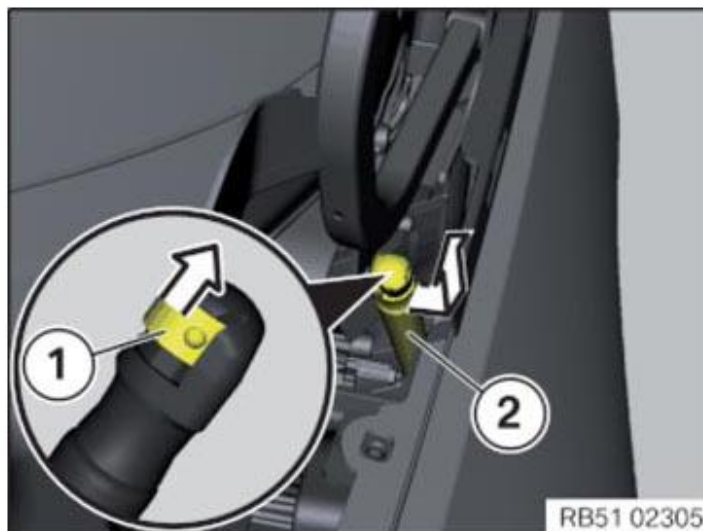




**Fig. 200: Sliding Retaining Spring Outwards**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide retaining spring (1) outwards.

Pull off gas pressure spring (2) from top ball head and feed out.



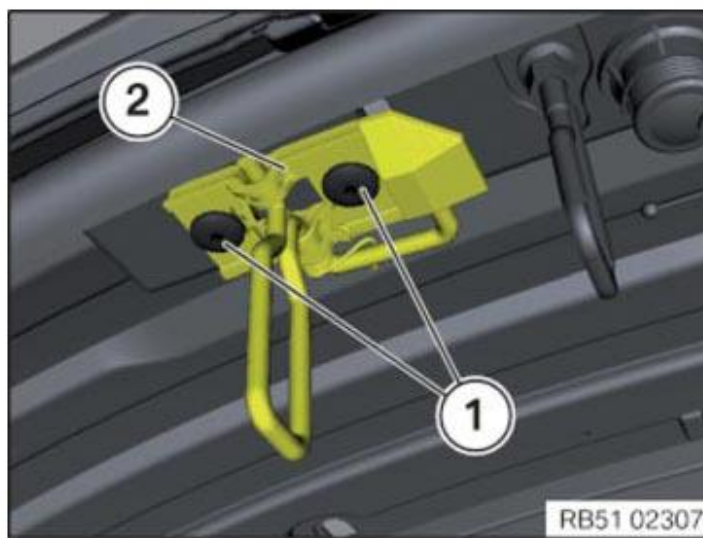
**Fig. 201: Pulling Off Gas Pressure Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

**51 23 201 REMOVING AND INSTALLING/REPLACING RELEASE MECHANISM FOR RETAINING HOOK ON ENGINE COMPARTMENT LID**

Release screws (1).

Remove release mechanism (2).

Tightening torque **51 23 4AZ** .



**Fig. 202: Identifying Mechanism And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **TRUNK LATCH, LOCKS**

### **51 24 004 ADJUSTING REAR LID LOCK**

**Special tools required:**

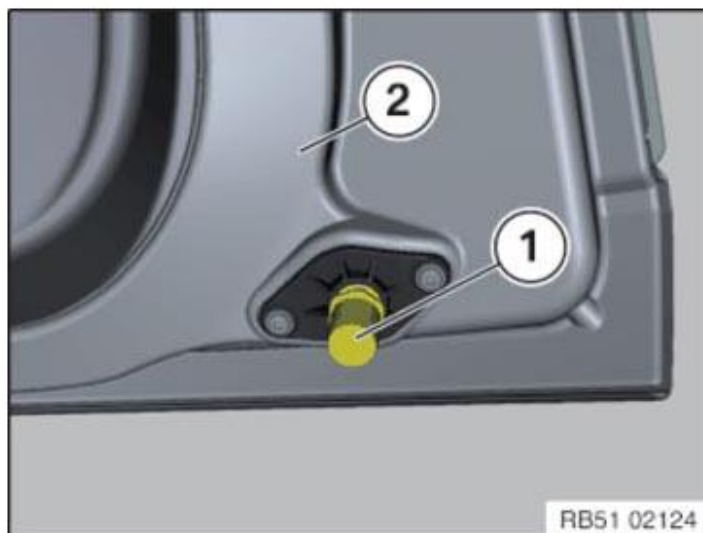
- [00 9 322](#)

**Prerequisite:**

Rear lid must be correctly adjusted to fit; if necessary, adjust REAR LID .

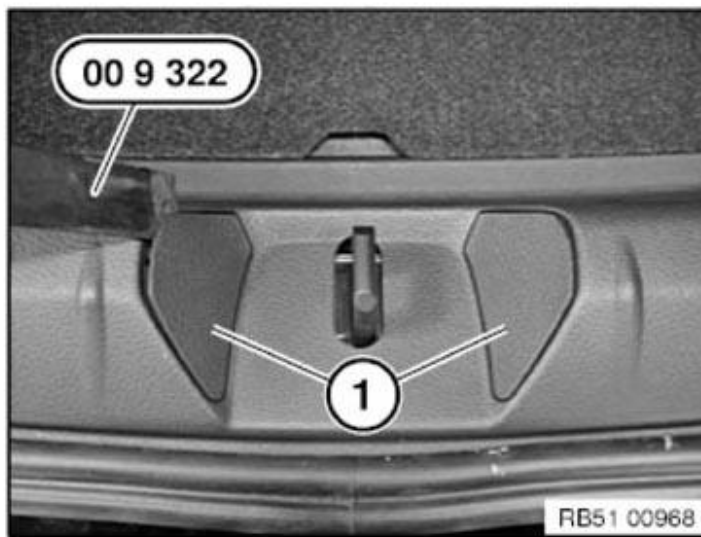
Fully screw in stop pad (1) on tailgate (2) on left and right.

See [REPLACING BUMP STOPS ON TAILGATE](#).



**Fig. 203: Identifying Stop Pad And Tailgate**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lift out covers (1) using special tool [00 9 322](#) .

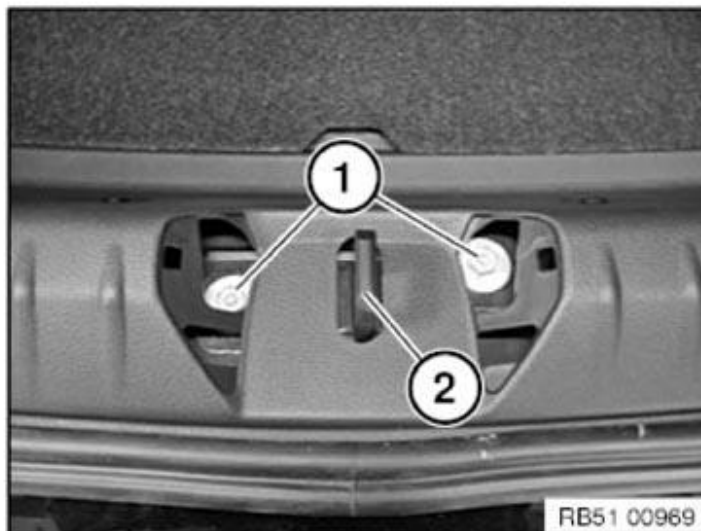


**Fig. 204: Lifting Out Covers Using Special Tool (00 9 322)**

Courtesy of BMW OF NORTH AMERICA, INC.

Slacken screws (1) until striker (2) can still just be moved and center itself.

IMPORTANT: Striker (2) must not brush against rear lid lock.



**Fig. 205: Identifying Striker And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Close rear lid.

Check gap dimensions and locking comfort.

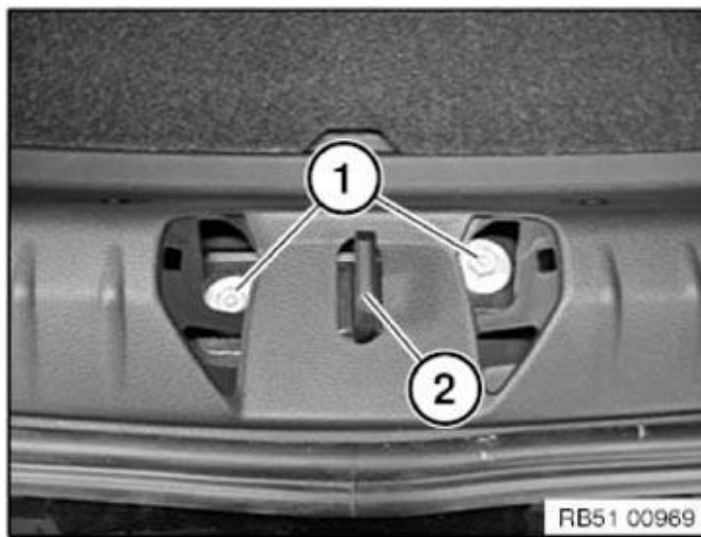
If necessary, repeat procedure.

**NOTE:** When the tailgate is closed, the striker must not touch or scrape against the rear lid lock. Look out for scratch marks.

Open tailgate.

Tighten down screws (1).

Tightening torque [51 24 2AZ](#).



**Fig. 206: Identifying Striker And Screws**

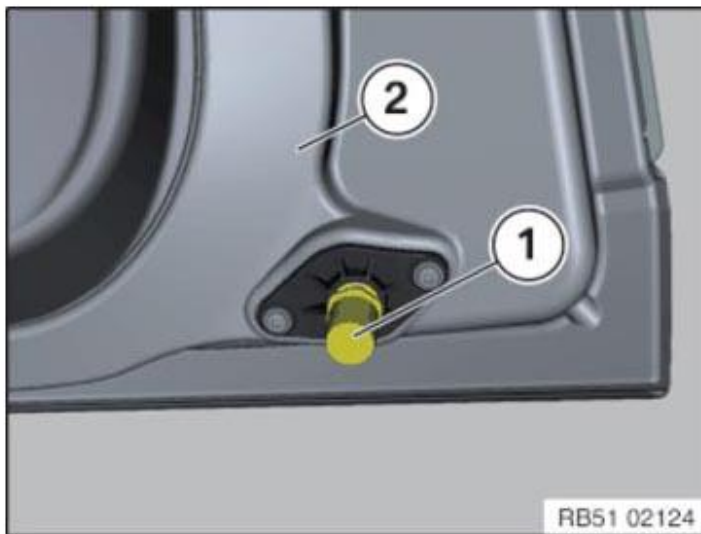
Courtesy of BMW OF NORTH AMERICA, INC.

Screw out stop pad (1) left/right until they are in contact with the tailgate.

It must be possible to pull out paper strips with moderate friction resistance between the tailgate and stop pad (1).

Then screw out stop pad (1) one-half rotation further.

See [REPLACING BUMP STOPS ON TAILGATE](#).



**Fig. 207: Identifying Stop Pad And Tailgate**

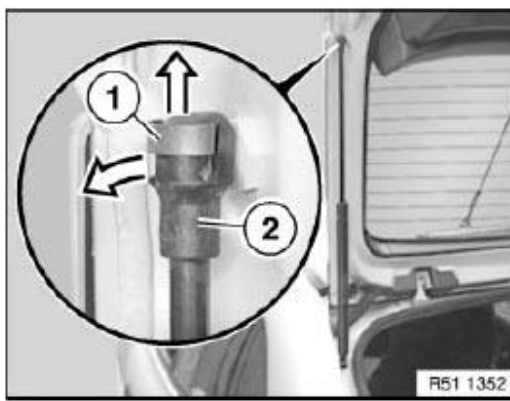
Courtesy of BMW OF NORTH AMERICA, INC.

**51 24 300 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT GAS PRESSURE SPRING FOR TAILGATE**

**WARNING:** Support tailgate in fully opened position with suitable apparatus. Danger of injury.

Make a written record of the installation position of the gas pressure support(s) before removing.

Slide retaining spring (1) to end of gas pressure spring (2) and lever out gas pressure spring. Repeat the procedure at the other end of the gas pressure spring (2) and remove.



**Fig. 208: Sliding Retaining Spring**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 24 146 REMOVING AND INSTALLING/REPLACING BUTTON FOR REAR LID ACTUATION**

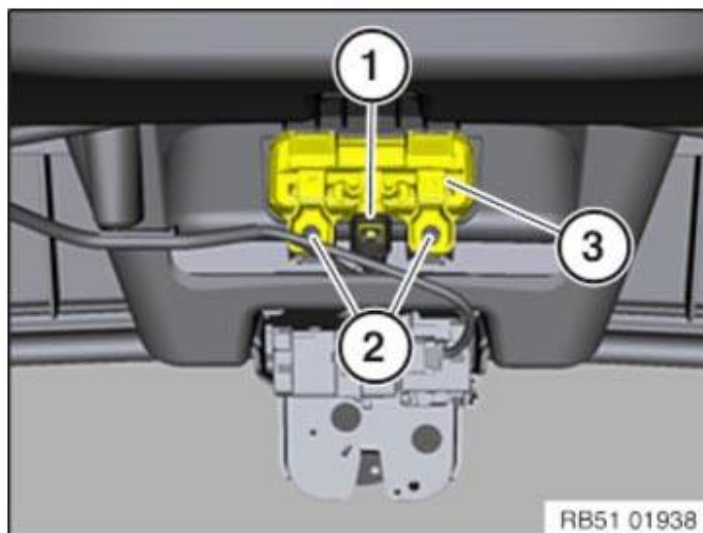
**Necessary preliminary tasks:**

- Remove **TRIM FOR REAR LID**

Unfasten plug connection (1) and disconnect.

Release screws (2) and remove button (3).

Tightening torque **51 24 3AZ** .



**Fig. 209: Identifying Button, Plug Connection And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 24 130 REMOVING AND INSTALLING/REPLACING STRIKER FOR TAILGATE LOCK**

**Necessary preliminary tasks:**

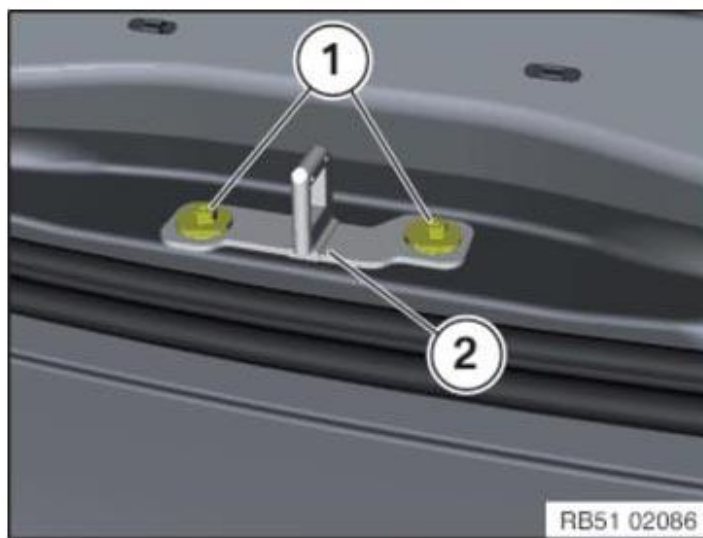
- Remove **TOP COVER FROM TAIL PANEL**

Release bolts (1) and remove striker (2).

Tightening torque **51 24 2AZ** .

*Installation note:*

Adjust **REAR LID LOCK**.



**Fig. 210: Identifying Striker And Bolts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Striker and tailgate lock must not be greased.

### **51 24 105 REMOVING AND INSTALLING/REPLACING TAILGATE LOCK**

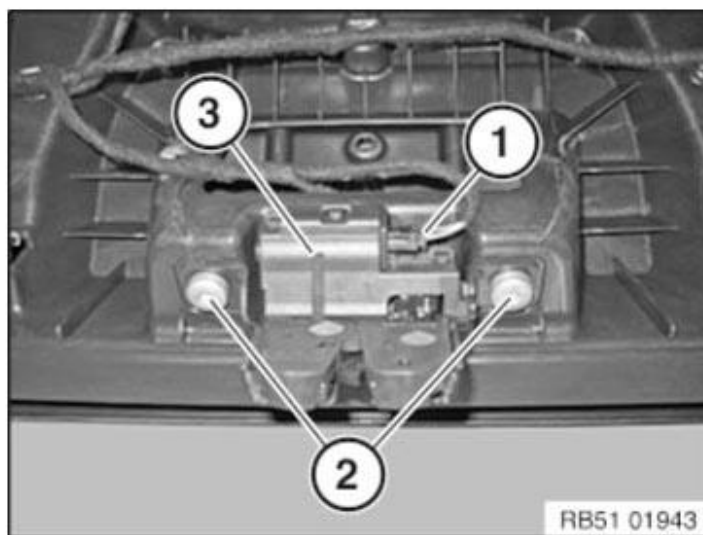
Necessary preliminary tasks:

- Remove **TRIM FOR REAR LID**

Unfasten plug connection (1) and disconnect.

Release screws (2) and remove tailgate lock (3).

Tightening torque **51 24 1AZ**.



**Fig. 211: Identifying Tailgate Lock, Plug Connection And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Perform a function check of tailgate lock with the tailgate open.

Concluding tasks:

Adjust **TAILGATE CATCH**.

## **WINDSHIELD AND REAR WINDOW**



# 51 31... GENERAL PROCEDURE FOR THE DISASSEMBLY AND INSTALLATION OF BONDED WINDOW GLASS

## 1. General instructions on window bonding

- See SAFETY AT WORK
- See INFORMATION ON VEHICLE PROTECTION
- See [MATERIALS FOR BONDING WINDOW](#)
- See [NOTES ON HEAD-UP DISPLAY](#)

The vehicle can be towed away or driven without a windscreen, rear window and side window.

When carrying out disassembly/installation work and during the hardening time, the vehicle must be standing on its wheels on a level surface.

The windscreen, rear window and side windows are glued to the body. This bonding will increase the torsional rigidity of the vehicle. To obtain perfect bonding, comply with the installation procedure described in the following.

## 2. Disassembly

### 2.1 Disassembly in general

The following dismantling methods are applied, according to the version:

- Cutting wire with [WIRE PULL HANDLES](#)
- [SPIDER](#) window glass removal system (not suitable for severely damaged window glass)

**NOTE:** When cutting out the window glass with wire pull handles, there is a risk of damage to the window glass if the wire is pulled over the window edge.

Unless otherwise described, only use this method when replacing the window glass.

Follow the individual repair instructions!

### 2.2 Disassembly of damaged window glass

The disassembly method described in the REP may be unsuitable depending on the degree of damage.

- e.g. suction cups cannot be attached to window glass around cracks
- Damaged window glass may damage and tear the nylon string

#### **Risk of damage!**

**IMPORTANT:** Use one of the other disassembly methods at your own discretion in the event of severely damaged window glass.

Make sure adjacent components are adequately protected.

## 3. Installation

### 3.1 Preparation

Position the windscreen or rear window on a universal work top or secure the components on a tool trolley using suction lifters.

Attach two suction lifters to the outsides of the window glass in the event of storage on a universal work top.

According to its size, fix side and door window glass onto the tool trolley using suction lifters or special tool [51 3 220](#) and set down on a suitable support.

Always keep the suction faces of the window glass suction lifters dry and clean.

**NOTE:** If accessibility is restricted, insert the window glass on a trial basis.

Bond two yellow plastic adhesive tapes (1) approx. 400 mm in length to the roof.

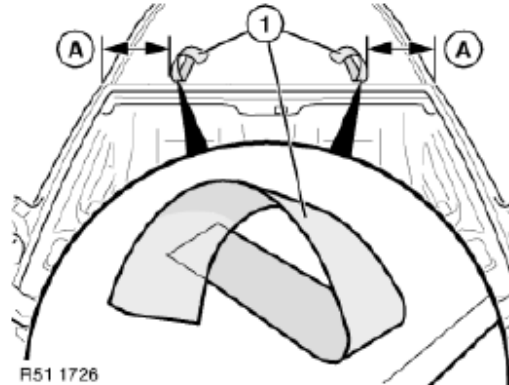
(A) = 250 mm

Only the yellow plastic adhesive tape may be used to fix the window glass.

The glass will slip down if other adhesive tapes are used.

Window glass slippage will result in leaks and wind noises.

After completing the paint work, the paint must be fully hardened before the plastic adhesive tapes are applied.



**Fig. 212: Identifying Distance Between Yellow Plastic Adhesive Tapes And Outside Corners Of Roof**  
Courtesy of BMW OF NORTH AMERICA, INC.

### 3.2 Pre-treatment of bonding surfaces

- Protect the vehicle interior against contamination, cover the Head-Up Display.
- Clean window glass and body aperture (with residual adhesive bead) with cleaning agent R2

IMPORTANT: Do **not** use Sika remover 208 for cleaning in the adhesive area.

- Observe an air drying time of at least 5 minutes (at least 15 minutes when applied to residual adhesive bead)
- Remove residual adhesive bead from body and window glass (see point [3.3](#))
- Touch up PAINTWORK DAMAGE

Pretreatment on new body component (no residual adhesive beads present):

Surface	Pretreatment
Panel painted	Wipe cleaning agent R1 dry with a paper towel or observe the air drying time of at least 1 minute
Carbon	Only cleaning agent R2
Carbon painted (e.g. roof outer skin M3)	Wipe cleaning agent R1 dry with a paper towel or observe the air drying time of at least 1 minute
Plastic (e.g. I01 A-pillar)	Cleaning agent R2 and ScotchBrite Multiflex abrasive pad

### 3.3 Remove adhesive residue from the body and window glass

Do not remove residual adhesive bead (1) until shortly before bonding.

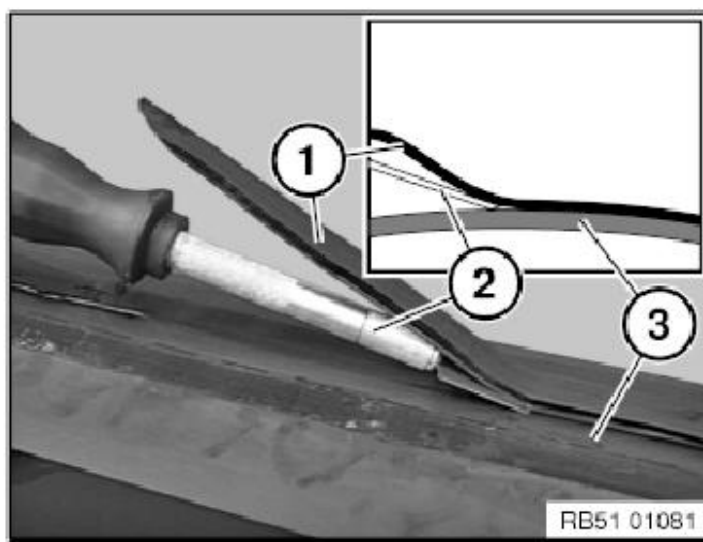
Use the pitchweld scraper to remove the residual adhesive bead (1) from the body aperture and window glass (3).

Position the pinchweld scraper (2) as shown and remove the residual adhesive bead (1) up to a thickness of approx. 0.5 mm.

Carbon body components are not to have scratches with a depth greater than 0.2 mm.

IMPORTANT:

Note, comply with life module check!



**Fig. 213: Removing Adhesive Residue From Body And Window Glass**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### 3.4 Installation of spacer (spacer buffer/dual-lock tapes)

Completely remove all residue of existing spacers before bonding new adhesive spacers.

The exact position of the spacers must be retained (see individual repair instructions).

Incorrectly fitted spacers will result in:

- Window glass breakage due to tension
- leakage (if the spacer is in the adhesive area)
- Wind noises

### 3.5 Add-on part

-Depending on the version, attach sealing, expanding foam tape, rain sensor, etc.

Observe **OVERVIEW OF ADDITIONAL WORK WITH RAIN SENSOR** when working with versions including the rain sensor!

Follow the individual repair instructions!

### 3.6 Pre-treatment of new window glass

- Apply a thin coat of glass activator (yellow stick); a final wipe is not necessary.
- Observe an air drying time of at least 2 minutes

The glass activator is used for adhesion between glass or ceramic glass and the adhesive. Therefore, a thin, homogeneous and continuous line of glass activator must be applied. If the window glass is to be reused with a cut-back adhesive bead, glass activator is not needed.

It must be guaranteed that a 1 to 2 mm wide line of glass activator is located on the ceramic glass next to the squeezed adhesive bead.

The adhesive bead may become up to 15 mm wide in compressed condition. The width of the glass activator is therefore normally a minimum of 17 mm for windscreens and rear windows and a minimum of 9 mm for side windows.

The glass activator may not be applied in the field of view or the point grid. Fresh glass activator in the field of view must immediately be wiped off with cleaning agent R2 because hardened glass activator will leave a haze behind.

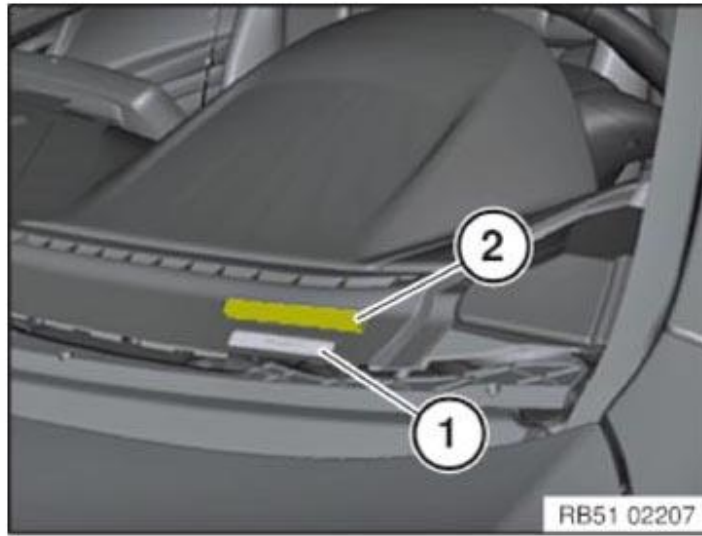
### 3.7 Version with inspection glass for vehicle identification number in windscreen

Foam tape (2) must be installed to protect the vehicle identification number (1) against tampering. If necessary, install foam tape 07 14 7 222 909.

Close off the inspection glass on the windscreen (bottom left) with Sika bonding base VP 206.

*Except for:*

- All US/GB models
- All models with a black dashboard cover, which means that the vehicle color cannot be seen through the inspection glass



**Fig. 214: Identifying Vehicle Identification Number And Foam Tape**  
Courtesy of BMW OF NORTH AMERICA, INC.

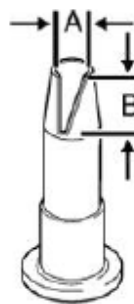
### 3.8 Nozzle preparation

Use the standard nozzle C for windscreens, rear windows, and body-specific fixed side window glass.

A	8 $\hat{\text{A}}\pm 1$ mm
B	12 $\hat{\text{A}}\pm 1$ mm

Prepare plastic nozzle for fixed door window glass.

A	8 $\hat{\text{A}}\pm 1$ mm
B	15 $\hat{\text{A}}\pm 1$ mm



31 51 190

**Fig. 215: Identifying Nozzle Preparation Dimensions**  
Courtesy of BMW OF NORTH AMERICA, INC.

Deviations are described in the individual repair instructions.

Black ceramic glass impermeable to UV light is located on the peripheral zone of the inside of the window to protect the adhesive bead.

Ceramic glass must not be damaged.

### 3.9 Apply adhesive

Adhesive is applied to the window glass using a cartridge gun.

Glue cartridge must be vertical to window glass.

The almost vertical part of the adhesive bead must be facing the outer window glass edge.

On window glass with guidelines, the adhesive bead must be applied centrally between the guidelines.

On window glass without guidelines, the position of the adhesive bead is specified in the individual repair instructions.

Coat bead joint.

Effect of differing adhesive quantities:

Too little adhesive:	Too much adhesive:
<ul style="list-style-type: none"><li>• Window glass rests too low in body aperture</li><li>• Insufficient squeezing of adhesive bead (leaking)</li></ul>	<ul style="list-style-type: none"><li>• Window glass rests too high in body aperture</li><li>• Wind noise may occur</li><li>• Strains/tensions may occur (window glass breakage)</li><li>• Dirt contamination of add-on parts by emerging adhesive</li><li>• Adhesive on uninsulated strainer pressure lines of aerial(s) (interference of reception)</li></ul>

*Note on bonding of windscreen:*

The adhesive amount specified in the individual repair instructions is sufficient if the specified adhesive bead size is maintained.

If too much adhesive is applied due to application-related variations (manual application), the specified adhesive amount may not be sufficient. To avoid interrupting adhesive application for longer than the permitted period, have another glue cartridge ready.

Once the adhesive bead has been applied, the window glass must be installed within 7 minutes

**IMPORTANT:** (depending on air humidity, temperature).

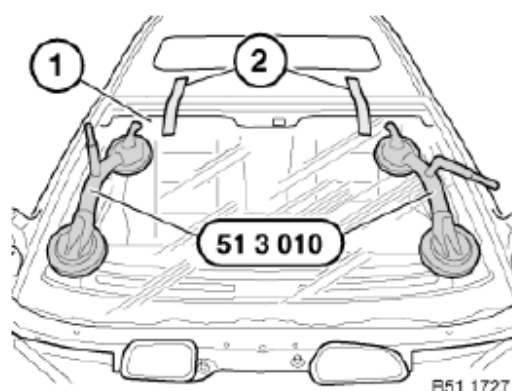
After 7 minutes the adhesive bead forms a skin which can no longer guarantee a perfect bond.

### 3.10 Mounting the window glass

To prevent a pressure build-up in the passenger compartment when the doors are closed:

- Open a side window

Mount window glass (1) with **SUCTION LIFTER 51 3 010**.



**Fig. 216: Holding Window Glass With Suction Lifter (51 3 010)**

Courtesy of BMW OF NORTH AMERICA, INC.

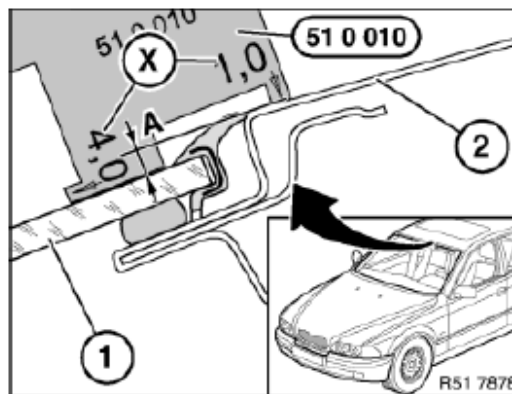
### 3.11 Adjusting the window glass

To avoid wind noise, the front and rear windows (1) must be lower than the roof outer skin (2).

Check ride height of the windscreen or rear window using special tool [51 0 010](#) .

Dimension (A) of window glass offset, refer to individual repair instructions.

X = measurement stages 1... 4 mm



**Fig. 217: Adjusting Window Glass**

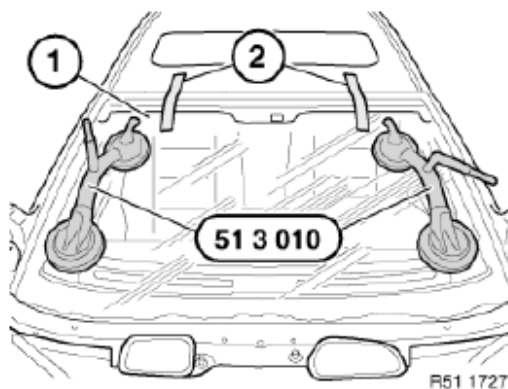
Courtesy of BMW OF NORTH AMERICA, INC.

### 3.12 Fixing the window glass

Fix the window glass with yellow plastic adhesive tapes (2).

Immediately remove dirt contamination with adhesive residue using Sika remover 208. Do not press out the window glass again.

Hardened adhesive can only be removed mechanically.



**Fig. 218: Holding Window Glass With Suction Lifter (51 3 010)**

Courtesy of BMW OF NORTH AMERICA, INC.

### 3.13 Label

Apply label (if applicable).

**Vacuum lifting tool, Hazet**





**Fig. 219: Identifying Hazet Vacuum Lifting Tool**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Order number:** 81 64 2 184 377

**Technical data:** Vacuum lifting tool with pivoting vacuum element, diameter 120 mm, can be attached to Hazet tool trolley types 179 and 180

**61 35... Overview, rain sensor (additional work when replacing the windscreen/sensor replacement)**

Sensor type/ Sensor shape	With windscreen replacement replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types square 60 x 40 mm	No	Yes	Yes	Yes

**62 30... Notes on head-up display**

**NOTE:** A special windscreen must be fitted to ensure that the Head-Up Display illustration can be projected correctly.  
 This windscreen comprises three sections. An outer and an inner glass pane are connected by a wedge-shaped plastic film.  
 The wedge shape prevents double projection of the Head-Up Display.  
 When the windscreen is replaced, the vehicle identification number and BMW parts catalogue must be checked to ascertain whether the windscreen in question is suitable for HUD.

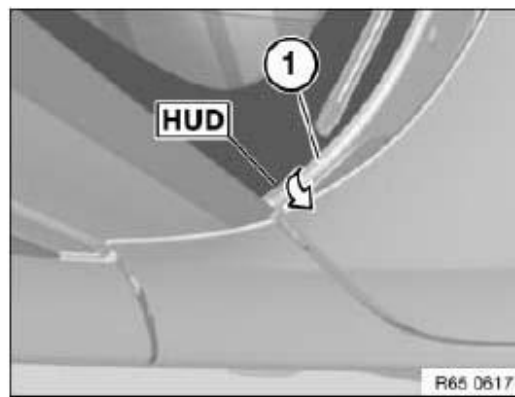
**Example of the display with a conventional windscreen:**

With a conventional windscreen, the projected illustration is reflected on the inner and outer glass pane, producing a double illustration.



**Fig. 220: Display - Conventional Windscreen**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Windscreens for Head-Up Display, for vehicles with model year up to 2012, are marked with the letters "HUD" on the outside at the bottom right below the seal (1) .



**Fig. 221: Adjusting Head-Up Display**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**513010 Siphon AM**

**NOTE:** (Siphon (2 pieces)) For removal and installation of the window glass. Is replaced by 81 64 2 184 377.

**SI number**

01 05 86 (604)

Consisting of:

1 = 0493119 Suction cup

**NOTE:** With elongated hole, suspension can be moved around all axles. Is replaced by 81 64 2 184 377.

2 = 0493120 Suction cup

**NOTE:** With bore hole, suspension can only be moved in longitudinal direction. Is replaced by 81 64 2 184 377.

3 = 0493121 Handle

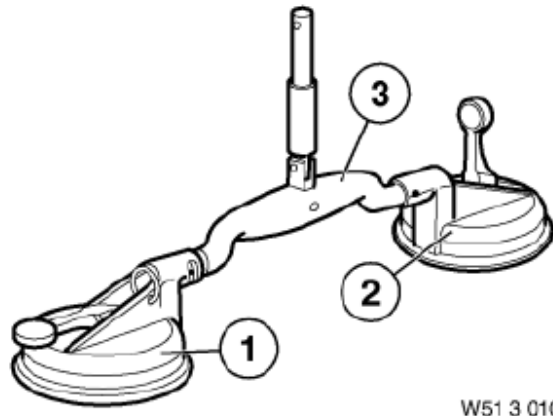
**NOTE:** (Grab handle): Is replaced by 81 64 2 184 377.

2 = 0493267 Plate

**NOTE:** (rubber plate without joint)

2 = 0493268 Joint

**NOTE:** (joint without rubber plate)



W51 3 010

**Fig. 222: Identifying Siphon (513010)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 31... MATERIALS FOR BONDING WINDOW**

**Special tools required:**

- [51 3 220](#)

**1. Tools**

Type	Type	Order/part number
Electric special cutter	SuperCut FSC 1.6Q	81 43 2 296 987
Knife set Contains:		
Knife (U-shape) 24/36/45 mm		
Knife (L shape) 25, 4 mm		81 43 9 428 596
Knife (straight with stop roller) 16 to 43 mm (adjustable) 14 mm (fixed)		
"Roll Out 2000"	Wire cutting system	81 62 0 301 768
"Spider"	Cutting system with nylon string	81 43 2 357 248
Wire pull handles	Â	81 43 2 326 501
CARTRIDGE GUN	Â	81 49 2 213 059
Pinchweld scraper set	Â	81 62 0 410 436
Siphon	Â	81 64 2 184 377
Single suction cup	Special tool	<a href="#">51 3 220</a>
Universal work table	Â	81 49 0 151 675

**2. Consumables:**

Naming	Designation, repair instructions/addition	BMW part number
Window glass repair kit, cold, 1 hour	<a href="#">SMALL REPAIR KIT</a>	83 19 2 289 285 83 19 2 289 180 (US) 83 19 2 180 001 (China)
Window glass repair kit, cold, 1 hour	<a href="#">LARGE REPAIR KIT</a> Like small repair kit, plus 1x window glass adhesive 300 ml	83 19 2 360 680 (not available for the US/China)

Naming	Designation, repair instructions/addition	BMW part number
Cutting wire for glass repair	Cutting wire, square	83 19 2 150 267
Nylon string	Nylon string	81 43 2 344 272
Multi-base filler	BMW multibase filler	∅
Cleaning agent	R1 Cleaning agent R1	83 19 2 211 217
Cleaning agent	R2 Cleaning agent R2	83 19 0 417 324
Adhesive tape	Plastic adhesive tape, yellow	83 19 9 410 979
Adhesive cleaner 208	Sika remover 208	83 19 9 407 780
Aktivator 205	Sika Aktivator 205 (e.g. for rubber frame on windscreen)	83 19 0 030 155
Bonding base VP 206	Sika bonding base VP 206 (e.g. for inspection glass for vehicle identification number)	83 19 9 407 777

### Storage of all consumables

Dry at 15 ∅ - 25 ∅°C.

### 51 31... NOTES ON WINDOW BONDING REPAIR KIT

∅	Part number	Part number (US)	Part number (China)
Small repair kit	83 19 2 289 285	83 19 2 289 180	83 19 2 180 001
- Window glass adhesive 300 ml	83 19 2 289 286	83 19 2 289 181	83 19 2 180 002
- Glass activator	83 19 0 444 142		
- C nozzle	83 19 2 155 589		
- Plastic nozzle and paper tissue	∅		
Large repair kit (Contains an additional window glass adhesive 300 ml)	83 19 2 360 680	Not available	Not available

Before working with the consumables, note the following information.

- IMPORTANT:
- Country-specific safety and industrial safety regulations
  - Material safety data sheet of manufacturer
  - Processing instructions on the packaging

#### 1. Storage and processing of all consumables

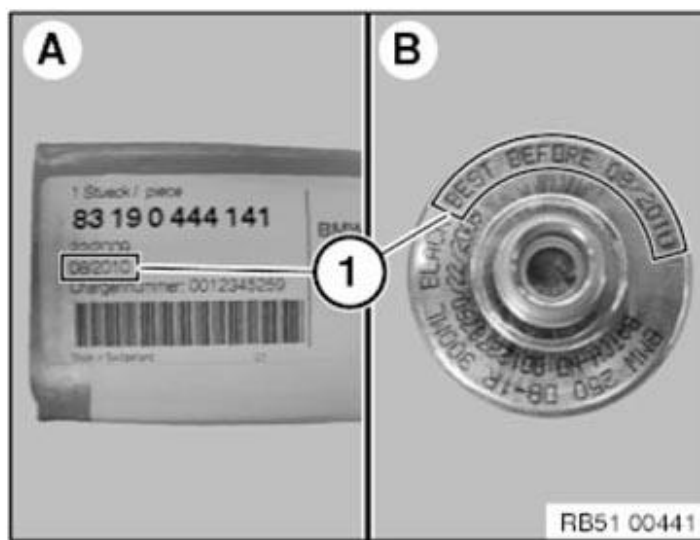
Dry at 15 ∅ - 25 ∅°C.

#### 2. Expiry date of adhesive:

Repair kit and glue cartridges are marked with a date (expiry).

Date (1) refers to the calendar week and year (KW/JJJJ).

The adhesive cannot be used after this date (1).



**Fig. 223: Identifying Adhesive Expiry Date**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### 3. Hardening of adhesive:

The adhesive hardens by reacting with air humidity at room temperature.

Once the adhesive bead has been applied, the window glass must be installed within 7 minutes  
 IMPORTANT: (depending on air humidity, temperature).

After 7 minutes the adhesive bead forms a skin which can no longer guarantee a perfect bond.

At ambient temperatures above 23 °C and 50 % relative air humidity (hot countries), the adhesive open time is shortened to approx. 5 minutes (skin formation time).

A relative air humidity of < 30% significantly slows hardening.

The adhesive hardening process is interrupted completely at ambient temperatures below 5 °C. In this event, there will be no increase in the strength of the bonded connection.

#### 3.1 Minimum hardening time:

Minimum hardening time is reached beginning at 22 °C and 38 % relative air humidity.

- 1 hour, vehicles without front passenger airbag (after which vehicle can be moved)
- 2 hours, vehicles with front passenger airbag in countries without mandatory seat belt usage

**NOTE:** In vehicles with front passenger airbag in countries without mandatory seat belt usage:  
 The vehicle can be transferred to the customer after a 1-hour hardening time with the following warning:  
 Once the windscreen glass has been bonded, all occupants must travel with their seat belts attached for 1 hour.

If the minimum hardening time is not adhered to, an accident can cause the passenger  
 IMPORTANT: together with the windscreen to fall out of the vehicle after the front passenger airbag deploys.

During the minimum hardening time of 1 hour, the vehicle must not be subjected to load on one side such as e.g.:

- one wheel on curb
- vehicle hoist
- etc.

Maneuvering inside garage/workshop:

- only permitted on level ground
- do not under any circumstances drive over approach ramps, e.g. into multistory parking structures

Do not remove adhesive tapes until after hardening time.

If the minimum hardening time of 1 hour is undercut, leaks and wind noises may occur at the window glass.

#### 4. Disposal of adhesive:

Hardened adhesive is disposed of as normal waste.

Non-hardened adhesive, glue cartridge and mixtures of adhesive and solvents and the like must be disposed of as hazardous waste.

The adhesive is disposed of in paper sacks so that it can react with moisture.

#### 5. Glass activator:

**WARNING:** Wear cut resistant gloves when breaking the glass ampule.

Prepare glass activator for processing by shaking and snapping (breaking glass ampoule).

Apply glass activator by pressing gently. There is no need for final wiping. Air drying time approx. 2 minutes.

#### 6. Expiry date of glass activator:

Repair kit and glass activator are marked with a date (best before date).

- The glass activator may only be used up to this date (if not already opened previously).
- After opening, keep only for one week even if the expiry date has not yet been reached.

#### 7. Disposal of glass activator:

Glass activator must not be disposed of as part of household waste.

Glass activator must be disposed of as hazardous waste.

### 61 35... OVERVIEW, RAIN SENSOR (ADDITIONAL WORK WHEN REPLACING THE WINDSCREEN/SENSOR REPLACEMENT)

- **1-Series:** E8x
- **3-Series:** E9x
- **5-Series:** E6x
- **6-Series:** E6x
- **X1:** E84
- **Z4:** E89

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor/ Programming/encoding necessary	When replacing the sensor/Initialization required	Connecting the diagnosis system required
Condensation sensor square 30 x 20 mm	Yes	No	No	No

- **5-Series:** E6x
- **6-Series:** E6x
- **7-Series:** E6x





Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing substitute visuals Programming/encoding necessary	When replacing the sensor/substitute visuals Initialization required	Connecting the diagnosis system required
all types square 60 x 40 mm	No	Yes	-	Yes	Yes
RLS approximately Å, 50 mm	No (new substitute visuals required, refer to BMW parts catalogue	-	No	Yes	Yes

- **X5:** E70
- **X6:** E7x

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing substitute visuals Programming/encoding necessary	When replacing the sensor/substitute visuals Initialization required	Connecting the diagnosis system required
RLPSS (Rain, light and precipitation solar sensor) (Designation is located on the back of the sensor) approximately Å, 50 mm	Yes	Yes	-	Yes	Yes
RLS (vehicle with no HUD) (Designation is located on the back of the sensor) approximately Å, 50 mm	No (new substitute visuals required, refer to BMW parts catalogue	-	No	Yes	Yes
RLSS (vehicle with HUD) (Designation is located on the back of the sensor) approximately Å, 50 mm	Yes	Yes	-	Yes	Yes

- **1-Series:** E8x
- **3-Series:** E9x
- **X1:** E84
- **X3:** E83
- **Z4:** E89

--

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types square 60 x 40 mm	No	Yes	Yes	Yes

- **5-Series:** F1x
- **5-Series GT:** F07
- **6-Series:** F06, F1x
- **7-Series:** F0x
- **X3:** F25
- **X4:** F26

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing substitute visuals Programming/encoding necessary	When replacing the sensor/substitute visuals Initialization required	Connecting the diagnosis system required
all types approximately $\tilde{A}$ , 35 mm	No	No	-	Yes	Yes
all types approximately $\tilde{A}$ , 50 mm	Yes	Yes	-	Yes	Yes
<b>Only for F25:</b> RLS approximately $\tilde{A}$ , 50 mm	No (new substitute visuals required, refer to BMW parts catalogue)	-	No	Yes	Yes

- **X5:** F15, F85
- **X6:** F16, F86

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types approximately $\tilde{A}$ , 35 mm	No	No	No	No

- **1-Series:** F2x
- **2-Series:** F2x
- **3-Series:** F3x, F8x
- **3-Series GT:** F34
- **4-Series:** F3x, F8x

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all up to 03/2014 except SBS (01) (Designation is located on the back of the sensor) approximately $\tilde{A}$ , 35 mm	No	No	Yes	Yes
SBS (01) (Designation is located on the back of the sensor) approximately $\tilde{A}$ , 35 mm	No	No	No	No
All as from 03/2014 approximately $\tilde{A}$ , 35 mm	No	No	No	No

**BMW i:**

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types approximately $\tilde{A}$ , 35 mm	No	No	No	No

**BMW from G series**

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types	No	No	No	No

**MINI (all):**

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types square 60 x 40 mm	No	Yes	Yes	Yes
all types approximately $\tilde{A}$ , 35 mm	No	No	No	No

**Rolls-Royce (all):**

Sensor type/Sensor shape	With windscreen replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types square 60 x 40 mm	No	Yes	Yes	Yes
all types approximately $\tilde{A}$ , 35 mm	No	No	Yes	Yes

Sensor type/Sensor shape	With windscreen replacement replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types approximately 50 mm	Yes	Yes	Yes	Yes

## 51 31 200 REMOVING AND INSTALLING REAR WINDOW

### Special tools required:

- [00 9 470](#)

IMPORTANT: The [GENERAL PROCEDURE FOR DISMANTLING/INSTALLATION OF AFFIXED WINDOW GLASS](#) serves as the basis for this repair instruction and must be observed without fail.

Removal is carried out with [SPIDER](#).

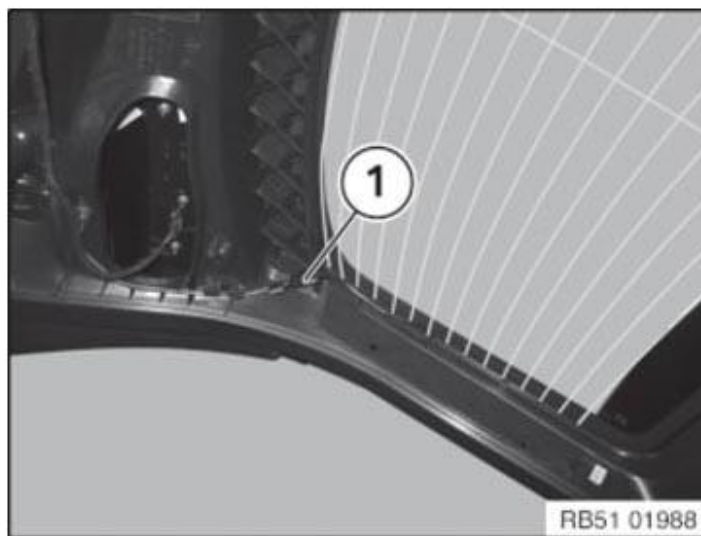
The following new parts/[CONSUMABLES](#) are required.

Material	Quantity
Rear window (with replacement)	1
Spacer buffer 5x5x20 mm	4
Small repair kit	1
Rear window gasket	1

### Necessary preliminary tasks:

- Remove [REAR SPOILER](#)
- Remove [REAR WINDOW WIPER MOTOR](#)
- Remove [COVER FOR REAR WINDOW FRAME](#) on left/right

Disconnect left/right electrical connector (1) and fix lead to rear window with adhesive tape.



**[Fig. 224: Identifying Rear Window Left/Right Electrical Connector](#)**

Courtesy of BMW OF NORTH AMERICA, INC.

### Attention!

Tape off body in area of piercing point with fabric adhesive tape (risk of damage).

Slide nylon string out of [SPIDER](#) into area (1) through adhesive bead.

Run nylon string around rear window in a clockwise direction (as seen from outside).

When feeding in the nylon string, make sure not to damage the gasket at the bottom of the rear window.

If the gasket is damaged, the tailgate needs to be replaced.



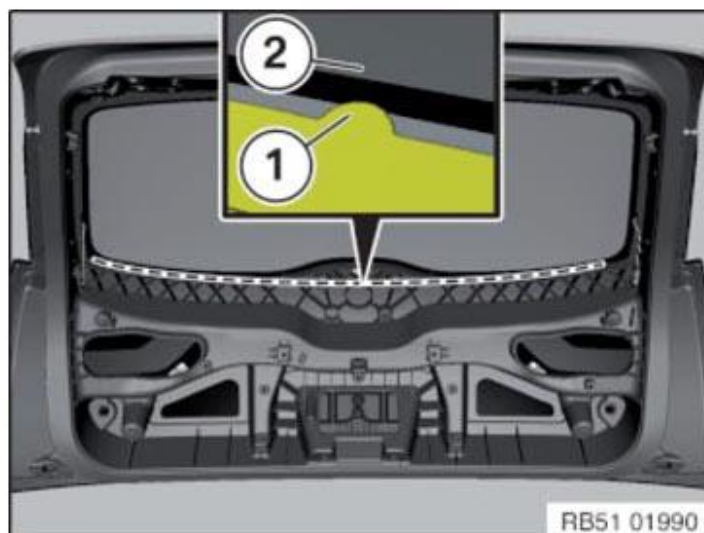
**Fig. 225: Identifying String Out Of Spider Sliding Area Through Adhesive Bead**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Risk of damage!

In spacer area (1), the nylon string must be pressed against rear window (2) with plastic protection.

When cut, the nylon string must be fed cleanly between rear window (2) and spacer (1).



**Fig. 226: Identifying Rear Window And Spacer**  
Courtesy of BMW OF NORTH AMERICA, INC.

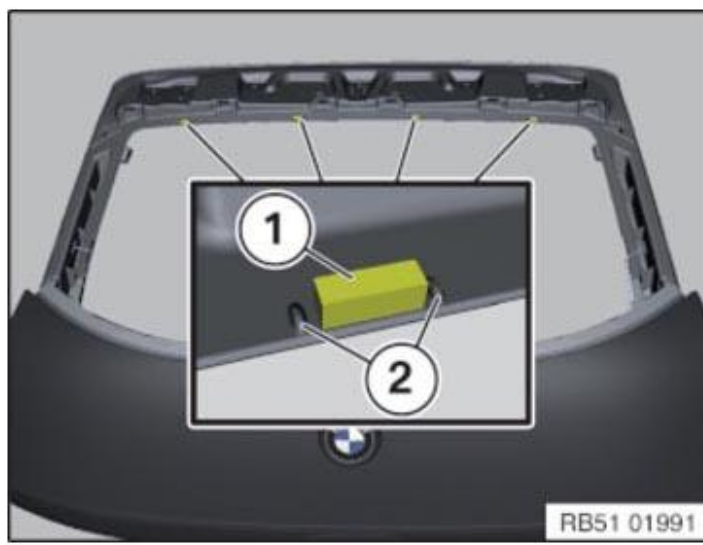
**Fitting spacer buffers:**

**Attention!**

Spacer buffers (1) are fitted to prevent rear window breakage.

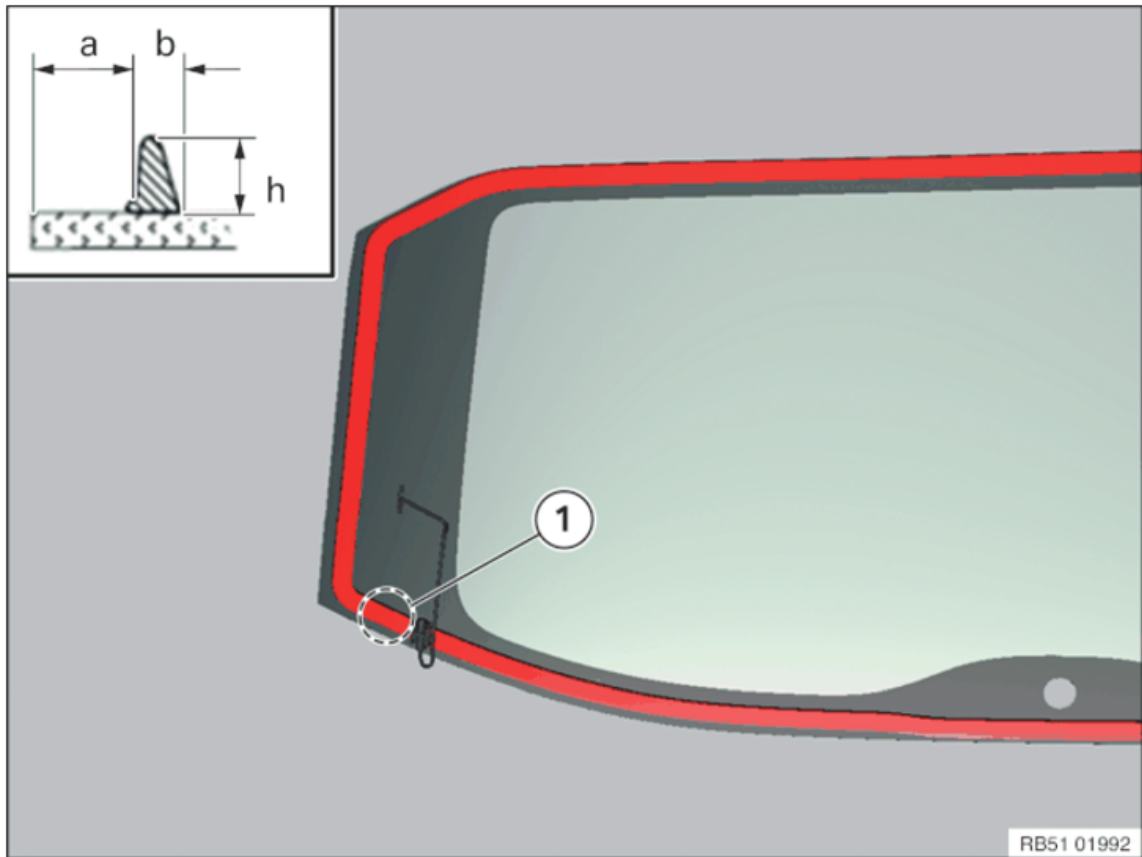
Completely remove the damaged spacer buffers (1).

Trim new spacer buffer (1) if necessary, and bond between marks (2).



**Fig. 227: Identifying Marks On Spacer Buffers**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Overview of rear window bonding:



**Fig. 228: Checking Rear Window Bonding Adhesive Bead Installation Dimension**  
 Courtesy of BMW OF NORTH AMERICA, INC.

<b>a</b> [mm] = Position adhesive bead	Place adhesive bead centrally on tolerance band.
<b>b</b> [mm] = Width adhesive bead	$7 \hat{A}\pm 1$
<b>h</b> [mm] = Height adhesive bead	$12 \hat{A}\pm 1$

**NOTE:** A tolerance band is printed on the ceramic (two dashed lines) that marks the position of the adhesive bead. Place adhesive bead centrally on tolerance band.

Bead joint must be located in area (1).

**Attention!**

Water ingress!



Apply adhesive bead (1) of height 5 mm to marked area of tailgate.

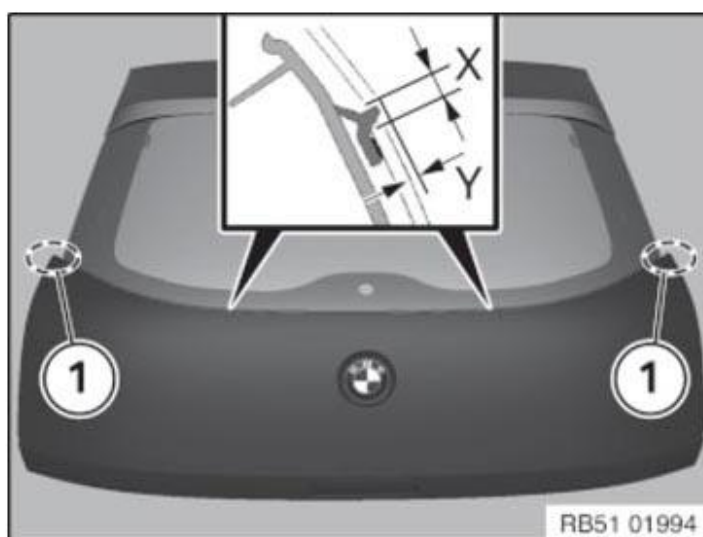


**Fig. 229: Identifying Adhesive Bead Applying Area On Tailgate**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Insert rear window into tailgate with suction lifter and align:

- Gap dimension between rear window and bottom glass cover:  
 $X = 4 \hat{\text{A}} \pm 1 \text{ mm}$  (use special tool [00 9 470](#) to measure)
- Protrusion of rear window relative to bottom window cover  
 $Y = 2 \hat{\text{A}} \pm 1 \text{ mm}$
- Align evenly at side (1)
- secure in this position with yellow plastic adhesive tapes



**Fig. 230: Checking Gap Dimension Between Rear Window And Bottom Glass Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **51 31 021 REMOVING AND INSTALLING/REPLACING WINDSCREEN RUBBER SURROUND**

**Special tools required:**

- [51 3 320](#)

**Necessary preliminary tasks:**

- Remove **WINDSCREEN**

The glass activator to pre-treat the area of the windscreen adhesive bead may not come in contact with the adhesive area of the cover.

**IMPORTANT:** The bonding result of the cover is otherwise compromised.

Therefore, the cover must be installed prior to application of the glass activator.

Follow notes on **COMPONENT BONDING** with double-sided adhesive tape.

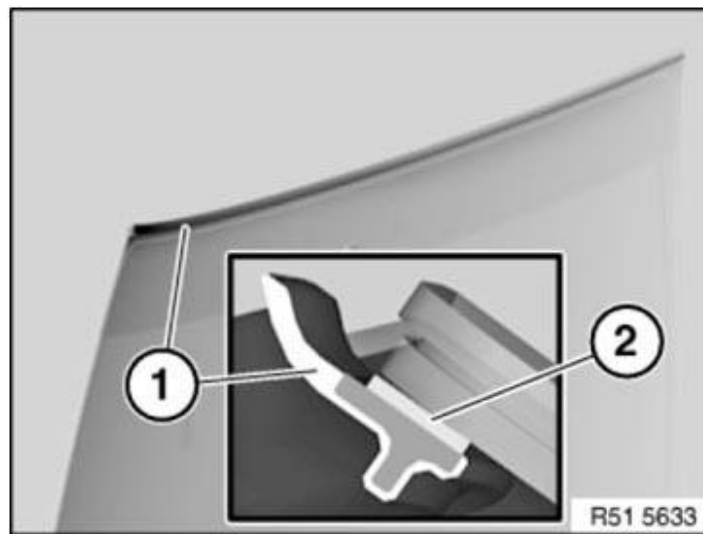
Detach cover (1).

Remove remnants of adhesive tape (2).

Clean bonding surface.

Air drying time:  $\geq 1$  minute

**IMPORTANT:** Adhesive area must be dry and free from dust and grease. Once it has been cleaned, do not touch the adhesive area with bare hands.



**Fig. 231: Identifying Adhesive Tape And Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

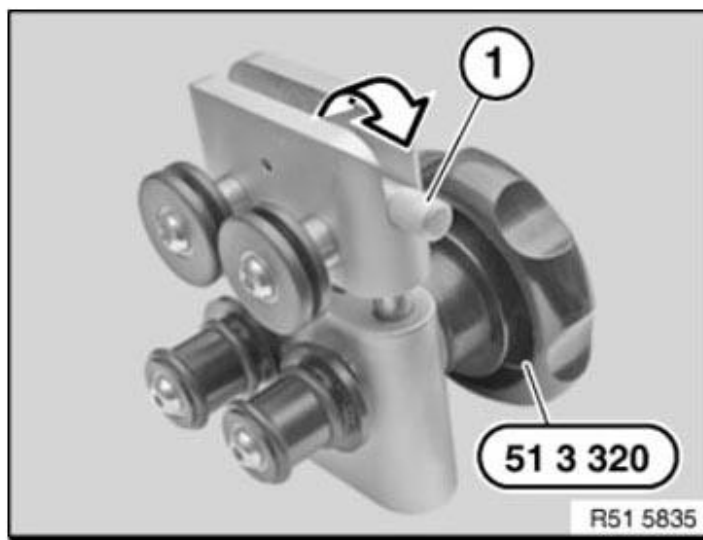
*Installation note:*

Pre-treat adhesive area with Sika-Aktivator205.

Air drying time:  $\geq 1$  minute

Sika Activator 205 must not get onto adhesive area of adhesive bead.

Reposition lever (1) and open special tool **51 3 320**.

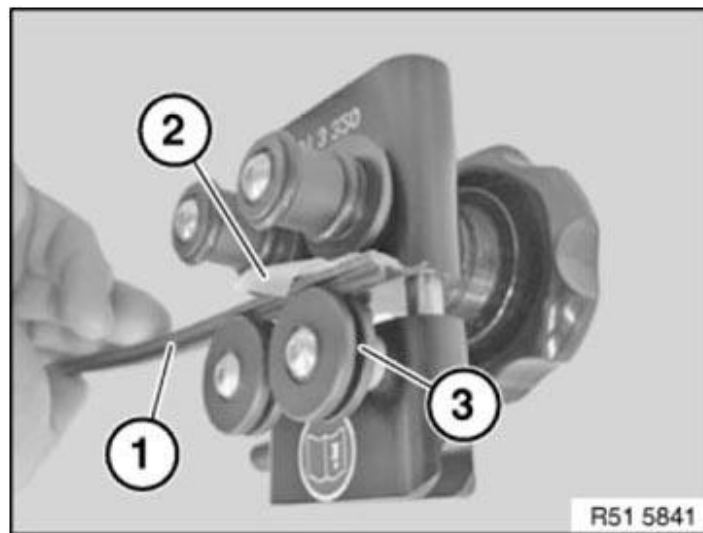


**Fig. 232: Installing Lever Using Special Tool (51 3 320)**

Courtesy of BMW OF NORTH AMERICA, INC.

Pull off protective film (2) in stages from adhesive tape.

Insert cover (1) in guide pulleys (3).



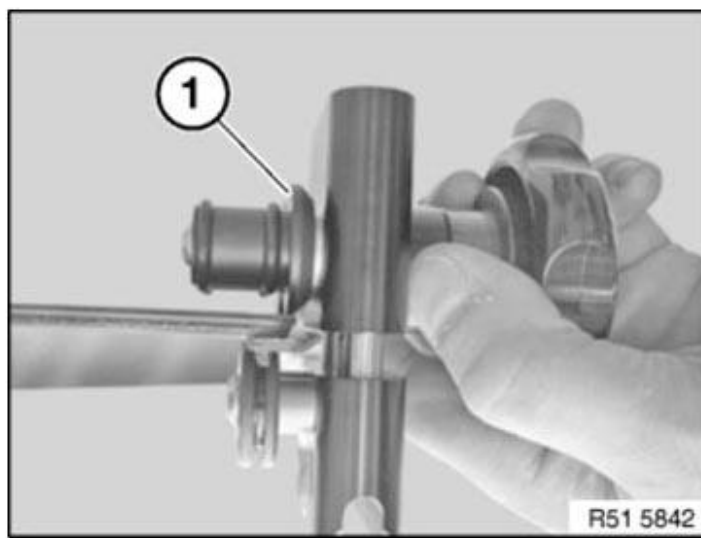
**Fig. 233: Pulling Off Protective Film In Stages From Adhesive Tape**

Courtesy of BMW OF NORTH AMERICA, INC.

Place special tool with contact rollers (1) up against window edge.

Align cover to window outer edge.

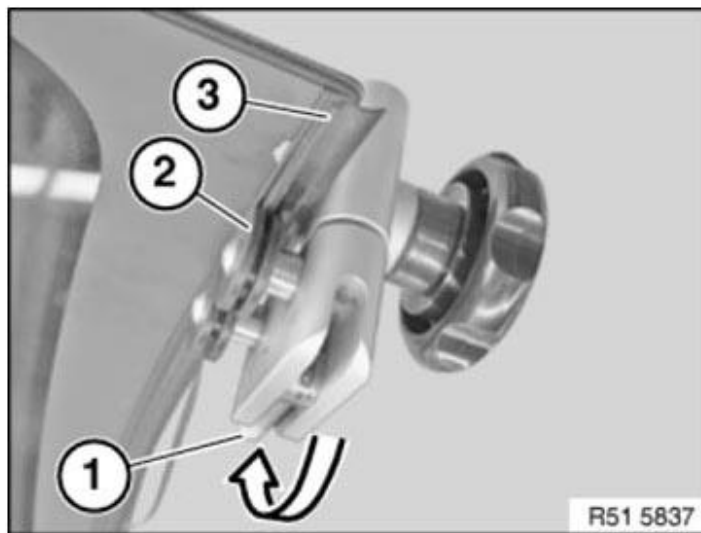
Fit cover and visually check for perfect seating.



**Fig. 234: Placing Special Tool With Contact Rollers Up Against Window Edge**  
Courtesy of BMW OF NORTH AMERICA, INC.

Reposition lever (1) and close special tool.

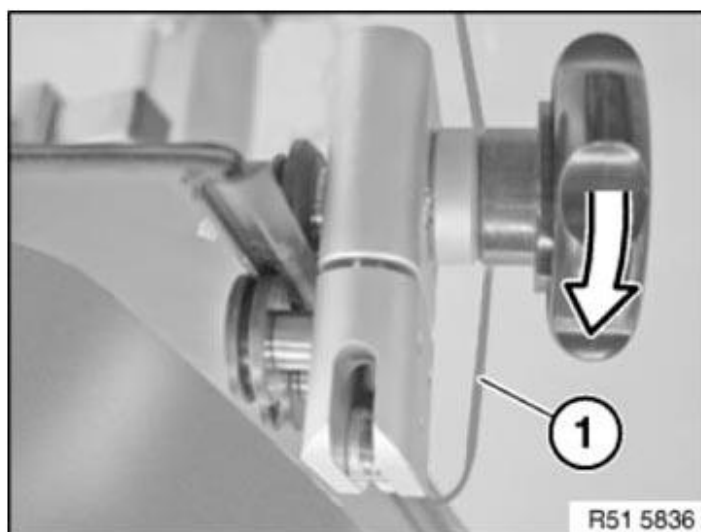
Make cover (3) is correctly seated in guide pulleys (2).



**Fig. 235: Positioning Special Tool Lever**  
Courtesy of BMW OF NORTH AMERICA, INC.

Continue to pull off protective film (1) in stages from adhesive tape.

Run special tool with hand wheel over entire upper window edge.



**51 31... REMOVING WINDOWS WITH A "SPIDER"**

**Windscreen removal system "Spider"**



- |                              |                                       |
|------------------------------|---------------------------------------|
| 1 "Spider" separation device | 6 Line threader                       |
| 2 Bit holder                 | 7 Line routing tool                   |
| 3 Operating instructions     | 8 Suction anchor                      |
| 4 Dashboard protection       | 9 Cord for separating adhesive strips |
| 5 Angular transmission       |                                       |

**Fig. 237: Identifying Spider Related Components**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Accessories required for operation (not included):**

Cordless screwdriver/drill with at least a 10.8 V Li-ion battery or a 18 V Ni-Cd battery and variable speed.

**NOTE:** Always use a low gear setting.

**NOTE:** Damage as well as ergonomic and health-endangering damage are minimized with the "Spider" disassembly system.

**Sourcing reference:**

**WARNING:** Follow **SAFETY INSTRUCTIONS** for working on vehicles with airbag systems (risk of injury).

**IMPORTANT:** Handle sharp-edged tools with care (risk of damage to the head airbag and the window glass).

**IMPORTANT:** Always keep both suction cups dry and clean to ensure their optimum adhesion on the windscreen. Suction cup may not be applied at the damaged point (crack in window glass). The bearing bushes of the shaft (spindle) must always be lubricated. Always wear safety goggles and protective gloves for your own safety.

The procedure for disassembly of the windscreen is described below as an example.

Deviations in the work procedure can be found in the individual repair instructions.

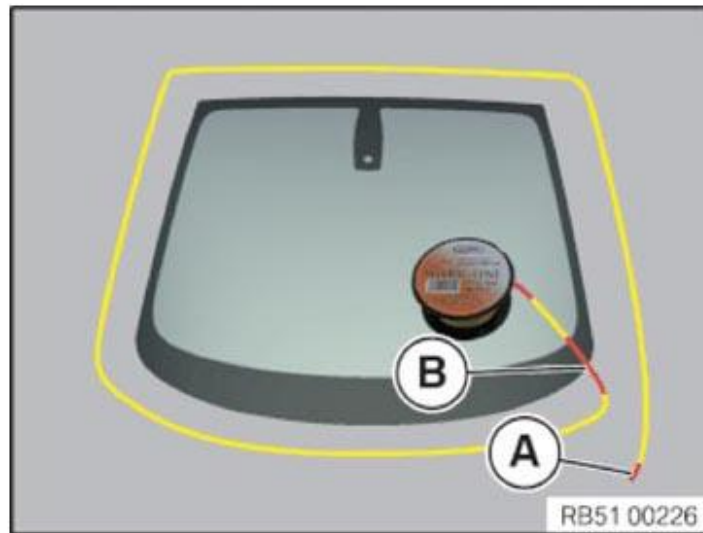
### General

A cord approx. 6.8 m long is used to cut through the adhesive bead.

The cord length to be used is identified by a short red mark (A) approx. 5 cm.

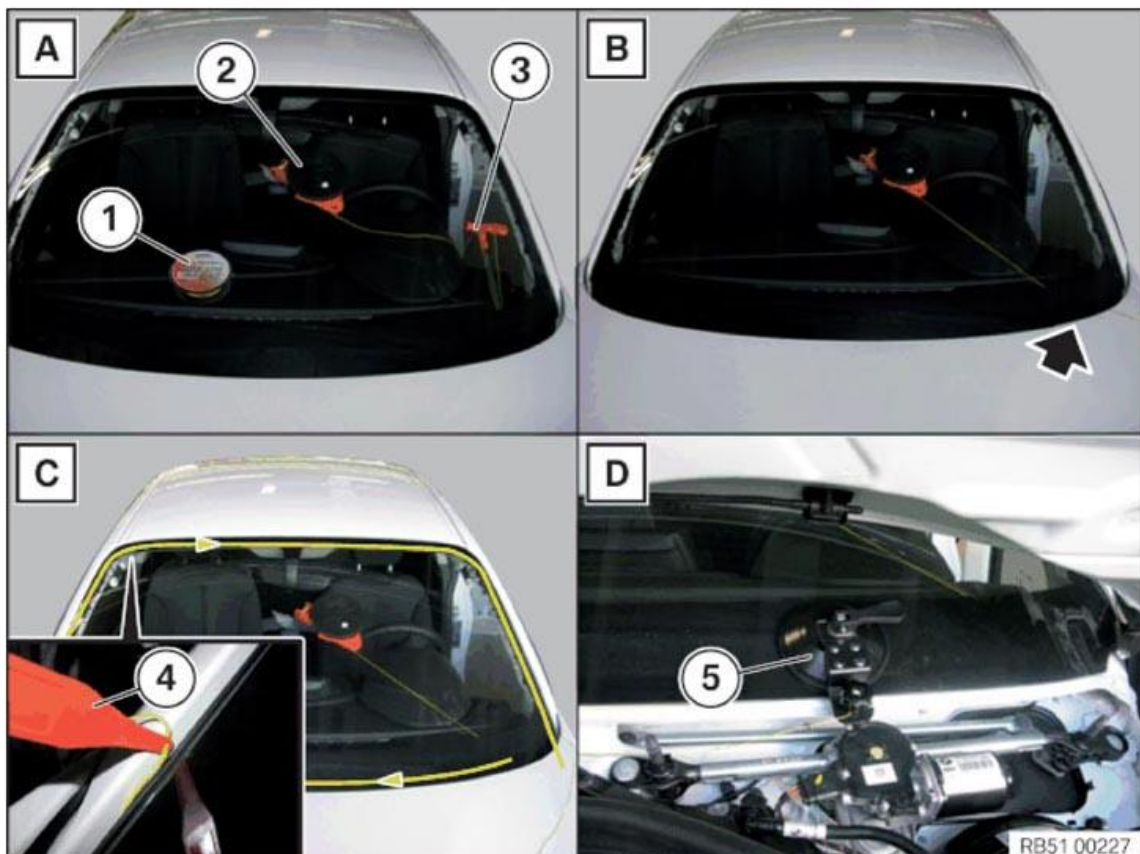
The part of the cord laid outside around the window glass (approx. 5 m) is identified with a long red mark (B) (approx. 18 cm).

The marks are applied so that the cord has to be pulled from the inside to the outside.



**Fig. 238: Identifying Windscreen Short And Long Red Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Preparation



**Fig. 239: Identifying Roller, Separation Device, Cord Threader, Pulling Aid And Suction Anchor**  
Courtesy of BMW OF NORTH AMERICA, INC.



- A. Pierce cord from the roller (1) or separation device (2) with cord threader (3) through the adhesive bead from the inside, protect the area from the inside as required.
- B. Pull out cord up to the first red mark (approx. 18 cm long).
- C. Lay cord around the window glass, use pulling aid (4) if required.
- D. Secure suction anchor (5) outside on window glass, secure cord to suction anchor (5).

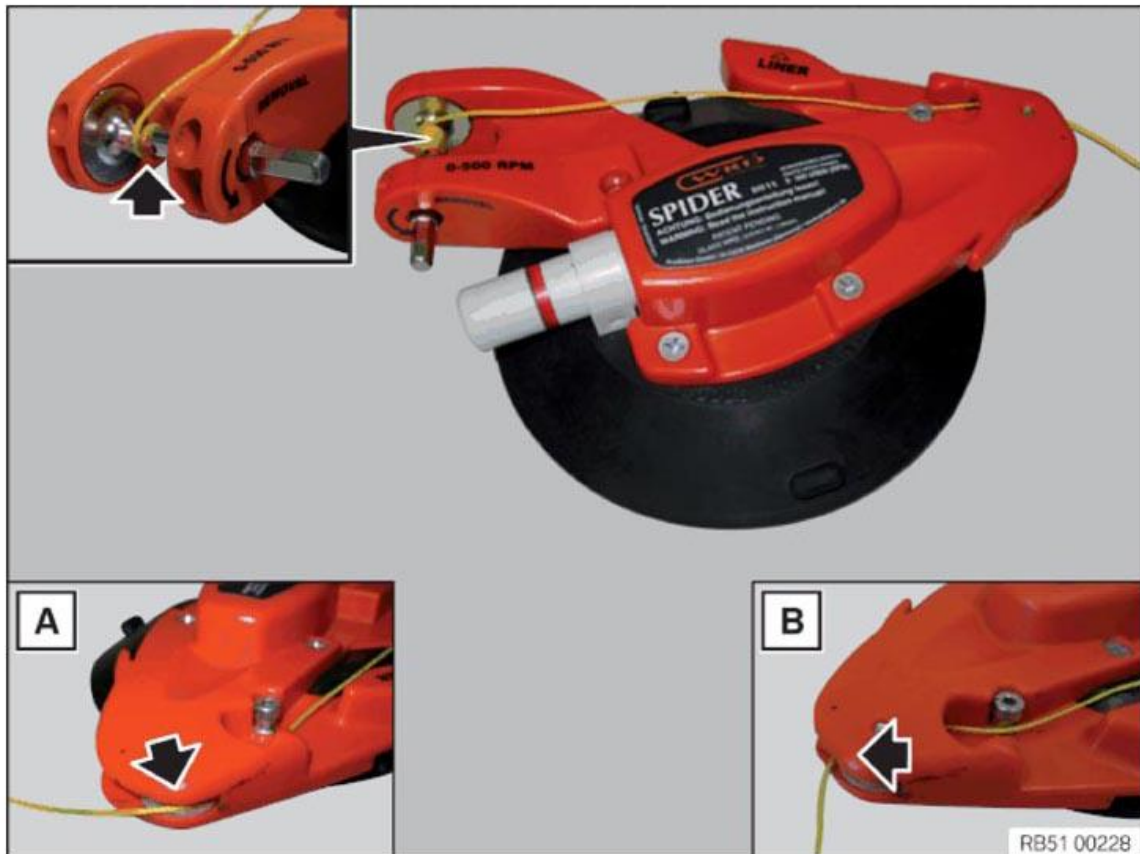
If required, unwind cord from roller (1) up to the second red mark (approx. 5 cm long) and cut off.

Make sure the cord lies below the window glass at all four corners.

Check that the cord is not caught on clamps or body.

Secure window glass on outside with adhesive tape against sliding.

### Feeding in the cord on the separation device



**Fig. 240: Feeding Cord Into Separation Device**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Normally, the adhesive bead is cut through counter clockwise seen from the passenger compartment.

- This means the cord must be fed into the separation device as shown in graphic A.

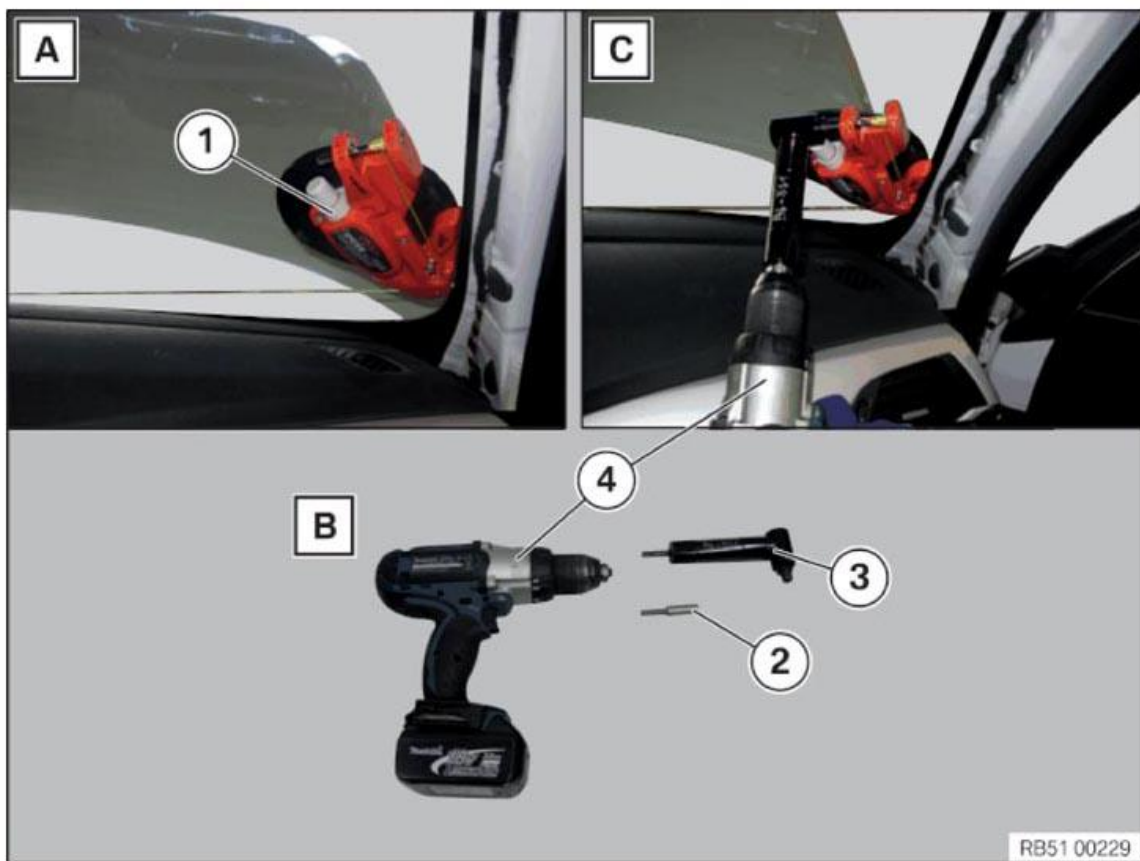
When accessibility is not optimal, the opposite cutting direction may be required (comply with individual repair instructions).

- This means the cord must be fed into the separation device as shown in graphic B.

Feed cord into coil and wind it on, at the same time trapping the end of the cord.

When winding the cord, the correct direction of rotation on the separation device must be observed.

### Cutting out procedure



**Fig. 241: Placing Cordless Screwdriver On Separation Device**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Optimum cutting is guaranteed when the cord is at an acute angle to the adhesive bead. There is a risk of the cord ripping if the angle is too obtuse.

The separation device must be positioned correspondingly to achieve the appropriate angle.

- A. Fix separation device (1) on window glass at bottom right.
- B. Depending on accessibility, attach bit holder (2) or angle gear (3) to cordless screwdriver (4).
- C. Place cordless screwdriver (4) on separation device (1) and start winding cord, observe direction of rotation on separation device.

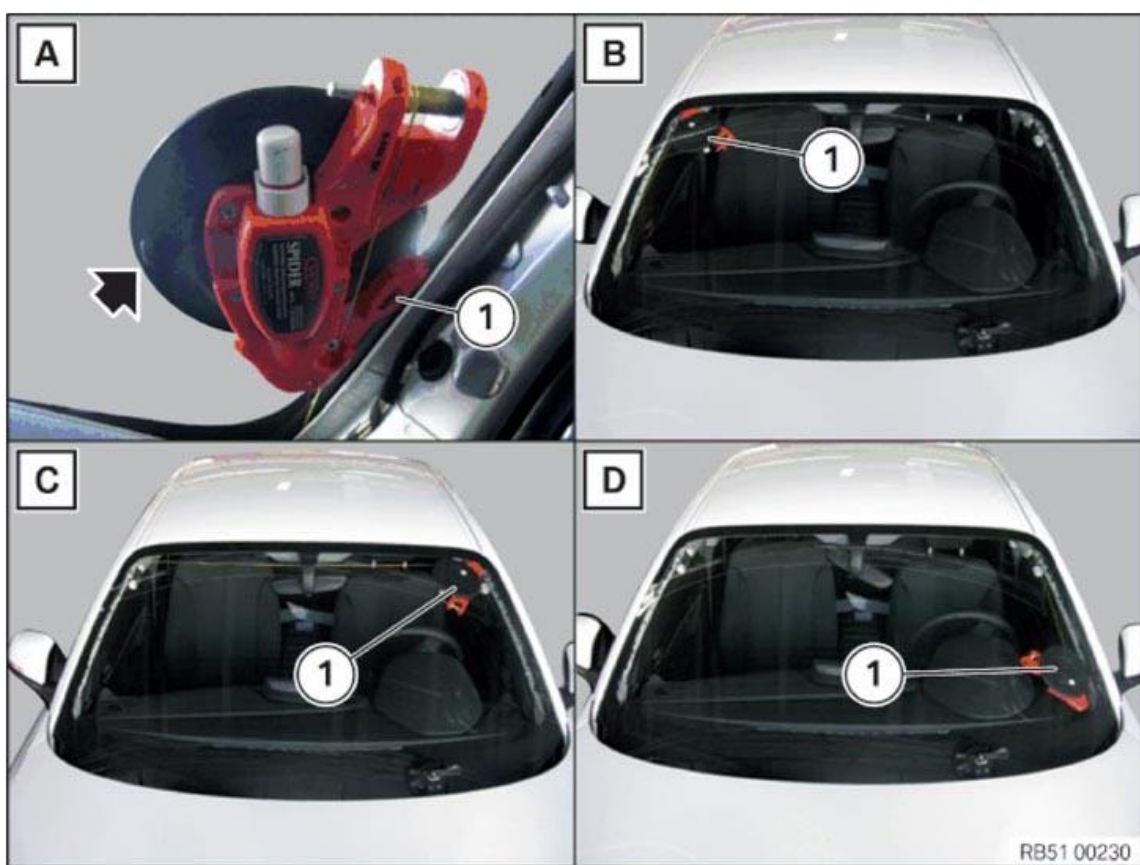
If required, over trim panel components with plastic protection.

Guide cord with plastic protection around sharp-edged positions.

Cut through adhesive bead up to bottom area of A-pillar.

Turn back cordless screwdriver (4) approx. 2 rotations and remove.

**Cutting out procedure**



**Fig. 242: Removing Windscreen Removal Tool From Window Glass**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- A. Discharge vacuum on windscreen removal tool (1) by pressing the tab, remove windscreen removal tool (1) from window glass.
- B. Reset removal tool (1) at illustrated and wind up cord up to the position of windscreen removal tool (1).
- C./D. Repeat further resetting, work sequence as given at B.

Additional resetting may be required for very curved window glass.

It is possible to reuse the cord. When a cord is used many times the risk of ripping increases.

Dirt contamination must be avoided when a cord is reused.

### **51 31 011 REPLACE WINDSCREEN**

**Special tools required:**

- [00 9 327](#)
- [51 0 010](#)

IMPORTANT: • The **GENERAL PROCEDURE FOR DISMANTLING/INSTALLATION OF AFFIXED WINDOW GLASS** serves as the basis for this repair instruction and must be observed without fail.

Removal is carried out with **SPIDER**.

The following new parts/**CONSUMABLES** are required.

Material	Quantity
Windscreen	1
Spacer buffer 5x5x20 mm	10
Large repair kit	1
Cover, windscreen	1

Material	Quantity
Sika Activator 205 (for windscreen cover)	1

**Necessary preliminary tasks:**

- Remove ENGINE COMPARTMENT LID
- Remove **COWL PANEL COVER**
- Remove both sides of **ROOF FRAME TRIM PANELS**
- Remove **INSIDE MIRROR**
- Remove **TRIM PANEL FOR ROOF PILLAR** (A-pillar) left/right

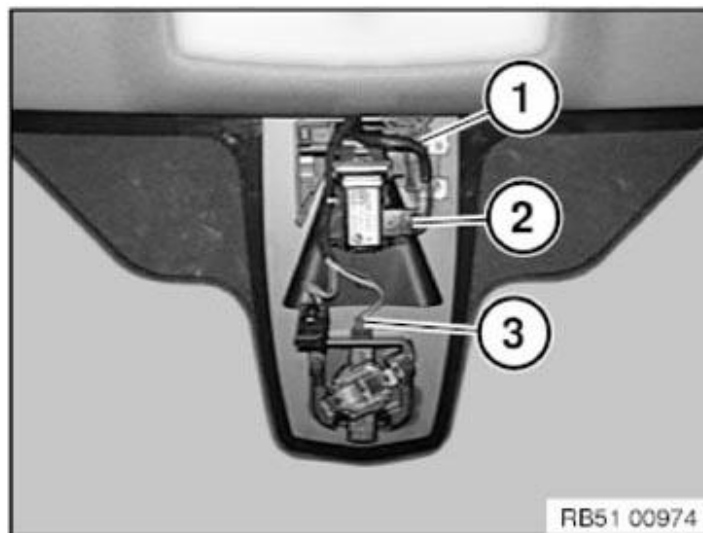
**Depending on version:**

Unplug plug connections (1 to 3).

Do not remount the rain-light solar and condensation sensor until after the windscreen is disassembled.

Remove camera.

**NOTE:** Cables torn from the windscreen must not be soldered back in place. The windscreen must be replaced.



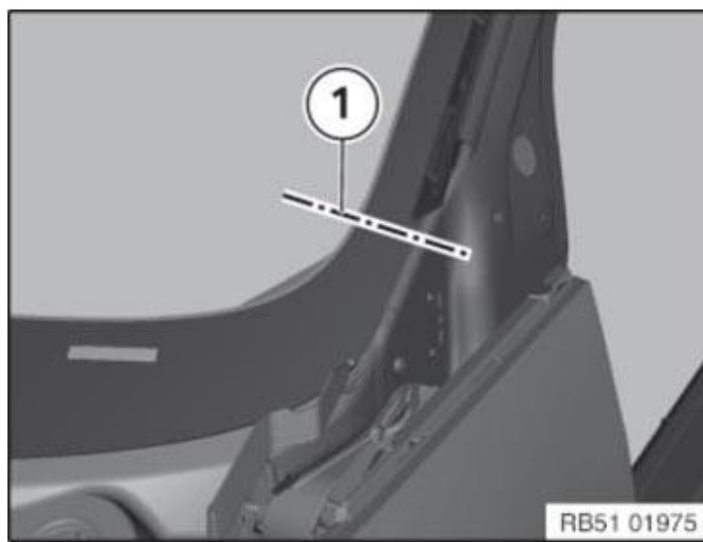
**Fig. 243: Identifying Windscreen Plug Connections**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Tape off body in area of piercing point with fabric adhesive tape.

Slide nylon string out of **SPIDER** along line (1) through adhesive bead.

For details on how to proceed, refer to: **WINDOW REMOVAL WITH "SPIDER"**.



**Fig. 244: Identifying String Out Of Spider Sliding Area Through Adhesive Bead**  
Courtesy of BMW OF NORTH AMERICA, INC.

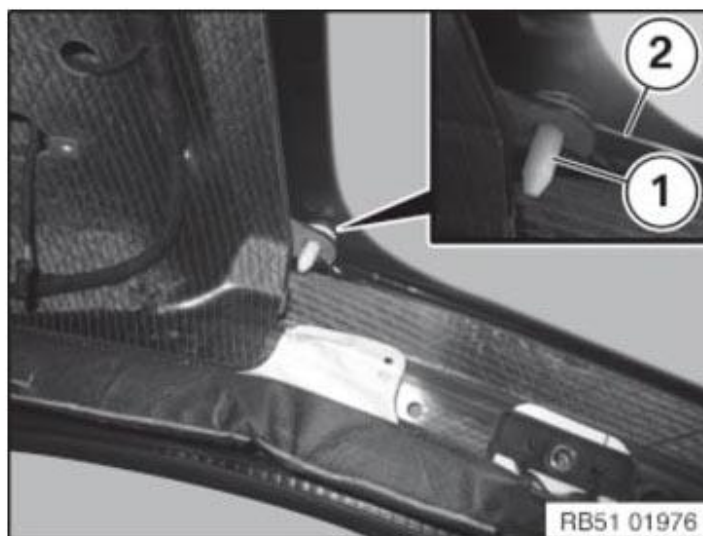
**Attention!**

Risk of damage!

A positioning pin (1) is located on the left and right at the top of the A-pillar area.

Positioning pin (1) is secured to windscreen with double-sided adhesive tape.

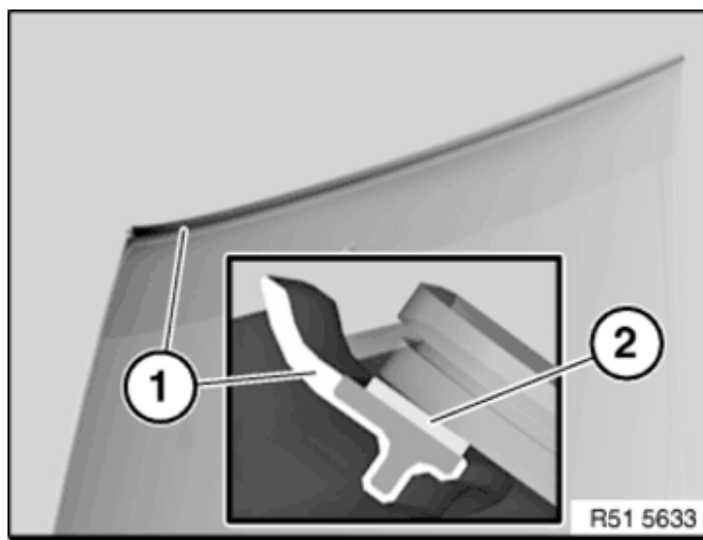
Release positioning pin (1) from windscreen using special tool [00 9 327](#) until nylon string (2) can be fed between positioning pin (1) and windscreen.



**Fig. 245: Identifying Positioning Pin And Nylon String**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install the [COVER/RUBBER FRAME](#) (1) for the windscreen.

Pre-treat adhesive area with Sika-Aktivator205.



**Fig. 246: Identifying Cover And Rubber Frame**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove the **RAIN/LIGHT/SOLAR AND CONDENSATION SENSOR** and immediately install on a new windscreen.

To prevent windscreen breakage and wind noise, completely remove any remnants of disassembled spacer buffers (1) and maintain the installation position exactly.

5 spacer buffers are fitted on each side.

Bond spacer buffer to window edge at points of equal distance.



**Fig. 247: Identifying Spacer Buffers**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**For new side frame/A-pillar:**

Roughen plastic adhesive area (1) on new part (without adhesive bead) using ScotchBrite Multiflex 51 91 0 402 967 emery pad.





**Fig. 248: Identifying Plastic Adhesive Applying Area On Side Frame And A-Pillar**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check expanding foam tape (1) for damage.

If required, stick new expanding foam tape (1) on the total width of instrument panel.

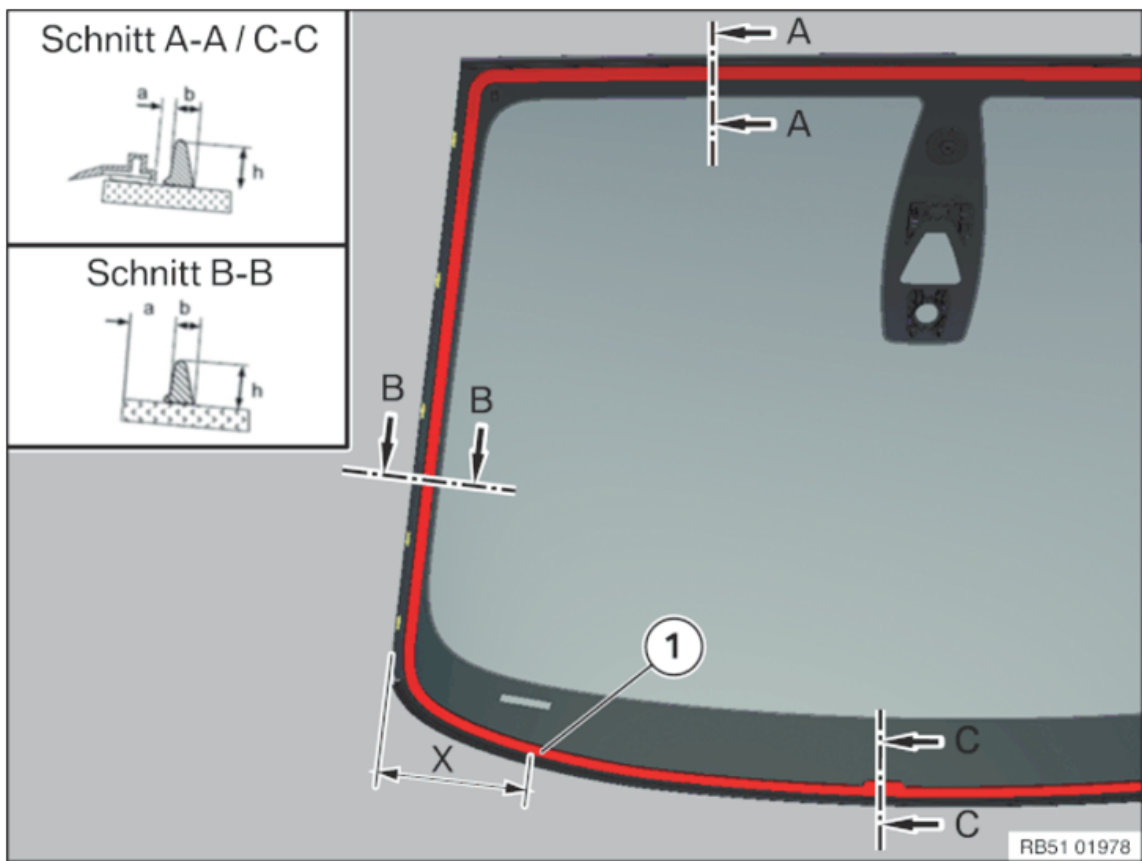
Expanding foam tape (1) must be bonded above the aperture (2) for chassis number.

Observe notes on **COMPONENT BONDING** with adhesive tape!



**Fig. 249: Identifying Aperture And Foam Tape**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Overview of windscreen bonding:**



**Fig. 250: Checking Windscreen Bonding Adhesive Bead Dimensions**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Cut	A - A	B - B	C - C
<b>a</b> [mm] = Position adhesive bead	3 $\hat{A}\pm 1$	13 $\hat{A}\pm 1$	3 $\hat{A}\pm 1$
<b>b</b> [mm] = Width adhesive bead	7 $\hat{A}\pm 1$	$\hat{A}$	$\hat{A}$
<b>h</b> [mm] = Height adhesive bead	12-2	$\hat{A}$	$\hat{A}$

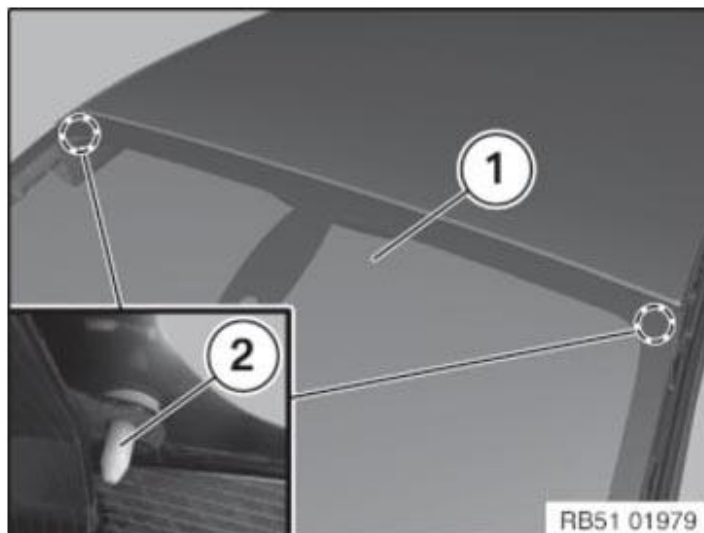
**NOTE:** A tolerance band is printed on the ceramic (two dashed lines) that marks the position of the adhesive bead. Place adhesive bead centrally on tolerance band.

x = approx. 200 mm (bead joint distance (1) to windscreen outer edge)

Two glue cartridges are required.

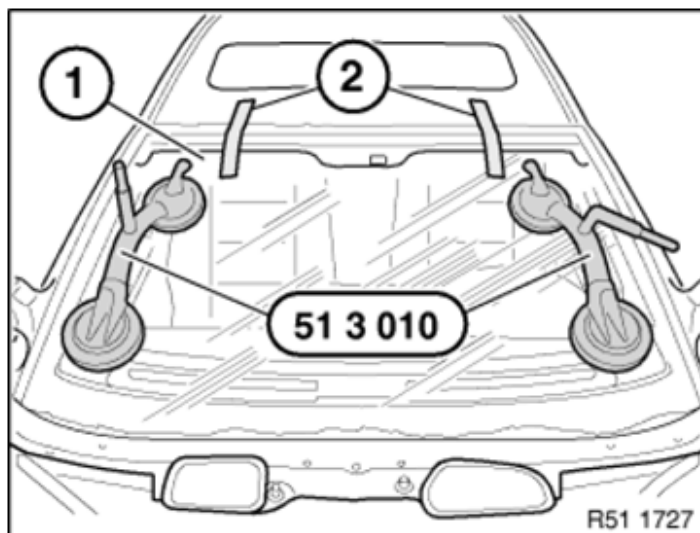
In order that the second bead joint can also be set in bottom area of windscreen, adhesive tape must be applied in a clockwise direction from the start (1).

Insert windscreen (1) into body using positioning pin (2).



**Fig. 251: Inserting Windscreen Into Body Using Positioning Pin**  
Courtesy of BMW OF NORTH AMERICA, INC.

Fix windscreen (1) at top using two yellow plastic adhesive tapes (2).



**Fig. 252: Fixing Windscreen At Top Using Yellow Plastic Adhesive Tapes**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Preload on top of windscreen to prevent wind noise:**

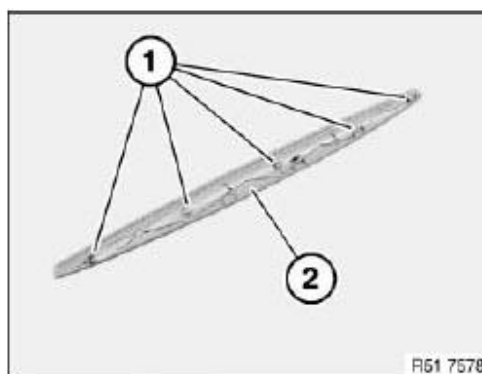
Windscreen (1) must be lower than roof outer skin (2). This is the only way to prevent wind noises.

Position special tool **51 0 010** in middle of vehicle depending on dimension (A) and check underprotrusion of windscreen (1).

Windscreen underprotrusion (A):

$$A = 2.5 \hat{A} \pm 1 \text{ mm}$$

X = Measurement stages 1... 4 mm



**Fig. 253: Checking Ride Height Of Windscreen Or Rear Window Using Special Tool (51 0 010)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Only with camera-based driver support systems:**

Carry out camera calibration via diagnosis system.

Under Service Functions menu:

- Driver assistance
  - Camera-based driver assistance systems
    - Calibration of camera-based driver support systems

**FRONT SIDE WINDOWS**

**Special tools required:**

- [2 356 862](#)
- [51 0 341](#)
- [51 0 342](#)
- [2 351 398](#)
- [51 3 240](#)

**Configuring the correct setting will fulfil the following properties:**

- Seal against water ingress
- No wind noise
- No rattling
- No unintentional reversing of side window during closing action (anti-trap safety function)

**Prerequisites for correct adjustment:**

- Vehicle is supported on wheels at ground level
- [REAR SIDE WINDOW](#) correctly adjusted
- FRONT DOOR correctly adjusted to fit
- Recharge [12 V BATTERY](#)

(Full operability of the power windows during the adjustment procedure is only assured with an external power supply)

When closing, the door window glass must not jam on the trim strip in any area of the window (window glass breakage). When performing measurement and adjustment work, do not slam the door (window pane may shatter).

Observe the checking and adjustment sequence!

**IMPORTANT:**

- I. Door window (stationary)
  1. Vertical/longitudinal direction
- II. II. Door window glass (movable):

1. Preload
2. Retraction depth/longitudinal direction

**I. Door window glass (stationary):**

**1. Ideal setting in vertical and longitudinal direction:**

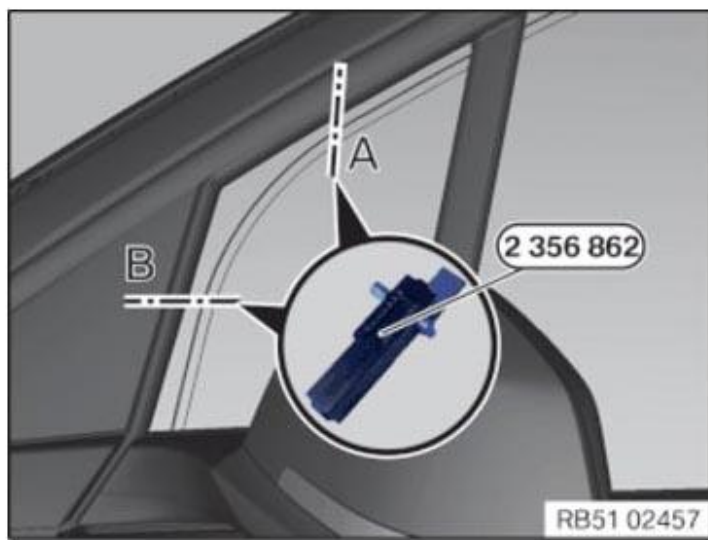
**1.1 Checking setting in vertical and longitudinal direction:**

Open door.

Connect special tool [2 356 862](#) at points (A and B) on the door window glass.

Close door.

Measure height adjustment of the door window glass in the area (A and B) using special tool [2 356 862](#) (use 5 mm holder).



**Fig. 254: Connecting Special Tool (2 356 862) At Points On Door Window Glass**  
 Courtesy of BMW OF NORTH AMERICA, INC.

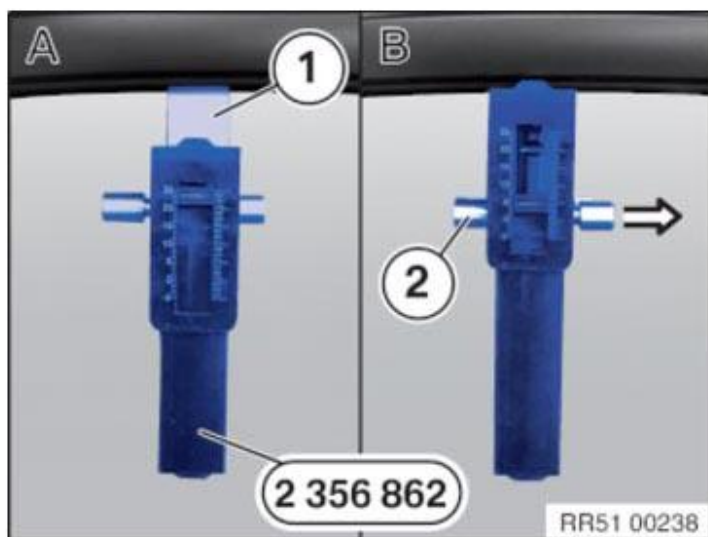
Area	Dimension	Â
A	2 Â±1 mm	Central measuring point
B	2 Â±1 mm	Central measuring point

**NOTE:** Check play of special tool **2 356 862** to edge of door window pane before each measurement.

Connect special tool **2 356 862** with 5 mm holder (1) in locked state (A) on door window glass.

Close door and undo lock (2).

Read retraction depth on the scale.

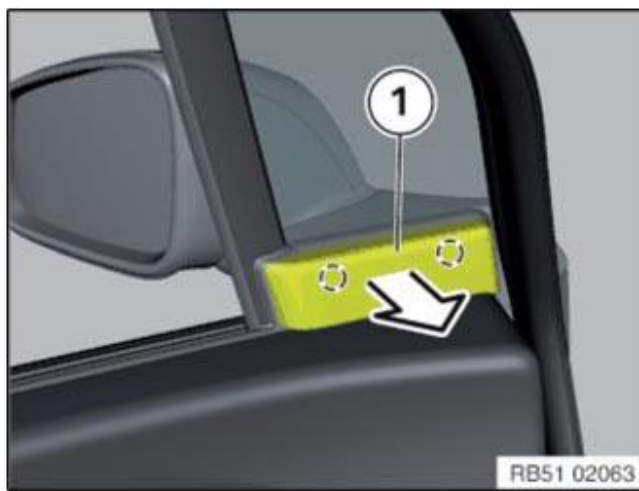


**Fig. 255: Connecting Special Tool (2 356 862) With Holder In Locked State On Door Window Glass**

Courtesy of BMW OF NORTH AMERICA, INC.

**1.2 Adjusting door window glass (fixed) in vertical and longitudinal direction:**

Detach cover (1).



**Fig. 256: Remove Window Frame Cover**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

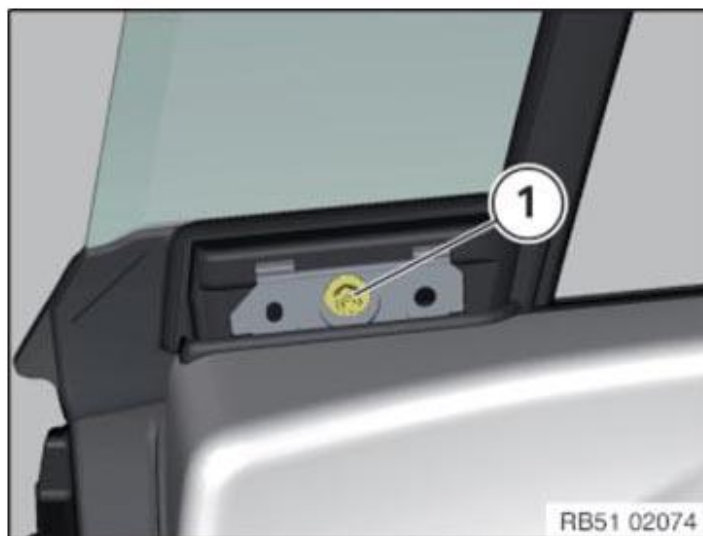
Adjust ideal dimension by moving the door window glass.

Tighten nut (1).

Tightening torque **51 33 4AZ** .

Check adjustment.

Repeat process if necessary.



**Fig. 257: Identifying Door Window Glass Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## II. Door window glass (movable):

### 1. Preload:

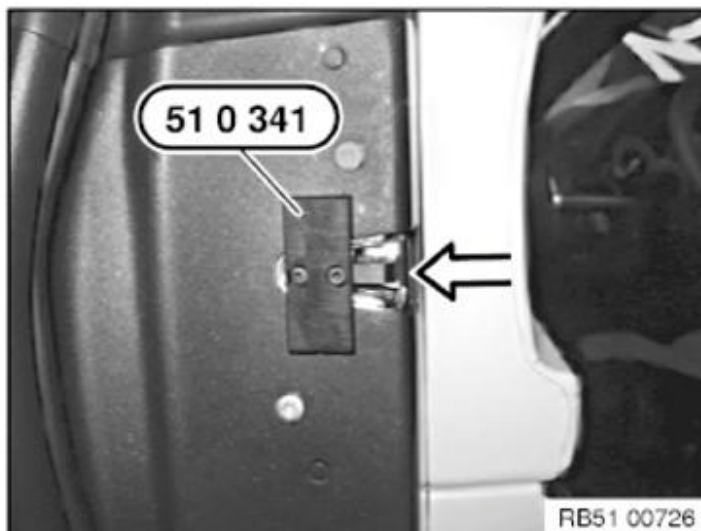
#### 1.1 Preparations:

Open door; move door window pane into uppermost position, if necessary.

Insert special tool **51 0 341** in rotary striker of door lock and manually lock rotary striker (short lift activation).

Close the door carefully up to the point where the special tool **51 0 341** magnetically adheres to the striker (defined door opening angle for measurement).





**Fig. 258: Inserting Special Tool (51 0 341) In Door Lock Rotary Striker**  
 Courtesy of BMW OF NORTH AMERICA, INC.

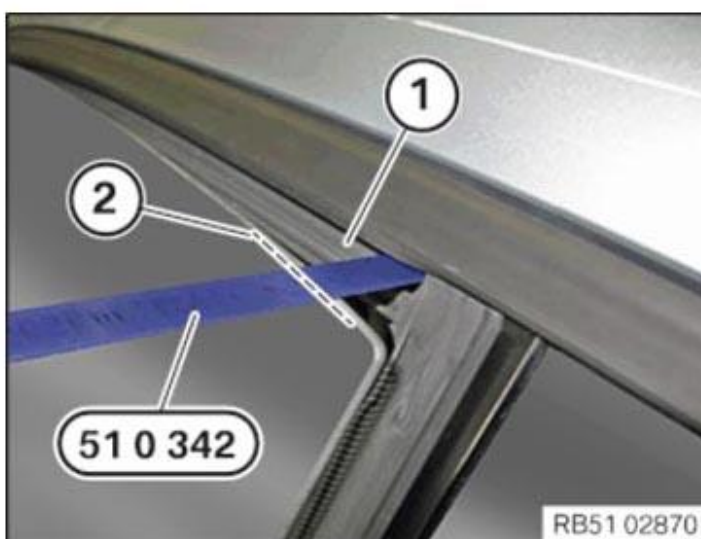
### 1.2 Preload ideal setting

**NOTE:** No force must be exerted on the door or door window pane during measurement.

Insert special tool [51 0 342](#) in gasket (1) up to limit position.

Determine dimension to the outer edge of the door window glass (2).

Dimension =  $43 \hat{A}\pm 1$  mm



**Fig. 259: Inserting Special Tool (51 0 342) In Gasket**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### 1.3 Adjust preload

Open door and remove sealing caps on door window frame.

Feed special tool [2 351 398](#) into the rear opening (1) of the door and apply to nut (2) and guide (3).

Slacken nut (2) with knob of the special tool [2 351 398](#) .

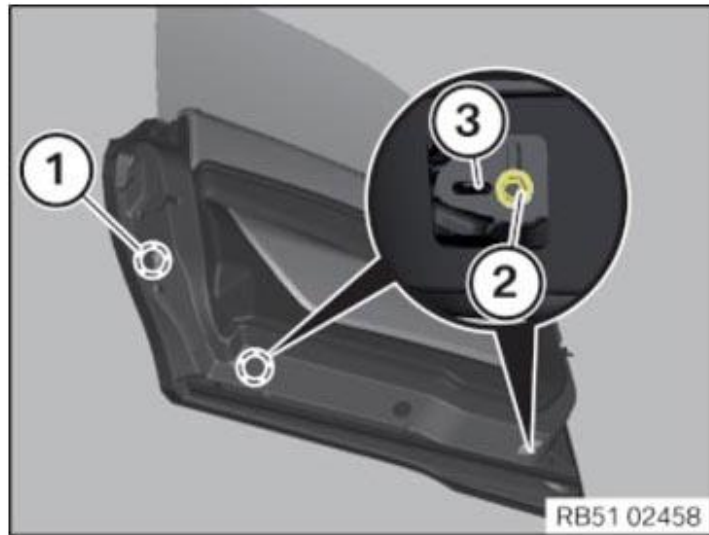
Turn the lever of the special tool [2 351 398](#) to adjust the preload and tighten nut (2).

Tightening torque [51 33 2AZ](#) .

Repeat the procedure at the front opening.

Check adjustment, repeat procedure if necessary.

Remove special tool [51 0 341](#) from rotary striker of door lock.



**Fig. 260: Identifying Rear Opening, Nut And Guide**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 2. Retraction depth/longitudinal direction

### 2.1 Checking ideal setting of retraction depth/longitudinal direction

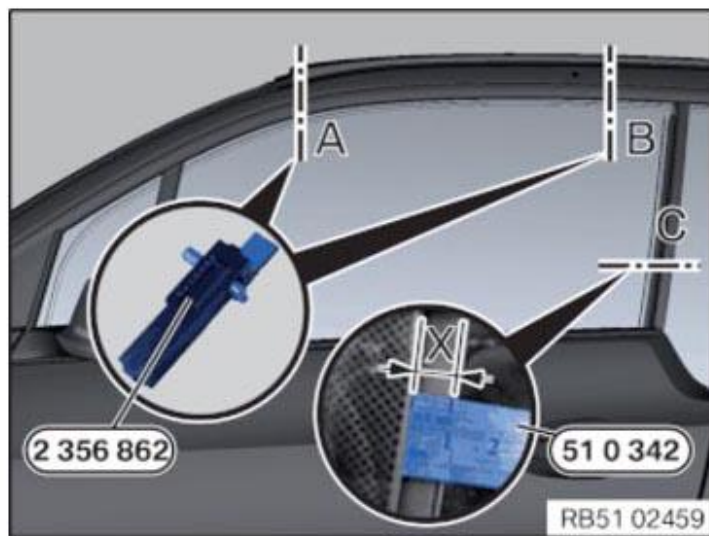
Open door.

Connect special tool [2 356 862](#) at measuring points (A and B) on door window glass.

Close door.

Measure distance (x) in area (C) of the door window glass to the side window at rear using special tool [51 0 342](#).

Measure height adjustment of the door window glass in the area (A and B) using special tool [2 356 862](#) (use 5 mm holder)



**Fig. 261: Measuring Height Adjustment Of Door Window Glass In Area (A And B) Using Special Tool (2 356 862)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Area	Dimension	Position of special tool 2 356 862
A	0, 8 mm	Approx. 150 mm above exterior mirror
B	0, 8 mm	Approx. 100 mm in front of outer edge of door window glass

Area	Dimension	Position of special tool 2 356 862
C	7 $\hat{A}$ ±1 mm	Door window glass front to rear door window glass trim Parallelism deviation maximum 1.5 mm
$\hat{A}$	13, 5 mm	Door window glass front to door window glass rear (without trim) Parallelism deviation maximum 1.5 mm

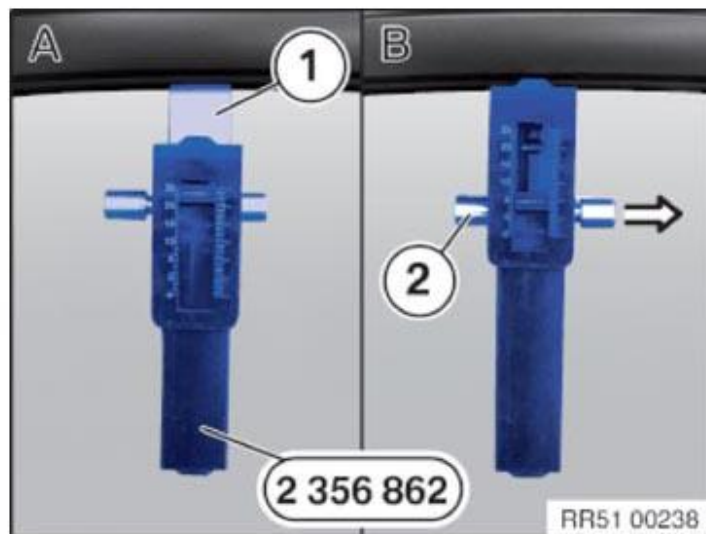
**IMPORTANT:** Door must open and close without the door window glass touching the roof trim strip (risk of damage).

**NOTE:** Check play of special tool [2 356 862](#) to edge of door window pane before each measurement.

Connect special tool [2 356 862](#) with 5 mm holder (1) in locked state (A) on door window glass.

Close door and undo lock (2).

Read retraction depth on the scale.



**Fig. 262: Connecting Special Tool (2 356 862) With Holder To Door Window Glass**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 2.2. Adjust retraction depth/longitudinal direction

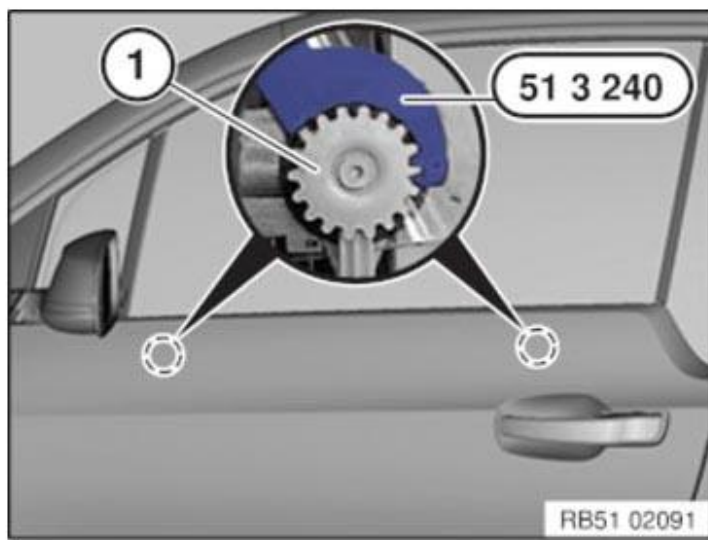
Remove [WEATHER STRIP](#) on outside of front door.

**NOTE:** Avoid damaging door window glass and window cavity through tool use.

When adjusting, ensure edge of door window glass continues to be supported by special tool [2 356 862](#) without any play.

Attach siphon to center of side window.

Slacken multipoint head cap screw (1) [51 3 240](#) with special tool until side window with siphon can just be moved with little effort.



**Fig. 263: Tightening Multipoint Head Cap Screw With Special Tool (51 3 240)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Always slacken both multipoint head cap screws to avoid tension in the power window system.

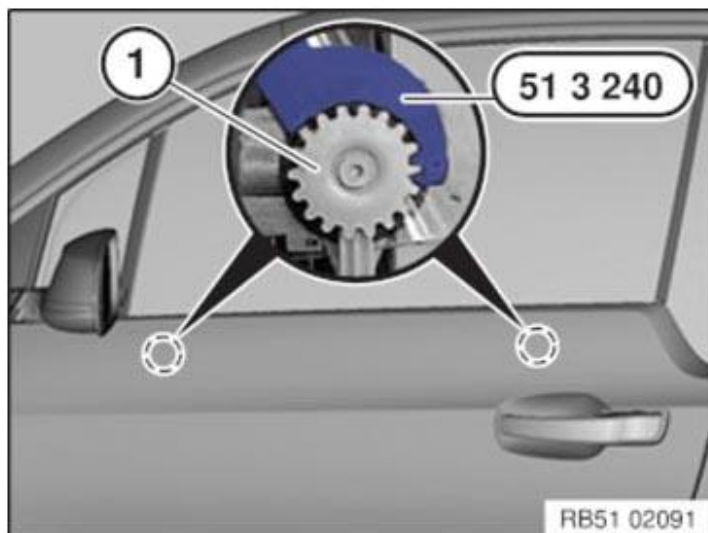
Adjust longitudinal direction and retraction depth of door window glass.

Tighten multipoint head cap screw (1) using special tool **51 3 240** and torque wrench.

Tightening torque **51 33 3AZ** .

**IMPORTANT:** Do not release or tighten multipoint head cap screw over inside of door (removed door trim panel; threaded bolt may snap).

Check adjustment, repeat procedure if necessary.



**Fig. 264: Tightening Multipoint Head Cap Screw With Special Tool (51 3 240)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

After completion of adjusting procedure, **INITIALIZE POWER WINDOW REGULATOR** .

### **51 32 200 REMOVING AND INSTALLING (REPLACING) FRONT FIXED DOOR WINDOW GLASS ON LEFT (RIGHT)**

**Necessary preliminary tasks:**

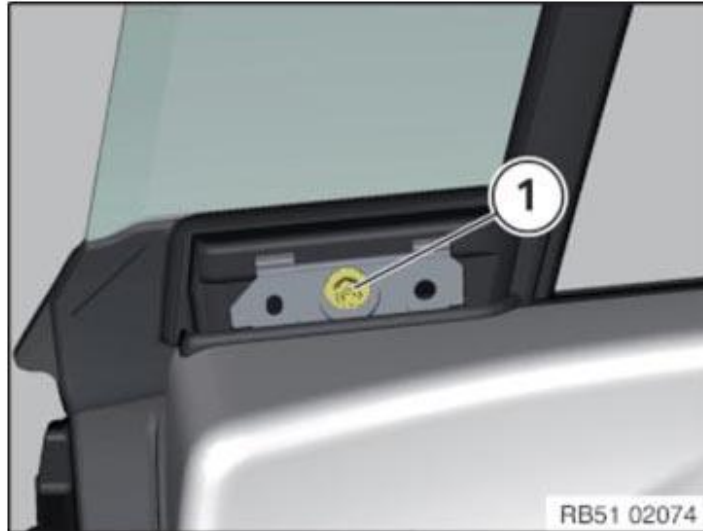
- Remove **EXTERIOR MIRROR ON FRONT DOOR**
- Remove **FRONT DOOR WINDOW GLASS**

Slacken nut (1).

Tightening torque [51 33 4AZ](#) .

*Installation note:*

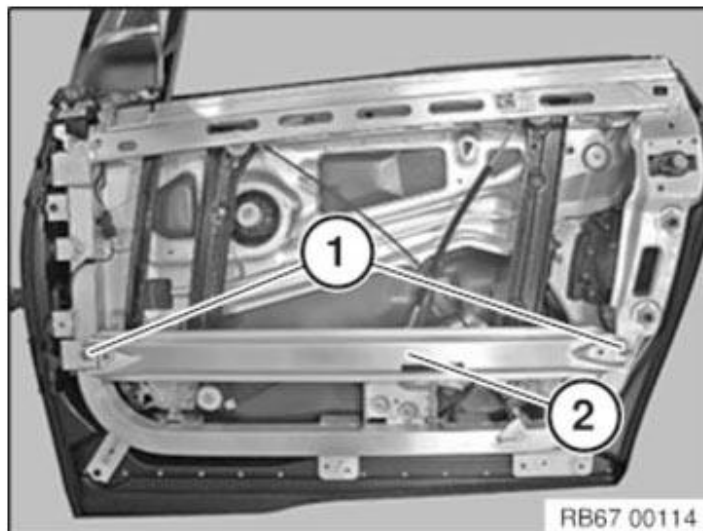
Replace nut (1).



**Fig. 265: Identifying Door Window Glass Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Remove strut (2).



**Fig. 266: Identifying Door Window Strut And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

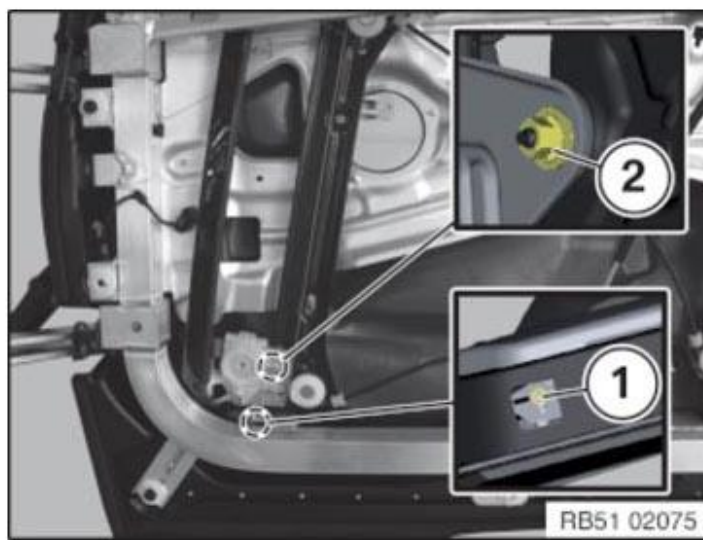
Release nut (1) from below.

Release nut (2) from rear.

Tightening torque [51 33 4AZ](#) .

*Installation note:*

Replace nuts (1) and (2).



**Fig. 267: Identifying Door Window Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull guide (1) with side window slightly upwards.

Release nut (2) from rear.

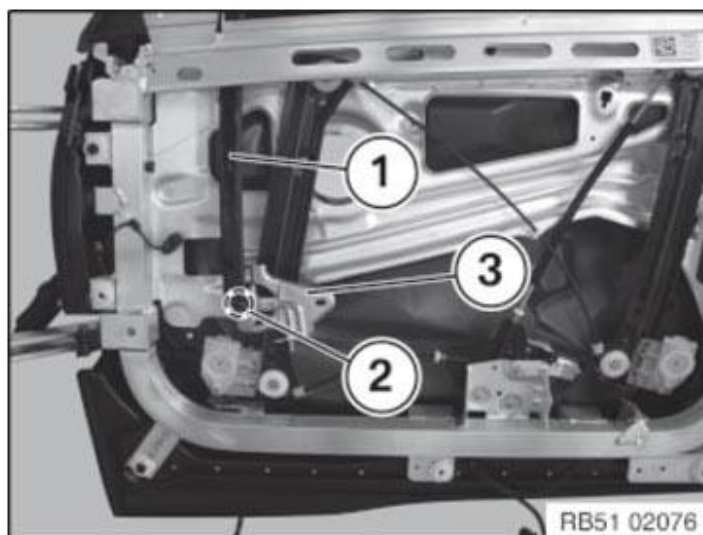
Tightening torque **51 33 4AZ**.

Take off holder (3).

Pull door window glass with guide (1) upwards.

*Installation note:*

Replace nut (2).



**Fig. 268: Identifying Door Window Glass Guide, Holder And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Adjusting **DOOR WINDOW GLASS**

**51 32 170 REMOVING AND INSTALLING/REPLACING DOOR WINDOW GLASS, FRONT LEFT OR RIGHT**

Special tools required:

- **51 3 240**



### Necessary preliminary tasks:

- Remove FRONT DOOR OUTER SKIN

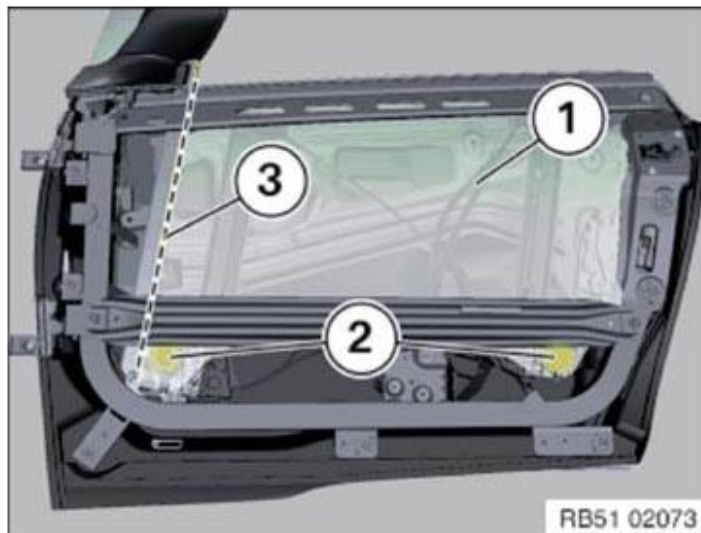
Move door window glass (1) fully downwards.

Release multipoint head cap screws (2) on ring gear using special tool [51 3 240](#) .

Tightening torque [51 33 3AZ](#) .

*Installation note:*

Make sure that door window glass (1) is correctly seated on window guide rail (3).



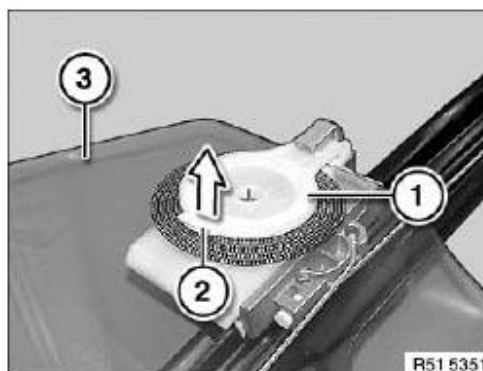
**Fig. 269: Identifying Door Window Glass, Window Guide Rail And Multipoint Head Cap Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Door window glass (3) remove for purposes of clarity.

Raise holder (1) at tab (2) and remove door window glass (3) in upward direction.

*Installation note:*

Make sure door window glass (1) is correctly seated in holder (2).



**Fig. 270: Removing Door Window Glass Tab**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Adjusting [DOOR WINDOW GLASS](#)
- Standardizing power window

## **FRONT POWER WINDOW REGULATOR**

## 51 33 000 REMOVING AND INSTALLING (REPLACING) POWER WINDOW REGULATOR IN LEFT OR RIGHT FRONT DOOR

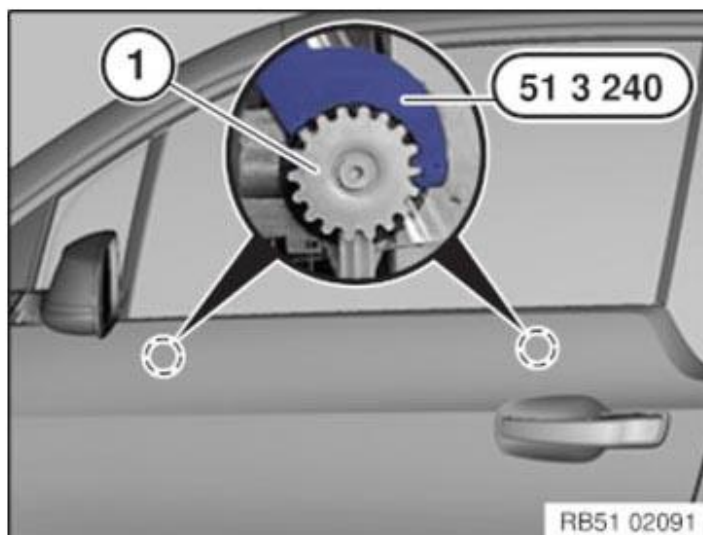
### Special tools required:

- [51 3 240](#)

### Necessary preliminary tasks:

- Remove [WEATHER STRIP](#)
- Remove INNER FRONT DOOR COVER

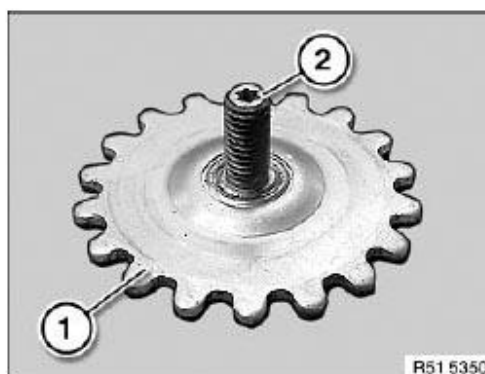
Slacken multipoint head cap screws (1) on ring gear with special tool [51 3 240](#) .



**Fig. 271: Tightening Multipoint Head Cap Screws On Ring Gear With Special Tool (51 3 240)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Slacken multipoint head cap screws on ring gear (1) until they can be screwed out slightly at inner star (2).



**Fig. 272: Identifying Ring Gear And Inner Star**

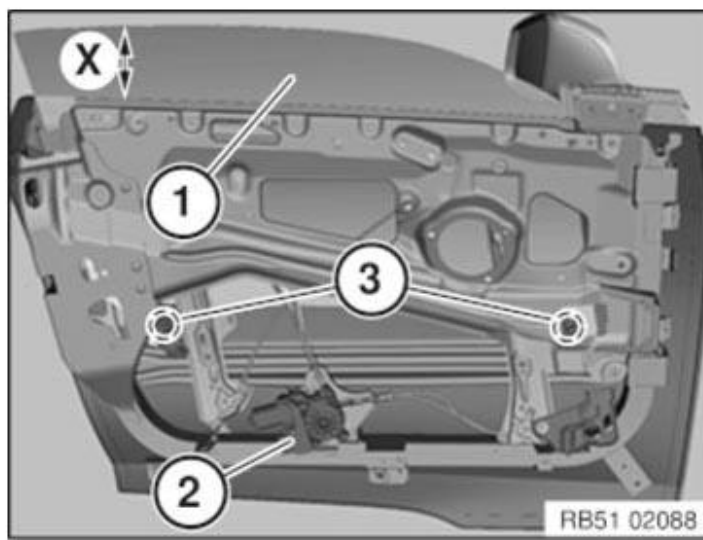
Courtesy of BMW OF NORTH AMERICA, INC.

Lower door window glass (1) down to dimension x.

x = approx. 110 mm.

Unfasten plug connection (2) and disconnect.

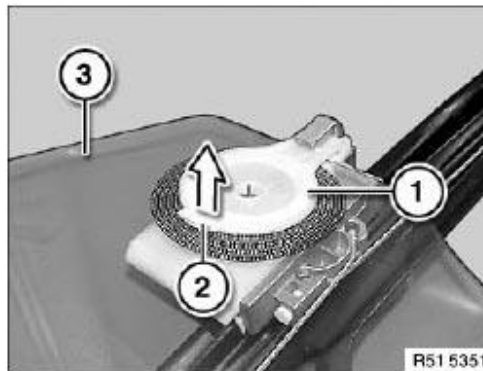
Screw out multipoint head cap screws (3) from rear.



**Fig. 273: Identifying Door Window Glass, Multipoint Head Cap Screws And Plug Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Door window glass (3) remove for purposes of clarity.

Raise holder (1) at tab (2) and remove door window glass (3) in upward direction.



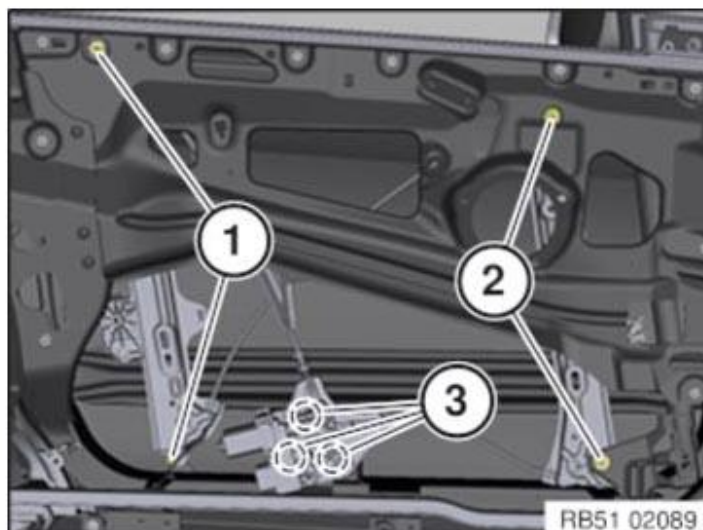
**Fig. 274: Removing Door Window Glass Tab**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release nuts (1) and (2).

Release nuts (3) from rear.

Tightening torque [51 33 2AZ](#).

Feed out power window regulator from door.



**Fig. 275: Identifying Power Window Regulator Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Installation note:

Adjust **SIDE WINDOW**.

**Replacement:**

Remount **FLAT MOTOR FOR POWER WINDOW REGULATOR**.

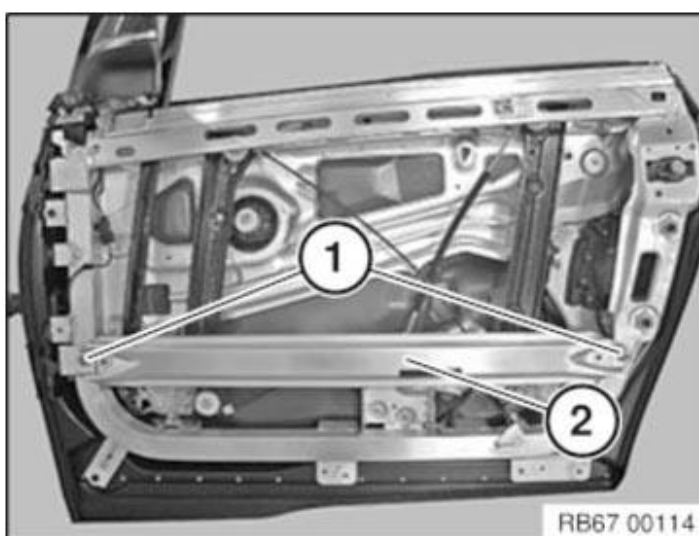
**(67 62 000 REMOVING AND INSTALLING OR REPLACING FLAT MOTOR FOR FRONT LEFT OR RIGHT POWER WINDOW REGULATOR)**

**Necessary preliminary tasks:**

- Remove FRONT DOOR OUTER SKIN

Release screws (1).

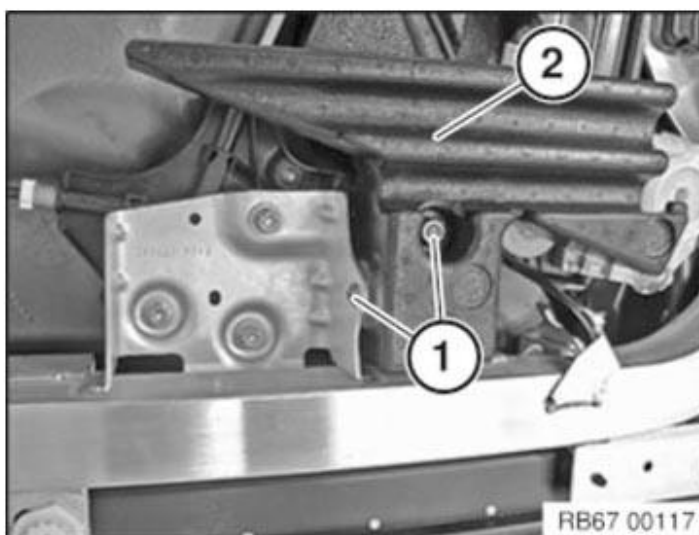
Tightening torque **41 51 4AZ** .



**Fig. 276: Identifying Door Window Strut And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Remove crashpad (2).

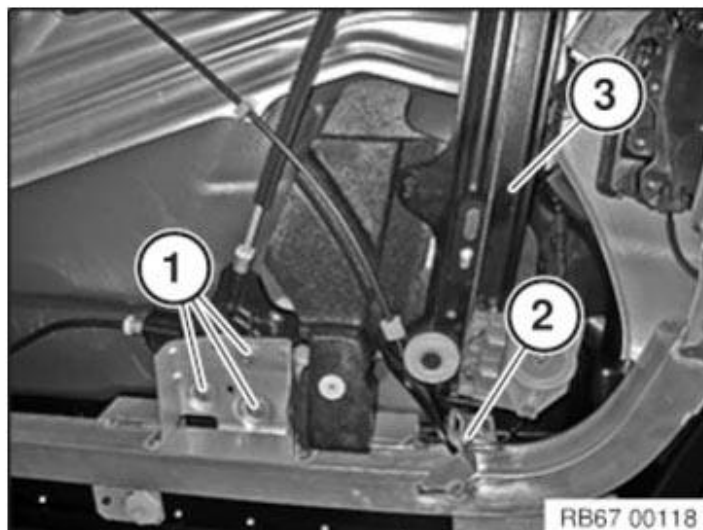


**Fig. 277: Identifying Crashpad And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release nuts (1 and 2).

Tightening torque [51 33 2AZ](#) .

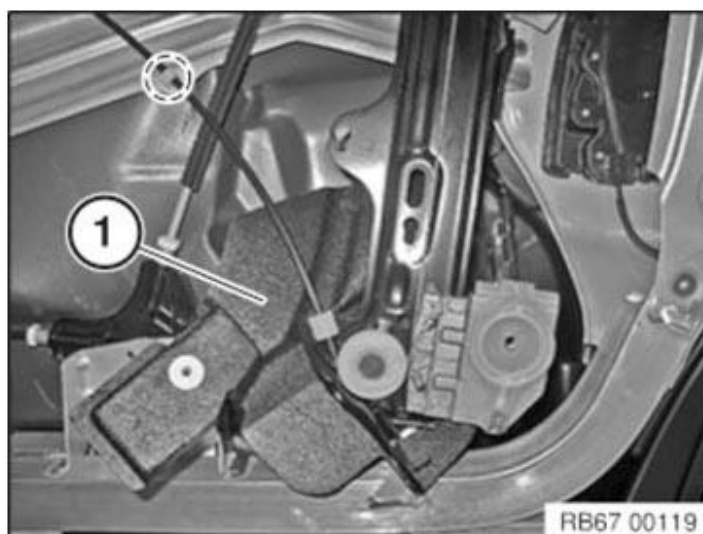
Feed out window lift rail (3) at bottom.



**Fig. 278: Identifying Window Lift Rail And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach cable in marked area.

Feed out crashpad (1).



**Fig. 279: Identifying Crashpad**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

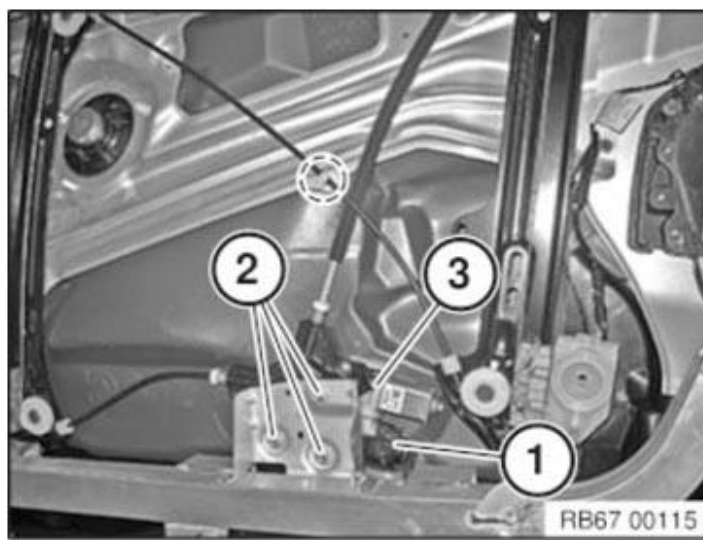
Unscrew nuts (2).

Tightening torque [51 33 2AZ](#) .

Detach cable in marked area.

Feed out flat motor (3).



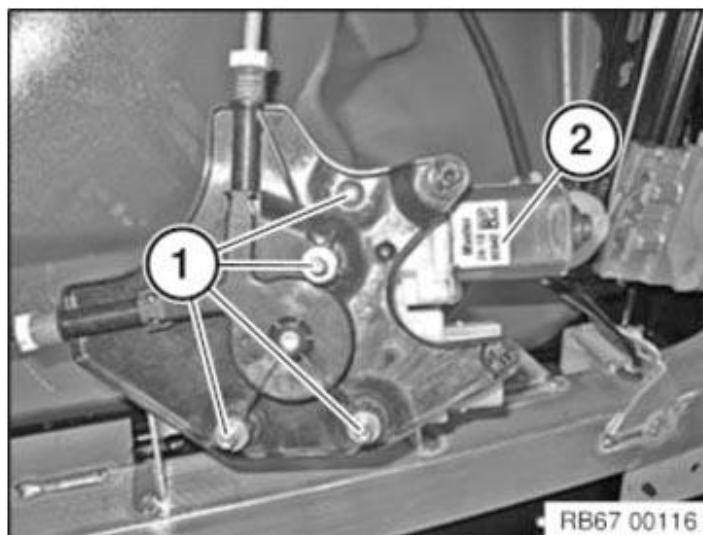


**Fig. 280: Identifying Flat Motor, Plug Connection And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque **51 33 1AZ**.

Remove flat motor (2).



**Fig. 281: Identifying Flat Motor And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

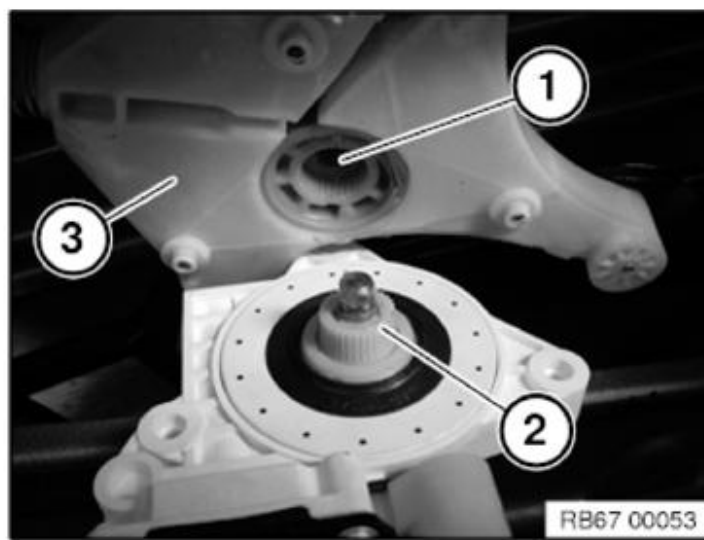
**NOTE:** Diagram similar.

*Installation note:*

Make sure drive shaft (2) is correctly seated in mounting (1) at power window regulator (3)!

Ensure that the flat motor (2) is assembled without tension.





**Fig. 282: Identifying Power Window Regulator And Drive Shaft**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

An initialization must be carried out in order to activate anti-trap mechanism.

Read and comply with **NOTES** on initialization of power window regulator.

## **REAR SIDE WINDOWS**

### **51 34 154 ADJUSTING REAR LEFT OR RIGHT DOOR WINDOW**

**Special tools required:**

- **51 0 342**
- **2 356 862**

**Prerequisite:**

- Vehicle must be standing on its wheels on a level floor
- Properly fit FOND DOOR .

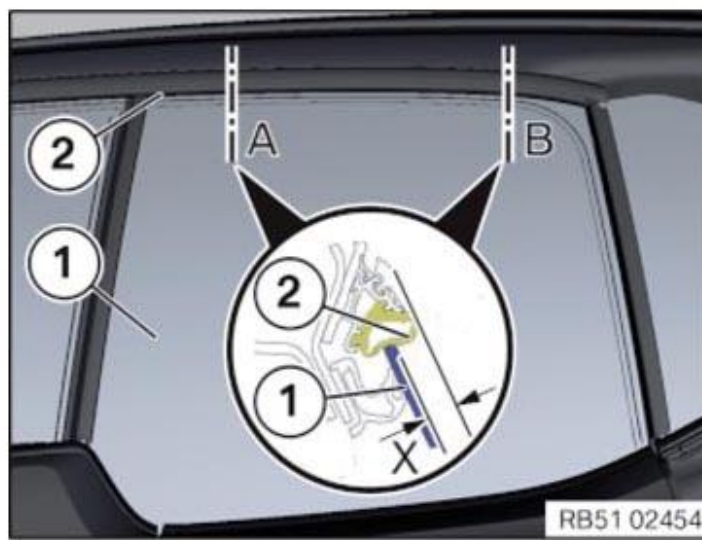
**1. Preload ideal setting:**

**1.1 Check preload setting:**

Close door.

Bring special tool **51 0 342** into contact with window guide gasket (2) and door window glass (1).

Measure the distance (X) between the door window glass (1) and the gasket (2) at measuring points (A) and (B).



**Fig. 283: Measuring Distance Between Door Window Glass And Gasket**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Area	Dimension (X) $\hat{A}$	$\hat{A}$
A	8.5 $\hat{A}\pm 2$ mm	Distance of measuring point approx. 50 mm from outer edge of window
B	9.5 $\hat{A}\pm 2$ mm	Distance of measuring point approx. 50 mm from outer edge of window

**NOTE:** No force must be exerted on the door or door window pane during measurement.

### 1.2 Adjust preload:

Remove **UPPER B-PILLAR TRIM PANEL**.

Loosen sealing (1) in upper area.



**Fig. 284: Identifying Sealing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** First perform the following operations on the upper adjusting element.

If the ideal values are not achieved, the lower adjusting element must also be adjusted.

Slacken nut (1).

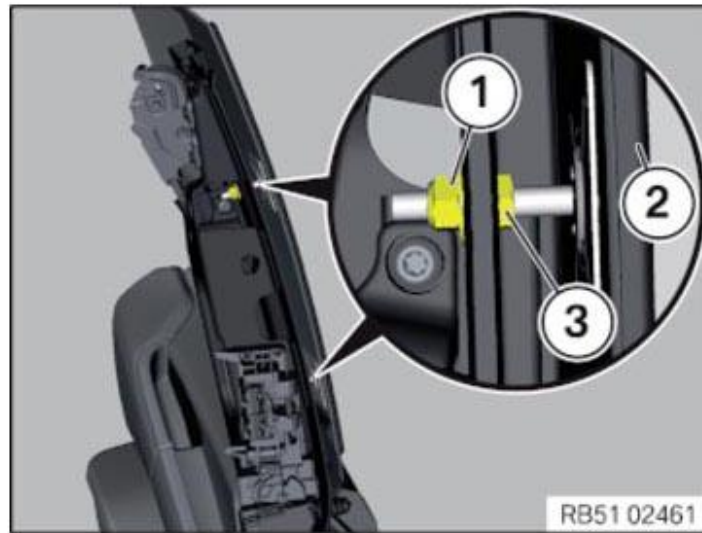
Adjust the preload of the door window glass (2) by twisting the adjusting nut (3).

Tighten nut (1).

Tightening torque **51 35 1AZ**.

Check the preload setting again.

Repeat process if necessary.



**Fig. 285: Identifying Door Window Glass And Adjusting Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

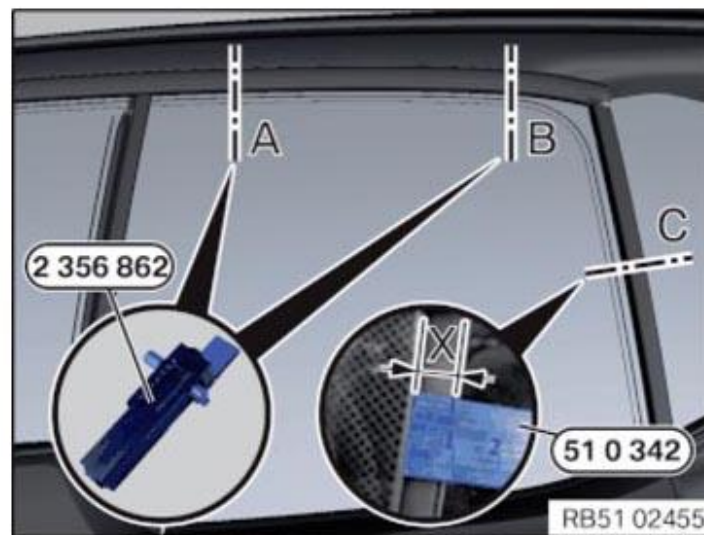
2. Ideal setting in transverse and longitudinal direction:

**2.1 Check setting in transverse and longitudinal direction:**

Open door.

Connect special tool [2 356 862](#) at points (A) and (B) on door window glass.

Close door.



**Fig. 286: Connecting Special Tool (2 356 862) At Points (A) And (B) On Door Window Glass**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Measure distance (x) in area (C) from the door window glass to the rear side window using special tool [51 0 342](#).

Measure height adjustment of the door window glass in areas (A and B) using special tool [2 356 862](#) (use 5 mm holder).

Area	Dimension	Â
A	-2 mm	Distance of measuring point approx. 50 mm from outer edge of window
B	-2 mm	Distance of measuring point approx. 50 mm from outer edge of window
C	5 $\hat{\pm}$ 1 mm	Door window glass to trim Parallelism deviation maximum 1.5 mm

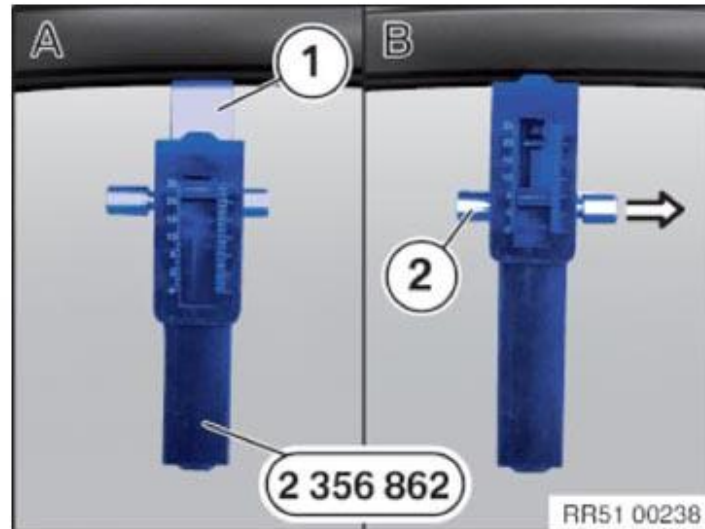
Area	Dimension	Â
Â	12, 5 mm	Door window glass to side window (without trim)

**NOTE:** Check play of special tool [2 356 862](#) to edge of door window pane before each measurement.

Connect special tool [2 356 862](#) with 5 mm holder (1) to the door window glass while in a locked state (A).

Close door and undo lock (2).

Read retraction depth on the scale.



**Fig. 287: Connecting Special Tool (2 356 862) With Holder To Door Window Glass**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 2.2 Adjust door window glass in transverse and longitudinal direction.

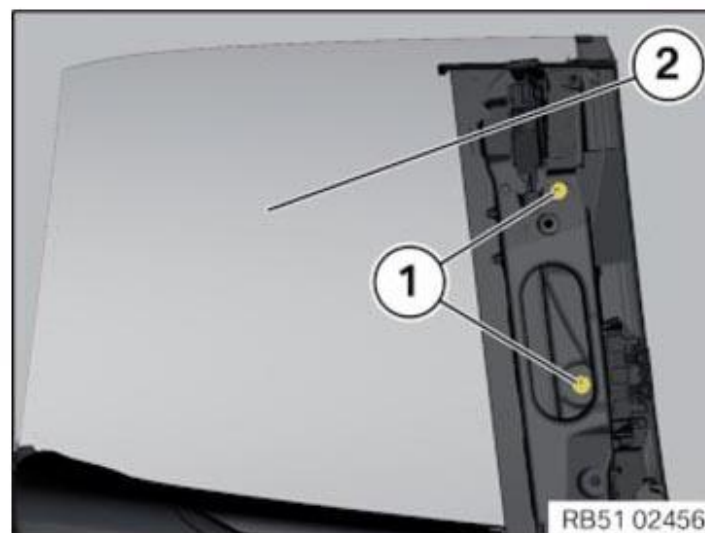
Remove [UPPER B-PILLAR TRIM PANEL](#).

Unscrew nuts (1).

Adjust it the optimum amount by moving the door window glass (2).

Tighten down nuts (1).

Tightening torque [51 35 1AZ](#) .



**Fig. 288: Identifying Door Window Glass And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Rear door must open and close without the door window glass touching the roof trim strip (risk of damage)

Check setting in transverse and longitudinal direction again.

Repeat process if necessary.

## **51 34 171 REPLACING REAR LEFT OR RIGHT DOOR WINDOW**

**Necessary preliminary tasks:**

- Remove **UPPER B-PILLAR TRIM PANEL**

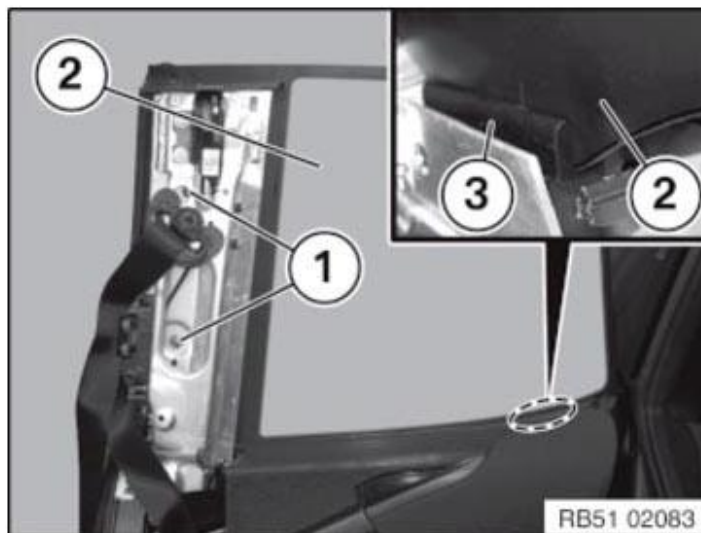
Unscrew nuts (2).

Tightening torque **51 35 1AZ** .

Pull door window glass (2) in front area outwards slightly and remove upwards.

*Installation note:*

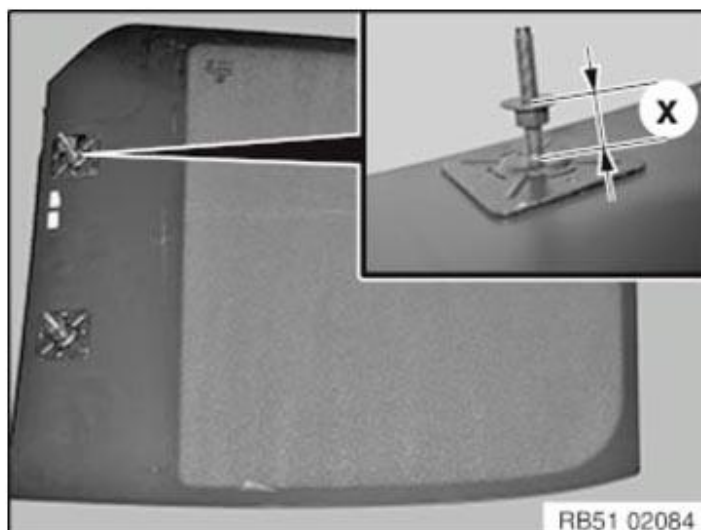
Door window glass (2) must be seated in guide (3) correctly.



**Fig. 289: Identifying Door Window Glass, Guide And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Transfer dimension x from adjusting screws on old window glass to adjusting screws on new window glass.



Installation note:

Adjust **SIDE WINDOW**.

**51 36 130 REMOVING AND INSTALLING (REPLACING) REAR LEFT (OR RIGHT) SIDE WINDOW**

- IMPORTANT:
- The **GENERAL PROCEDURE FOR DISMANTLING/INSTALLATION OF AFFIXED WINDOW GLASS** serves as the basis for this repair instruction and must be observed without fail.

Removal is carried out with **SPIDER**.

The following new parts/**CONSUMABLES** are required.

Material	Quantity
Side window (with replacement)	1
Spacer buffer 5x5x20 mm	4
Velcro fastener	6
Small repair kit	1
C-pillar window frame	1
Front trim (with replacement)	1
Rear trim (with replacement)	1

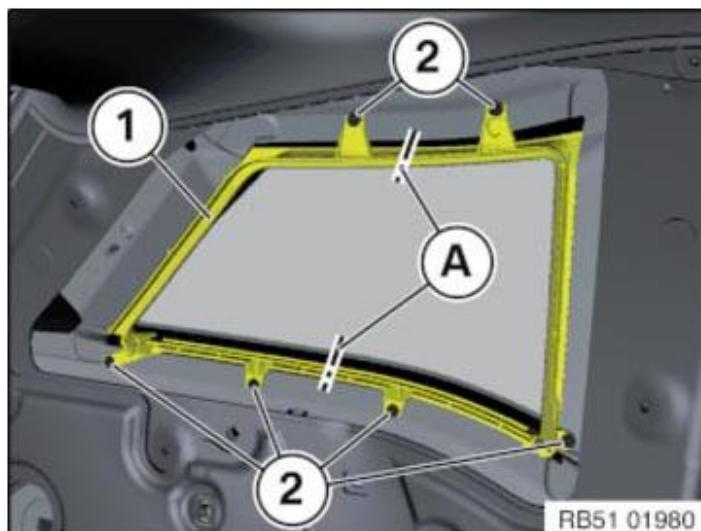
**Necessary preliminary tasks:**

- Remove rear side wall. See REMOVING LEFT REAR SIDE PANEL or REMOVING RIGHT REAR SIDE PANEL .
- Remove **SHOULDER**
- Remove **TRIM PANELS FOR REAR ROOF PILLAR** (C-pillar)
- Remove rear outer **ROOF FRAME TRIM PANEL**

**NOTE:** The trim (1) must be destroyed for the side window to be disassembled.

Unfasten screws (2).

Cut through trim (1) in area (A) and feed out.



**Fig. 291: Identifying Trim Cutting Area**  
Courtesy of BMW OF NORTH AMERICA, INC.



**When reusing side window:**

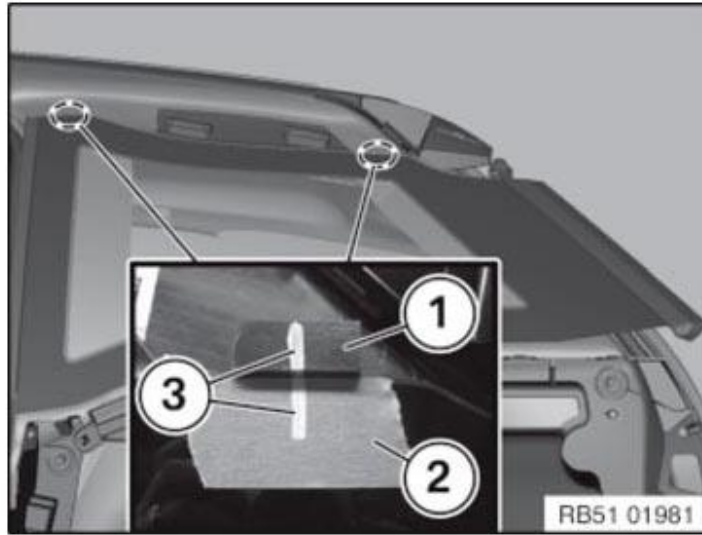
Mark position of side window.

Position support (1) for fixing to window edge and bond to body.

Bond adhesive tape (2) to window edge.

Mark (3) adhesive tape (2) and support (1).

**NOTE:** Part number 16 11 1 178 676 can be used as support (1).



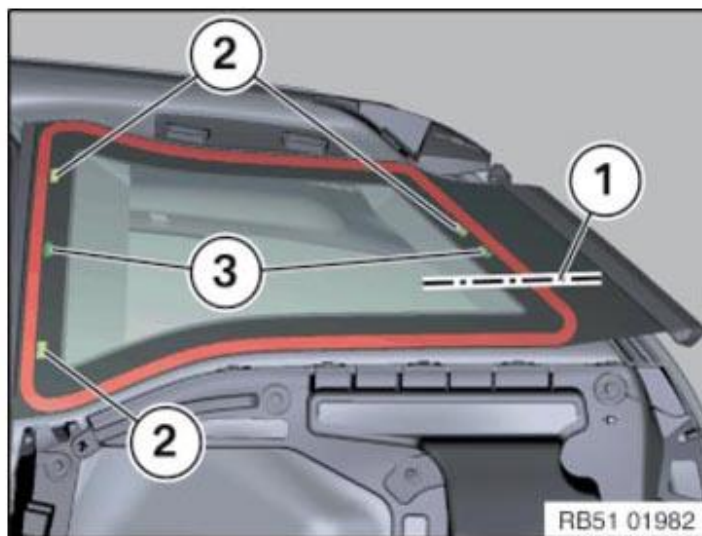
**Fig. 292: Identifying Adhesive Tape Applying Area On Window Edge**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Tape off body in area of piercing point (1) with fabric adhesive tape (risk of damage).

Slide nylon string out of **SPIDER** at line (1) through adhesive bead.

*Left side window:*



**Fig. 293: Identifying Line On Adhesive Bead**  
Courtesy of BMW OF NORTH AMERICA, INC.

Run nylon string around side window in an counter clockwise direction (as seen from outside).

Cut through adhesive bead in an counter clockwise direction (as seen from outside).

*Right side window:*

Place nylon string clockwise around side window seen from outside.

Cut through adhesive bead in a clockwise direction (as seen from outside).

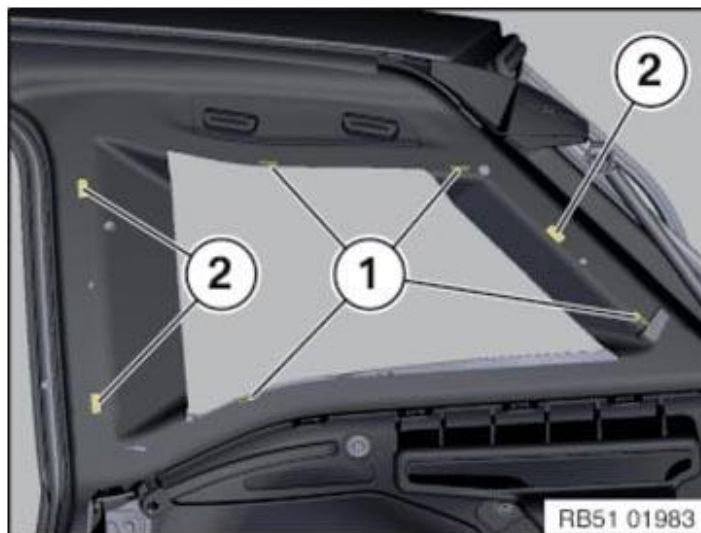
Secure side window against falling out.

When cutting, the Velcro fasteners (2) and the centering pins (3) are cut through.

Increased effort must be reckoned with at these points.

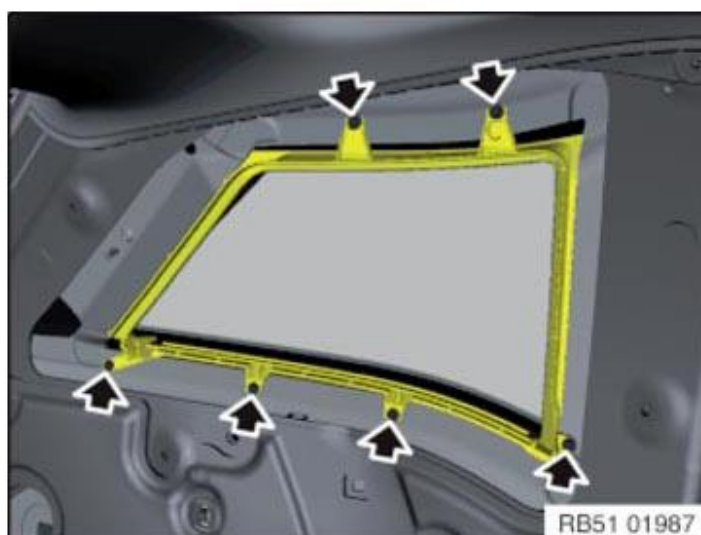
To prevent window breakage and wind noise, completely remove all remnants of damaged spacer buffers (1) and Velcro fasteners (2) and ensure the installation position is precisely adhered to.

Bond new spacer buffers (1) and Velcro fasteners (2) to marked body areas or side window frames.



**Fig. 294: Identifying Spacer Buffers And Velcro Fasteners**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed in new trim from outside and secure with screws.



**Fig. 295: Locating Trim Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**For new side frame**

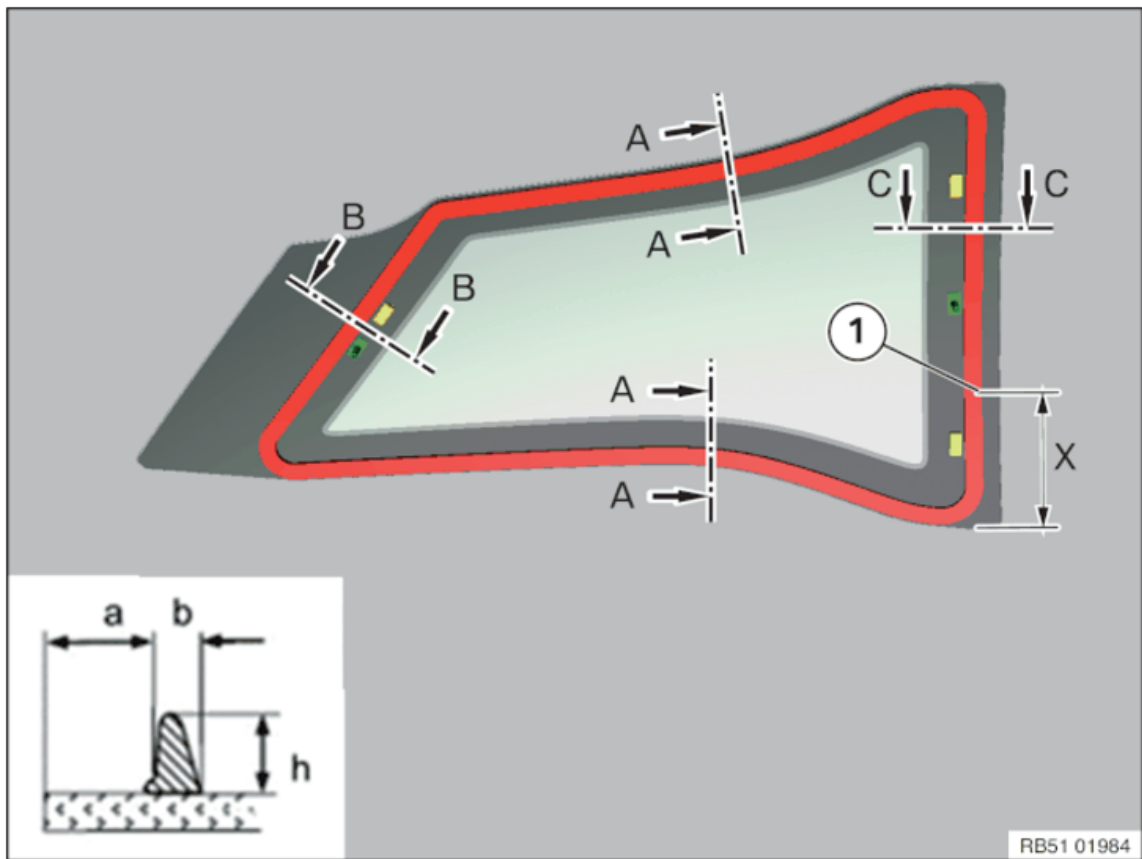
Adhesive area (1) on new part (without adhesive bead) needs to be roughened by means of ScotchBrite Multiflex (51 91 0 402 967) emery pad.



**Fig. 296: Identifying Adhesive Applying Area On Side Frame**

Courtesy of BMW OF NORTH AMERICA, INC.

Overview for side window bonding:



**Fig. 297: Overview Of Rear Side Window Bonding**

Courtesy of BMW OF NORTH AMERICA, INC.

Cut	A - A	B - B	C - C
<b>a</b> [mm] = Position adhesive bead	6 mm	30 mm (to dot matrix)	18 mm
<b>b</b> [mm] = Width adhesive bead	7 $\hat{A}$ $\pm$ 1	$\hat{A}$	$\hat{A}$
<b>h</b> [mm] = Height adhesive bead	12-2	$\hat{A}$	$\hat{A}$

x = approx. 130 mm (bead joint distance (1) to side window outer edge)

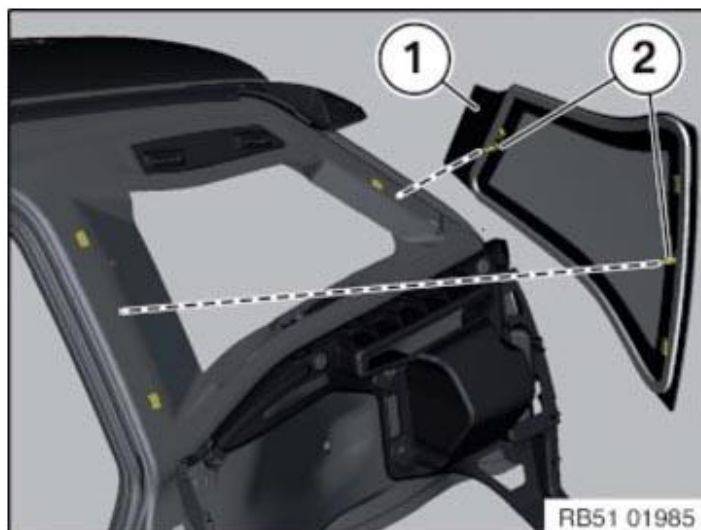
**Installing new side window:**

Align side window (1) with suction lifter over centering pins (2) and press down.

Engage side window (1) in Velcro fasteners.

Reassemble the vehicle.

Mount new **C-PILLAR TRIM** and **D-PILLAR TRIM**.



**Fig. 298: Identifying Centering Pins And Side Window**

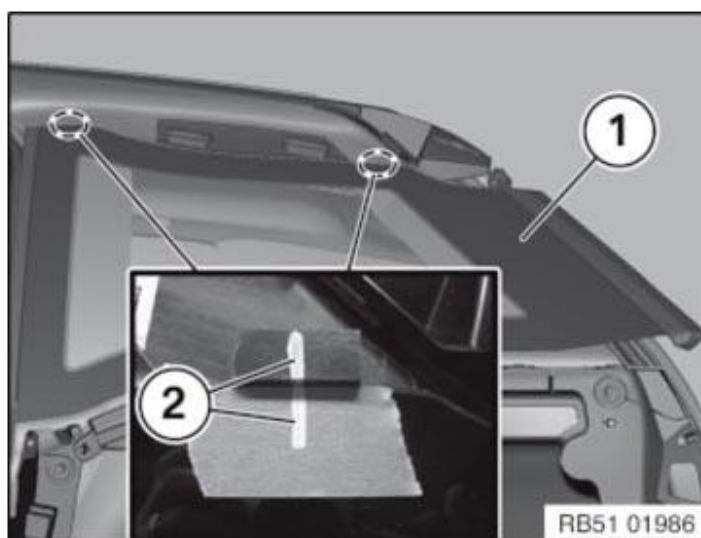
Courtesy of BMW OF NORTH AMERICA, INC.

**Reusing side window:**

Align side window (1) with suction lifter at mark (2) and press down.

Engage side window (1) in Velcro fasteners.

Fix side window (1) in position with yellow plastic adhesive tape.



**Fig. 299: Identifying Side Window**

Courtesy of BMW OF NORTH AMERICA, INC.

**FRONT DOOR TRIM PANEL WITH ARM REST**

**51 41 000 REMOVING AND INSTALLING (REPLACING) FRONT LEFT OR RIGHT DOOR TRIM PANEL**

**Special tools required:**

- **64 1 020**

When working on trim panel components, make sure that the sensitive surfaces are not scratched or damaged.

Press cover (1) in top area inwards and remove.

Release screw underneath.

Tightening torque [51 41 1AZ](#) .



**Fig. 300: Pressing Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

Lever out cover (1) in direction of arrow using special tool [64 1 020](#) and remove.



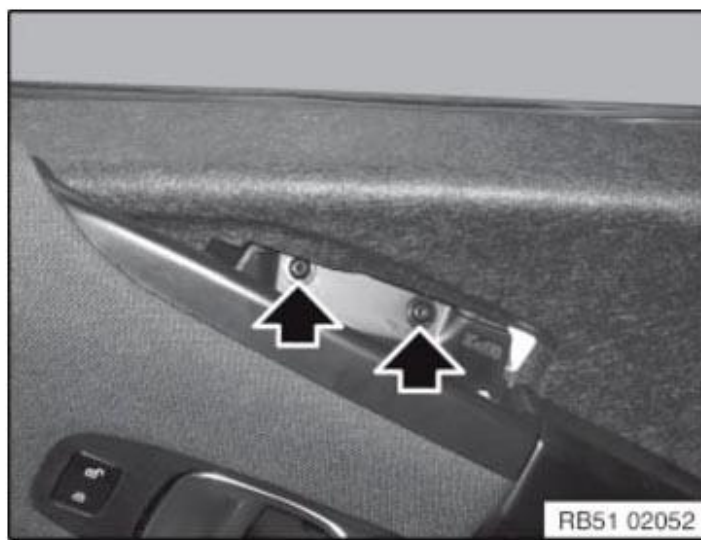
**Fig. 301: Removing Cover Using Special Tool (64 1 020)**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws.

Tightening torque [51 41 1AZ](#) .





**Fig. 302: Locating Front Door Trim Panel Screws**

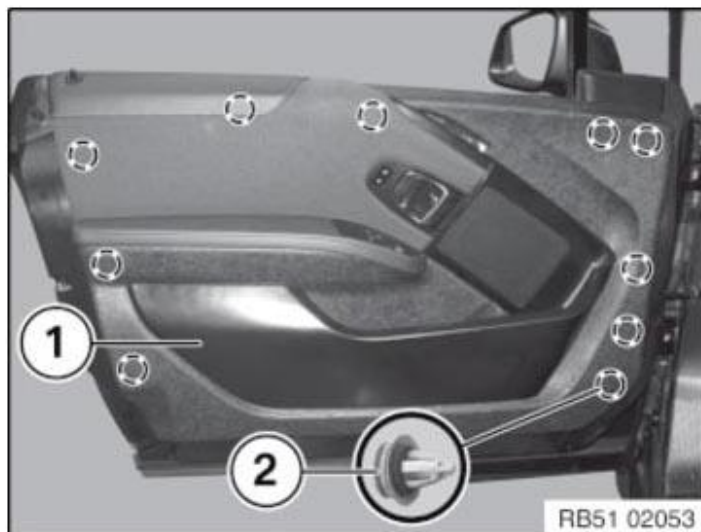
Courtesy of BMW OF NORTH AMERICA, INC.

Lever door trim panel (1) out of clips (2) beginning at the top.

**IMPORTANT:** **Risk of damage.** Do not pull on map pocket. Door trim panel lower section may separate from door trim panel upper part.

*Installation note:*

Replace faulty clips (2).



**Fig. 303: Identifying Door Trim Panel And Clips**

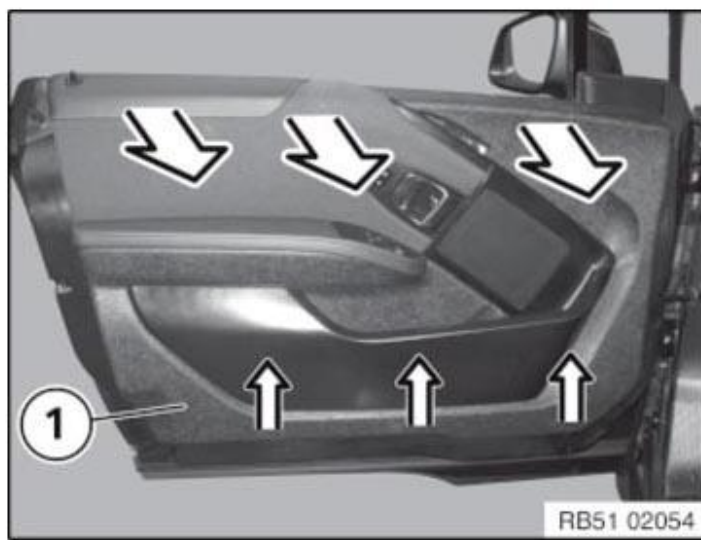
Courtesy of BMW OF NORTH AMERICA, INC.

Fold door trim panel (1) away from door slightly, beginning in the top area.

Release corresponding plug connections and cable clips.

Remove door trim panel (1) upwards.





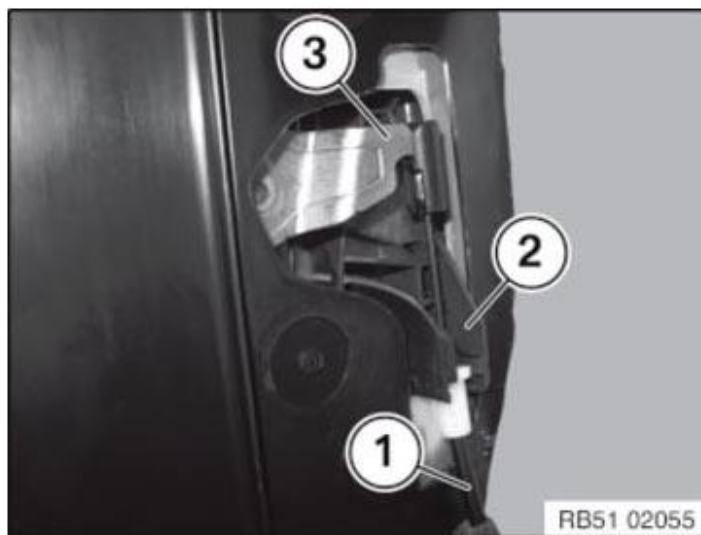
**Fig. 304: Removing Door Trim Panel**

Courtesy of BMW OF NORTH AMERICA, INC.

Disengage Bowden cable (1) for release lever first at counter support (2) and then at door lock (3).

*Installation note:*

Perform function check for door inside handle with door open and rotary striker lock closed.



**Fig. 305: Identifying Bowden Cable, Counter Support And Door Lock**

Courtesy of BMW OF NORTH AMERICA, INC.

When replacing, swap over the following parts:

- **SWITCH FOR CENTRAL LOCKING**
- **POWER WINDOW SWITCH**

*Installation note:*

After assembling the door trim panel proceed as follows:

- Open side window
- Lock with ignition key
- Check for ease of movement on locking button linkage
- If necessary, align linkage

**41 51 045 REMOVING/INSTALLING/REPLACING COVER OF FRONT DOOR, INNER LEFT OR RIGHT**

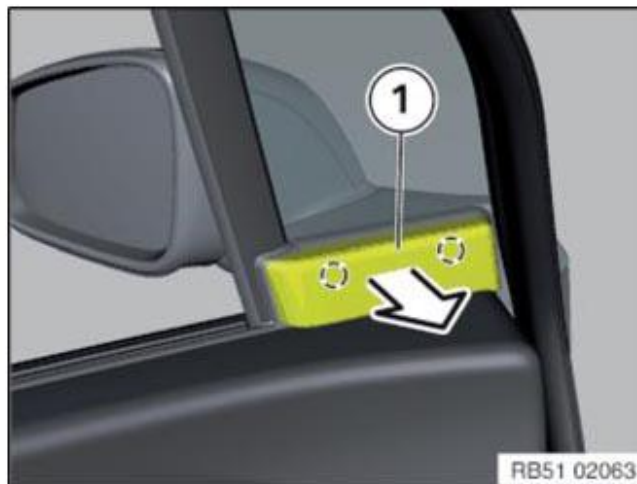
Read contents of BODY, GENERAL .

**NOTE:** Observe (REPAIR STAGE 1) procedure!

Necessary preliminary tasks:

- Remove **DOOR TRIM PANEL**
- Remove front DOOR
- Fix DOOR ON ASSEMBLY STAND
- Remove **SPEAKER**

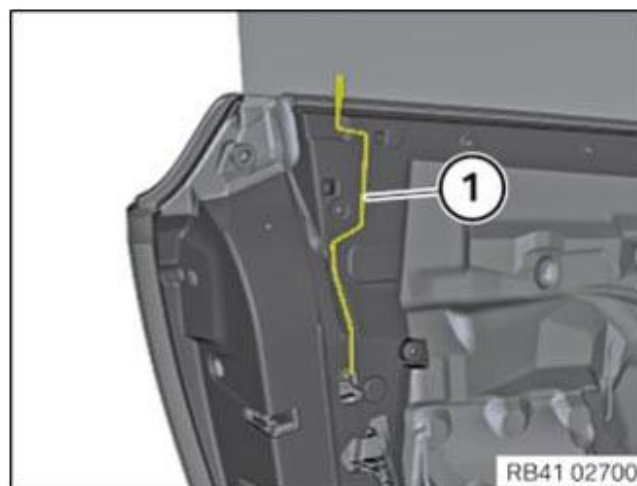
Lever out window frame cover (1) and remove.



**Fig. 306: Removing Window Frame Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

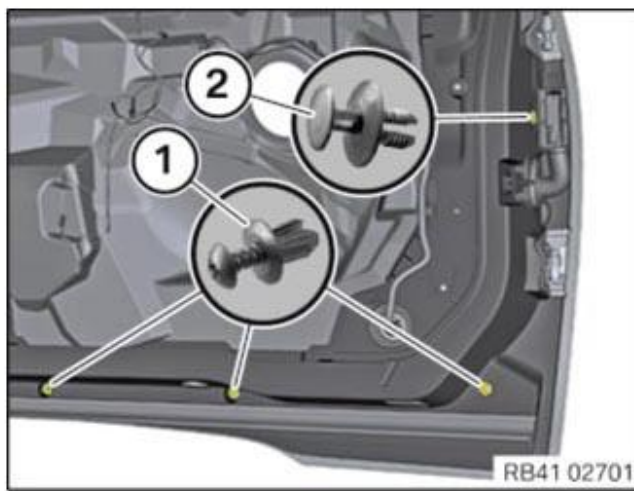
Lift out operating rod (1).



**Fig. 307: Identifying Operating Rod**

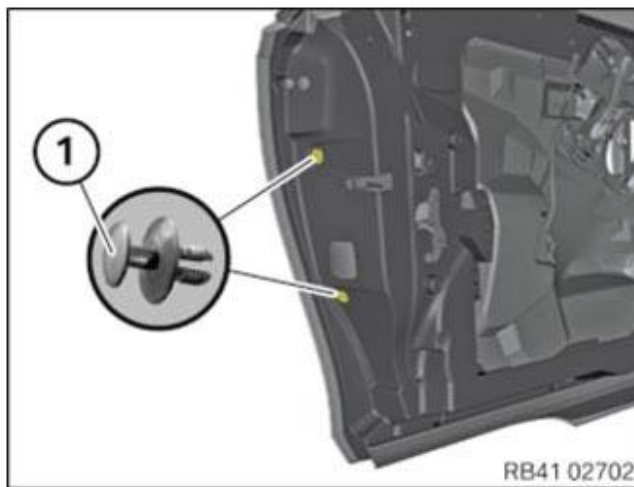
Courtesy of BMW OF NORTH AMERICA, INC.

Release expanding rivets (1 and 2).



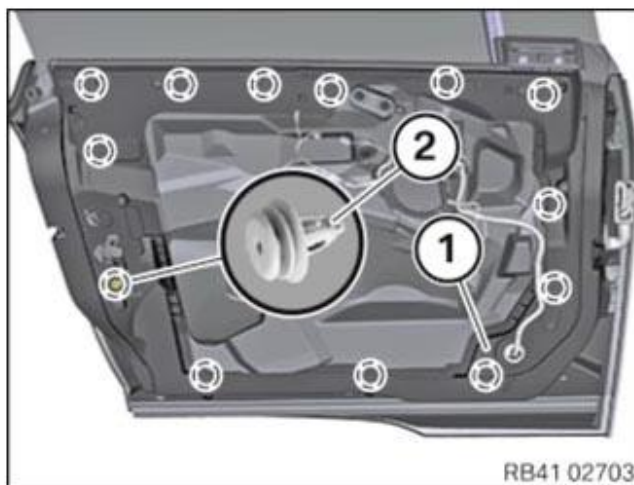
**Fig. 308: Identifying Expanding Rivets**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release expanding rivet (1).



**Fig. 309: Identifying Expanding Rivet**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release cover (1) from the clips (2).



**Fig. 310: Identifying Cover And Clips**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Feed cable grommets (1) out of cover (3).

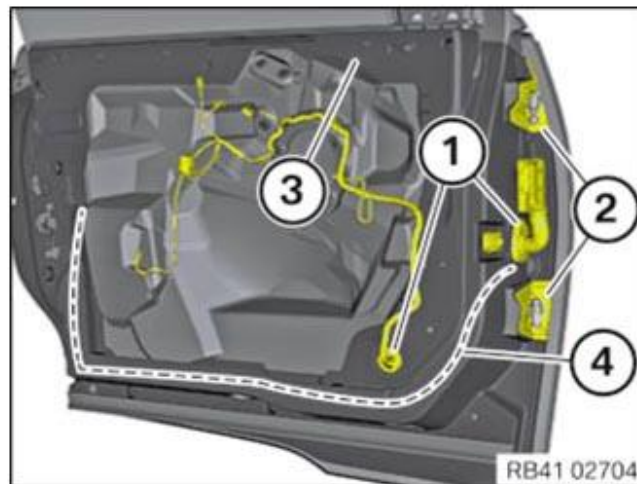
Release hinge covers (2) from cover (3).

Slightly pull cover (3) back and release cable clip from wiring harness (4).

Feed wiring harness completely out of cover (3).

Risk of damage!

IMPORTANT: Hold door on assembly stand in position and release mounting for door stop on assembly stand.  
Remove cover (3).  
Fix door stop on assembly stand.

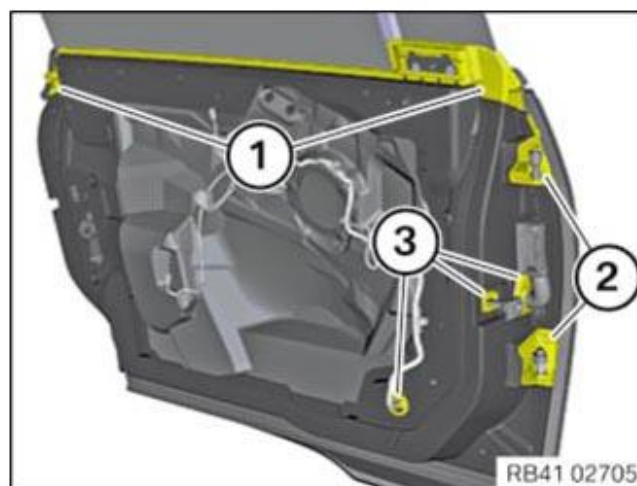


**Fig. 311: Identifying Cable Grommets, Hinge Covers And Wiring Harness**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure the following components are correctly seated:

- Weather strip (1)
- Hinge covers (2)
- Grommets (3)

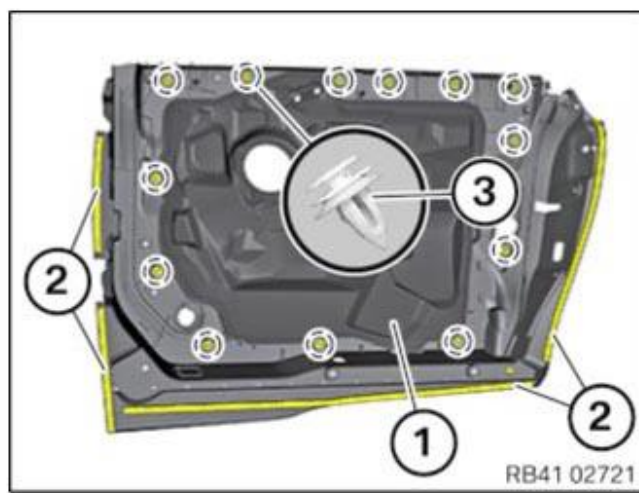


**Fig. 312: Identifying Weather Strip, Hinge Covers And Grommets**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Sealing foil (1) and gaskets (2) must not be damaged.

Replace faulty clips (3).



**Fig. 313: Identifying Gaskets, Foil And Faulty Clips**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## REAR DOOR TRIM PANEL WITH ARM REST

### 51 42 000 REMOVING AND INSTALLING (REPLACING) REAR LEFT OR RIGHT DOOR TRIM PANEL

Special tools required:

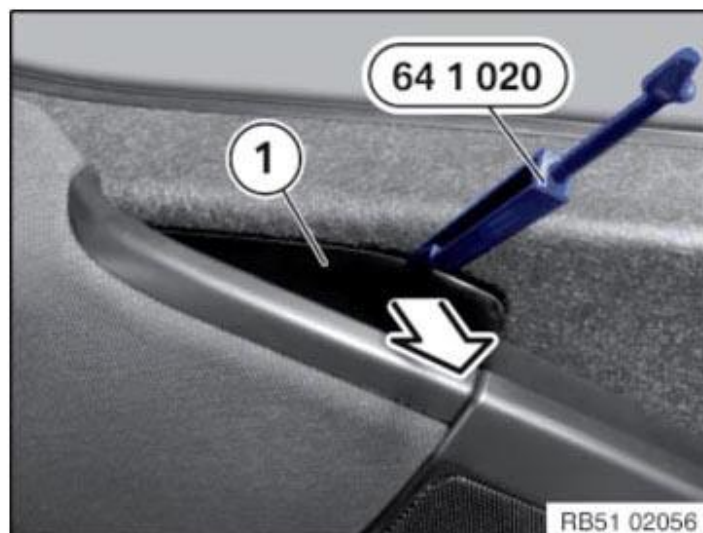
- [64 1 020](#)

When working on trim panel components, make sure that the sensitive surfaces are not scratched or damaged.

Necessary preliminary tasks:

- Remove [ROOF PILLAR TRIM PANEL \(B-PILLAR\)](#).

Lever out cover (1) in direction of arrow using special tool [64 1 020](#) and remove.



**Fig. 314: Removing Cover Using Special Tool (64 1 020)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [51 42 1AZ](#).

Lever our door trim panel (3) from clips (2).

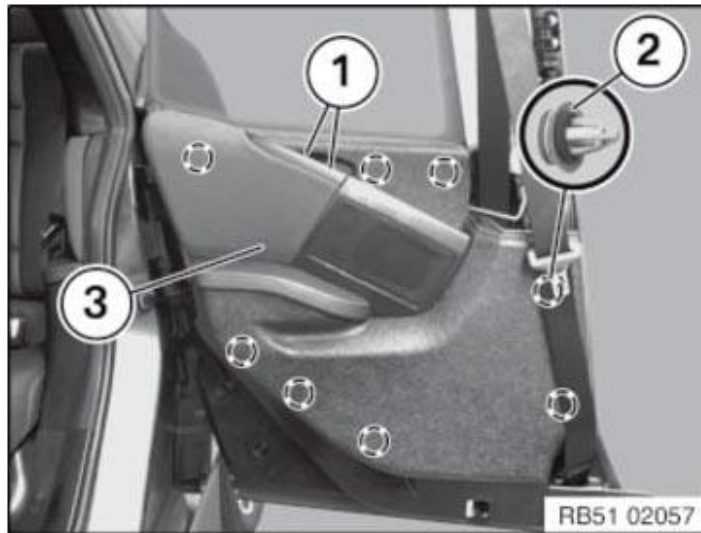
*Installation note:*

Replace faulty clips (2).



Unlock associated plug connections and disconnect.

Remove door trim panel.(3).



**Fig. 315: Identifying Door Trim Panel, Clips And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

### **41 52... REMOVING AND INSTALLING/REPLACING THE LEFT OR RIGHT SHROUD TRIM FOR B-PILLAR**

Read contents of BODY, GENERAL .

**NOTE:** Observe (REPAIR STAGE 1) procedure!

**Necessary preliminary tasks:**

- Remove REAR DOOR OUTER SKIN
- Remove **FRONT LOCK STRIKER**
- Remove **TRIM PANEL FOR B-PILLAR**

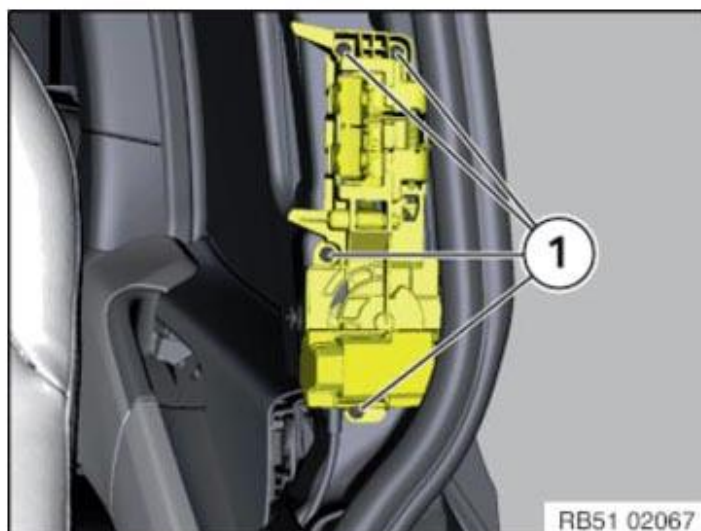
Release screws (1).

Tightening torque **51 22 5AZ** .

Feed door opener out of B-pillar.

*Installation note:*

After installation, carry out function check with door open.



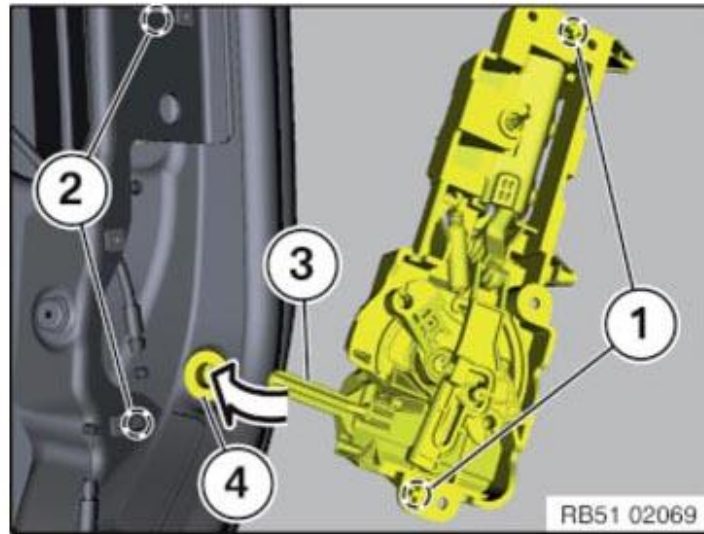


**Fig. 316: Identifying Inside Door Opener Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

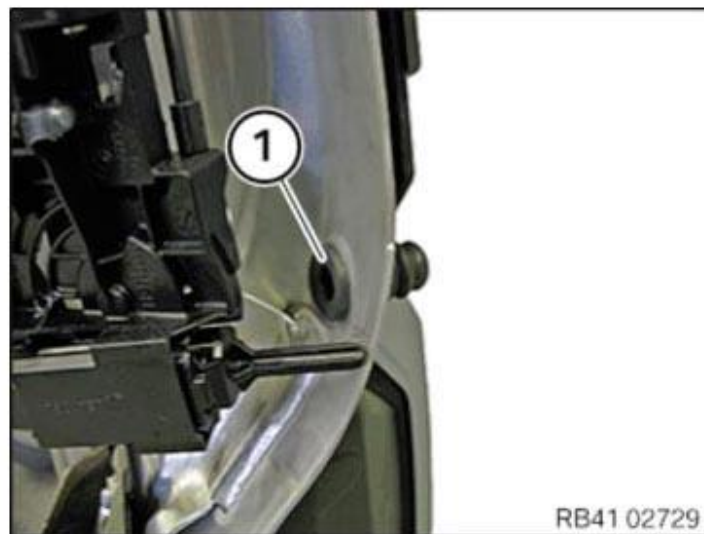
Insert guides (1) into bore holes (2).

Insert pin (3) into grommet (4).



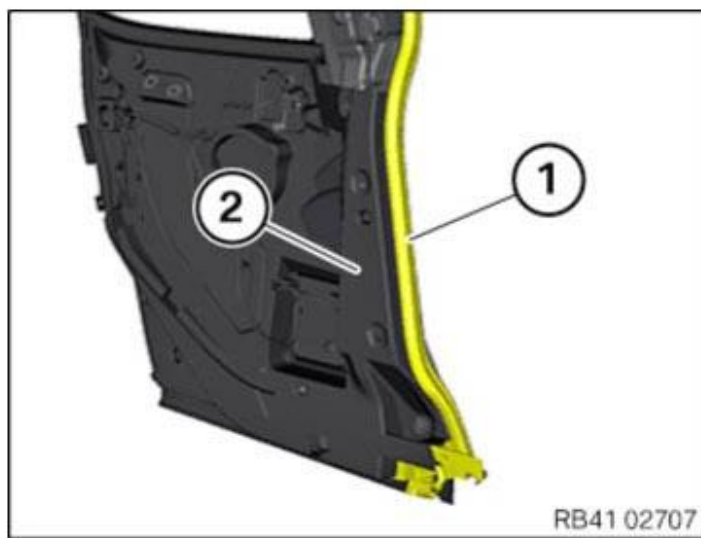
**Fig. 317: Inserting Pin Into Grommet**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove grommet (1).



**Fig. 318: Identifying Grommet**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release gasket (1) from cover (2).

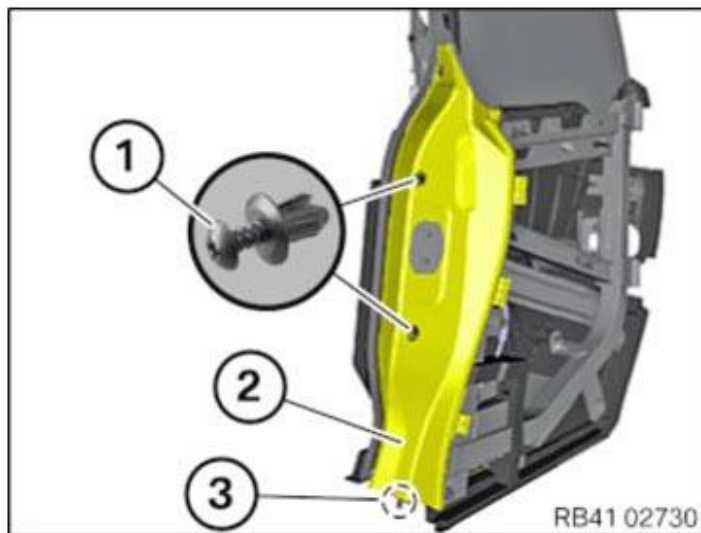


**Fig. 319: Identifying Gasket And Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

Release expanding rivet (1).

Release shroud trim (2) from latch mechanism (3) and feed out.



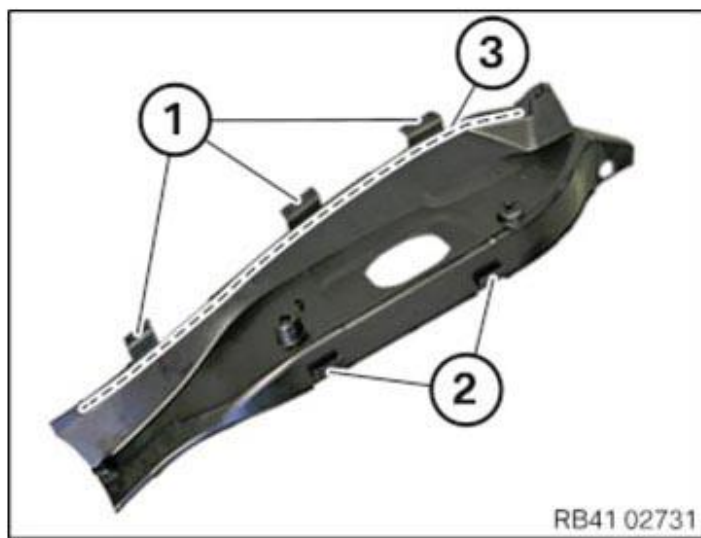
**Fig. 320: Identifying Expanding Rivet, Shroud Trim And Latch Mechanism**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Guides (1 and 2) must not be missing or damaged.

The seal (3) must not be damaged or missing.



**Fig. 321: Identifying Seal And Guides**

Courtesy of BMW OF NORTH AMERICA, INC.

**41 52 045 REMOVING/INSTALLING/REPLACING COVER OF REAR DOOR, INNER LEFT OR RIGHT**

Read contents of BODY, GENERAL .

**NOTE:** Observe (REPAIR STAGE 1) procedure!

Necessary preliminary tasks:

- Remove REAR DOOR
- Fix DOOR ON ASSEMBLY STAND
- Remove **SPEAKER**
- Remove **FRONT SEAT BELT**
- Remove **AERIAL FOR COMFORT ACCESS**

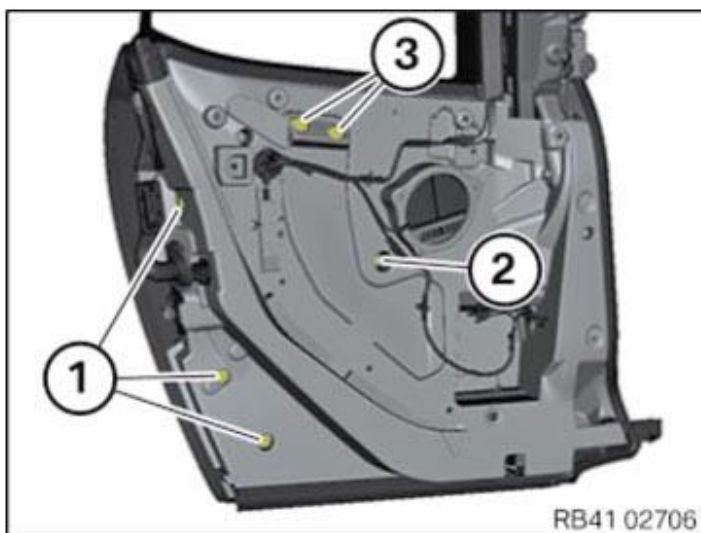
Release expanding rivet (1).

Release screw (2).

Release expansion nuts (3).

*Installation note:*

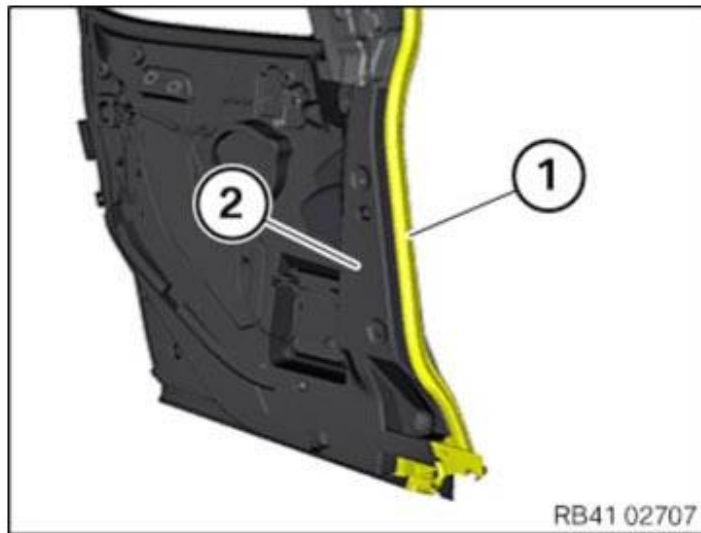
Renew expansion nuts (3).



**Fig. 322: Identifying Expanding Rivet, Expansion Nuts And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Release gasket (1) from cover (2).



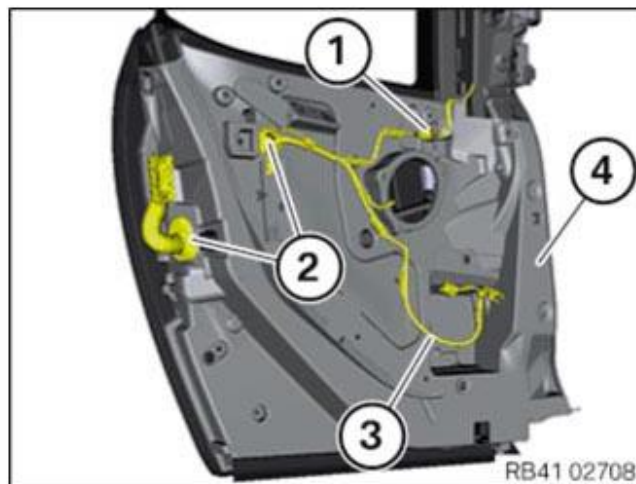
**Fig. 323: Identifying Gasket And Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug connections (1) and disconnect.

Release cable grommets (2).

Release wiring harness (3) on all cable clips from the cover (4).



**Fig. 324: Identifying Cover, Wiring Harness, Cable Grommets And Plug Connections**

Courtesy of BMW OF NORTH AMERICA, INC.

Release cover (1) from the clips (2).

Feed out cover (1) from the sealings (3).

Feed wiring harness out of the cover (1).

Risk of damage!

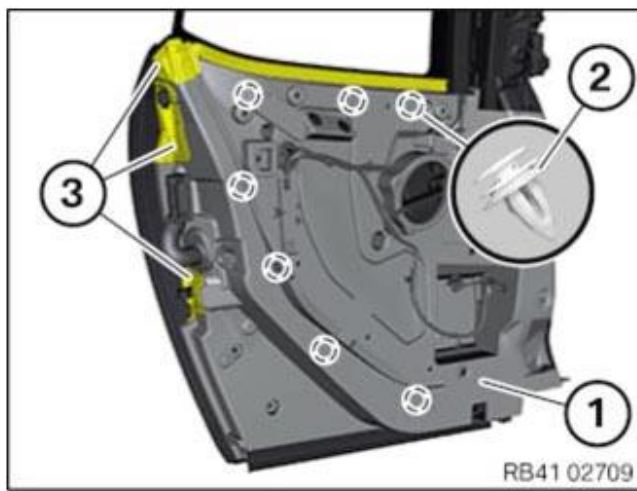
IMPORTANT: Hold door on assembly stand in position and release mounting for door stop on assembly stand.

Remove cover (1).

Fix door stop on assembly stand.

*Installation note:*

Make sure the sealings (3) are correctly seated on the cover (1).

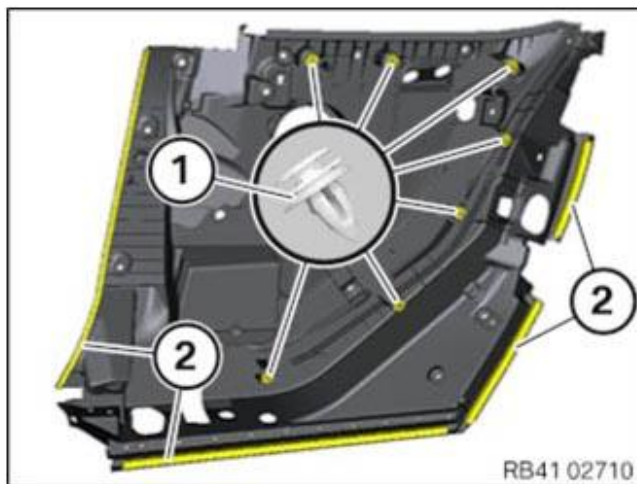


**Fig. 325: Identifying Cover, Sealings And Clips**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace faulty clips (1).

Gaskets (2) must not be damaged.



**Fig. 326: Identifying Gaskets And Faulty Clips**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **SIDE COVERING WITH ARMRESTS**

### **51 43 201 REMOVING AND INSTALLING OR REPLACING TRIM FOR ROOF PILLAR AT FRONT (A-PILLAR), LEFT OR RIGHT**

**WARNING:** Follow **SAFETY INSTRUCTIONS** for working on vehicles with airbag systems.

IMPORTANT: Do not use any sharp-edged tools to remove trim panel (risk of damage to head airbag).

Lever out cover (1) and release screw underneath.

Tightening torque **51 43 1AZ** .

Release trim panel (2) inwards from clips (3).

Feed out trim panel (2) upwards from dashboard.

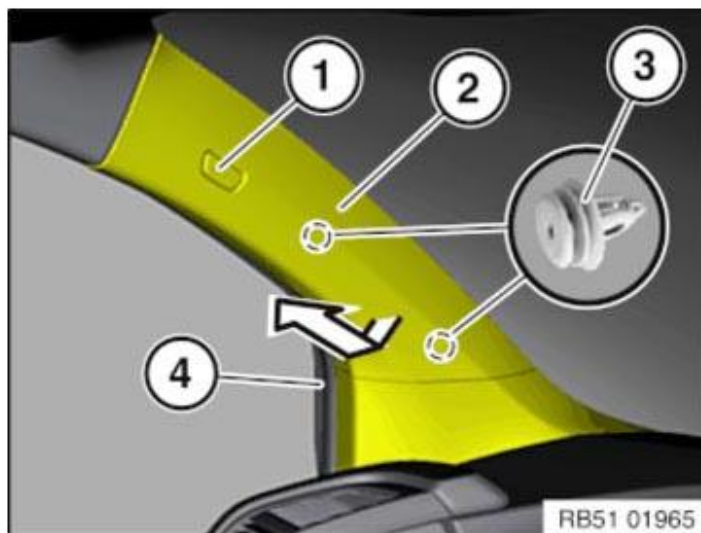
*Installation note:*

Make sure edge protection (1) is correctly seated.



If necessary, lever out clips (3) remaining in body and insert in trim panel (2).

Replace faulty clips (3).



**Fig. 327: Removing Trim Panel With Clips**

Courtesy of BMW OF NORTH AMERICA, INC.

### **51 43 251 REMOVING AND INSTALLING OR REPLACING TRIM FROM REAR LEFT OR RIGHT ROOF PILLAR**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

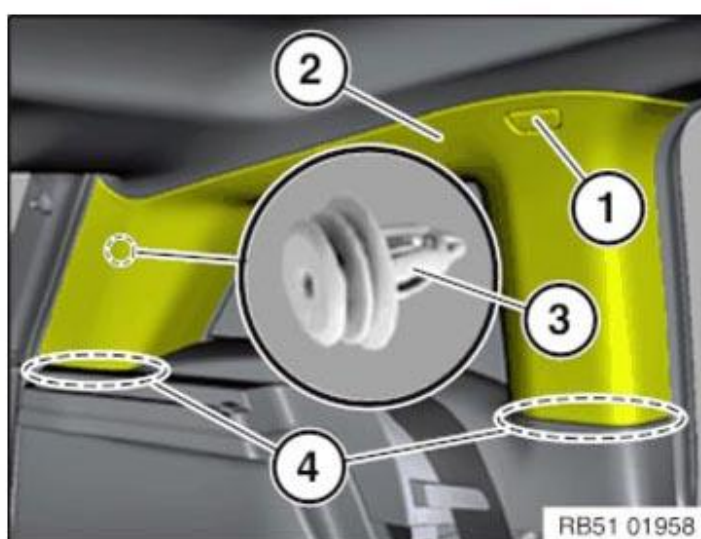
Lever out trim (1) and release screw underneath.

Release trim panel (2) at clip (3).

Release trim panel (2) upwards out of latch mechanisms in area (4).

*Installation note:*

Make sure trim panel (2) edge protection is correctly seated.



**Fig. 328: Identifying Trim, Clip And Trim Panel**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

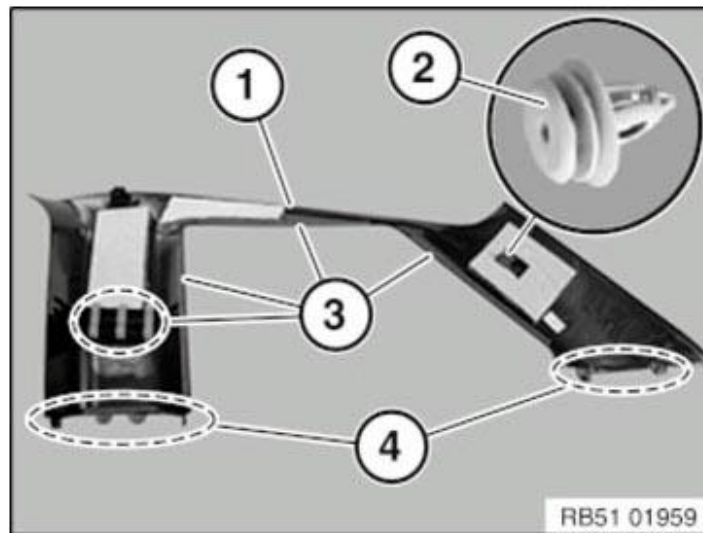
The following parts of the trim panel (1) must not be missing or damaged:

(2) Clip



(3) Foam material

(4) Catches



**Fig. 329: Identifying Trim Panel, Clip, Foam Material And Catches**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 43 002 REMOVING AND INSTALLING REAR LEFT OR RIGHT SIDE TRIM PANEL**

**Necessary preliminary tasks:**

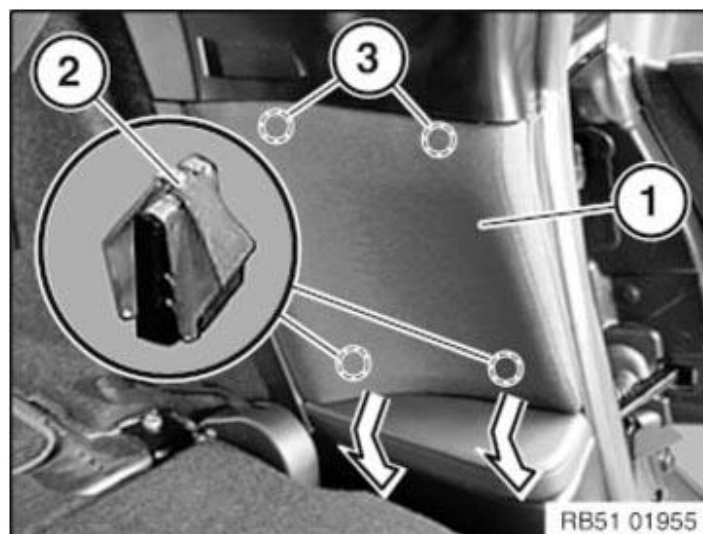
- Remove **DOOR SILL COVER STRIP**
- Remove **REAR SEAT**

Detach trim panel (1) from clamps (2) towards inside.

Feed out trim panel (1) toward the bottom from guides in area (3).

*Installation note:*

Replace faulty clamps (2).



**Fig. 330: Detaching Trim Panel From Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

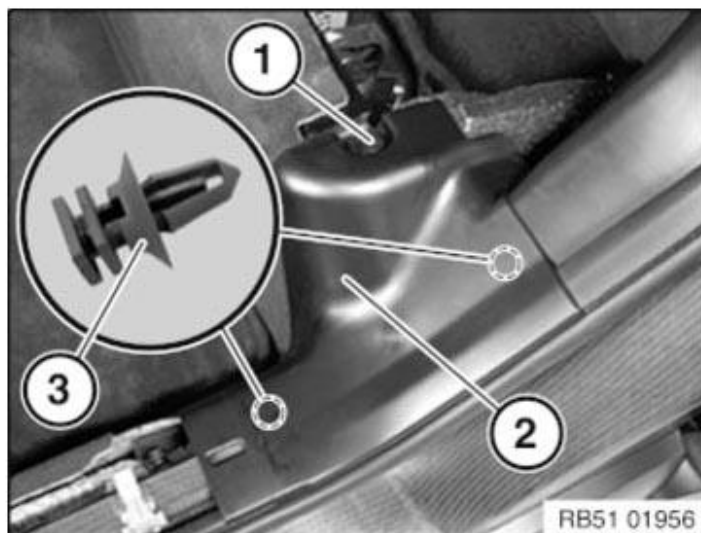
Release expansion rivet (1).

Release trim (2) at clips (3) and remove.

*Installation note:*

Replace faulty clips (3).

Remove trim (2) with preassembled clips (3).



**Fig. 331: Identifying Expansion Rivet, Trim And Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach edge protection (1) in area of side trim panel (3).

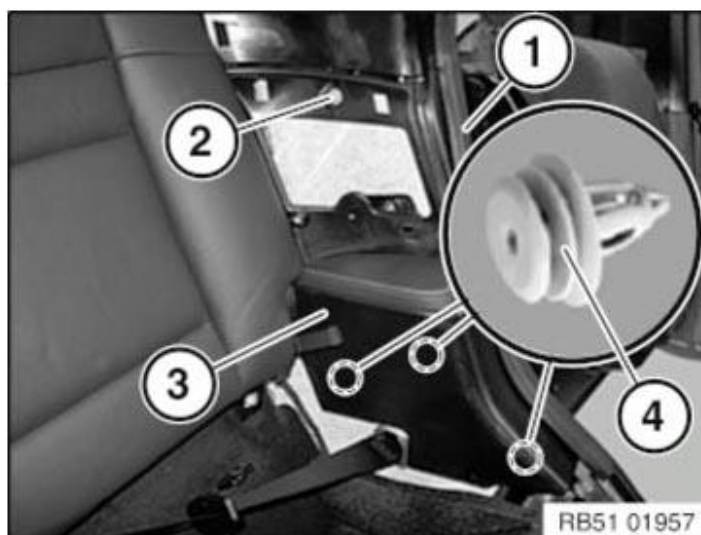
Release screw (2).

Release side trim panel (3) from clips (4).

Feed out side trim panel (3).

*Installation note:*

Replace faulty clips (4).



**Fig. 332: Identifying Side Trim Panel, Edge Protection, Screw And Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

**51 43 340 REMOVING AND INSTALLING/REPLACING B-PILLAR TRIM PANEL AT TOP ON LEFT OR RIGHT**

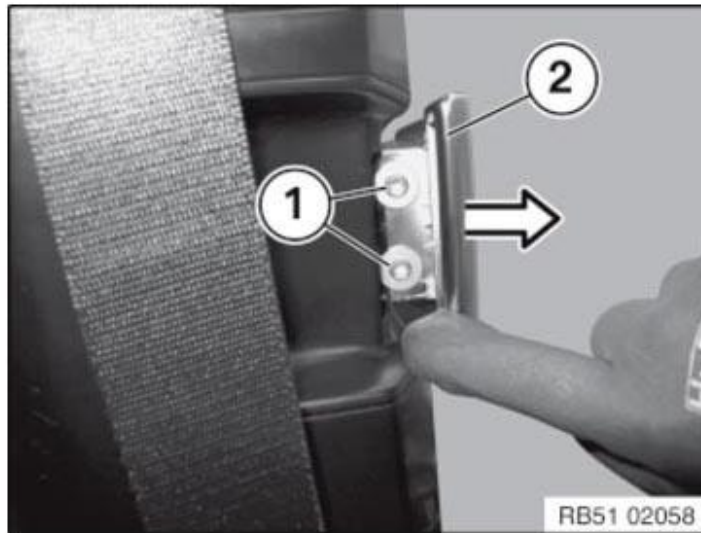
Pull out door handle (2).

Release screws (1) by approx. 2-3 turns.

Do not fully unscrew screws (1)!

Tightening torque [51 22 5AZ](#) .

Remove door handle (2) in direction of arrow.

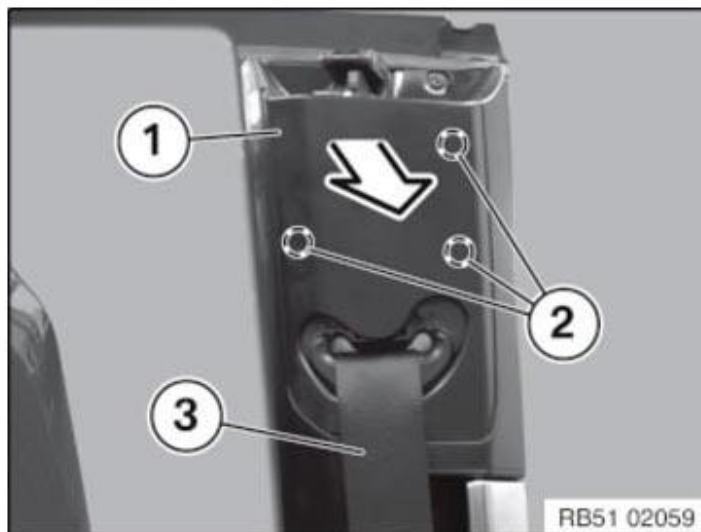


**Fig. 333: Pulling Out Door Handle**

Courtesy of BMW OF NORTH AMERICA, INC.

Release trim (1) from latch mechanisms (2) in direction of arrow.

Feed out trim (1) from seat belt (3) and remove.



**Fig. 334: Releasing Trim From Latch Mechanisms**

Courtesy of BMW OF NORTH AMERICA, INC.

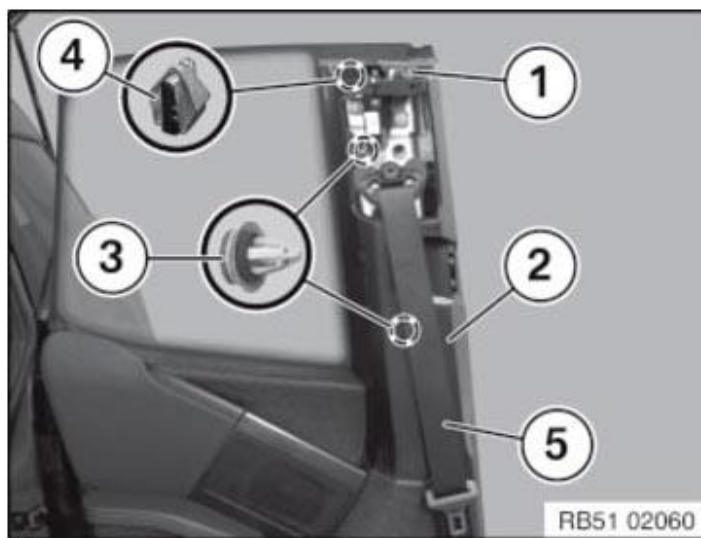
Release screw (1).

Lever out trim panel (2) from clips (3) and clamp (4).

Feed out trim panel (2) from seat belt (5) and remove.

*Installation note:*

If necessary, replace faulty clips (3) and faulty clamps (4).



**Fig. 335: Identifying Seat Belt, Trim Panel, Clips, Clamp And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 43 070 REMOVING AND INSTALLING/REPLACING SIDE TRIM PANEL, FOOTWELL, ON A-PILLAR, LEFT**

**Necessary preliminary tasks:**

- Remove **FRONT DOOR SILL COVER STRIP (INSIDE)**
- Remove **TRIM PANEL FOR PEDAL MECHANISM**

Detach edge protection (1) in area of side trim panel (2).

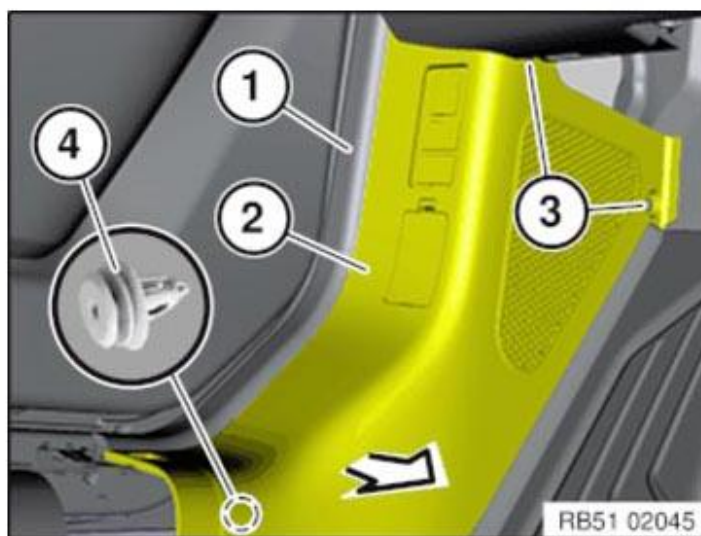
Release screws (3).

Release side trim panel (2) from clip (4) in direction of arrow and remove.

Unlock and disconnect plug connections, according to the equipment.

*Installation note:*

Make sure edge protection (1) is correctly seated.



**Fig. 336: Releasing Side Trim Panel From Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, lever out clip (4) remaining in bore hole and attach to side trim panel (2).

**When replacing, remount the following parts according to the equipment:**

- **ENGINE COMPARTMENT UNLOCKING SWITCH**

- **FUEL FILLER FLAP UNLOCKING SWITCH**
- **TAILGATE RELEASE SWITCH**

## **51 43 075 REMOVING AND INSTALLING/REPLACING SIDE TRIM PANEL, FOOTWELL, ON A-PILLAR, RIGHT**

### **Necessary preliminary tasks:**

- Remove **TRIM FOR DASHBOARD AT BOTTOM RIGHT**
- Remove **FRONT DOOR SILL COVER STRIP (INNER)**, right

Detach edge protection (1) in area of side trim panel (3).

Release screws (4).

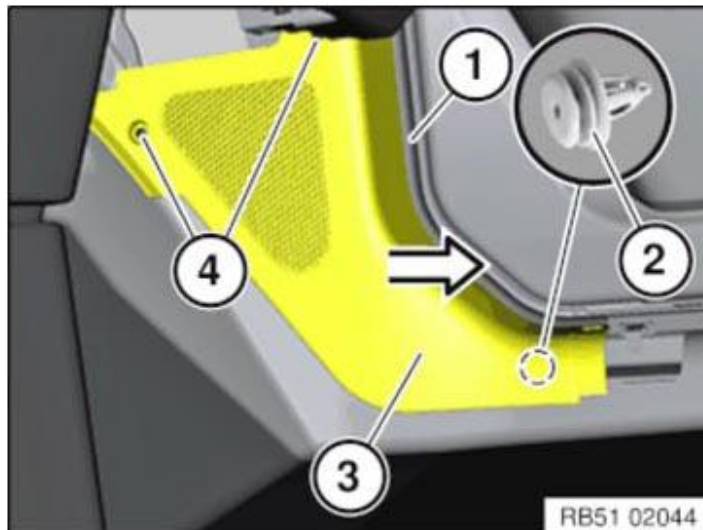
Pull side trim panel (3) off clip (2) in direction of arrow.

Release clip (2) from body and insert in side trim panel (3).

### *Installation note:*

Make sure edge protection (1) is correctly seated.

Replace the faulty clip (2).



**Fig. 337: Pulling Side Trim Panel Off Clip**

Courtesy of BMW OF NORTH AMERICA, INC.

## **ROOF TRIM PANEL**

### **51 44 011 REMOVING AND INSTALLING/REPLACING HEADLINING (VERSION WITH SLIDE/TILT SUNROOF)**

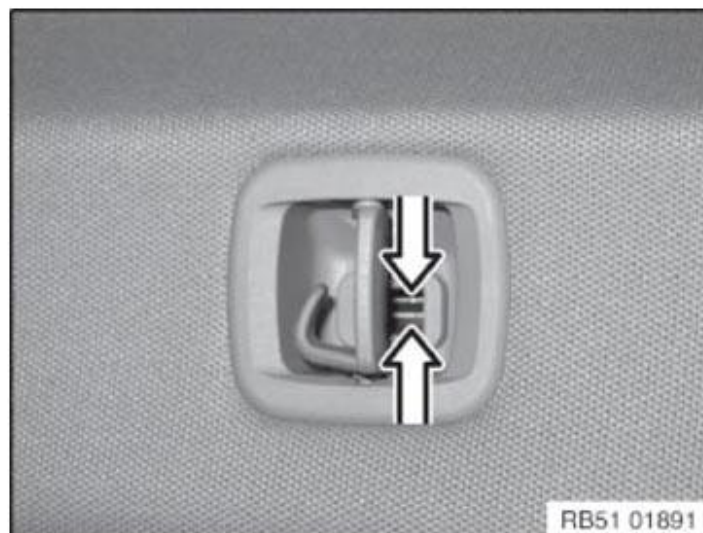
### **Necessary preliminary tasks:**

- Remove **TRIM PANEL FOR ROOF PILLAR AT FRONT** (A-pillar) left/right
- Remove **SUN VISOR AND COUNTER SUPPORT** left/right
- Remove **MICROPHONE** left/right
- Open slide/tilt sunroof at front
- Remove **ROOF SWITCH CLUSTER** or **FRONT INTERIOR ROOF LIGHT**
- Remove all **GRAB HANDLES**
- Remove **INTERIOR ROOF LIGHTS AT REAR**
- Remove **TRIM PANEL FOR ROOF PILLAR AT REAR** left/right
- Release edge protection on all doors in the headlining area
- Release tailgate gasket halfway



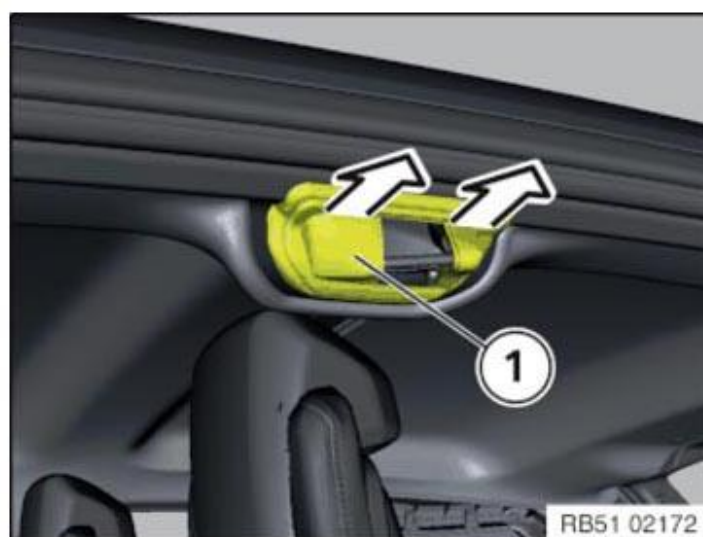
Open coat hook halfway.

Press clamps together and feed coat hook out towards the inside.



**Fig. 338: Pressing Headlining Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove left and right trim (1).



**Fig. 339: Removing Left And Right Trim**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release left and right screws (1) and take off left and right trims (2).

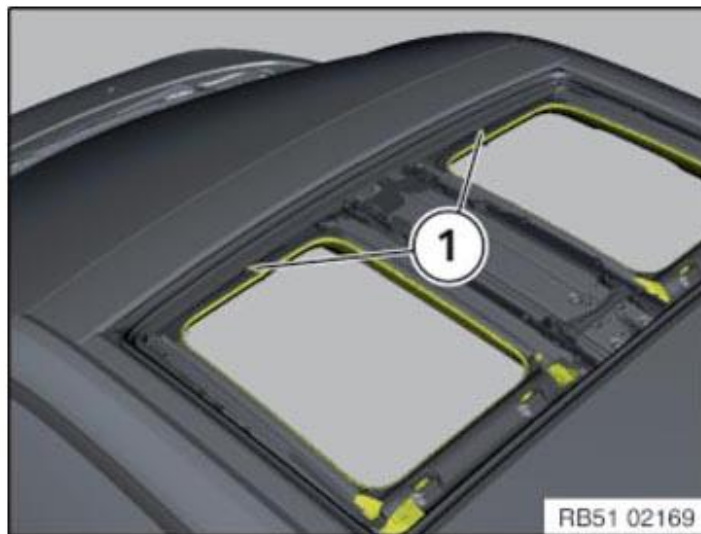




**Fig. 340: Identifying Trims And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

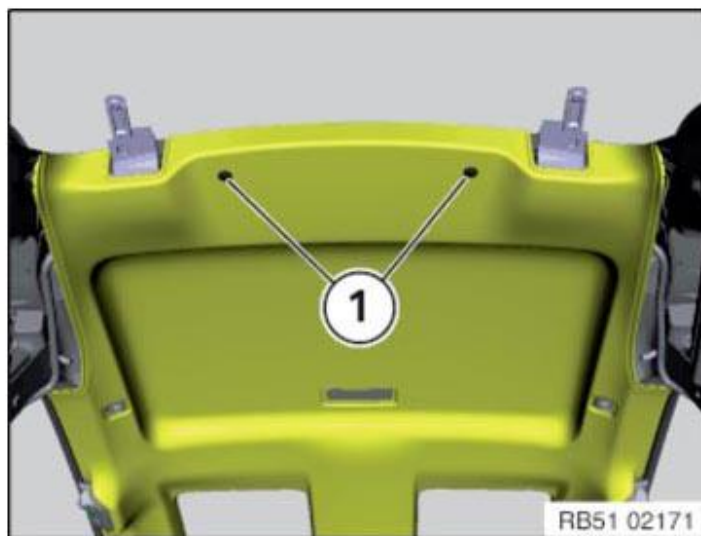
Open slide/tilt sunroof.

Release screws (1).



**Fig. 341: Identifying Slide/Tilt Sunroof Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

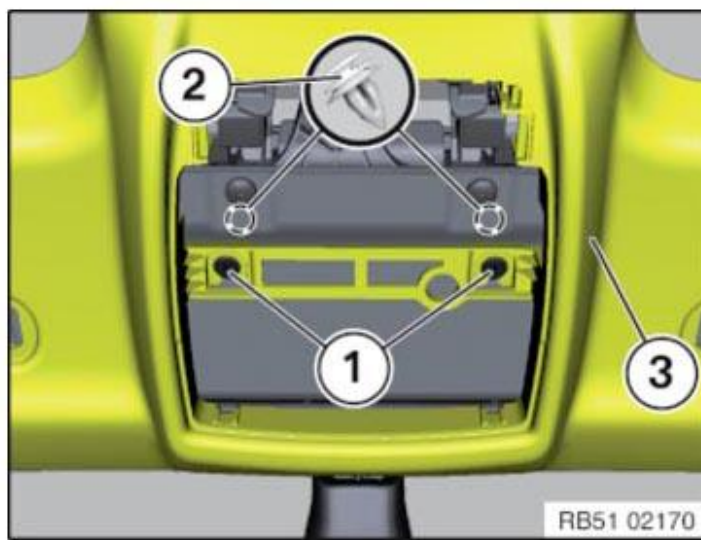
Release expanding rivet (1).



**Fig. 342: Identifying Expanding Rivet**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release expanding rivet (1).

Unclip headlining (3) at clip (2).



**Fig. 343: Identifying Expanding Rivet, Headlining And Clip**

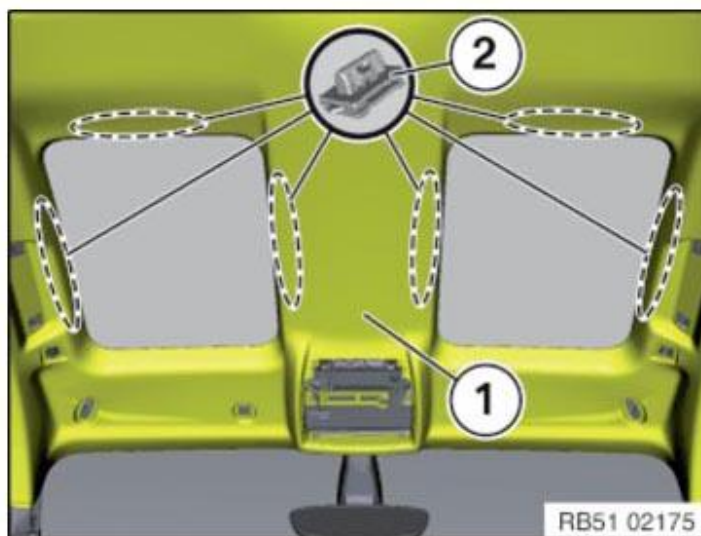
Courtesy of BMW OF NORTH AMERICA, INC.

Adjust backrest of driver's and front passenger seat all the way back.

Release headlining (1) from clips (2) in downward direction in the marked areas.

*Installation note:*

If necessary, replace faulty clips (2).



**Fig. 344: Identifying Headlining And Clip**

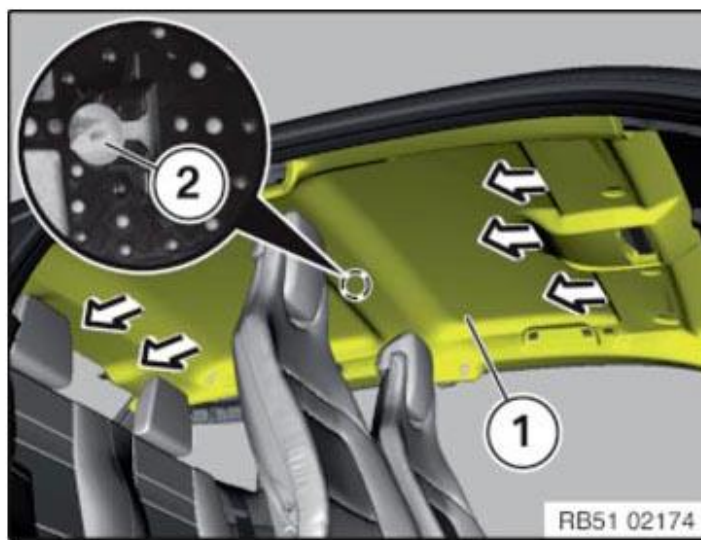
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully pull headlining (1) rearward until headlining (1) is fed out of clip (2).

Open all doors and side windows.

Feed out headlining (1) with an assistant.

Pull down headlining (1).



**Fig. 345: Removing Headlining**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

installation sequence:

1. Attach headlining to the clips at front and rear
2. Screw down front headlining
3. Mount grab handles
4. Screw down sun visors and counter supports
5. Secure edge protection to headlining
6. Fix tailgate gasket on headlining
7. Add final details to vehicle

**51 44 001 REMOVING AND REFITTING/REPLACING ROOFLINER (VERSION WITHOUT SLIDING/TILTING SUNROOF)**

Except for the steps relating to the slide/tilt sunroof, the work is identical to:

Removing and installing/replacing HEADLINING (VERSION WITH SLIDE/TILT SUNROOF).

**INSTRUMENT CLUSTER TRIM PANEL**

**51 45 310 REMOVING AND INSTALLING (REPLACING) COVER FOR DASHBOARD, CENTER**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

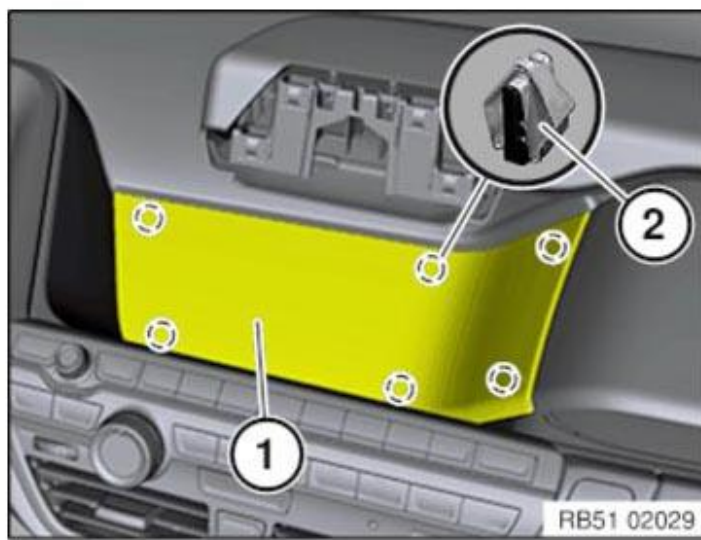
**Necessary preliminary tasks:**

- Remove CENTRAL INFORMATION DISPLAY (CID)

Unclip trim (1) from clamps (2) and remove.

*Installation note:*

Replace faulty clamps (2).



**Fig. 346: Identifying Trim And Clamps**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 45 291 REMOVING AND INSTALLING (REPLACING) GLOVE BOX TRIM**

Special tools required:

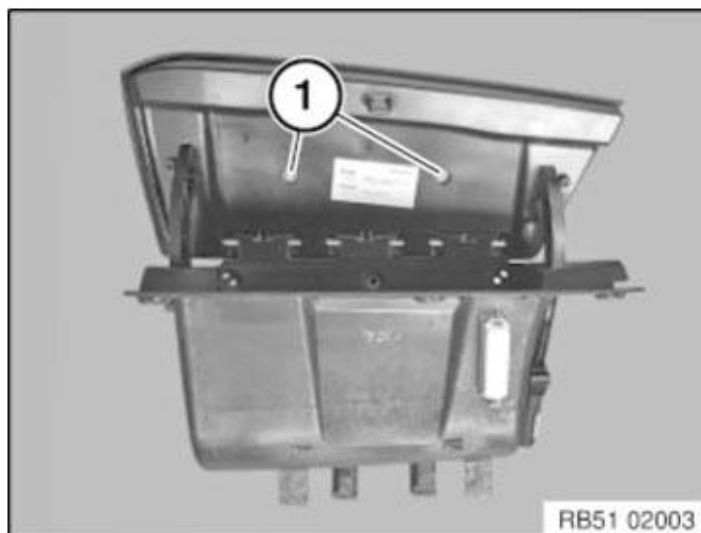
- [00 9 340](#)

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

Necessary preliminary tasks:

- Remove [GLOVE BOX](#)

Release screws (1).

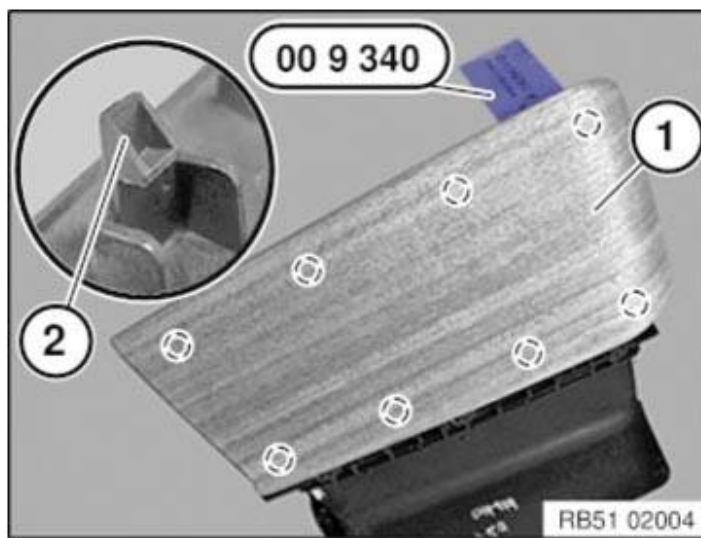


**Fig. 347: Identifying Glove Box Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Carefully lever out trim (1) from latch mechanisms (2) using special tool [00 9 340](#) and remove.

*Installation note:*

Catches (2) must not be damaged or missing.



**Fig. 348: Removing Trim From Latch Mechanisms Using Special Tool (00 9 340)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

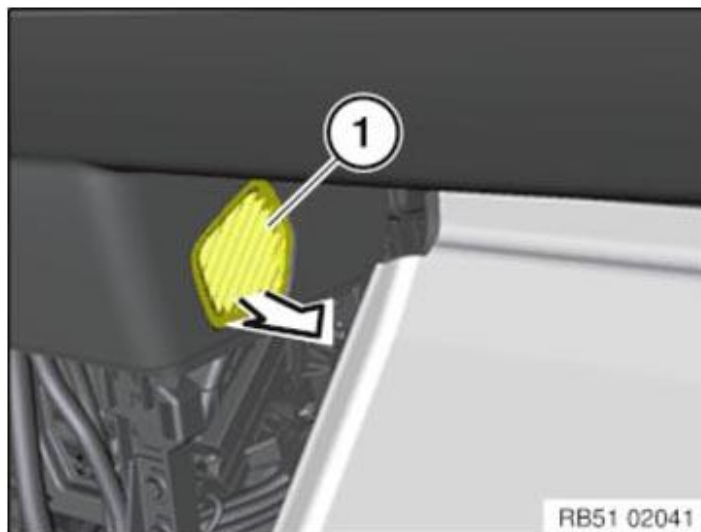
### **51 45... REMOVING AND INSTALLING CENTER DASHBOARD TRIM PANEL**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

**Necessary preliminary tasks:**

- Remove **LOWER CENTER INSTRUMENT PANEL TRIM**
- Remove **TRIM FOR PEDAL MECHANISM**

Pull out left and right grille (1).



**Fig. 349: Pulling Out Left And Right Grille**  
 Courtesy of BMW OF NORTH AMERICA, INC.

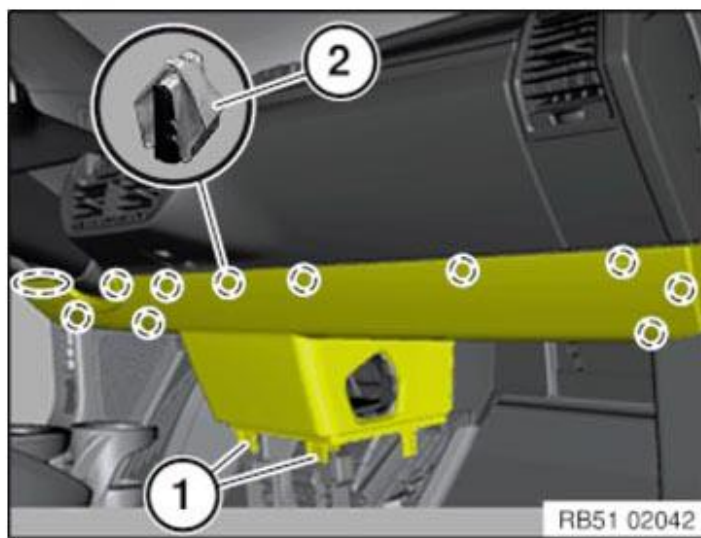
Release screws (1).

Lift trim panel out of clamps (2) and remove.

*Installation note:*

Replace faulty clamps (2).





**Fig. 350: Identifying Trim Panel Clamps And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

### 51 45 370 REMOVING AND INSTALLING DECORATIVE STRIP ON LEFT DASHBOARD

**NOTE:** Procedure is described under [REMOVING LIGHT OPERATING FACILITY](#) .

### 51 45 030 REMOVING AND INSTALLING INSTRUMENT PANEL TRIM

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work :  
 De-energize the [HIGH-VOLTAGE SYSTEM](#) .  
 Observe [SAFETY INFORMATION](#) for handling electric vehicles.

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

#### Necessary preliminary tasks:

- Disconnect [NEGATIVE BATTERY LEAD](#)
- Remove [TRIM PANEL FOR ROOF PILLAR](#) at front left and right
- Remove [CENTRAL INFORMATION DISPLAY](#)
- Remove [STEERING COLUMN CONTROL PANEL](#)
- Remove [MID-RANGE SPEAKER DASHBOARD](#)
- Remove [RADIO AND IHKA CONTROLS](#)
- Remove [GEAR SELECTOR SWITCH](#)
- Remove [INSTRUMENT PANEL](#)
- Remove [RIGHT GLOVE BOX WITH HOUSING](#)
- Remove [TRIM PANEL FOR PEDAL ASSEMBLY](#)
- Remove [CENTER DASHBOARD TRIM PANEL](#)
- Remove [LIGHT OPERATING UNIT](#)
- Remove [SIDE PANEL ON DASHBOARD](#)
- Remove [PASSENGER'S SIDE KNEE AIRBAG](#)

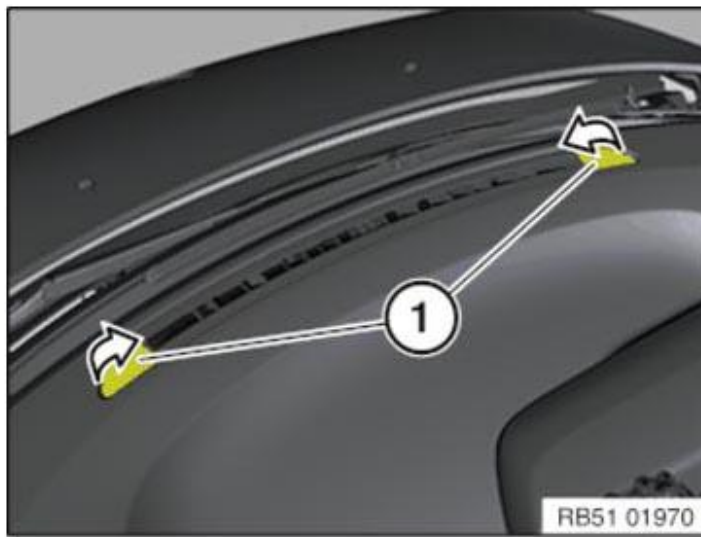
Remove covers (1) and release the Torx screw T20 underneath.

Risk of breakage of windscreen.

**IMPORTANT:**

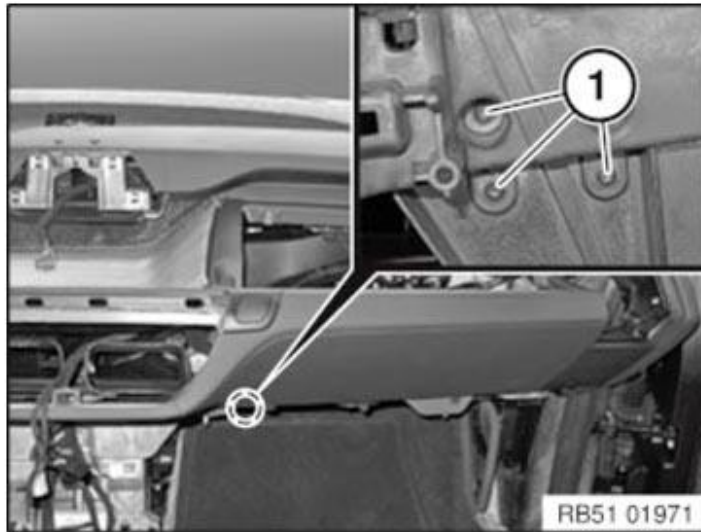
Do not loosen the hexagon screw SW13.





**Fig. 351: Removing Covers**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

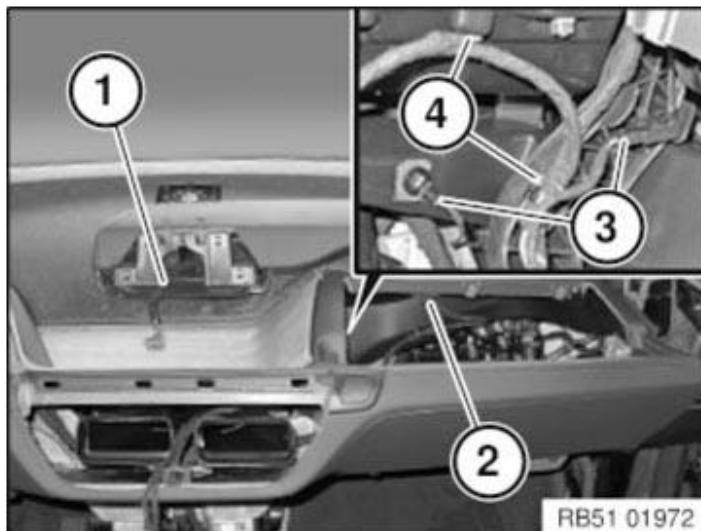


**Fig. 352: Identifying Instrument Panel Trim Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed back cable (1).

**NOTE:** To make feeding in easier, attach the cable (1) to a string and feed back.

The string remains in the dashboard.



**Fig. 353: Identifying Back Cable, Plug Connections And Cable Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock **AIRBAG PLUG CONNECTIONS** (2) and disconnect.

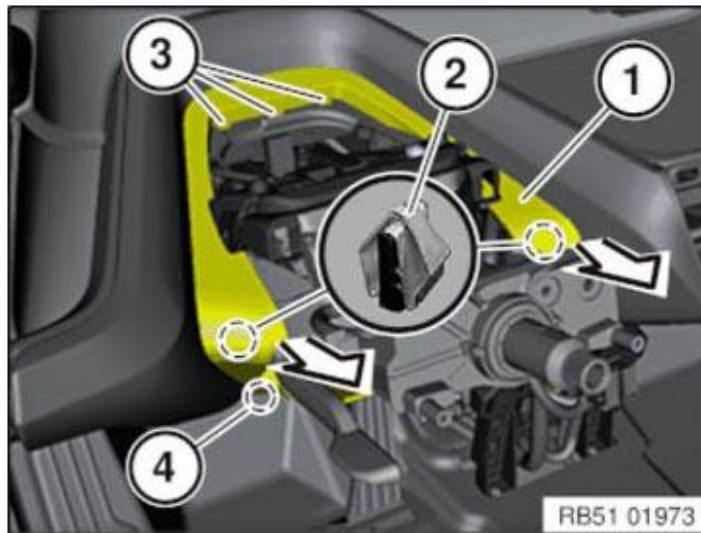
Unlock plug connections (3) and disconnect.

Unfasten cable strap (4).

Release trim (1) from clamps (2) in direction of arrow and feed out.

*Installation note:*

Ensure the correct seating of the guides (3 and 4).



**Fig. 354: Releasing Trim From Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) on dashboard at bottom.

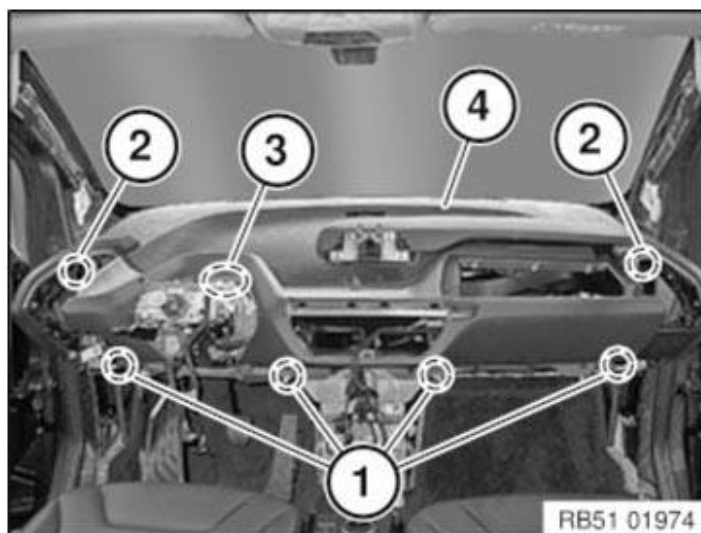
Release screws (2) in left/right air duct.

Loosen screws (3).

Tightening torque **51 45 6AZ**.

With the aid of a second person, pull dashboard (4) towards rear slightly and feed out electrical wiring, release further cable clips if necessary.

Remove dashboard (4) and feed out all electrical wires.



**Fig. 355: Identifying Dashboard And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

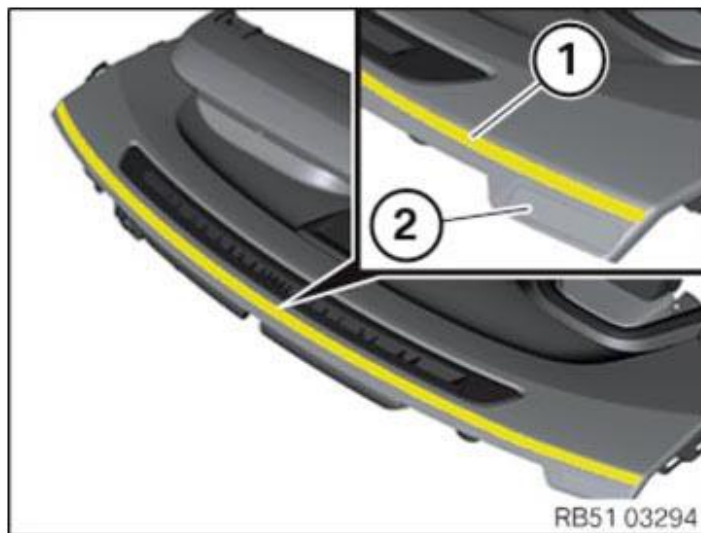
Make sure all electrical lines are correctly routed.

Check expanding foam tape (1) for damage.

If required, stick new expanding foam tape (1) on the total width of instrument panel.

The expanding foam tape (1) needs to be bonded above the aperture (2) for the chassis number.

Observe notes on **COMPONENT BONDING** with adhesive tape!



**Fig. 356: Identifying Aperture And Foam Tape**  
Courtesy of BMW OF NORTH AMERICA, INC.

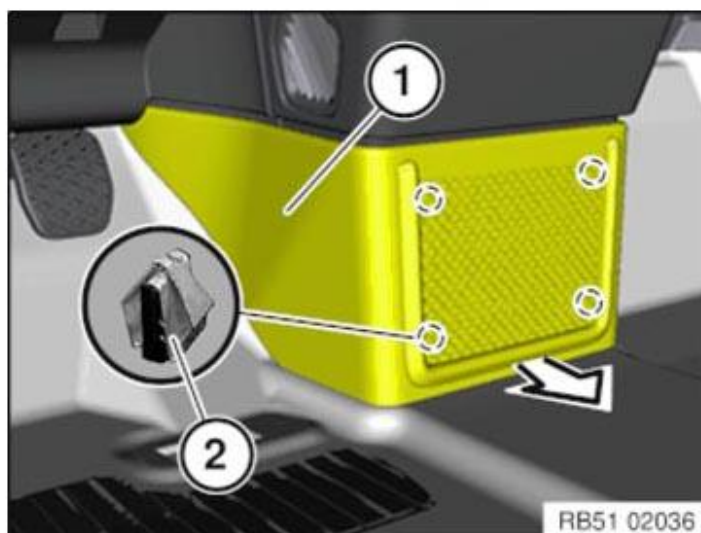
**51 45... REMOVING AND INSTALLING/REPLACING BOTTOM CENTER INSTRUMENT PANEL TRIM**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

Pull trim panel (1) out of clamps (2) in direction of arrow.

*Installation note:*

Replace faulty clamps (2).



**Fig. 357: Pulling Trim Panel Out Of Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Necessary preliminary tasks:**

- Remove **INSTRUMENT PANEL TRIM**

**US version:**

- Disconnect **PLUG CONNECTION FROM DRIVER'S KNEE PROTECTION AIRBAG MODULE**

Release clamping bolts (1) of steering shaft at steering column.

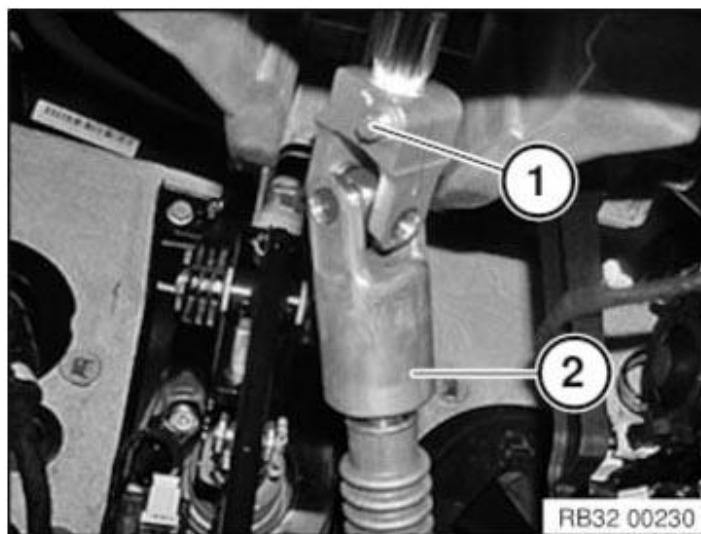
Tightening torque **32 31 4AZ** .

Release steering shaft from steering column.

*Installation note:*

For reuse, clean threads to remove all remnants of screw locking adhesive.

Replace clamping bolts.



**Fig. 358: Identifying Steering Shaft And Clamping Bolts**

**Courtesy of BMW OF NORTH AMERICA, INC.**

Counter-hold the steering shaft in the passenger compartment on the steering column when sliding the universal joint onto the steering column!

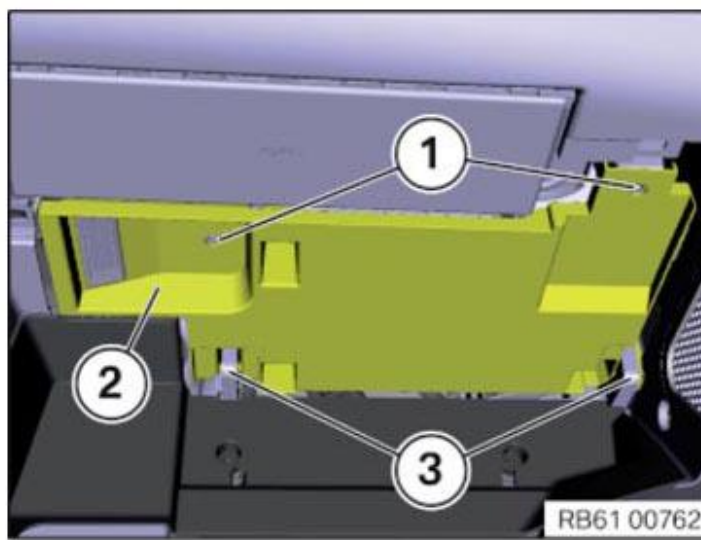
Clamping bolts must rest in groove of steering gear or steering column.

Release screws (1).

Feed out power distribution box (2) from instrument panel support (3).

Feed out power distribution box (2) towards footwell.

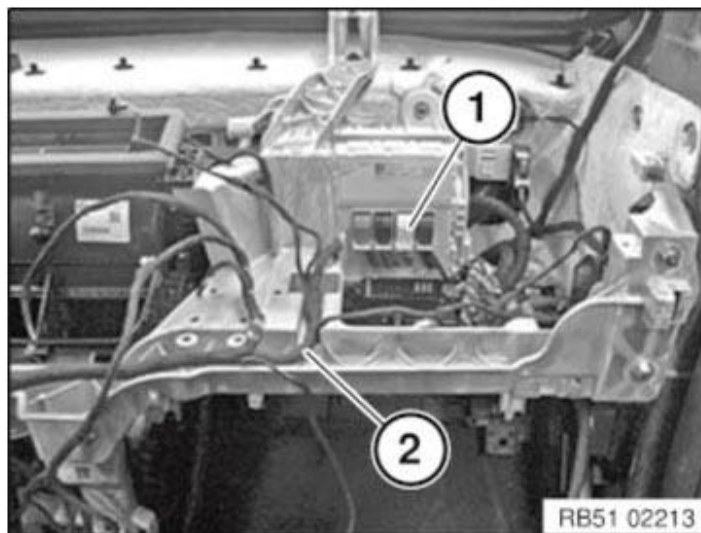




**Fig. 359: Identifying Power Distribution Box, Instrument Panel Support And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

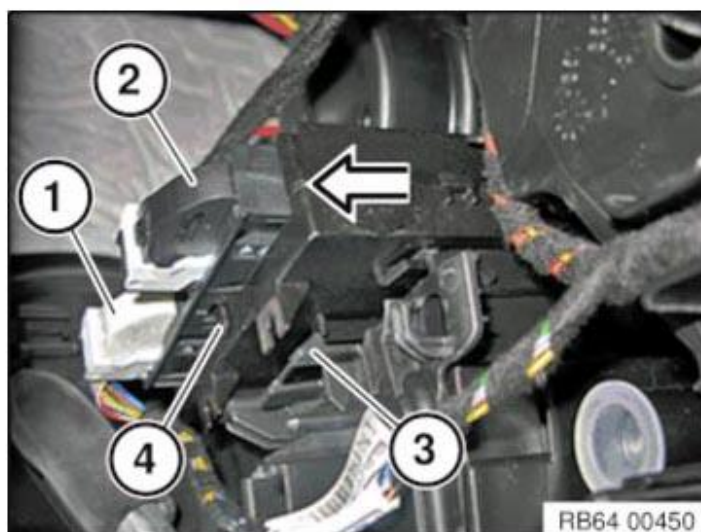
Release wiring harness (2) at all cable clips and feed back.

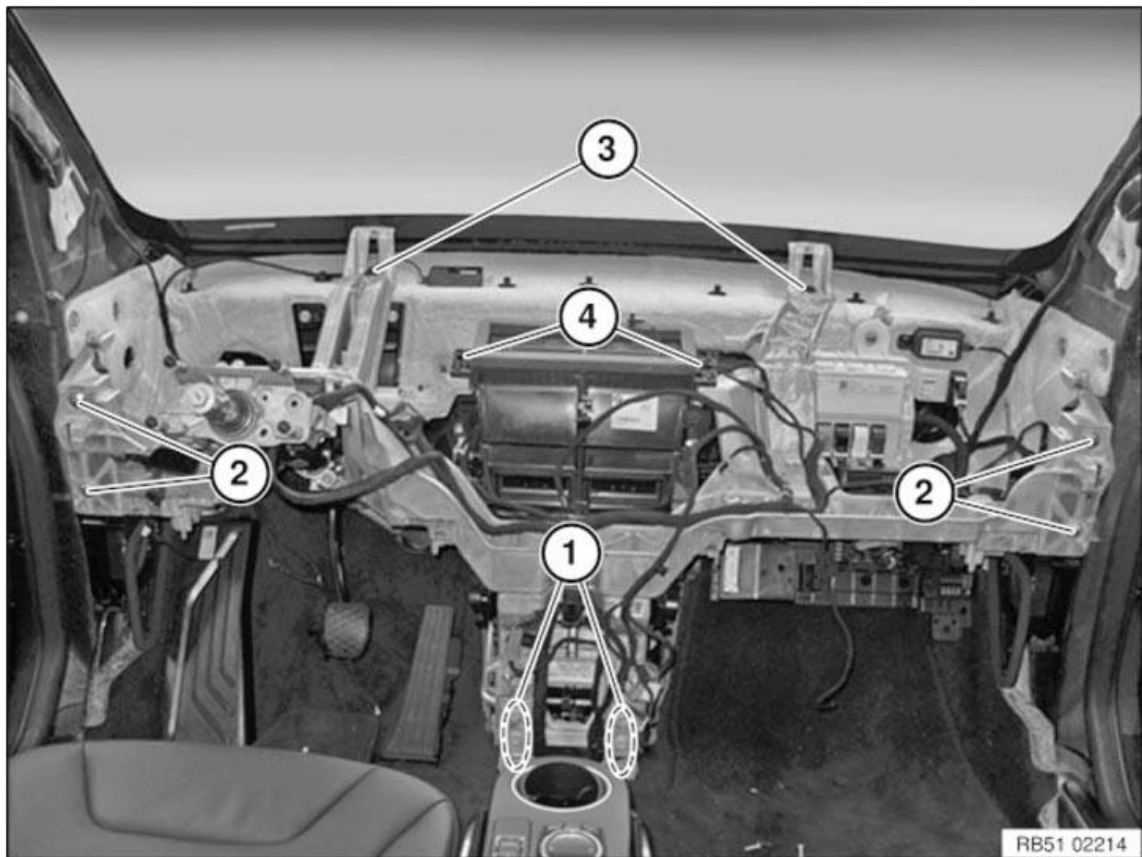


**Fig. 360: Identifying Wiring Harness And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (2).

Control unit (4) does not have to be removed.





**Fig. 362: Identifying Heating And Air-Conditioning Unit With Nuts Or Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and remove associated brackets. Tightening torque **51 45 3AZ** .

Unscrew nuts (2). Tightening torque **51 45 2AZ** .

Release screws (3). Tightening torque **51 45 1AZ** .

Release screws (4) at heating and air-conditioning unit.

Slightly raise heating and air-conditioning unit and feed out support.

If necessary, release further cable clips.

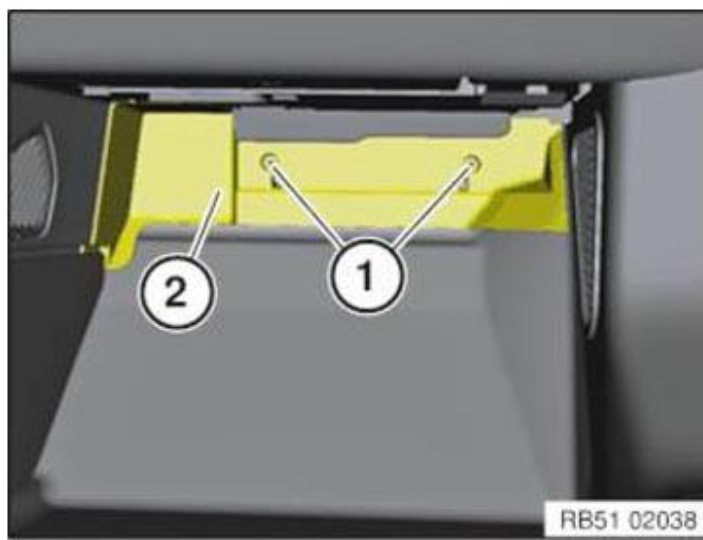
**Replacement:**

- Remount **STEERING COLUMN**
- Remount **AIRBAG MODULE FOR DRIVER'S KNEE PROTECTION**

**51 45 195 REMOVING AND INSTALLING/REPLACING INSTRUMENT PANEL TRIM, BOTTOM RIGHT**

Unfasten screws (1) and take off trim (2).





**Fig. 363: Identifying Instrument Panel Trim And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 45... REMOVING AND INSTALLING/REPLACING SIDE PANEL ON DASHBOARD ON LEFT OR RIGHT**

**Special tools required:**

- [00 9 327](#)

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

Pull off seal (1) in the area of the side panel (2).

Unclip side panel from dashboard (2) in direction of arrow with special tool [00 9 327](#) and feed out at a slant to the rear.



**Fig. 364: Removing Side Panel From Dashboard With Special Tool (00 9 327)**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 45 260 REMOVING AND INSTALLING/REPLACING TRIM ON LEFT OF DASHBOARD**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

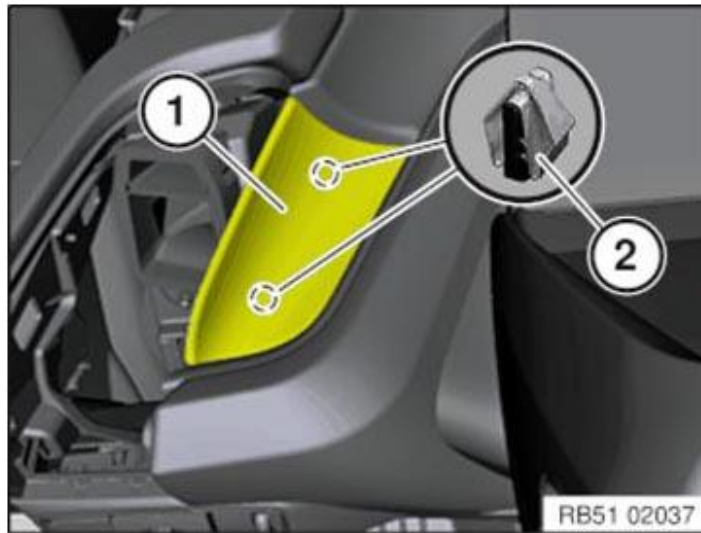
**Necessary preliminary tasks:**

- Remove [LEFT FRESH AIR GRILLE](#)

Unclip trim (1) from clamps (2) and remove.

*Installation note:*

Replace faulty clamps (2).



**Fig. 365: Identifying Trim And Clamps**

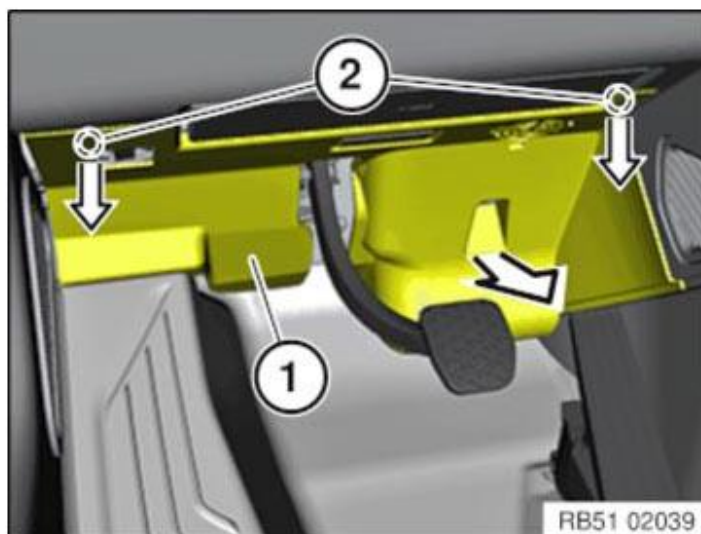
Courtesy of BMW OF NORTH AMERICA, INC.

**51 45 184 REMOVING AND INSTALLING/REPLACING TRIM PANEL FOR PEDAL MECHANISM**

Unclip trim panel (1) out of clamps (2).

Lower trim panel (1) slightly and disconnect plug connections behind.

Pull out trim panel (1) towards rear.



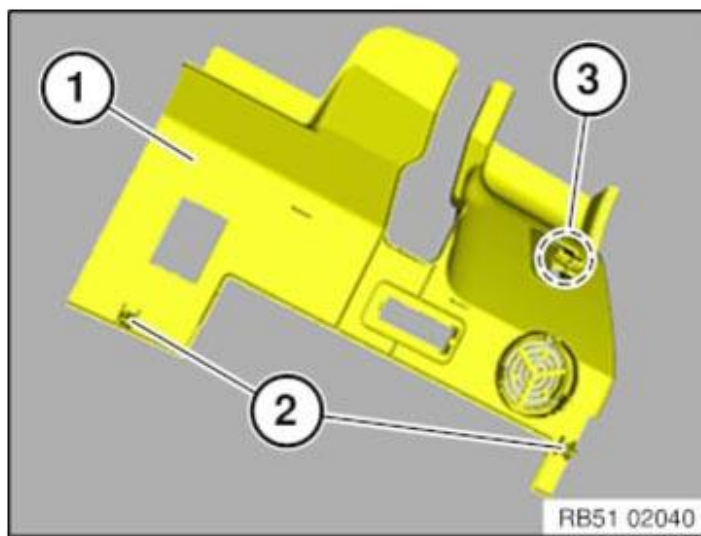
**Fig. 366: Removing Trim Panel With Clamps**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Clamps (2) and guide (3) on trim panel (1) must not be damaged.

Insert guide (3) correctly into corresponding holder on vehicle.



**Fig. 367: Identifying Clamps, Guide And Trim Panel**

Courtesy of BMW OF NORTH AMERICA, INC.

When replacing, remount the following parts depending on the version:

- **HANDS-FREE SYSTEM SPEAKER**
- **FOOTWELL LIGHT**

**51 45... REPLACE STORAGE NET ON INSTRUMENT PANEL TRIM, BOTTOM CENTER**

When working on trim panel components, make sure that visible surfaces are not scratched or damaged (e.g. by sharp-edged tools).

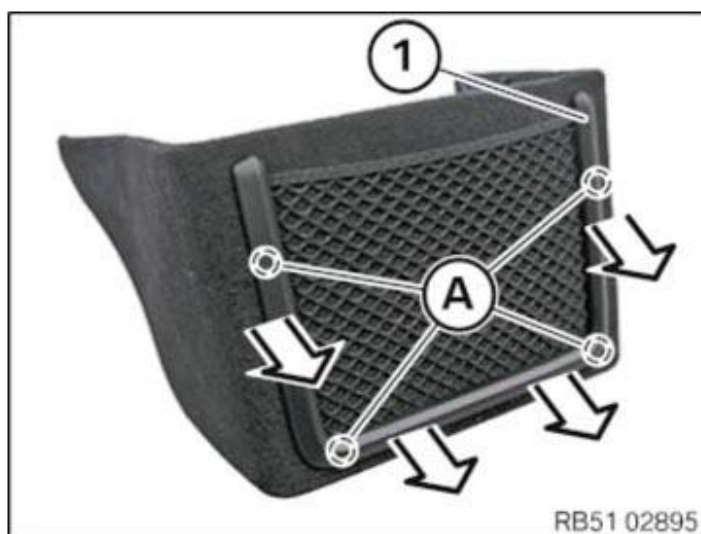
**Necessary preliminary tasks:**

- Remove **INSTRUMENT PANEL TRIM, BOTTOM CENTER**

**Removal:**

Unclip frame (1) in direction of arrow.

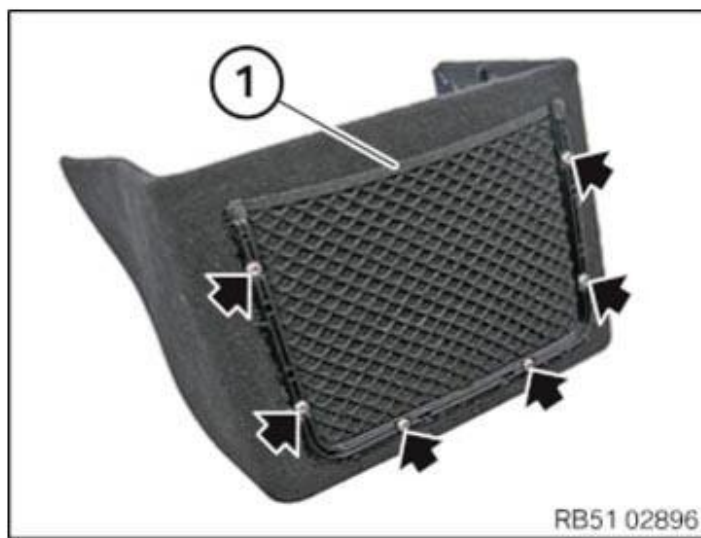
**NOTE:** Frame (1) can be bonded in area (A) with the storage net.



**Fig. 368: Removing Frame**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws and remove the storage net (1).



**Fig. 369: Identifying Storage Net With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Secure storage net (1) with the screws.

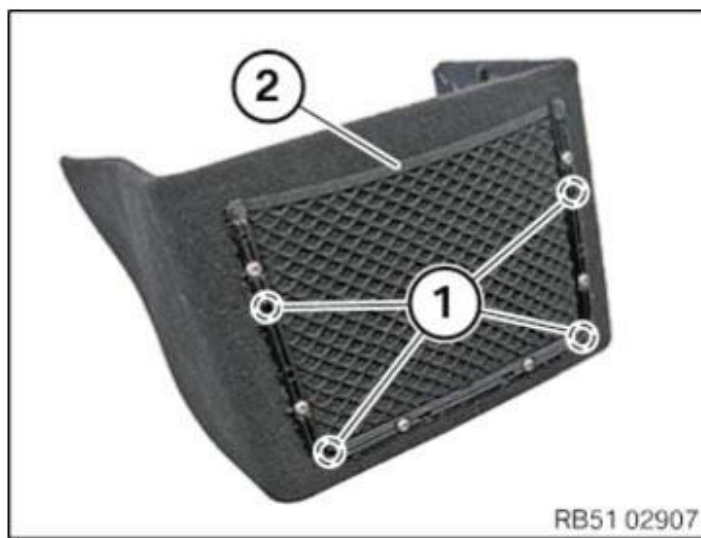
Tightening torque [51 45 9AZ](#).



**Fig. 370: Identifying Storage Net With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean adhesive area (1) on storage net (2) and corresponding counterpart on the frame.

Apply adhesive from [ADHESIVE SET K6](#) on adhesive area (1) on storage net (2).



**Fig. 371: Identifying Adhesive Area And Storage Net**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Clip on frame (1) on the storage net (2).

No gap shall be visible in area (A) between the frame (1) and the trim panel (3).



**Fig. 372: Identifying Trim Panel, Frame And Storage Net**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Install **INSTRUMENT PANEL TRIM, BOTTOM CENTER**

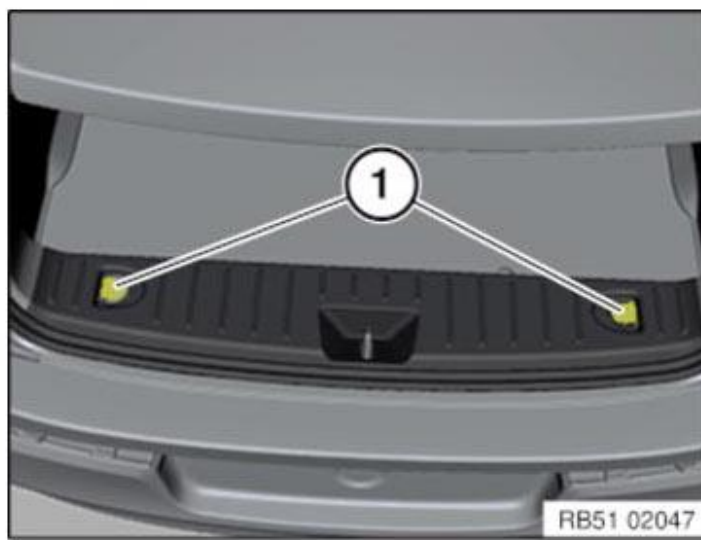
**PARCEL SHELF TRIM PANEL/ROLLER SUN BLIND**

**51 46 050 REMOVING AND INSTALLING/REPLACING TOP COVER ON TAIL PANEL**

**Necessary preliminary tasks:**

- Remove **LUGGAGE COMPARTMENT FLOOR TRIM PANEL**

Release covers (1).



**Fig. 373: Identifying Covers**

Courtesy of BMW OF NORTH AMERICA, INC.

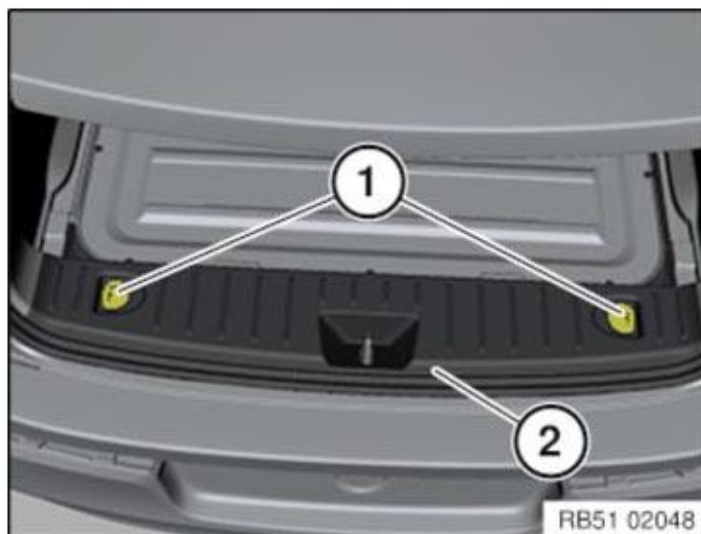
Loosen screws (1) and remove lashing eyes.

Tightening torque **51 47 1AZ** .

Remove trim (2) upwards.

*Installation note:*

Make sure edge protection for tailgate (2) is correctly seated on cover.



**Fig. 374: Identifying Trim And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

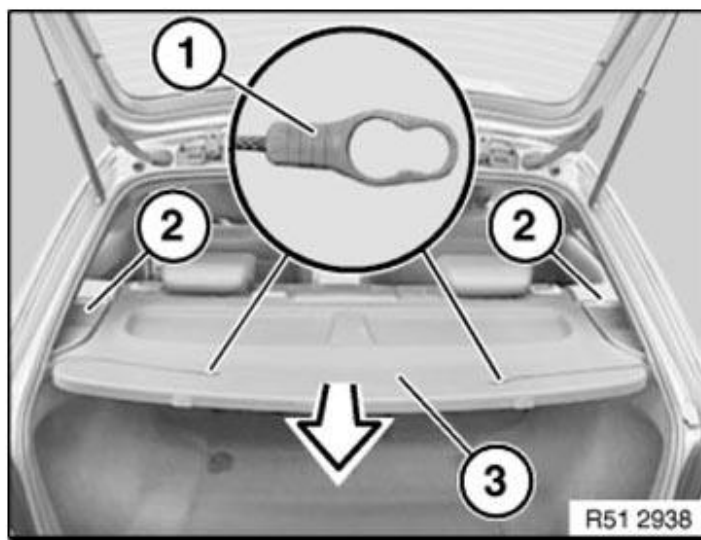
**51 46 003 REMOVING AND INSTALLING/REPLACING TRIM PANEL FOR STORAGE SHELF**

Open tailgate.

Release holding straps (1) on left and right.

Pull storage shelf (3) out of guides (2).





**Fig. 375: Pulling Storage Shelf Out Of Guides**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## FLOOR/LUGGAGE COMPARTMENT/ENGINE COMPARTMENT TRIM PANELS

### 51 47 315 REMOVING AND INSTALLING/REPLACING FRONT CARPET FOR PASSENGER COMPARTMENT

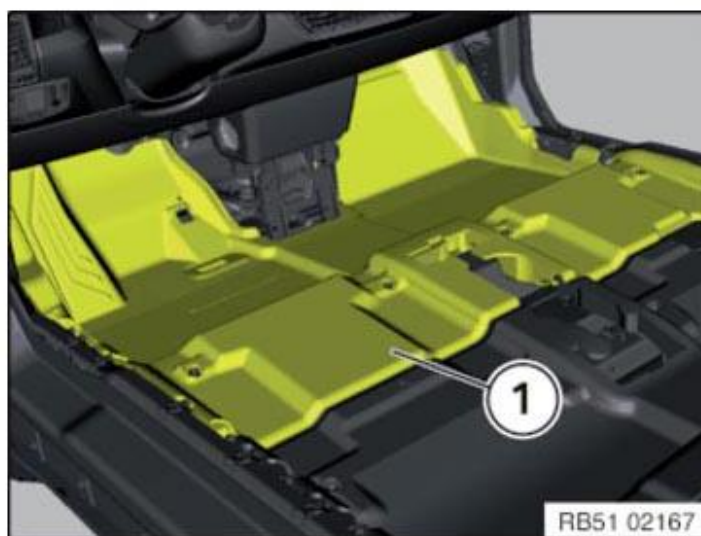
#### Necessary preliminary tasks:

- Remove both front seats. See [REMOVING DRIVER'S SEAT](#) and [REMOVING PASSENGER'S SEAT](#) .
- Remove [COMPLETE ACCELERATOR PEDAL MODULE](#)
- Remove [CENTER CONSOLE](#).
- Remove front left/right footwell side trim panel. See [SIDE TRIM PANEL, LEFT](#) and [SIDE TRIM PANEL, RIGHT](#).
- Remove [INSTRUMENT PANEL TRIM AT BOTTOM MIDDLE](#)

Remove carpet (1) toward rear/top and if necessary feed out cable.

*Installation note:*

Make sure apertures and attachments points are in correct position.

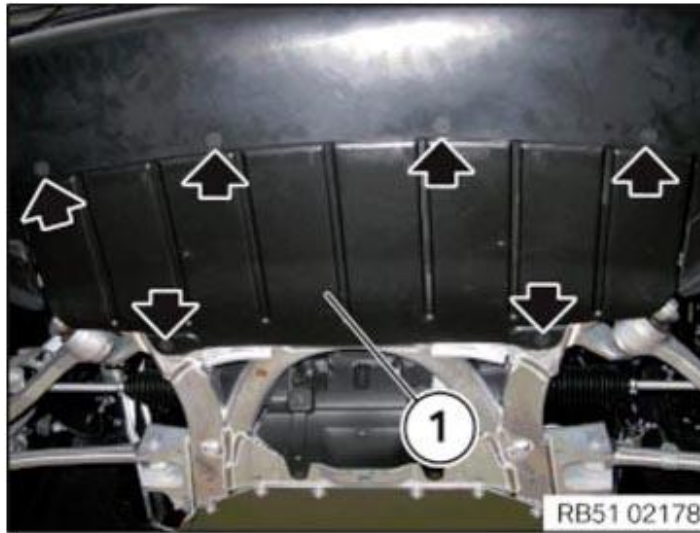


**Fig. 376: Identifying Carpet**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### 51 47 490 REMOVING AND INSTALLING/REPLACING FRONT UNDERBODY PROTECTION

Release screws.

Remove underbody protection (1).



**Fig. 377: Identifying Underbody Protection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 47 440 REMOVING AND INSTALLING OR REPLACING REAR CARPET ON SEAT PAN**

**Necessary preliminary tasks:**

- Remove both front seats. See **REMOVING DRIVER'S SEAT** and **REMOVING PASSENGER'S SEAT**.
- Remove **REAR SEAT**
- Remove **BOTH DOOR SILL COVER STRIPS**
- Remove **COMPLETE CENTER CONSOLE**

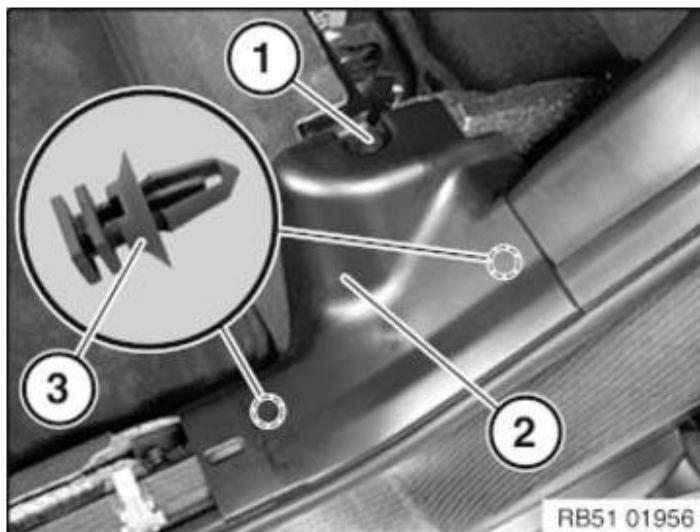
Release expansion rivet (1).

Release trim (2) at clips (3) and remove.

*Installation note:*

Replace faulty clips (3).

Remove trim (2) with preassembled clips (3).



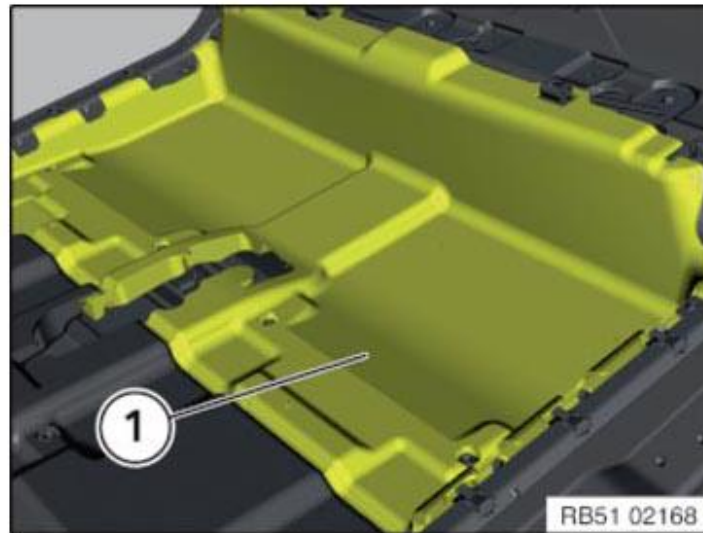
**Fig. 378: Identifying Expansion Rivet, Trim And Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed out associated cables.

Take out carpet (1) toward the top.

*Installation note:*

Make sure apertures and attachment points are in correct position.



**Fig. 379: Identifying Carpet**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 47 000 REMOVING AND INSTALLING/REPLACING FRONT (INSIDE) LEFT OR RIGHT DOOR SILL COVER STRIP**

**Special tools required:**

- [00 9 325](#)

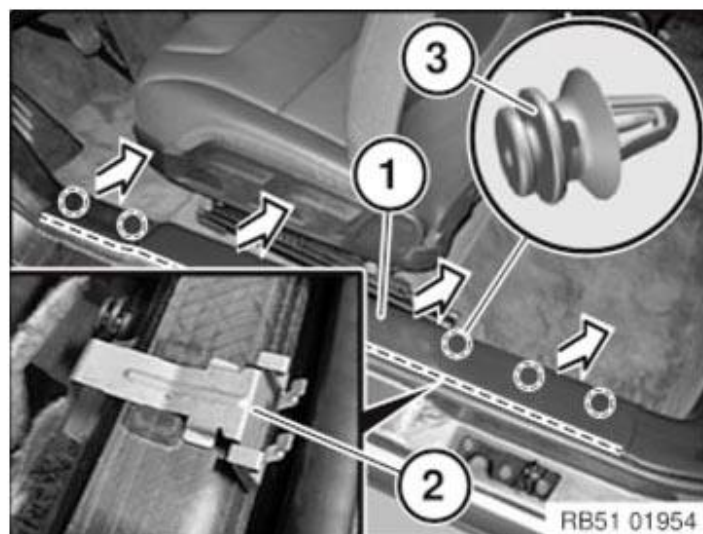
Fully adjust front seat upwards.

Release door sill cover strip (1) upwards out of clamps (2) using special tool [00 9 325](#) .

Release door sill cover strip (1) inwards out of clips (3).

*Installation note:*

Replace defective clips (2) and catches (3).



**Fig. 380: Releasing Door Sill Cover Strip Upwards Out Of Clamps Using Special Tool (00 9 325)**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 47 151 REMOVING AND INSTALLING/REPLACING LEFT LUGGAGE COMPARTMENT WHEEL ARCH TRIM**

**Necessary preliminary tasks:**

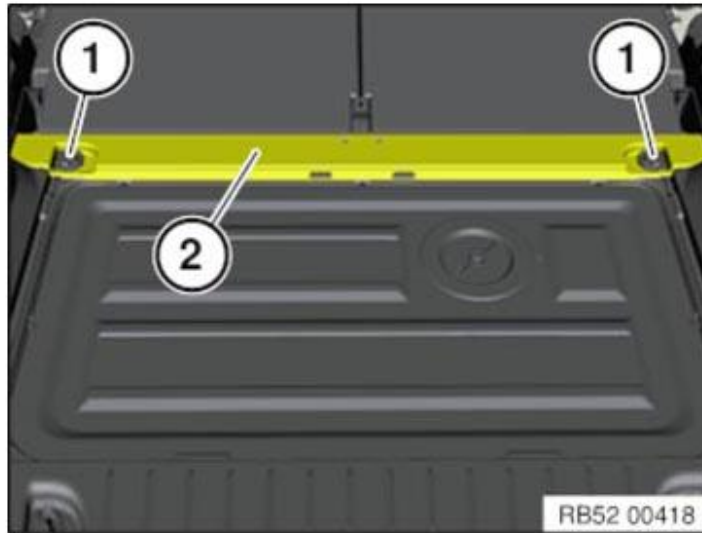
- Remove **LEFT SIDE TRIM PANEL**
- Remove **COVER ON TAIL PANEL**
- Remove **STORAGE SHELF (PARCEL SHELF)**

Unclip covers (1) and loosen the screws underneath.

Tightening torque **51 47 1AZ** .

Remove the lashing eyes.

Remove cross member trim panel (2) upwards.



**Fig. 381: Identifying Cross Member Trim Panel And Covers**  
 Courtesy of BMW OF NORTH AMERICA, INC.

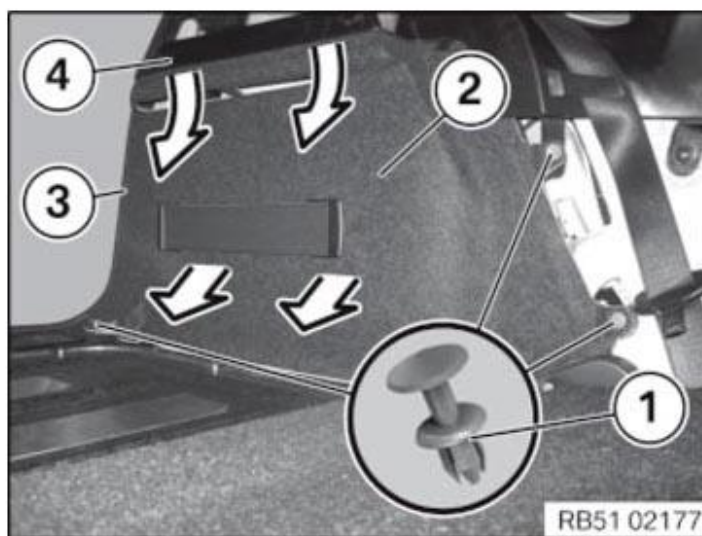
Release expanding rivet (1).

If necessary, disconnect related plug connections.

Feed out luggage compartment wheel arch panel (2) in direction of arrow

*Installation note:*

Luggage compartment wheel arch panel must fit correctly under tailgate rubber seal (3) and shoulder (4).



**Fig. 382: Feeding Out Luggage Compartment Wheel Arch Panel**  
 Courtesy of BMW OF NORTH AMERICA, INC.

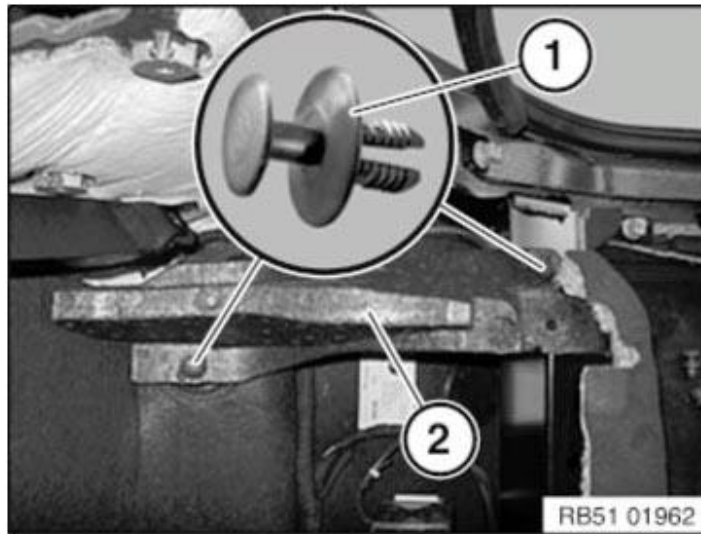


**Necessary preliminary tasks:**

- Remove luggage compartment wheel arch panel. See [LEFT LUGGAGE COMPARTMENT WHEEL ARCH TRIM](#) or [RIGHT LUGGAGE COMPARTMENT WHEEL ARCH PANEL](#).
- Remove [PANEL FOR ROOF PILLAR AT REAR](#)

Release expanding rivet (1).

Remove support (2).



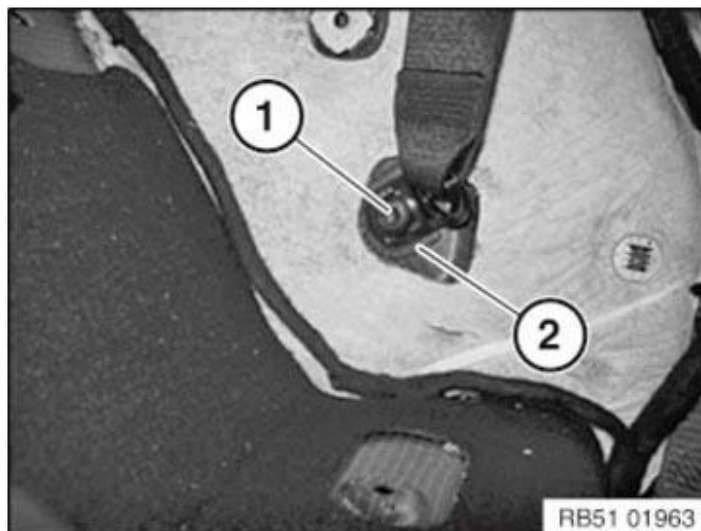
**Fig. 383: Identifying Expanding Rivet And Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque [72 11 21AZ](#) .

*Installation note:*

Make sure end fitting is correctly positioned on body (2).

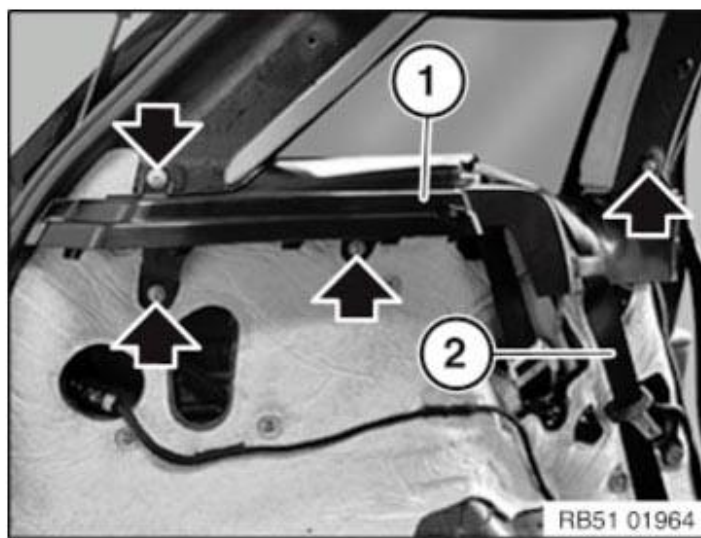


**Fig. 384: Identifying Body And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws.

Remove shoulder (1) inwards.

Feed out seat belt (2).



**Fig. 385: Identifying Seat Belt And Shoulder With Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 47 101 REMOVING AND INSTALLING/REPLACING LUGGAGE COMPARTMENT FLOOR TRIM PANEL**

Remove luggage compartment floor trim panel in direction of arrow.



**Fig. 386: Removing Luggage Compartment Floor Trim Panel**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 47 104 REMOVING AND INSTALLING/REPLACING LUGGAGE COMPARTMENT SERVICE CAP**

Necessary preliminary tasks:

- Remove **LUGGAGE COMPARTMENT FLOOR TRIM PANEL**

Release screws and remove service cap upwards.

Tightening torque **51 47 4AZ** .

**IMPORTANT:** The neoprene nuts are damaged if specified torque is exceeded.  
This can lead to rattling of service cap.

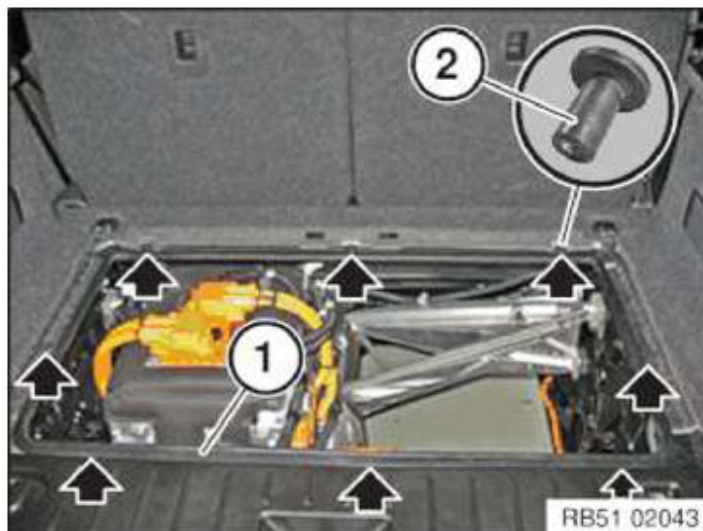




**Fig. 387: Locating Luggage Compartment Service Cap Neoprene Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Check gasket (1) and neoprene nuts (2) for damage and replace, if necessary.



**Fig. 388: Identifying Gasket And Neoprene Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**51 47 161 REMOVING AND INSTALLING/REPLACING RIGHT LUGGAGE COMPARTMENT WHEEL ARCH PANEL**

**Operation is identical to:**

Removing and installing/replacing left luggage compartment wheel arch panel.

**51 47 312 REPLACING FOOTREST FOR FRONT VEHICLE INTERIOR**

**Necessary preliminary tasks:**

- Remove **TRIM PANEL FOR PEDAL MECHANISM**.

**NOTE:** The footrest has been bonded to the carpet or secured by welded plastic pins.

Loosen and remove the mounting of the footrest (1).



**Fig. 389: Identifying Footrest**

Courtesy of BMW OF NORTH AMERICA, INC.

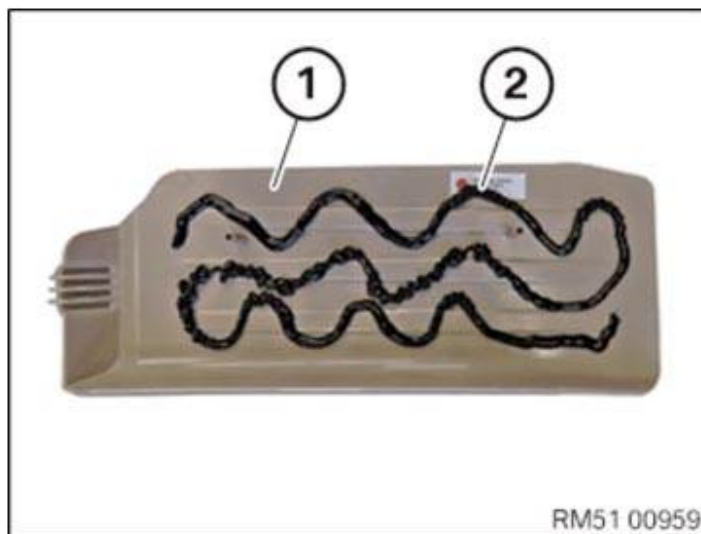
*Installation note:*

Pre-treat the footrest (1) using primer 206.

Apply an adhesive bead (2) with  $\tilde{\text{A}} \sim 5$  mm to the footrest (1).

Use **WINDOW GLASS ADHESIVE**.

Fit footrest (1) to carpet and bond.



**Fig. 390: Identifying Adhesive Bead Applying On Footrest**

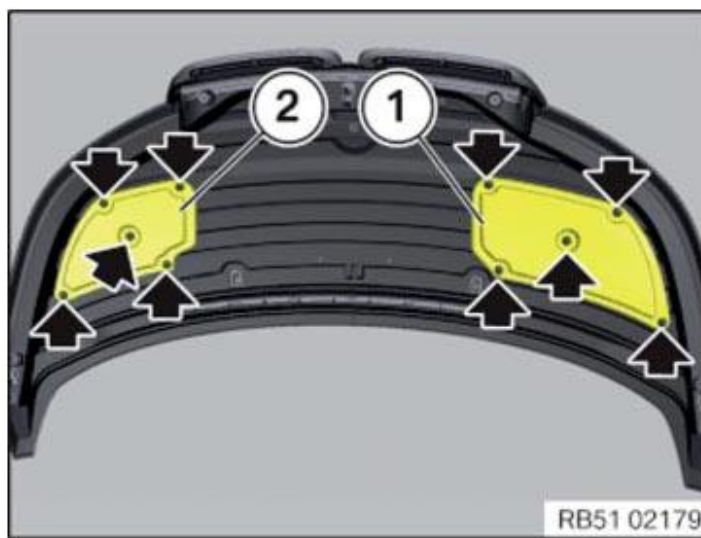
Courtesy of BMW OF NORTH AMERICA, INC.

## **FRONT LID INSULATION LINING**

### **51 48 001 REMOVING AND INSTALLING/REPLACING INSULATION LINING ON ENGINE HOOD/BONNET**

Release all clips on left damping material (1) and right damping material (2).

Remove left and right damping material.



**Fig. 391: Identifying Damping Material With Clips**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## REAR LID TRIM PANEL

### 51 49 000 REMOVING AND INSTALLING OR REPLACING TRIM FOR REAR LID

#### Necessary preliminary tasks:

- Only loosen both **COVERS FOR REAR WINDOW FRAME** on left/right in the bottom area, **do not remove**.
- Remove warning triangle.

Release screws (1) and remove holder for warning triangle.

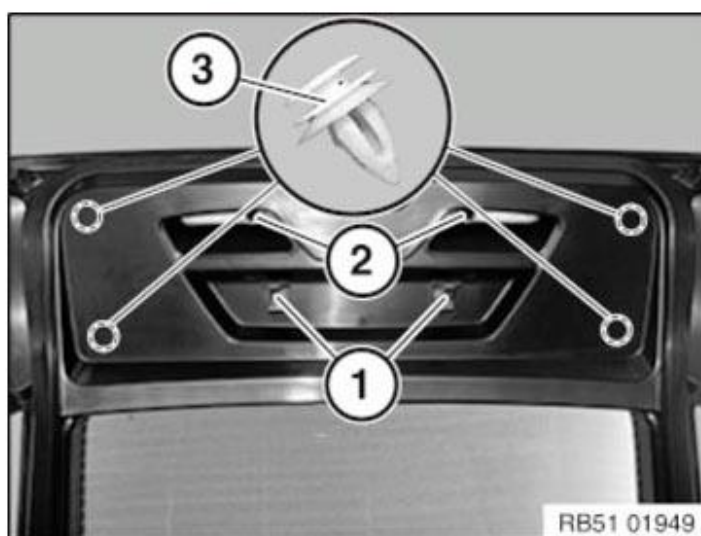
Unfasten screws (2).

Release trim panel at clips (3) and remove.

*Installation note:*

Replace faulty clips (3).

If necessary, lift out clips remaining in body and pre-install on trim panel.



**Fig. 392: Identifying Trim Panel Clips And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### 51 49 003 REMOVING AND INSTALLING/REPLACING COVER FOR REAR WINDOW FRAME ON LEFT OR RIGHT

**Special tools required:**

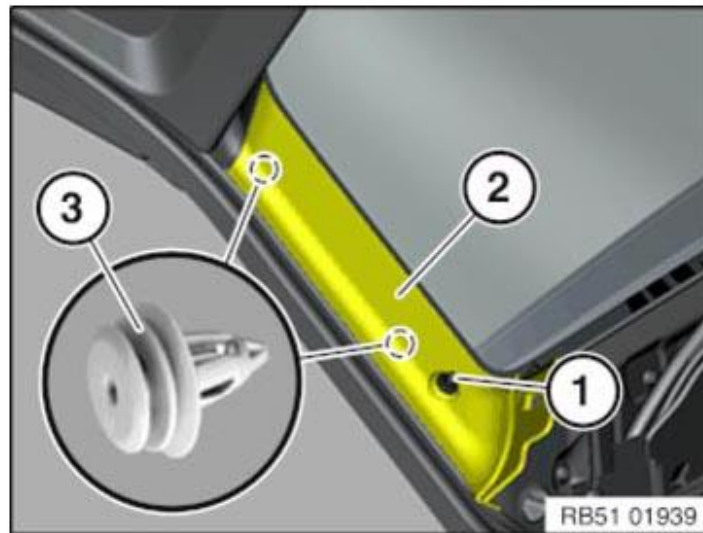
- [00 9 325](#)

**Necessary preliminary tasks:**

- Release holding straps of storage shelf
- Remove [COVER FOR REAR WINDOW FRAME AT TOP](#)

Release screw (1) and remove retaining knob.

Release trim (2) from clips (3) using special tool [00 9 325](#) and remove.

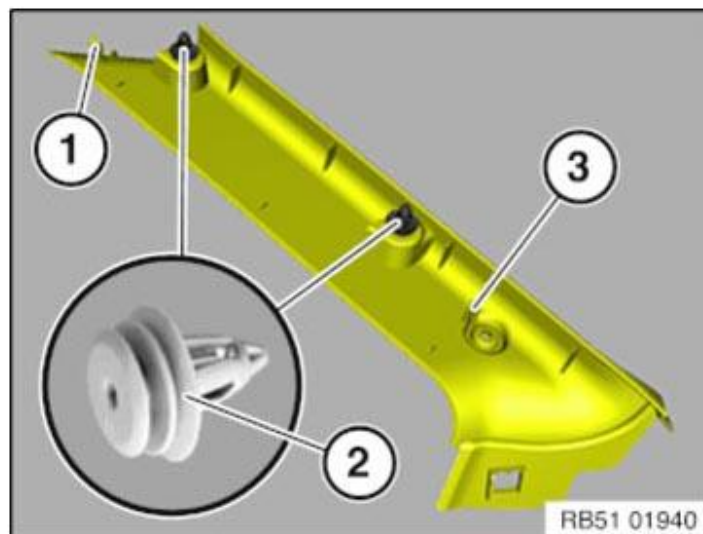


**Fig. 393: Identifying Trim, Clips And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

The following parts of the trim must not be missing or damaged:

1. Latch mechanism
2. Clip
3. Guide



**Fig. 394: Identifying Latch Mechanism, Clip And Guide**  
Courtesy of BMW OF NORTH AMERICA, INC.

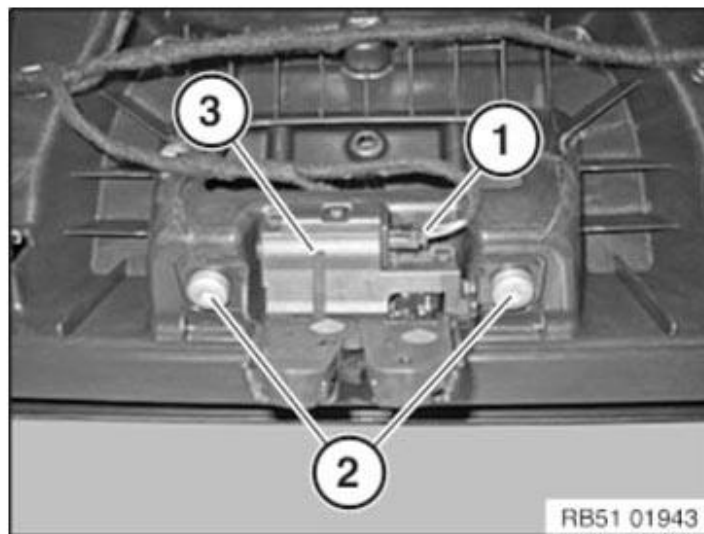
**Special tools required:**

- [2 298 505](#)

Detach cover (1) with special tool [2 298 505](#) from clip (2).

*Installation note:*

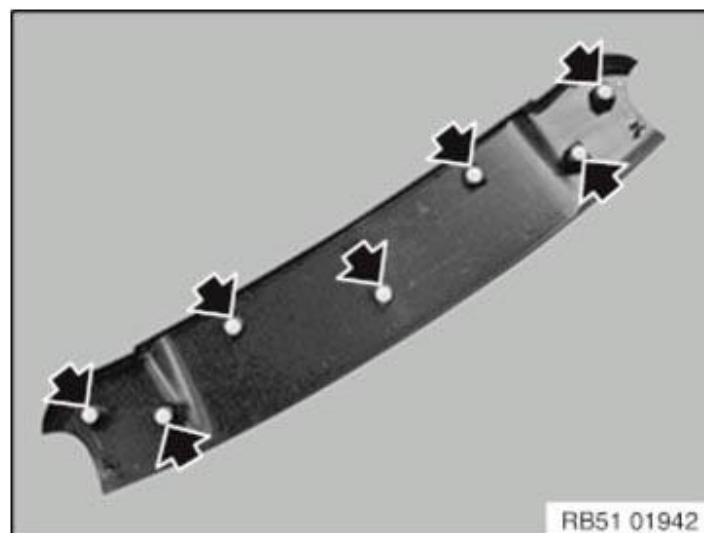
If necessary, pull off clips (2) from tailgate and insert in cover (1).



**Fig. 395: Identifying Tailgate Lock, Plug Connection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace faulty clips.



**Fig. 396: Locating Cover Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **FRONT LUGGAGE COMPARTMENT WELL**

### **51 64 050 REMOVING AND INSTALLING/REPLACING FRONT LUGGAGE COMPARTMENT WELL**

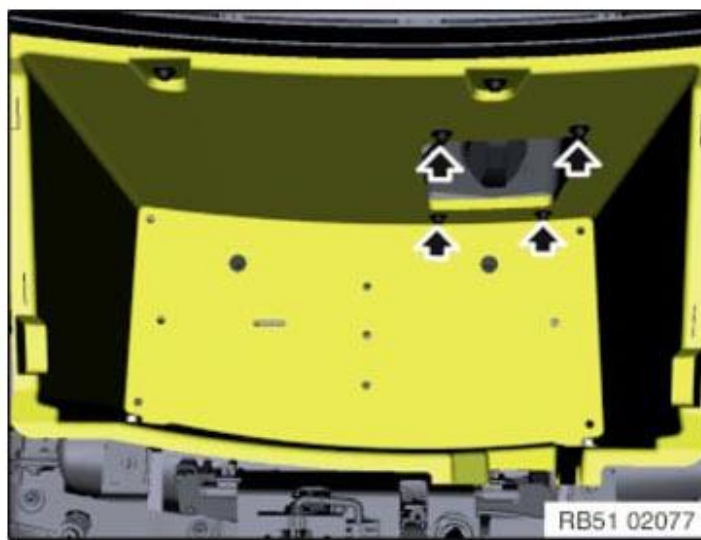
**Necessary preliminary tasks:**

- Remove front left and right [LUGGAGE COMPARTMENT COVER](#)

**For Japanese national-market version only:**

Release screws.

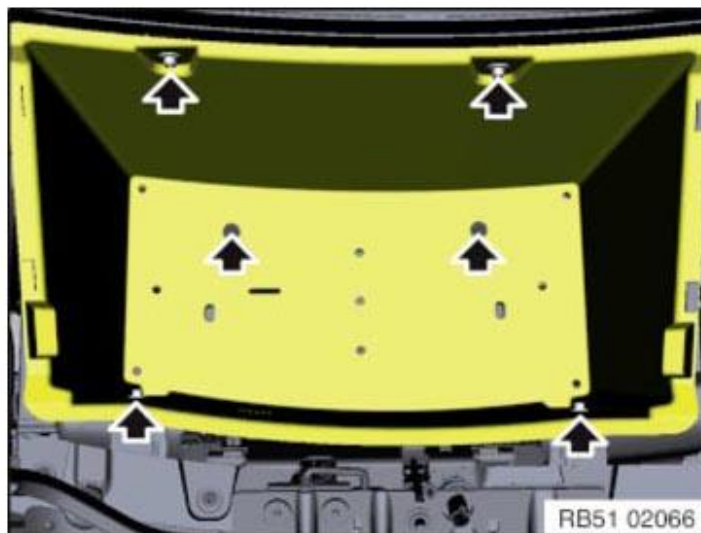




**Fig. 397: Locating Luggage Compartment Cover Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws.

Remove luggage compartment well upwards.



**Fig. 398: Locating Luggage Compartment Cover Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **GASKETS/SEALS, LOOSE BODY COMPONENTS**

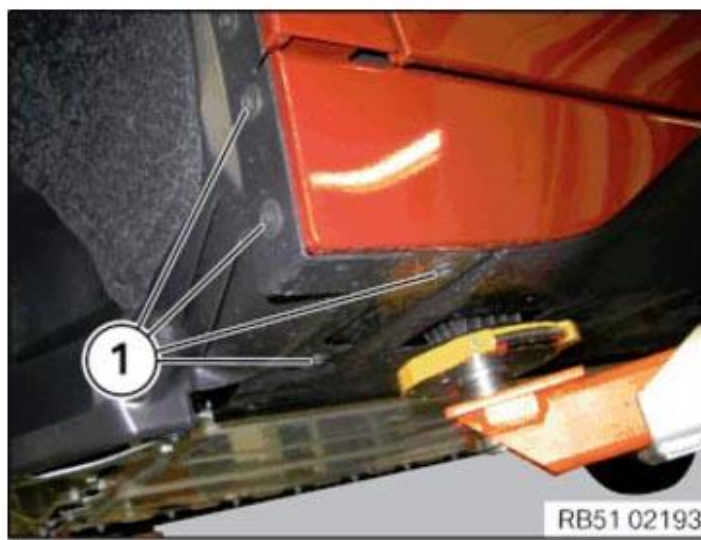
### **51 71 447 REMOVING AND INSTALLING OR REPLACING TRIM PANEL FOR COVER ON LEFT OR RIGHT SIDE MEMBER**

Special tools required:

- [00 9 327](#)
- [00 9 340](#)

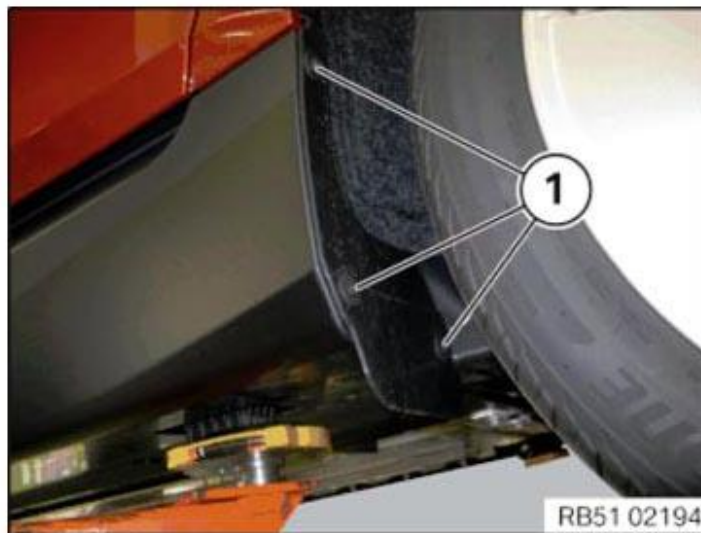
Release screws (1).





**Fig. 399: Removing Side Member Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

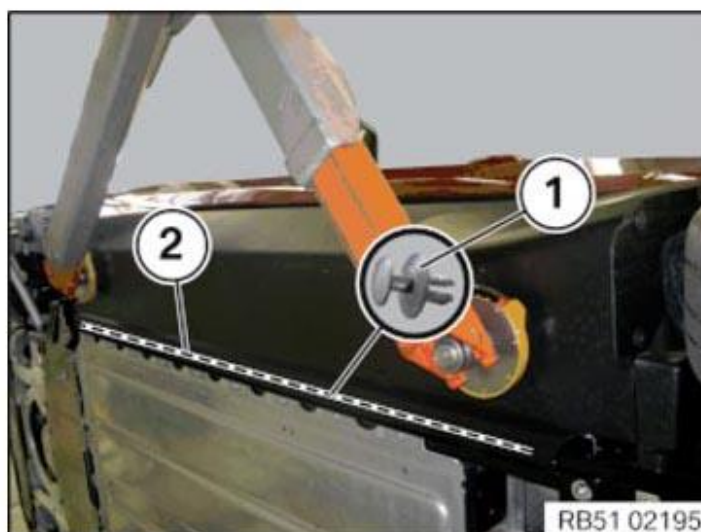


**Fig. 400: Identifying Cover Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release all clips (1) in vicinity of dashed line (2).

*Installation note:*

Replace faulty clips (1).

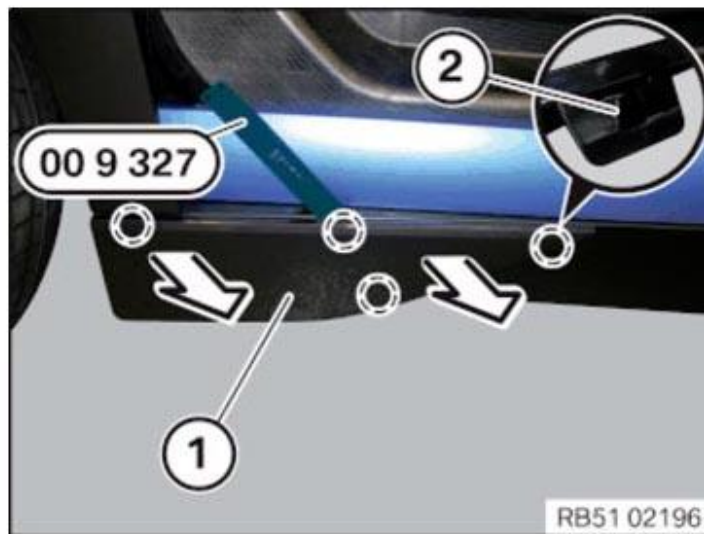


**Fig. 401: Identifying Dashed Line And Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lever out trim (1) with special tool [00 9 327](#) at latch mechanisms (2) and remove.

*Installation note:*

Latch mechanisms (2) must not be damaged.



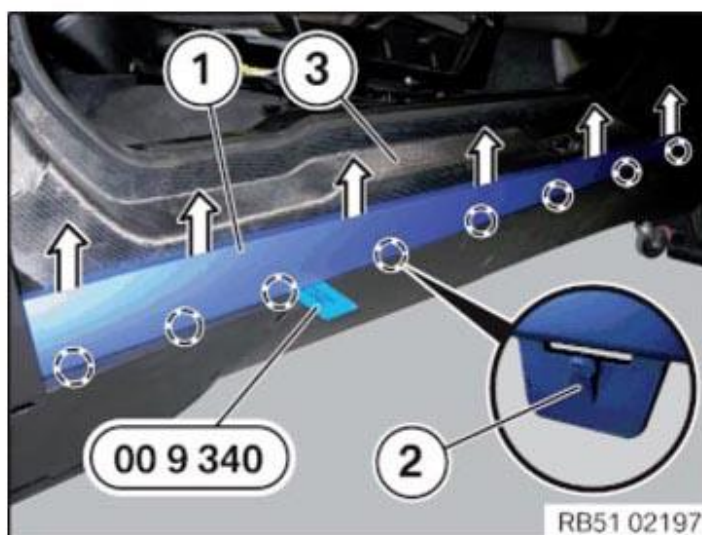
**Fig. 402: Removing Trim With Special Tool (00 9 340)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lever out trim (1) with special tool [00 9 340](#) upward out of latch mechanisms (2) and remove.

*Installation note:*

Latch mechanisms (2) must not be damaged.

Make sure trim (1) is correctly seated on side sill (3).



**Fig. 403: Removing Trim From Latch Mechanisms With Special Tool (00 9 340)**  
Courtesy of BMW OF NORTH AMERICA, INC.

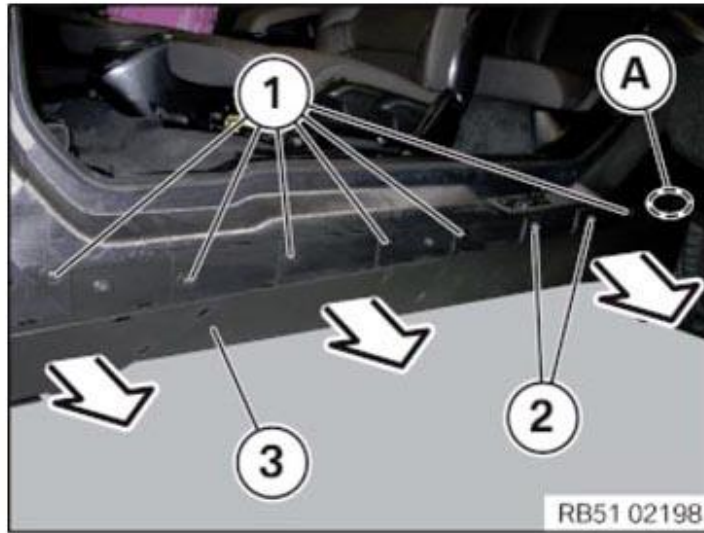
Release screws (1).

Tightening torque [51 71 3AZ](#) .

Unscrew nuts (2).

Tightening torque [51 71 2AZ](#) .

Disengage cover (3) in area (A) and remove in direction of arrow.



**Fig. 404: Disengaging Cover**

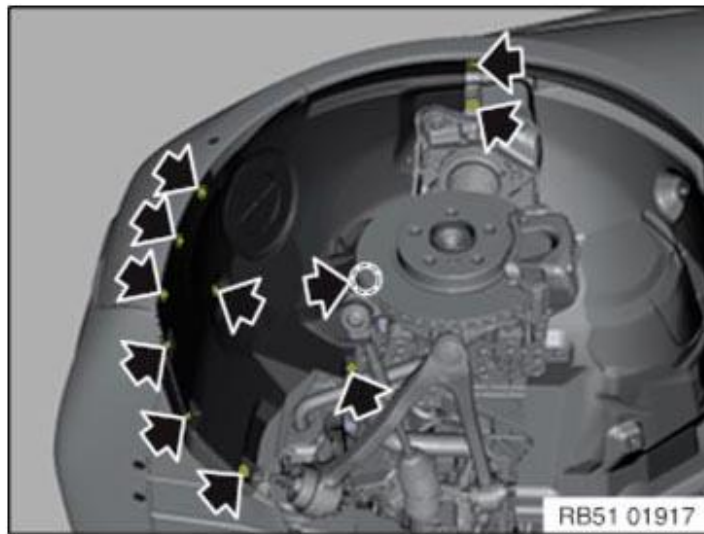
Courtesy of BMW OF NORTH AMERICA, INC.

**51 71 038 REMOVING AND INSTALLING/REPLACING FRONT LEFT OR RIGHT WHEEL ARCH COVER (FRONT SECTION)**

**NOTE:** Figure without front wheel for purposes of clarity.

Release screws/nuts.

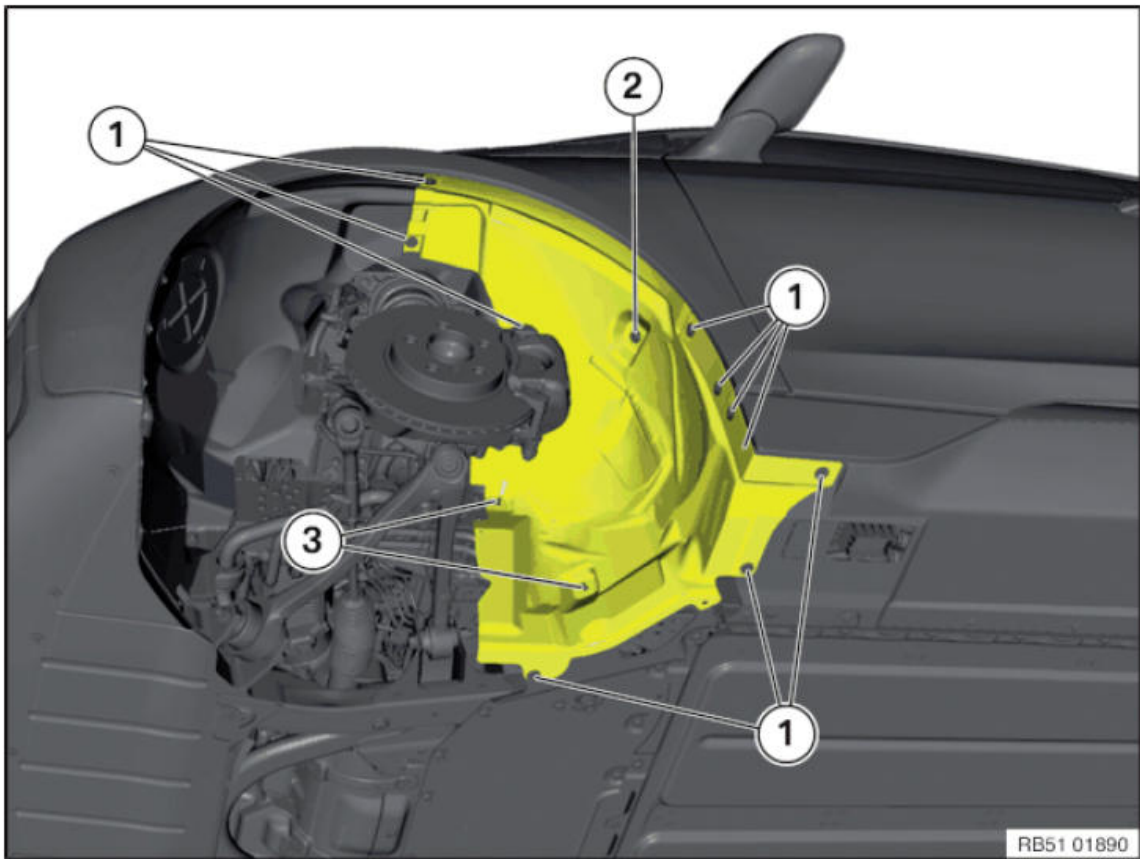
Feed out wheel arch cover.



**Fig. 405: Locating Wheel Arch Cover Screws And Nuts**

Courtesy of BMW OF NORTH AMERICA, INC.

**51 71 039 REMOVING AND INSTALLING/REPLACING FRONT LEFT OR RIGHT WHEEL ARCH COVER (REAR SECTION)**



**Fig. 406: Identifying Front Wheel Arch Cover Plastic Nuts, Screws And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Figure without front wheel for purposes of clarity.

Release screws (1).

Slacken nut (2).

Release plastic nuts (3).

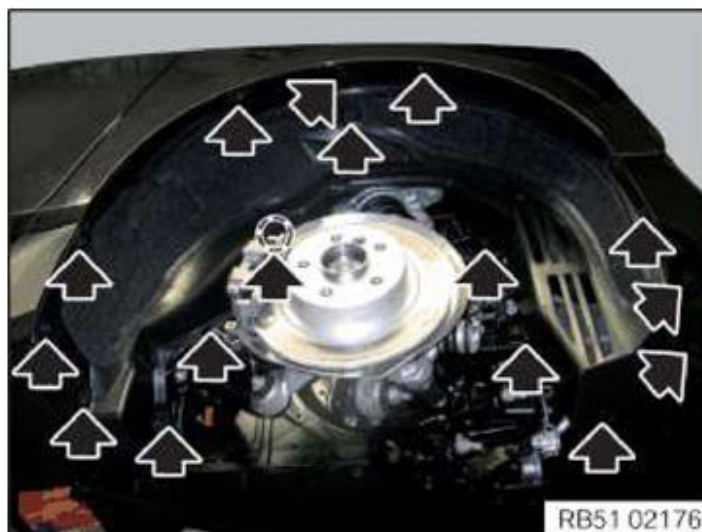
Feed out front wheel arch cover (rear part).

**51 71 041 REMOVING AND INSTALLING/REPLACING REAR LEFT OR RIGHT WHEEL ARCH COVER**

**NOTE:** Figure without rear wheel for purposes of clarity.

Release screws/nuts.

Feed out wheel arch cover.





**51 71 412 REMOVING AND INSTALLING/REPLACING REAR SPOILER**

Special tools required:

- **51 0 010**

Necessary preliminary tasks:

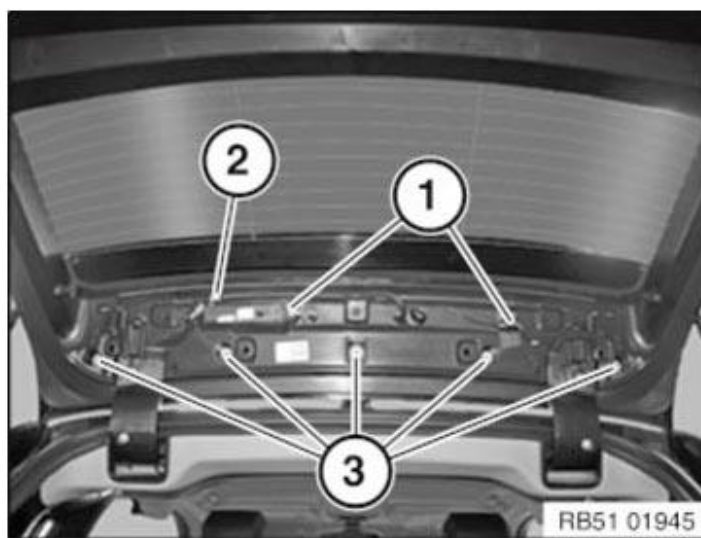
- Remove upper **REAR WINDOW FRAME COVER**

Unlock plug connections (1) and disconnect.

Unlock hose pipe (2) and disconnect.

Unscrew nuts (3).

Tightening torque **51 71 1AZ** .



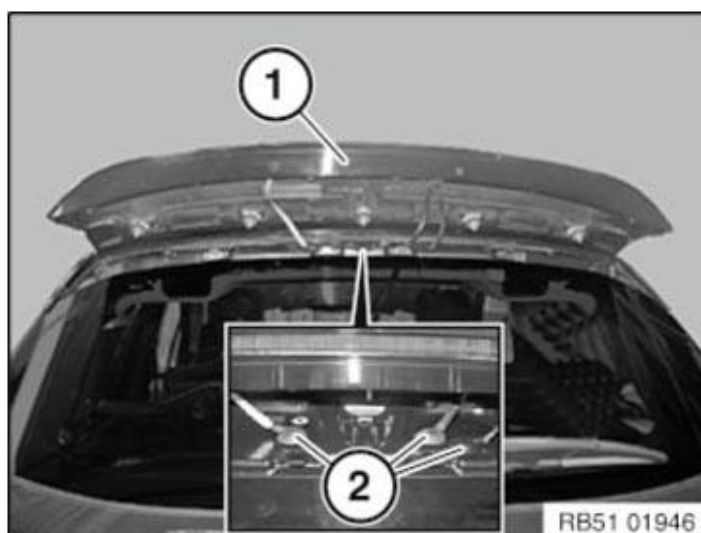
**Fig. 408: Identifying Hose Pipe, Plug Connections And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull rear spoiler (1) slightly towards rear and lift.

Release grommets (2) from tailgate.

*Installation note:*

Make sure grommets (2) are correctly seated.



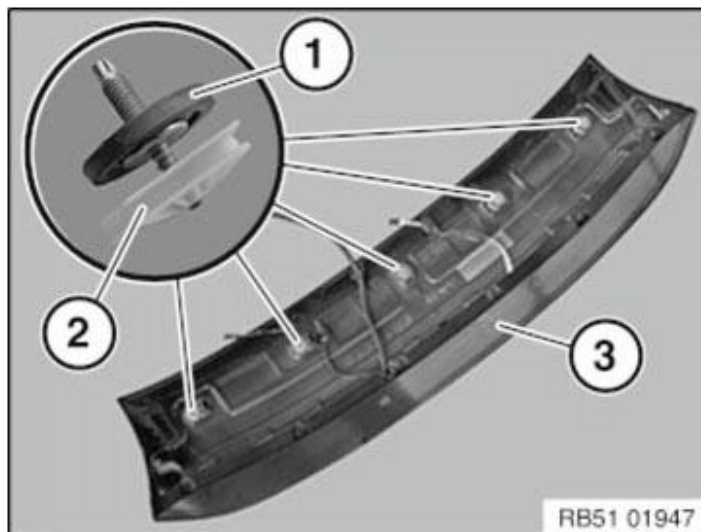
**Fig. 409: Identifying Rear Spoiler And Grommets**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Sealing surface (1) on adjusting elements (2) must not be damaged.

### Replacement

Swap over **THIRD BRAKE LIGHT** .



**Fig. 410: Identifying Brake Light, Sealing Surface And Adjusting Elements**  
Courtesy of BMW OF NORTH AMERICA, INC.

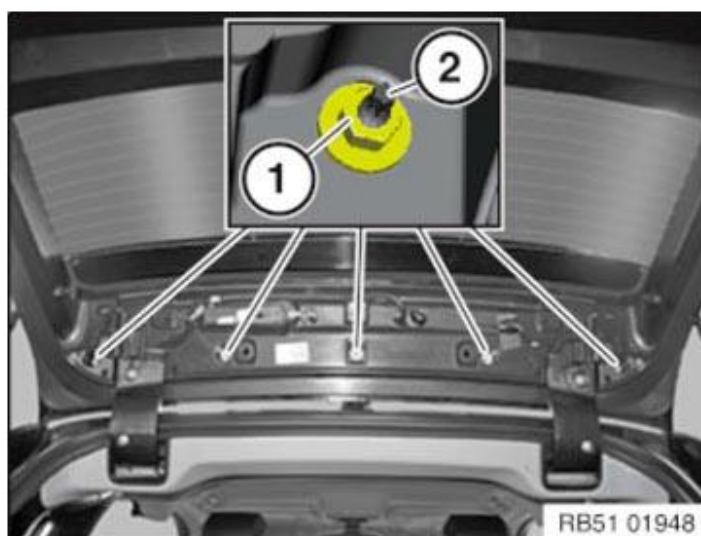
### Adjusting the rear spoiler:

Observe GAP DIMENSIONS .

Measure short length of rear spoiler to roof using special tool **51 0 010** .

Slacken nuts (1) if necessary and adjust rear spoiler using adjusting screw (2).

Tightening torque **51 71 1AZ** .



**Fig. 411: Identifying Rear Spoiler Nuts And Adjusting Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **51 71 360 REMOVING AND INSTALLING/REPLACING SEAL FOR TAILGATE**

Follow the notes on fitting **SEALS**.



**Necessary preliminary tasks:**

- Release **REAR GAS PRESSURE SPRINGS** on tailgate.

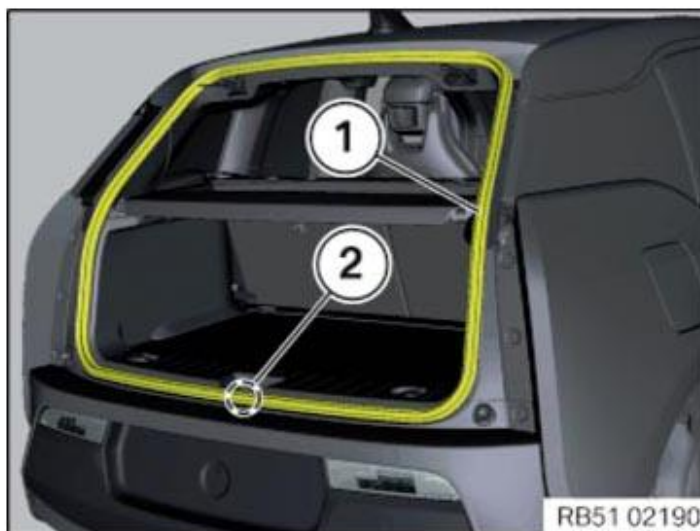
Detach seal (1) from luggage compartment lid cutout.

*Installation note:*

Start installation at top middle.

The contact point (2) of the sealing (1) must be at the bottom center.

Make sure seal (1) is correctly seated on body and all trim panel parts.



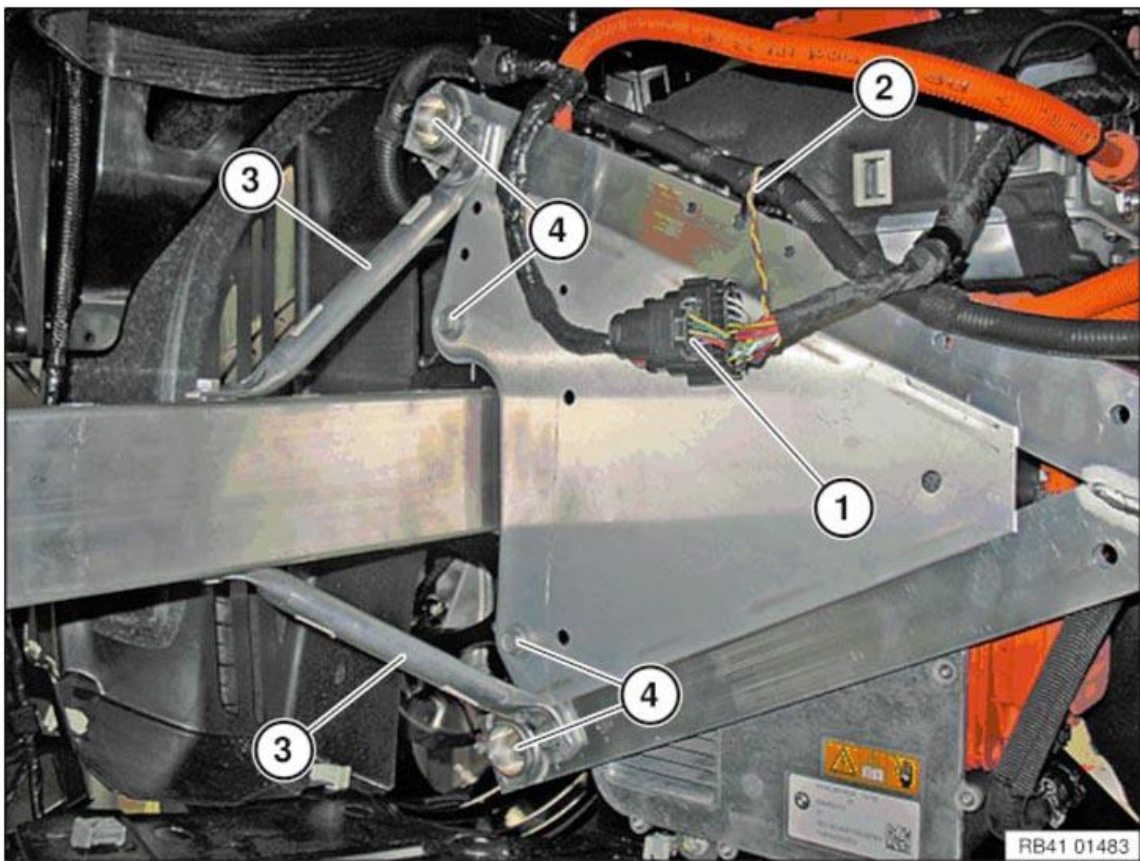
**Fig. 412: Identifying Contact Point And Seal**  
Courtesy of BMW OF NORTH AMERICA, INC.

**41 11 650 REMOVING AND INSTALLING/REPLACING THE VERTICAL STRUT (SUPPORT FOR BUMPER PANEL REMOVED)**

Read contents of BODY, GENERAL .

**NOTE:** Observe (REPAIR STAGE 1) procedure!

**Removal of the vertical strut**



**Fig. 413: Identifying Cable Strap, Tension Strut, Connector And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

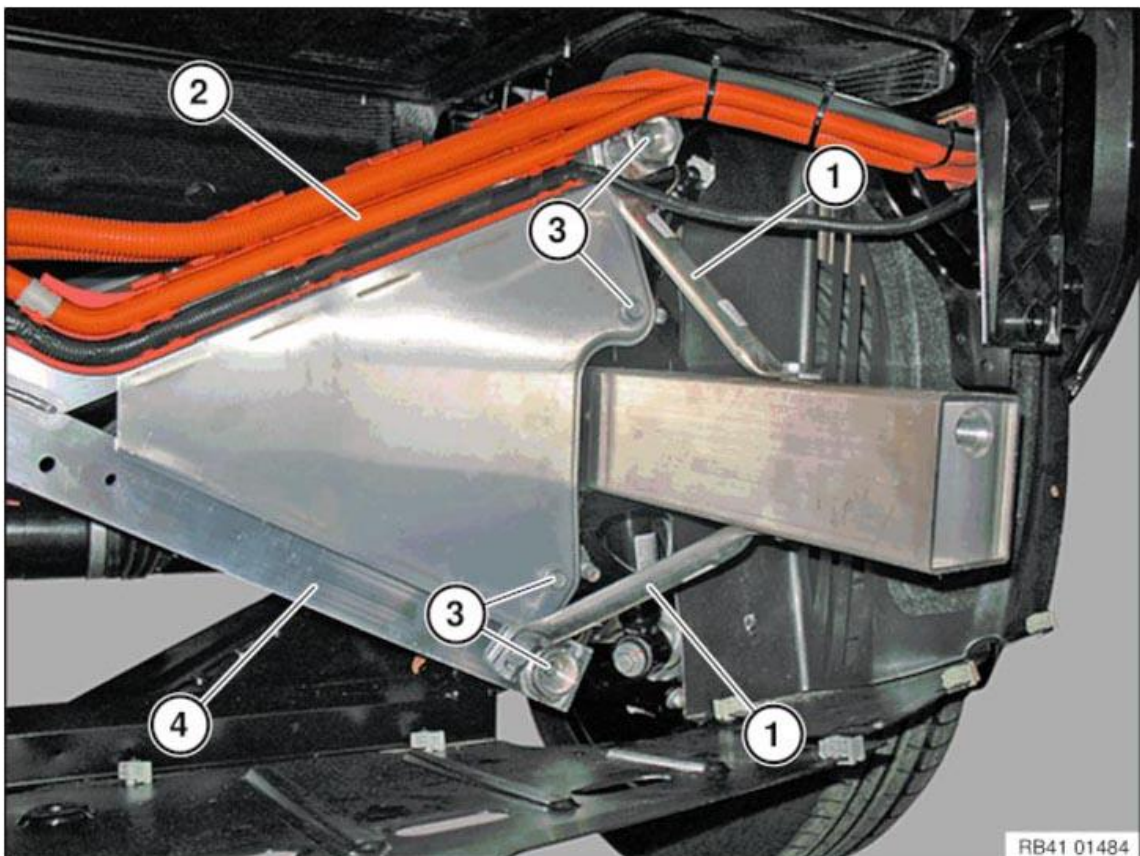
Release connector (1) by rotating.

Cut open cable strap (2).

Remove tension strut at top and bottom (3).

Release screws (4).

Tightening torque [41 11 4AZ](#).



**Fig. 414: Identifying Tension Strut, High-Voltage Cables And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove tension strut at top and bottom (1).

Unclip high-voltage cables (2) (4x).

Loosen screws (3).

Tightening torque **41 11 4AZ** .

Remove vertical strut (4).

### **Installation of the vertical strut**

The installation takes place in reverse order.

Tighten screws with tightening torque.

### **41 11 650 REMOVING AND INSTALLING/REPLACING VERTICAL STRUT (RANGE EXTENDER) (SUPPORT FOR BUMPER PANEL REMOVED)**

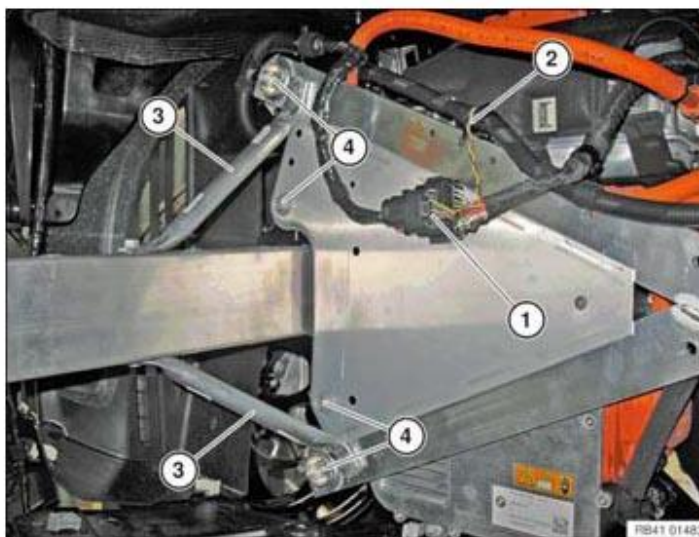
Read contents of BODY, GENERAL .

**NOTE:**        **Observe (REPAIR STAGE 1) procedure!**

Necessary preliminary tasks:

- Remove **COMPLETE EXHAUST SYSTEM** .
- Remove **INTAKE FILTER HOUSING** .
- Remove **ENGINE COMPARTMENT FAN** .

Removal of the vertical strut



**Fig. 415: Identifying Exhaust System Holder, Heat Shield, Clamps And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and remove exhaust system holder (2).

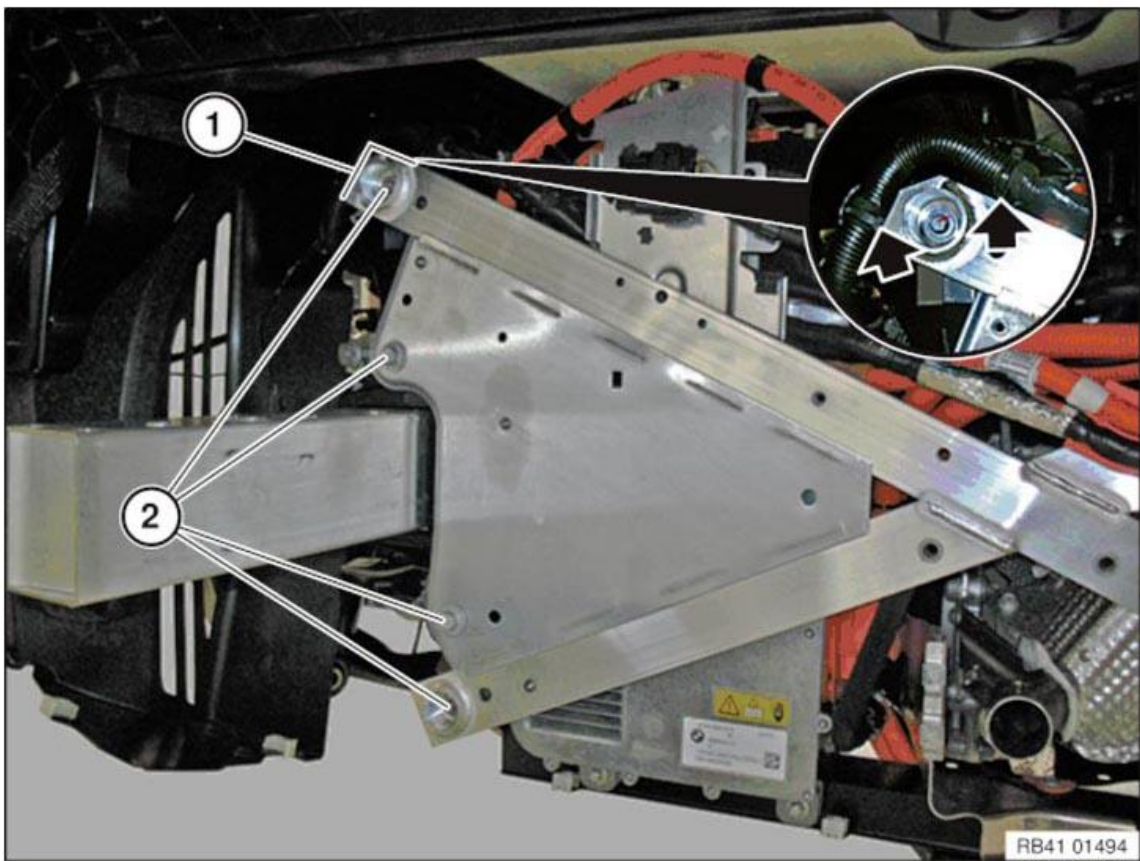
Tightening torque **18 20 1AZ** .

Loosen screws (3).

Pull heat shield (4) out of clamps (5) and remove.

Tightening torque **18 30 6AZ** .





**Fig. 416: Identifying Drive Module Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

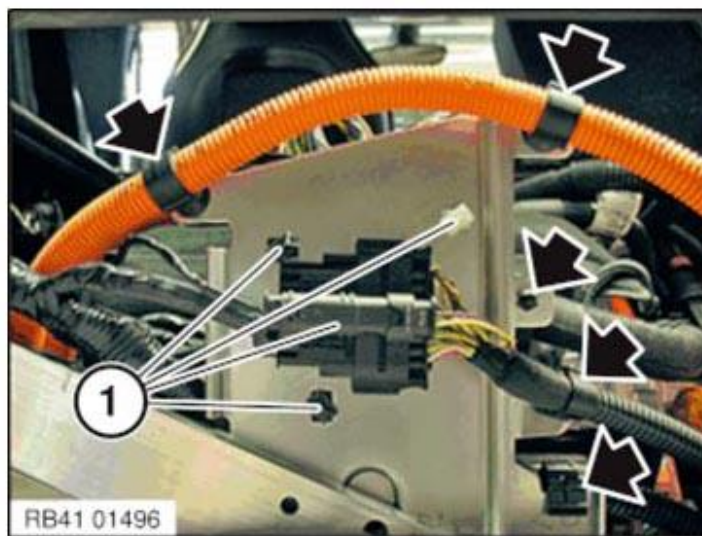
Unclip cable in area (1).

Unfasten screws (2).

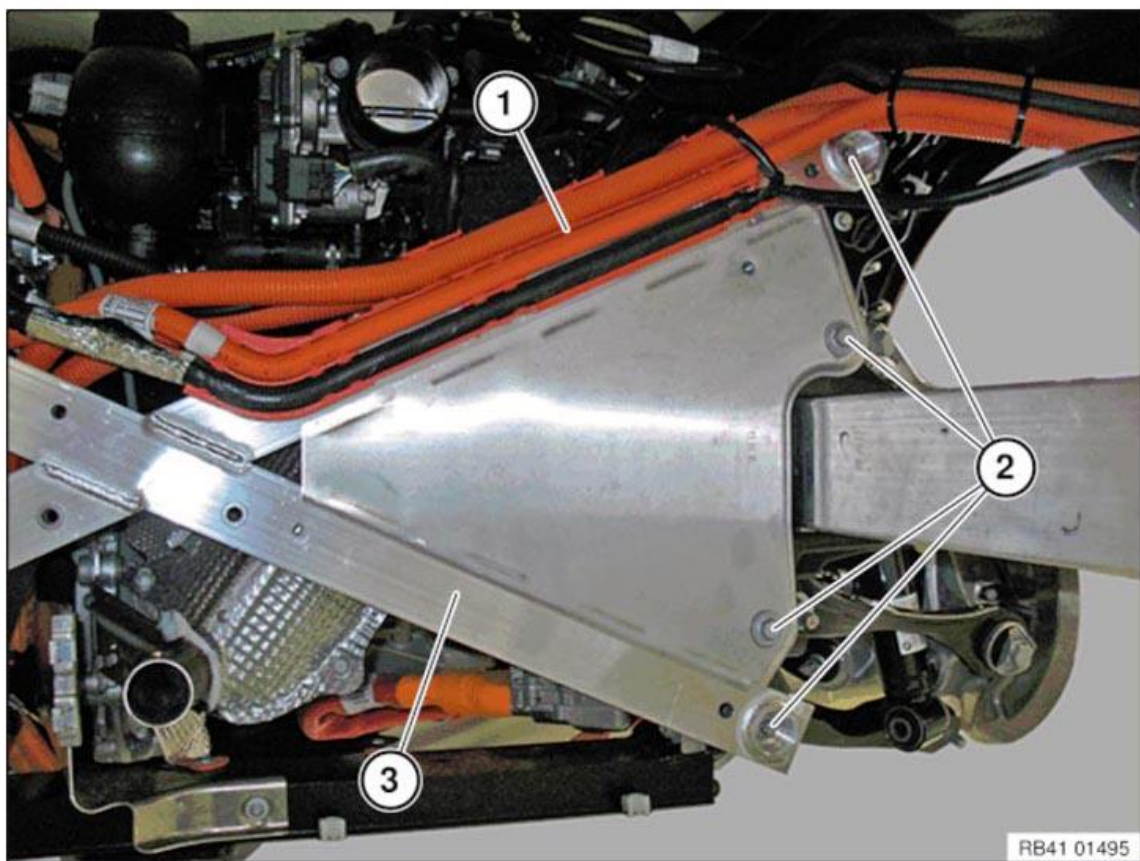
Tightening torque [41 11 4AZ](#) .

Turn connector housing (1) 45° and remove.

Unclip cable at marked areas.



**Fig. 417: Identifying Connector Housing**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 418: Identifying High-Voltage Cables, Vertical Strut And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip high-voltage cables (1) (4x).

Unfasten screws (2).

Tightening torque [41 11 4AZ](#) .

Remove vertical strut (3).

#### **Installation of the vertical strut**

The installation takes place in reverse order.

Tighten screws with tightening torque.

## **MUCKET FOR DOORS**

### **51 72 000 REPLACING EDGE PROTECTION FOR LEFT OR RIGHT FRONT DOOR**

When working on trim panel components, make sure that the sensitive surfaces are not scratched or damaged.

#### **Necessary preliminary tasks:**

- Remove [FRONT DOOR SILL COVER STRIP \(INNER\)](#).

IMPORTANT: Follow [NOTES](#) for fitting sealing!

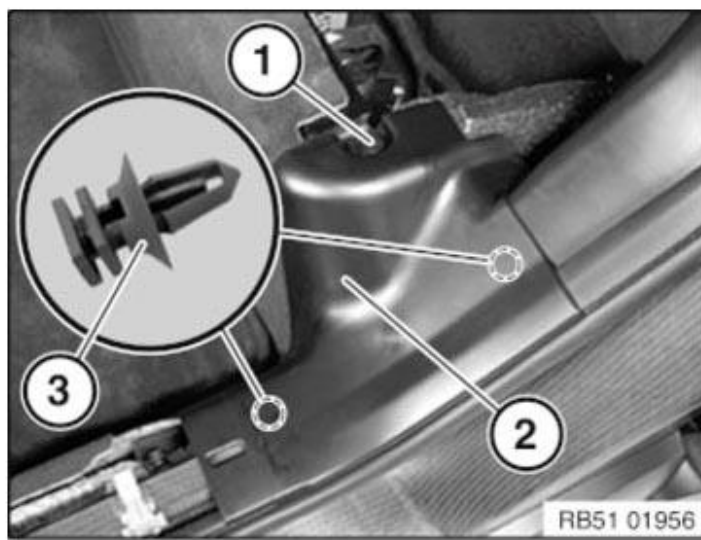
Release expansion rivet (1).

Release trim (2) at clips (3) and remove.

*Installation note:*

Replace faulty clips (3).

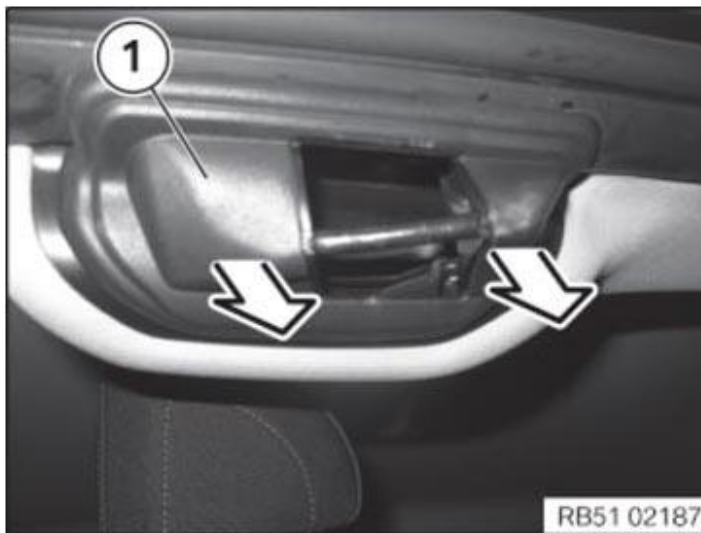
Remove trim (2) with preassembled clips (3).



**Fig. 419: Identifying Expansion Rivet, Trim And Clips**

Courtesy of BMW OF NORTH AMERICA, INC.

Pull off trim (1) in direction of arrow.



**Fig. 420: Pulling Off Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

Detach edge protection (1).

*Installation note:*

Install edge protection (1) starting in area "A".

When installed, the location of joint of edge protection (1) must be in area "B".





**Fig. 421: Identifying Edge Protection Installation Position**

Courtesy of BMW OF NORTH AMERICA, INC.

### **51 72... SEALING INSTALLATION**

**NOTE:** The utmost care must be taken when removing all sealings on the vehicle. Incorrect fitting can lead to wind noise and water ingress among other things and can affect the ease of closing and opening.

The following instructions only apply to sealing without sealant.

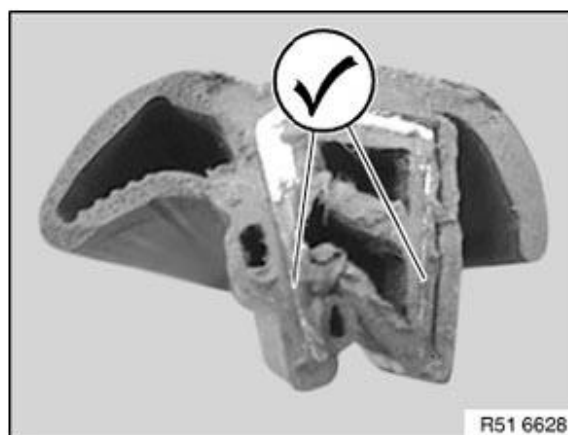
Sealings with sealant must be replaced each time they are disassembled.

Sealing surfaces must be cleaned.

- **In general, the following applies:**

Sealings on the side frame can be fitted and removed any number of times.

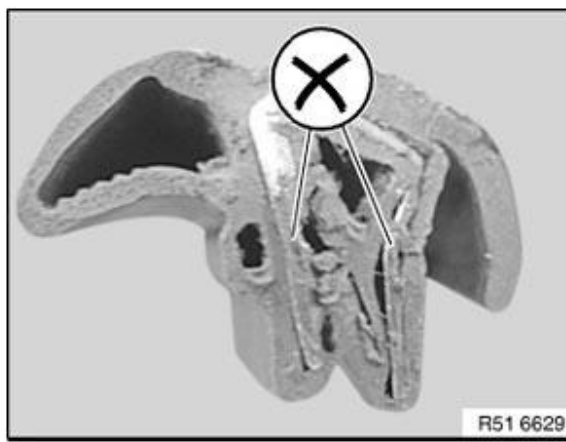
- Sealings must not be damaged or torn.
- The clamping surface must be compressed by hand far enough to ensure that a tight connection on the side flange is still possible. The sealing shanks may touch each other slightly. A completely compressed sealing is not permitted.



**Fig. 422: Identifying Seals Installation Position (Correct)**

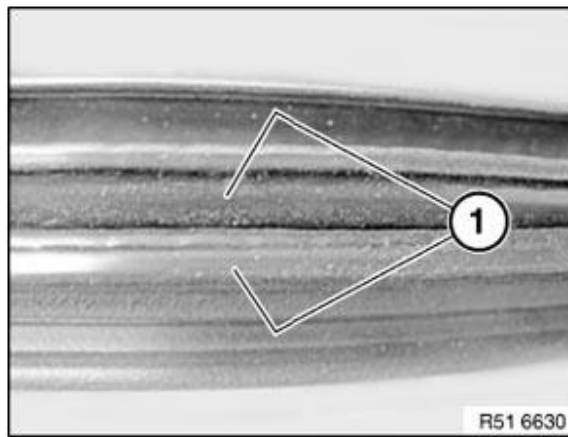
Courtesy of BMW OF NORTH AMERICA, INC.

- It is not necessary to use special tools to compress the clamping surface. This can be done carefully by hand.
- The sealings must always be fitted except in the case of blockages. There is no defined contact pressure.
- A new gasket must be fitted if sealings in the tailgate area are repeatedly fitted and removed (water ingress due to cracked sheet metal).



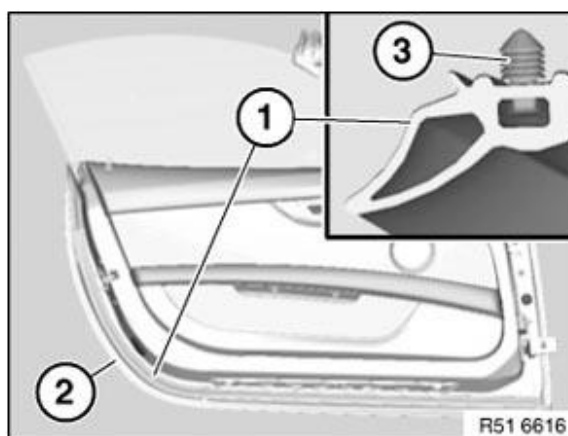
**Fig. 423: Identifying Seals Installation Position (Incorrect)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Sealings must be checked for correct fit after installation. If necessary, sealings should be lifted over the adjacent components using the appropriate tool. Neighboring components must not be damaged.
- Sealings must be replaced if the metal inlay of the sealing is visible (corrosion).
- Ensure the clamping surface is even all round.



**Fig. 424: Identifying Clamping Area**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Sealings that are installed with plastic clips fit tightly against the body. If this is not the case, replace the clips or sealings.



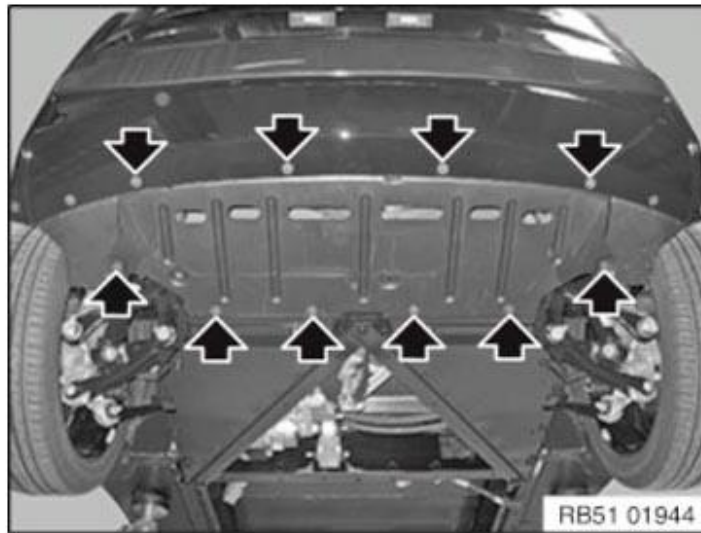
**Fig. 425: Identifying Joint Seal With Plastic Clips**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **UNDERBODY PANELLING**

### **51 75 110 REMOVING AND INSTALLING/REPLACING REAR UNDERBODY PANELLING**

Release screws.

Remove underbody panelling.



**Fig. 426: Locating Underbody Panelling Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## SEALS

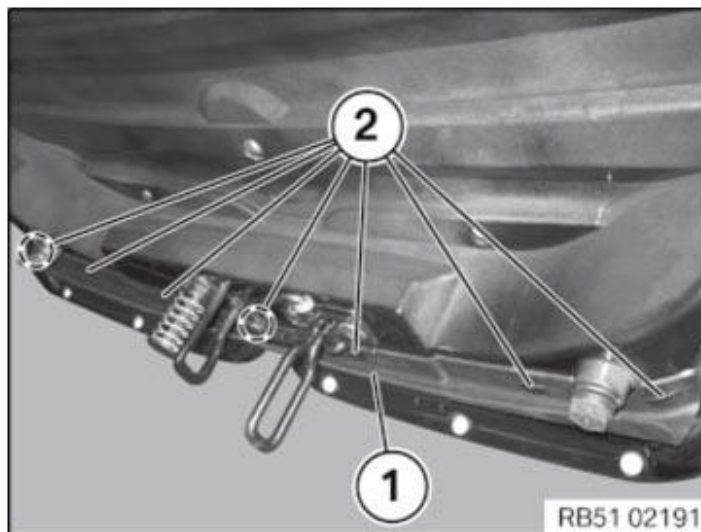
### 51 76 031 REMOVING AND INSTALLING/REPLACING FRONT AND REAR GASKET OF ENGINE COMPARTMENT LID

#### Front gasket:

Release gasket (1) at clips (2).

*Installation note:*

Replace faulty clips (2).



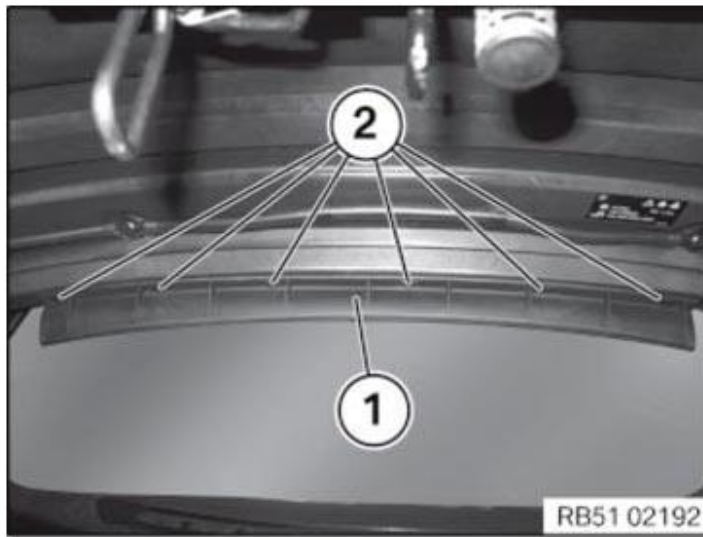
**Fig. 427: Identifying Front Gasket And Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### Rear gasket:

Release gasket (1) at clips (2).

*Installation note:*

Replace faulty clips (2).



**Fig. 428: Identifying Rear Gasket And Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

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[Back To Article](#)

## ACCESSORIES AND BODY, CAB

Body Equipment - Special Tools - All I3 Models - i3

### BODY EQUIPMENT

#### 2355737 ACCESSORIES MINIMUM SET: MECHANICAL TOOLS AM

**NOTE:** Applies to: BMW i Aftersales CFRP Full Grip cone for blind rivets, item number 83 19 0 301 414 and 83 19 0 301 419

SI number

01 07 13 (937)



**Fig. 1: Identifying Accessories (2355737)**

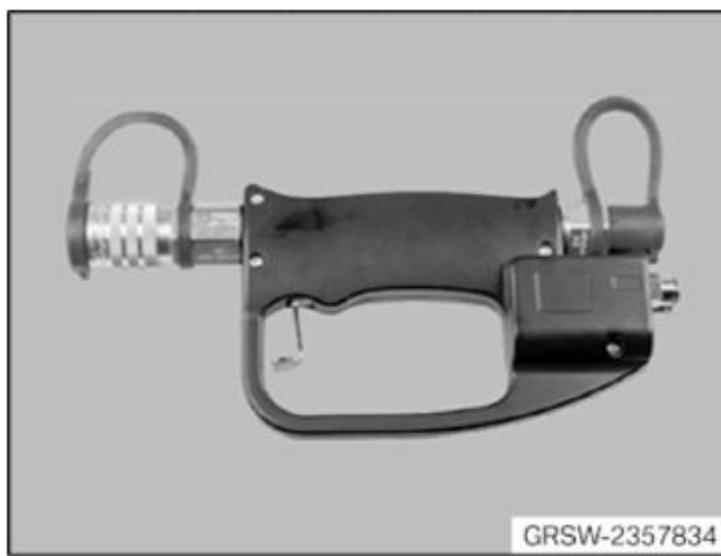
Courtesy of BMW OF NORTH AMERICA, INC.

#### 2357834 ACCESSORIES AM

**NOTE:** Applies to: BMW i Aftersales CFK Full. In the future, the part will be offered and sold directly by the TKR (manufacturer) web shop.

SI number

01 07 13 (937)



**Fig. 2: Identifying Accessories (2357834).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**510341 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**



**Fig. 3: Identifying Adapter (510341).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**512190 ADJUSTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** (door lock tensioner) For pre-tensioning front and rear door locks when installing. Change to tool through use of noise-optimized locks from 02/2004. Illustration items: 1 = knurled nut 51 2 191 2 = support 51 2 192 3 = protection 51 2 196 4 = mandrel 51 2 197

**Storage Location**

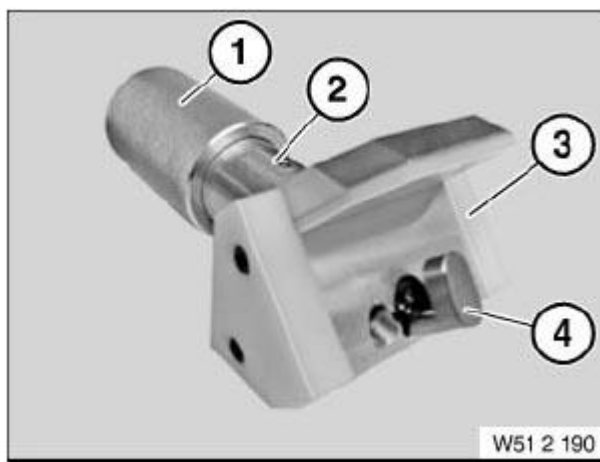
B44

C44

**SI number**

01 06 02 (864)





**Fig. 4: Identifying Adjuster (512190)**

Courtesy of BMW OF NORTH AMERICA, INC.

Consisting of:

1 = [0494470](#) Nut

**NOTE:** (Knurled nut) Replaced by 00 9 120 (0 490 504)

2 = [0494471](#) Upholstery

2 = [0494472](#) Guard

**NOTE:** Is replaced by [51 2 196](#) (0 494 906) with the use of noise-optimized locks from 02/2004

2 = [0494473](#) Mandrel

**NOTE:** Is replaced by [51 2 197](#) (0 494 907) with the use of noise-optimized locks from 02/2004

2 = [0494474](#) Shaped element

**NOTE:** E85 (omitted)

3 = [0494906](#) Guard

**NOTE:** Replaces guard 51 2 193

4 = [0494907](#) Mandrel

**NOTE:** Replaces mandrel 51 2 194

### **2351398 ADJUSTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Adjuster for side windows spare batteries: BR435/CR435 Also valid for: BMW i Basic Associated contour-graphic silhouette foil can be ordered under: 83 30 2 356 848.

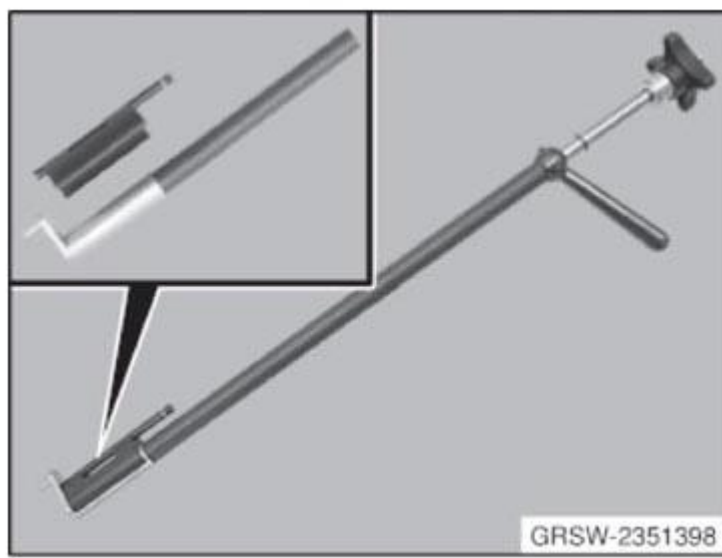
#### **Storage Location**

A74

A73

#### **SI number**

01 03 13 (915)



**Fig. 5: Identifying Adjuster (2351398)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356862 DEVICE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Device for measuring the side window retraction depth. Also valid for: BMW i Aftersales Basic. This tool set replaces the tool 2304553

**Storage Location**

Individual

**SI number**

01 29 13 (998)



**Fig. 6: Identifying Device (2356862)**  
Courtesy of BMW OF NORTH AMERICA, INC.

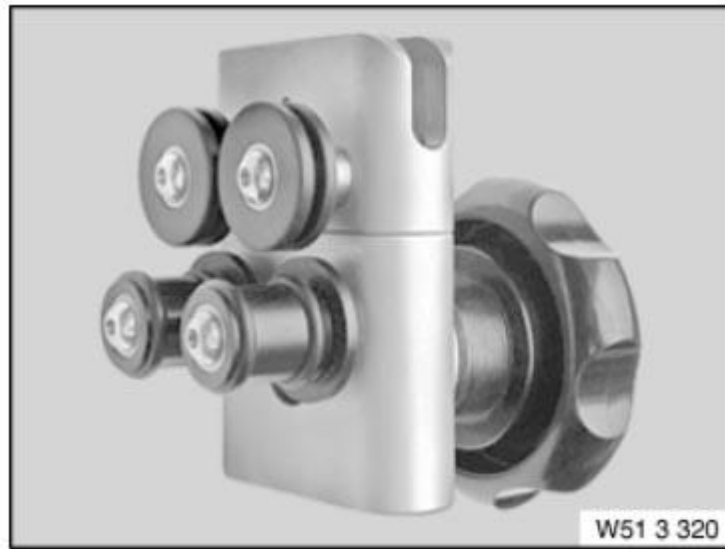
**513320 FITTING AID MINIMUM SET: MECHANICAL TOOLS**

**NOTE:** For correct installation of upper rubber seal on windscreen.

**Storage Location**

A26

**SI number**



**Fig. 7: Identifying Fitting Aid (513320).**

Courtesy of BMW OF NORTH AMERICA, INC.

**510010 GAUGE MINIMUM SET: MECHANICAL TOOLS**

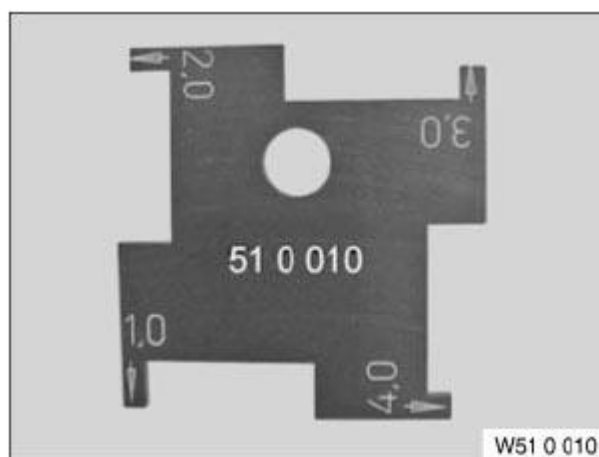
**NOTE:** (test gauge for installing windscreen and rear window) (replaces special tool 51 3 210 from 06/2005)

**Storage Location**

B2

**SI number**

01 10 05 (189)



**Fig. 8: Identifying Gauge (510010).**

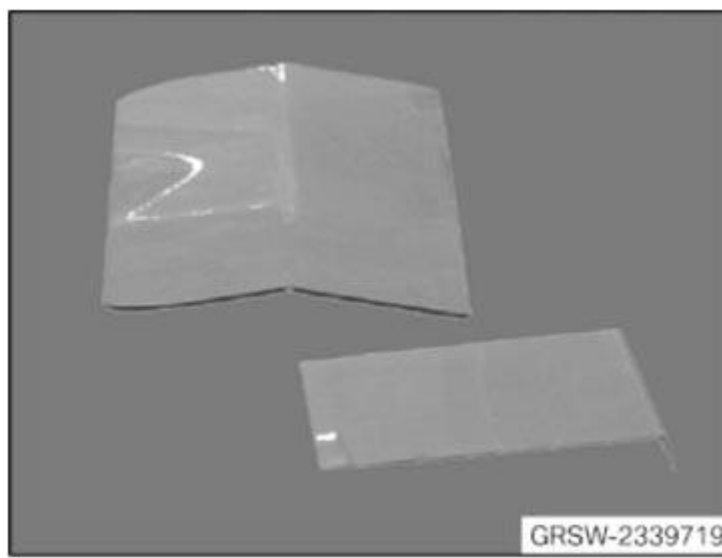
Courtesy of BMW OF NORTH AMERICA, INC.

**2339719 GUARD MECHANICAL TOOL**

**NOTE:** The transparent interior protectors are used to protect the window frame trim when working on window removals.

**SI number**

05 15 12 (869)



**Fig. 9: Identifying Guard (2339719)**

Courtesy of BMW OF NORTH AMERICA, INC.

**512196 GUARD MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Replaces guard 51 2 193

**512193 GUARD MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Is replaced by 51 2 196 (0 494 906) with the use of noise-optimized locks from 02/2004

**2326501 HANDLE MECHANICAL TOOL**

**NOTE:** (Pull handles) Cutting wire pull handles for removing rear, quarter light and side windows. Replaces tool 513270.



**Fig. 10: Identifying Handle (2326501)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2360051 HOOK WRENCH MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** for adjusting frameless side window glasses, also applies to: BMW i Aftersales Basic contour-graphic silhouette foil is included in the delivery specification.

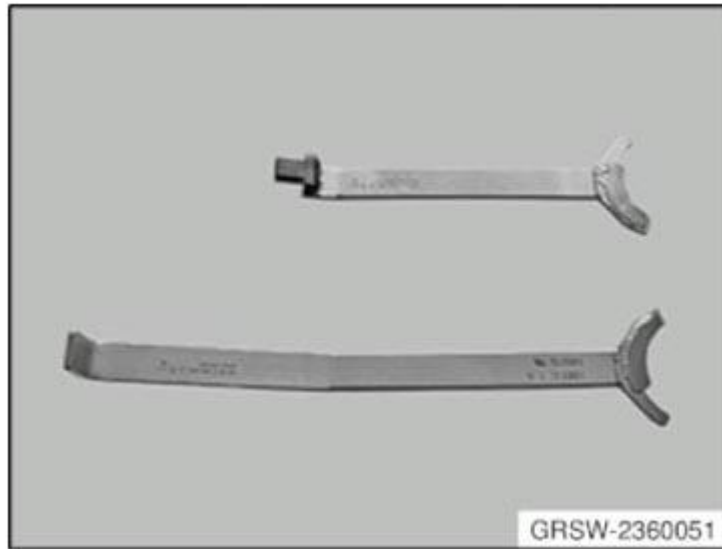
**Storage Location**

B74

A74

SI number

01 26 14 (128)



**Fig. 11: Identifying Hook Wrench (2360051)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355740 HOSE AM**

**NOTE:** Applies to: BMW i Aftersales Carbon Full

Storage Location

Individual

SI number

01 07 13 (937)

Consisting of:

1 = **2357834** Accessories

**NOTE:** Applies to: BMW i Aftersales CFK Full. In the future, the part will be offered and sold directly by the TKR (manufacturer) web shop.



**Fig. 12: Identifying Hose (2355740).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2407566 LASER AM**

**NOTE:** For aligning a number plate or a support for a number plate on the vehicle (front bumper).

**SI number**

01 05 15 (235)



**Fig. 13: Identifying Laser (2407566).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2287447 MAGNET MINIMUM SET: MECHANICAL TOOLS AM**

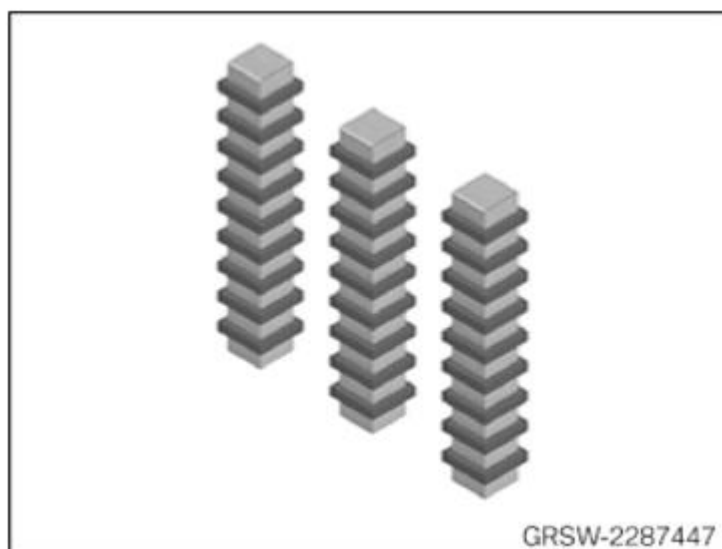
**NOTE:** Set consisting of 30 magnets. Applies to: Aftersales CFRP Full

**Storage Location**

Individual

**SI number**

01 52 13 (056)



**Fig. 14: Identifying Magnet (2287447).**

Courtesy of BMW OF NORTH AMERICA, INC.



**512194 MANDREL MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Is replaced by [51 2 197](#) (0 494 907) with the use of noise-optimized locks from 02/2004

**512197 MANDREL MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Replaces mandrel 51 2 194



**[Fig. 15: Identifying Mandrel \(512197\)](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355730 MILLING CUTTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: Aftersales CFRP Full stud milling cutter for hand milling device for CFRP, part number 83 30 2 355 729

SI number

01 05 13 (935)



**[Fig. 16: Identifying Milling Cutter Minimum Set \(2355730\)](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355731 MILLING CUTTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: Aftersales CFRP Full trapezoidal milling cutter for hand milling device for CFRP, part number 83 30 2 355 729

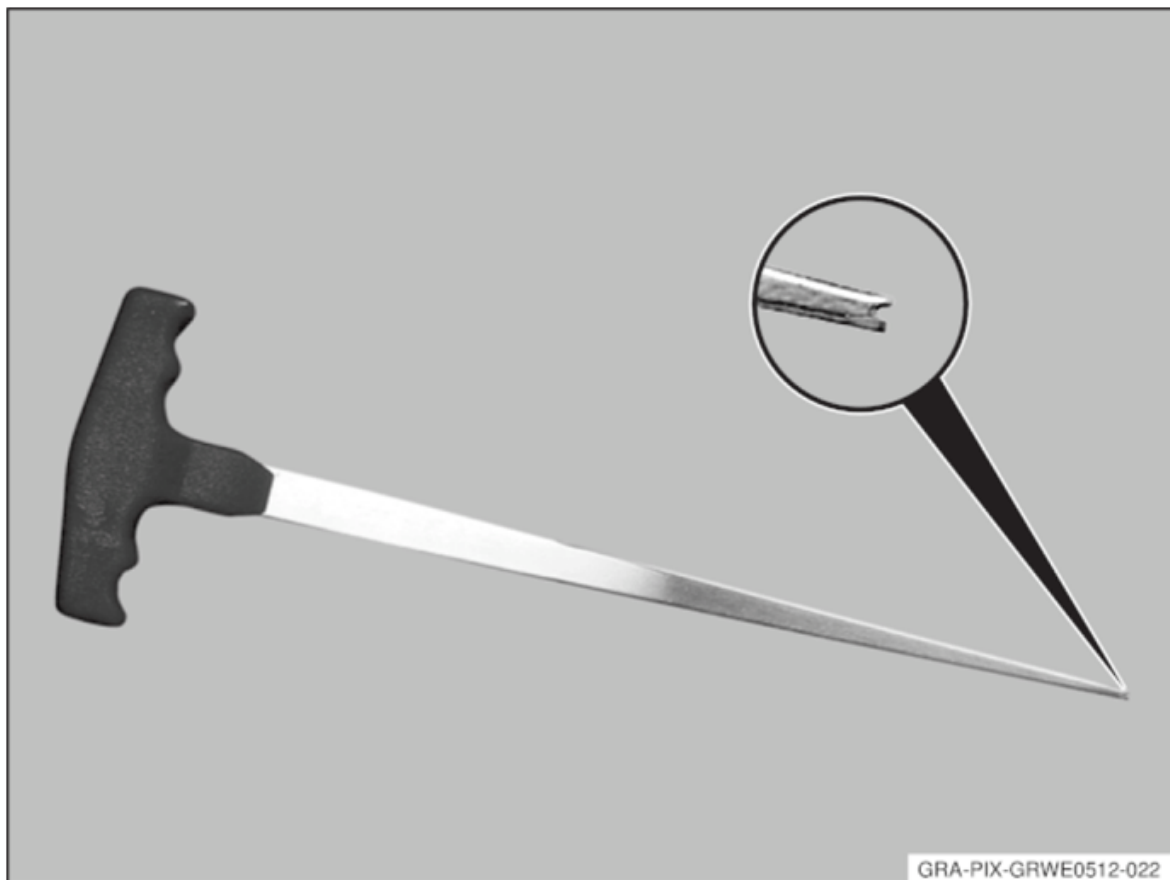


**Fig. 17: Identifying Milling Cutter (2355731).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**512191 NUT MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** (Knurled nut) Replaced by 00 9 120 (0 490 504)

**2336541 REMOVAL AID AM**



**Fig. 18: Identifying Removal Aid (2336541).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Wire starter for window removal

Individual

SI number

05 07 12 (849)

### **2357248 REMOVAL AND INSTALLATION KIT AM**

**NOTE:** Removal system for removing glued windshields, side and rear windows without causing damage. The windows are cut out using an ultra-strong cord made from braided polyethylene fibres.

SI number

05 06 13 (934)



**Fig. 19: Identifying Removal And Installation Kit (2357248).**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2155739 RIVETING TOOL SET AM**



**Fig. 20: Identifying Riveting Tool Set (2155739).**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** For setting blind rivet nuts and blind rivet screws.

**SI number**

05 05 08 (504)

**2355732 RIVETING TOOL SET MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Carbon Full

**Storage Location**

Individual

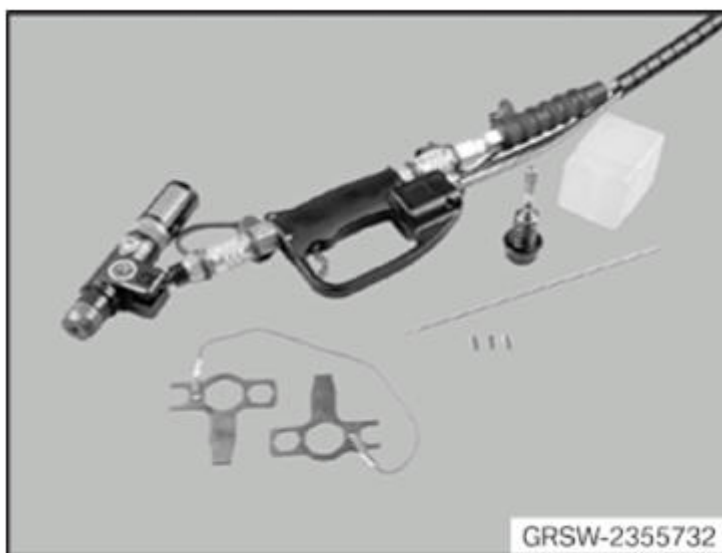
**SI number**

01 07 13 (937)

Consisting of:

1 = **2355737** Accessories

**NOTE:** Applies to: BMW i Aftersales CFRP Full Grip cone for blind rivets, item number 83 19 0 301 414 and 83 19 0 301 419



**Fig. 21: Identifying Riveting Tool Set (2355732)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**512195 SHAPED ELEMENT MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** E85 (omitted)

**2359976 SIPHON MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** For fixing and adjusting frameless side/door window glass. Also valid for: BMW i Aftersales Basic

**Storage Location**

B74

A74

A73

**SI number**



**Fig. 22: Identifying Siphon (2359976)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2184377 SIPHON MECHANICAL TOOL**

**NOTE:** Siphon for the removal, installation and positioning of vehicle windows.

**SI number**

08 01 10 (635)



**Fig. 23: Identifying Siphon (2184377)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**510342 STEEL TAPE MEASURE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Delivery 2 pcs.



**Fig. 24: Identifying Steel Tape Measure (510342)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**513220 SUCTION CUP AM**

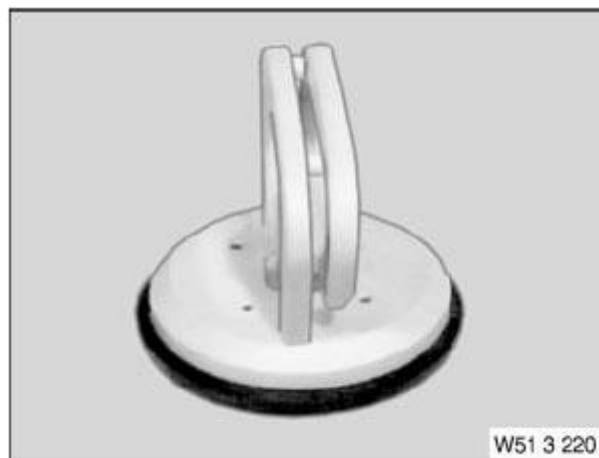
**NOTE:** (Suction cup) For lifting out side windows

**Storage Location**

Individual

**SI number**

01 17 00 (623)



**Fig. 25: Identifying Suction Cup (513220)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2359575 TEMPLATE AM**

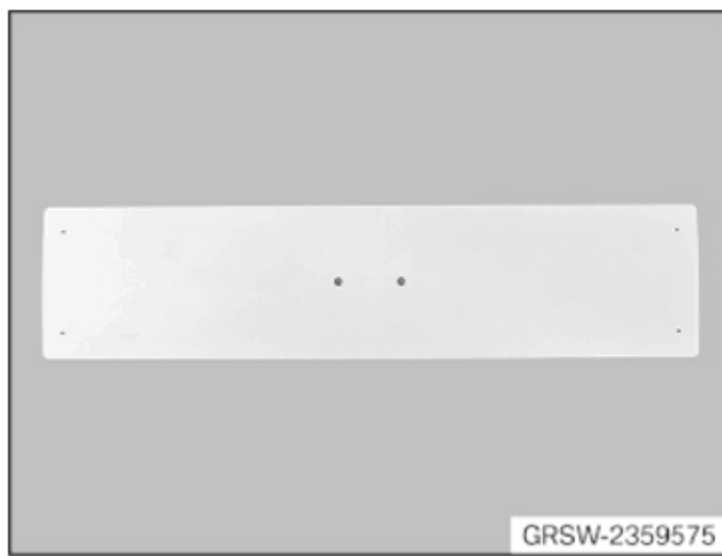
**Storage Location**

Individual

**SI number**

01 22 14 (124)





**Fig. 26: Identifying Template (2359575)**

Courtesy of BMW OF NORTH AMERICA, INC.

**510340 TOOL MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** (adapter striker) For adjusting disc pre-tension on frameless BMW door windows

**Storage Location**

A25

**SI number**

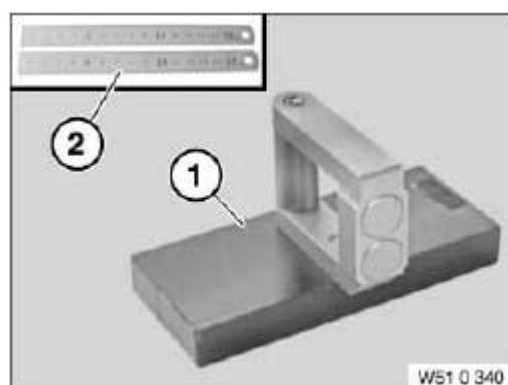
01 13 08 (456)

Consisting of:

1 = **0496455** Adapter

2 = 0496456 Steel tape measure

**NOTE:** Delivery 2 pcs.



**Fig. 27: Identifying Tool (510340)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355729 TOOL MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: Aftersales CFRP Full

**Storage Location**

Individual

**SI number**

01 05 13 (935)

Consisting of:

1 = **2355730** Milling cutter

**NOTE:** Applies to: Aftersales CFRP Full stud milling cutter for hand milling device for CFRP, part number 83 30 2 355 729

2 = 2355731 Milling cutter

**NOTE:** Applies to: Aftersales CFRP Full trapezoidal milling cutter for hand milling device for CFRP, part number 83 30 2 355 729



**Fig. 28: Identifying Tool (2355729)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2405562 TOOL SET AM**

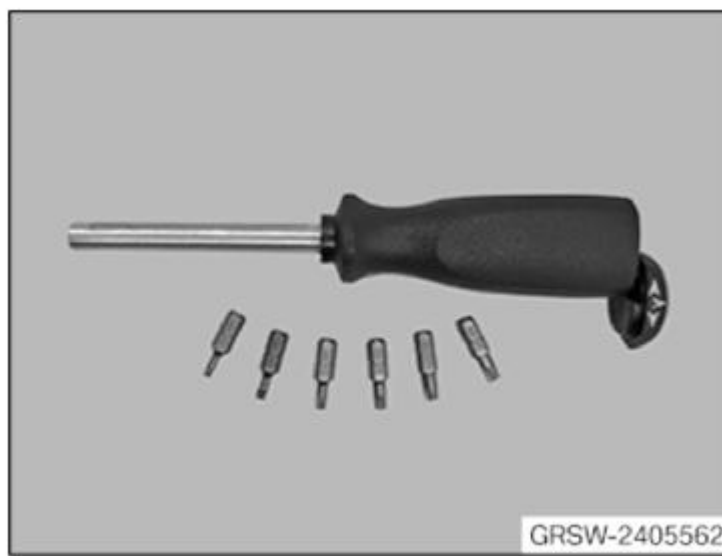
**NOTE:** with 5-star bit

**Storage Location**

Individual

**SI number**

01 49 14 (202)



**Fig. 29: Identifying Tool Set (2405562)**

Courtesy of BMW OF NORTH AMERICA, INC.

**512192 UPHOLSTERY MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** No longer available separately. Available only as complete set 51 2 190

**2298505 WEDGE MINIMUM SET: MECHANICAL TOOLS**

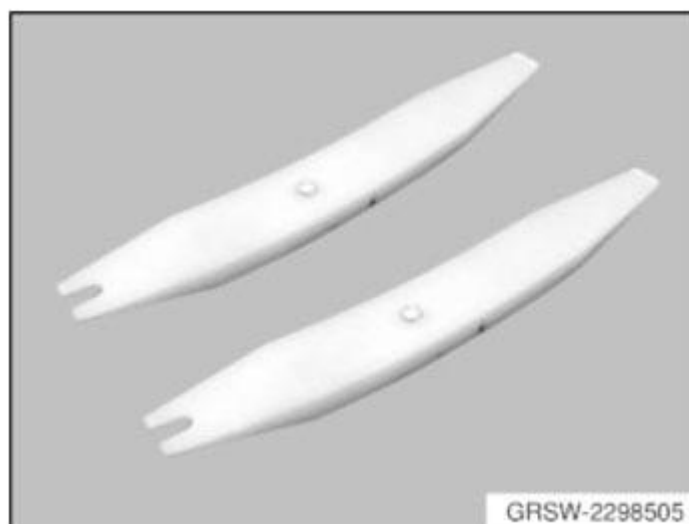
**NOTE:** Set (delivery of 2 pieces)

**Storage Location**

C34

**SI number**

01 03 12 (792)



**Fig. 30: Identifying Wedge (2298505)**

Courtesy of BMW OF NORTH AMERICA, INC.

**513240 WRENCH MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** For adjusting door window glass to fit

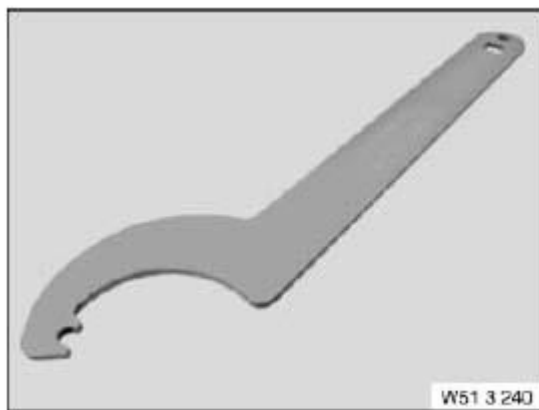
**Storage Location**

A83

B83

SI number

01 11 07 (362)



**Fig. 31: Identifying Wrench (513240)**  
Courtesy of BMW OF NORTH AMERICA, INC.

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**ACCESSORIES AND BODY, CAB****Body Equipment - Tightening Torques - All I3 Models - i3****DOOR LOCKS, REAR****51 22 DOOR LOCKS, REAR****TIGHTENING TORQUE SPECIFICATION - REAR DOOR LOCKS**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Door lock to rear door, top	I01	Â	Â	9 Nm
2AZ Door lock to rear door, bottom	I01	Â	Â	9 Nm
3AZ Striker to body, top	I01	Â	Â	39 Nm
4AZ Striker to body, bottom	I01	Â	Â	24 Nm
5AZ Door opener to rear door	I01	Â	Â	0.9 Nm
6AZ Door stop to pillar	I01	Â	Â	22 Nm
7AZ Door stop to rear door	I01	Â	Â	11.6 Nm

**AZD-AZD-AZDMUC5123-04 ENGINE COMPARTMENT LID CATCH/LOCKS****51 23 ENGINE COMPARTMENT LID CATCH/LOCKS****TIGHTENING TORQUE SPECIFICATION - ENGINE COMPARTMENT LID CATCH/LOCKS**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Engine compartment lock to lock support	I01	Â	Â	7.6 Nm
	I12	Â	Â	8 Nm
2AZ Retaining hook to lock support,	I01	Â	Â	7.6 Nm
3AZ Lock support, to connection	I01	Â	Â	7.6 Nm
4AZ Striker to engine compartment lid	I01	Â	Â	7.6 Nm

**FLOOR-LUGGAGE COMPARTMENT-ENGINE COMPARTMENT TRIM PANEL****51 47 FLOOR-LUGGAGE COMPARTMENT-ENGINE COMPARTMENT TRIM PANEL****TIGHTENING TORQUE SPECIFICATION - FLOOR-LUGGAGE COMPARTMENT-ENGINE COMPARTMENT TRIM PANEL**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Lashing eye to body	I01/I12	Â	Â	19 Nm
2AZ Side trim panel, rear to body	I01	Â	Â	3.3 Nm
3AZ Mounting, storage shelf (shoulder) to body	I01	Â	Â	3.3 Nm
4AZ Service cap in luggage compartment	I01	Â	Â	1 Nm
	I12	Â	Â	1.7 Nm
5AZ Cover, loading edge	I12	Â	Â	2 Nm

**FRONT DOOR LOCKS****51 21 FRONT DOOR LOCKS****TIGHTENING TORQUE SPECIFICATION - FRONT DOOR LOCKS**

Â	Type	Thread	Tightening specifications	Value
1AZ Door lock to front door	I01	Â	Â	8.8 Nm
	I12	Â	Â	7.6 Nm
2AZ Lock striker to rear door	I01	Â	Â	24 Nm
3AZ Door stop to pillar	I01	Â	Â	22 Nm
4AZ Door stop to inner door panel	I01	Â	Â	11.6 Nm
5AZ Support, outer door handle to front door	I01	Â	Â	3 Nm
6AZ Lock barrel to support, outer door handle	I01	Â	Â	2.3 Nm
	I12	Â	Â	3 Nm
7AZ Outer door handle to support, outer door handle	I01	Â	Â	3 Nm
8AZ Lock striker to body	I12	Â	Â	24 Nm
9AZ Fixture, door actuator to body	I12	Â	Â	38 Nm

## FRONT BUMPER

### 51 11 FRONT BUMPER

#### TIGHTENING TORQUE SPECIFICATION - FRONT BUMPER

Â	Type	Thread	Tightening specifications	Dimension
1AZ Bumper panel on air duct, top	I01/I12	Â	Â	8 Nm
2AZ Bumper panel on side wall	I01	Â	Â	3.5 Nm
	I12	Â	Â	3.3 Nm
3AZ Support, top, to deformation element, top	I01	M8	Renew screws	28 Nm
		M8	Â	19 Nm
		M6x20	Â	8.8 Nm
4AZ Deformation element, top to front axle support,	I01	M12	Renew screws Jointing torque Angle of rotation	100 Nm 180 Â°
5AZ Carrier, bottom, to deformation element, bottom	I01	Â	Renew screws	11.8 Nm
	I12	Â	Â	19 Nm
6AZ Deformation element, bottom to front axle support,	I01/I12	Â	Renew screws	19 Nm
7AZ Vertical strut to deformation element, top and bottom	I01/I12	M6x16	Renew screws	8 Nm
8AZ Support/number plate to bumper	I01/I12	Â	Â	1 Nm
9AZ Number plate on bumper panel (thread repair)	I01/I12	M5	Â	4.5 Nm
10AZ Z-support to support	I12	M6x16	Â	8.0 Nm
11AZ Deformation element, top, to engine carrier	I12	M8	Â	28 Nm
		M6	Â	8 Nm
12AZ Support angle to deformation element, top	I12	M6	Â	8 Nm
13AZ Headlight fixture to deformation element, bottom	I12	M6	Â	8 Nm
14AZ Ornamental grille to bumper	I12	Â	Â	2 Nm
15AZ Air curtain to bumper	I12	Â	Â	1.8 Nm
16AZ i-cam holder to bumper	I12	Â	Â	1.8 Nm
17AZ Front panel support to deformation element	I01	Â	Â	30 Nm

## FRONT DOOR TRIM PANEL WITH ARMREST



## 51 41 FRONT DOOR TRIM PANEL WITH ARMREST

### TIGHTENING TORQUE SPECIFICATION - FRONT DOOR TRIM PANEL WITH ARMREST

Â	Type	Thread	Tightening specifications	Dimension
1AZ Door trim panel to front door	I01	Â	Â	2.6 Nm
2AZ Handle to door	I12	Â	Â	3 Nm
3AZ Emergency operation housing to door	I12	Â	Â	3 Nm
4AZ Handle on door trim panel	I12	Â	Â	1.1 Nm
5AZ Armrest to door trim panel	I12	Â	Â	2 Nm

## FRONT PANEL

### 51 64 FRONT PANEL

### TIGHTENING TORQUE SPECIFICATION - FRONT PANEL

Â	Type	Thread	Tightening specifications	Dimension
1AZ Module carrier, side panel to front panel	I01	Â	Â	3.5 Nm
2AZ Front panel to holder, rear	I01	M8x80	Replace screw	28 Nm
3AZ Front panel to support	I01	Â	Â	19 Nm
4AZ Mounting, headlight to front panel	I01	Â	Â	8 Nm
5AZ Storage box	I01	Â	Â	3 Nm
6AZ Lock support to front panel	I01	Â	Â	7.6 Nm
7AZ Holder, expansion tank to front panel	I01	M6x20	Â	8 Nm
8AZ Air duct to deformation element	I01	Â	Â	4 Nm
9AZ Holder, headlight to front panel	I01	Â	Â	8 Nm
10AZ Fixture, radiator, top to strut	I12	Â	Â	8 Nm
11AZ Cross connection, top to support Front panel	I12	Â	Â	8 Nm
12AZ Support, front panel to console	I12	Â	Â	8 Nm
13AZ Console, front panel console to engine support	I12	Â	Â	8 Nm

## AZD-AZD-AZDMUC5171-04 GASKETS AND LOOSE BODY COMPONENTS

### 51 71 GASKETS AND LOOSE BODY COMPONENTS

### TIGHTENING TORQUE SPECIFICATION - GASKETS AND LOOSE BODY COMPONENTS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Rear spoiler	I01	Â	Â	6 Nm
2AZ Trim panel for cover to side member	I01	Nut	Â	5 Nm
3AZ Trim panel for cover to side member	I01/I12	Screw	Â	5 Nm
4AZ Underbody panelling	I12	Â	Screw without metric thread	3 Nm
			Screw with metric thread	5 Nm
5AZ Roof frame trim panel holder to hinge	I12	Â	Â	5 Nm

## HEADLINING

### 51 44 HEADLINING

### TIGHTENING TORQUE SPECIFICATION - HEADLINING

Â	Type	Thread	Tightening specifications	Dimension
1AZ Headlining to slide/tilt sunroof, front	I01	Â	Â	1.2 Nm

Â	Type	Thread	Tightening specifications	Dimension
2AZ Headlining to C-pillar speaker support	I12	Â	Â	2.6 Nm

## MIRRORS, FINISHERS, ASHTRAYS, CONSOLES

### 51 16 MIRRORS, FINISHERS, ASHTRAYS, CONSOLES

#### TIGHTENING TORQUE SPECIFICATION - MIRRORS, FINISHERS, ASHTRAYS AND CONSOLES

Â	Type	Thread	Tightening specifications	Dimension
1AZ Exterior mirror to front door	I01	thread cutting	new exterior mirror, initial screw connection	6 Nm 8 Nm
	I12	M6x65	Â	8 Nm
2AZ Glove box to dashboard	I01	Â	Â	1.8 Nm
	I12	Â	Â	2.4 Nm
3AZ Trim, center console, front to support, center console	I01/I12	Â	Â	1.8 Nm
4AZ Side trim panel, center console to support, center console	I01	Â	Â	1.8 Nm
5AZ Chrome ring to support, center console	I01	Â	Â	1.8 Nm
6AZ Palm rest to support, center console	I01	Â	Â	1.8 Nm
7AZ Center armrest to support, center console	I01	Hexagon screw	Â	7 Nm
8AZ Support, center console to body	I01	Â	Â	7 Nm
	I12	Â	Â	4.6 Nm

## POWER WINDOWS, FRONT

### 51 33 POWER WINDOWS, FRONT

#### TIGHTENING TORQUE SPECIFICATION - FRONT POWER WINDOWS

Â	Type	Thread	Tightening specifications	Value
1AZ Flat motor to power window regulator	I01	Â	Â	5 Nm
	I12	Â	Â	4.5 Nm
2AZ Window regulator to door	I01	Â	Â	9.5 Nm
	I12	Nut	Â	7.6 Nm
	I12	M6x16	Â	8 Nm
3AZ Door window glass to power window regulator	I01	Â	Multipoint screw With special tool <a href="#">51 3 240</a> and torque wrench (long lever arm)	12 Nm 9 Nm
4AZ Fixed window glass to door	I01	Â	Replace nut	8 Nm
	I12	Â	Replace nut	7.6 Nm
5AZ Trim of B-pillar/window frame to door	I12	Â	Â	2.5 Nm

## POWER WINDOWS, REAR

### 51 35 POWER WINDOWS, REAR

#### TIGHTENING TORQUE SPECIFICATION - REAR POWER WINDOWS

Â	Type	Thread	Tightening specifications	Value

Â	Type	Thread	Tightening specifications	Value
1AZ Door window glass to door	I01	Â	Â	8 Nm

## REAR BUMPER

### 51 12 REAR BUMPER

#### TIGHTENING TORQUE SPECIFICATION - REAR BUMPER

Â	Type	Thread	Tightening specifications	Dimension
1AZ Bumper panel to guide, middle	I01	Â	Â	2 Nm
	I12	Â	Â	5 Nm
2AZ Bumper panel on side wall	I01	Â	Â	2 Nm
	I12	Â	Â	1.8 Nm
3AZ Bumper panel to underbody panelling	I01/I12	Â	Â	3 Nm
4AZ Guide, middle, to body	I01	Â	Â	2 Nm
5AZ Support to deformation element	I01	M10 M8	Â	36 Nm 15 Nm
	I12	M8x80	Â	19 Nm
6AZ Deformation element to body	I01	Â	Â	96 Nm
	I12	M10x90	Â	38 Nm
7AZ Trailing link to deformation element/strut brace	I01	Â	Â	15 Nm
8AZ Guide, middle to luggage compartment well	I12	Â	Â	8 Nm
9AZ BMW badge to bumper	I12	Â	Â	1.8 Nm
10AZ Number plate support to bumper panel	I12	Â	Â	3 Nm

## REAR DOOR TRIM PANEL WITH ARMRESTS

### 51 42 REAR DOOR TRIM PANEL WITH ARMRESTS

#### TIGHTENING TORQUE SPECIFICATION - REAR DOOR TRIM PANEL WITH ARMRESTS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Door trim panel to rear door	I01	Â	Â	2.6 Nm
2AZ Shroud to rear door	I01	Â	Â	3 Nm

## SIDE TRIM PANEL WITH ARMRESTS

### 51 43 SIDE TRIM PANEL WITH ARMRESTS

#### TIGHTENING TORQUE SPECIFICATION - SIDE TRIM PANEL WITH ARMRESTS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Trim, front roof pillar (A-pillar) on body	I01	Â	Â	2.3 Nm
	I12	Â	Â	4.8 Nm
2AZ Trim, rear roof pillar (C-pillar) on body	I01	Â	Â	2.3 Nm
	I12	Â	Â	2.6 Nm
3AZ B-pillar trim to body	I12	Â	Â	2.6 Nm

## TAILGATE LOCKS

### 51 24 TAILGATE LOCKS

#### TIGHTENING TORQUE SPECIFICATION - TAILGATE LOCKS

Â	Type	Thread	Tightening specifications	Dimension

Â	Type	Thread	Tightening specifications	Dimension
1AZ Rear lid latch to rear lid	I01	Â	Â	18.5 Nm
2AZ Striker to body	I01	Â	Â	18.5 Nm
3AZ Tailgate button to tailgate	I01	Â	Â	2 Nm
4AZ Tailgate lock to console	I12	Â	Â	8 Nm

## TRIM PARTS, COVERS, HANDLE STRIP

### 51 13 TRIM PARTS, COVERS, HANDLE STRIP

#### TIGHTENING TORQUE SPECIFICATION - TRIM PARTS, COVERS AND HANDLE STRIP

Â	Type	Thread	Tightening specifications	Dimension
1AZ Trim strip to gutter strip	I01	Â	Â	4 Nm

## TRIM PARTS, COVERS, HANDLE STRIP

### 51 13 TRIM PARTS, COVERS, HANDLE STRIP

#### TIGHTENING TORQUE SPECIFICATION - TRIM PARTS, COVERS AND HANDLE STRIP

Â	Type	Thread	Tightening specifications	Dimension
1AZ Trim strip to gutter strip	F33	Oval-head self-tapping screw	Â	1.8 Nm
2AZ A-pillar node on the cowl panel	F33	M5x16	Â	3.3 Nm

## TRIM, INSTRUMENT TRIM PANEL

### 51 45 TRIM, INSTRUMENT TRIM PANEL

#### TIGHTENING TORQUE SPECIFICATION - TRIM AND INSTRUMENT TRIM PANEL

Â	Type	Thread	Tightening specifications	Dimension
1AZ Basic carrier for dashboard to bulkhead	I01	Â	Â	21.4 Nm
	I12	Â	Replace screws	21 Nm
2AZ Basic carrier for dashboard to A-pillar	I01	Â	Â	21.4 Nm
	I12	Â	Â	21 Nm
3AZ Basic carrier for dashboard to tunnel	I01	Â	Â	21.4 Nm
	I12	Â	Â	19 Nm
4AZ Support, CID to basic carrier,	I01	Â	Â	2.7 Nm
5AZ Support, left/right to basic carrier,	I01	Â	Â	1.8 Nm
6AZ Dashboard to basic carrier,	I01	Â	Â	1.8 Nm
	I01	Metric	Â	6.8 Nm
	I12	Â	Â	2.4 Nm
7AZ Support to heating and air-conditioning unit	I12	Â	Â	4 Nm
8AZ Support, lower to bulkhead	I12	Â	Replace screws	7 Nm
9AZ Storage net to instrument panel trim	I01	Â	Â	1.5 Nm

## ACCESSORIES AND BODY, CAB

### Communication Systems - Repair - All I3 Models - i3

## TELEMATICS SYSTEM

### 84 10 820 REMOVE & INSTALL (REPLACE) TELEMATICS CONTROL UNIT

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the **HIGH-VOLTAGE SYSTEM** .  
Observe **SAFETY INFORMATION** for handling electric vehicles.

IMPORTANT: Observe the **INFORMATION ON PROTECTION FROM ELECTROSTATIC DISCHARGE** .

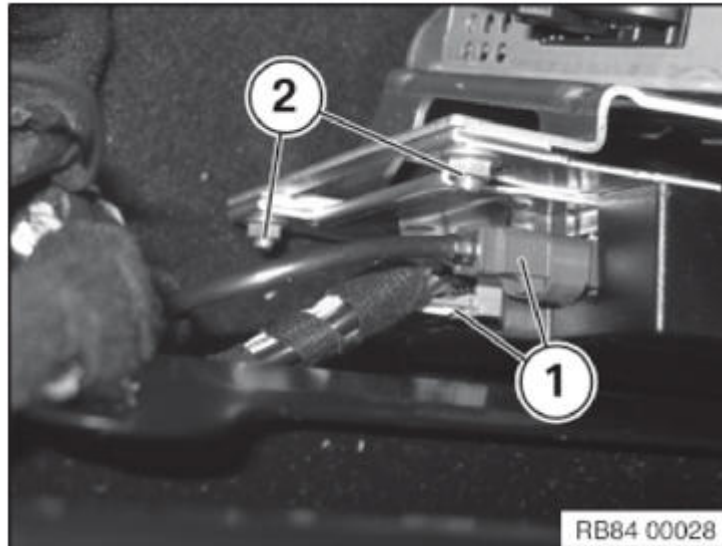
Comply with notes and instructions on **HANDLING OPTICAL FIBRE** .

#### Necessary preliminary tasks:

- Disconnect **BATTERY EARTH LEAD**
- Remove **REAR SEAT**

Unlock and disconnect the connector (1).

Unscrew nuts (2).



**Fig. 1: Identifying Telematics Control Unit Connector And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

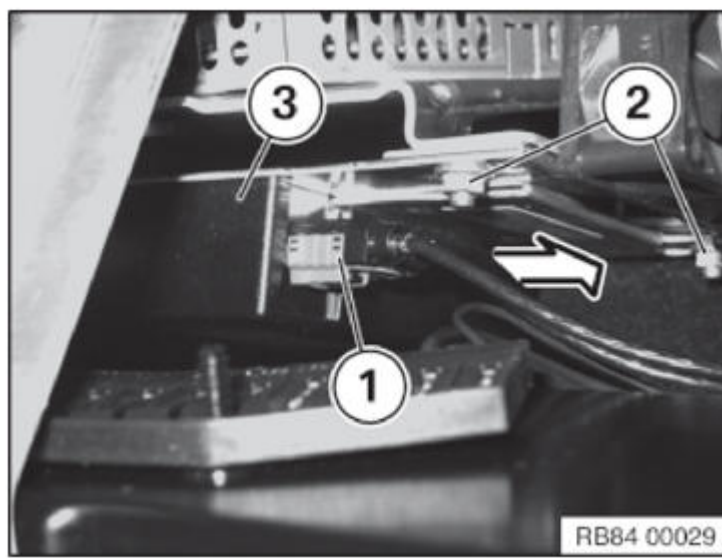
Unlock and disconnect the connector (1).

Unscrew nuts (2).

Remove telematics control unit (3) in direction of arrow.

*Installation note:*

Note color coding of connector.



**Fig. 2: Removing Telematics Control Unit**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** When replacing telematics control unit, it should be checked whether the defective telematics control unit has been equipped with an **EMERGENCY BATTERY**:

- if no , then the new part is installed without an emergency battery !
- if yes , then the new part should be equipped with new emergency battery (separate purchase order, telematics control unit is delivered without emergency battery!)

**Replacement:**

- Carry out **VEHICLE PROGRAMMING/ENCODING** .

### **84 10 810 REMOVING AND INSTALLING (REPLACING) TELEMATIC COMMUNICATION BOX**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the **HIGH-VOLTAGE SYSTEM** .  
Observe **SAFETY INFORMATION** for handling electric vehicles.

**IMPORTANT:** Observe the **INFORMATION ON PROTECTION FROM ELECTROSTATIC DISCHARGE** .

Comply with notes and instructions on **HANDLING OPTICAL FIBRE** .

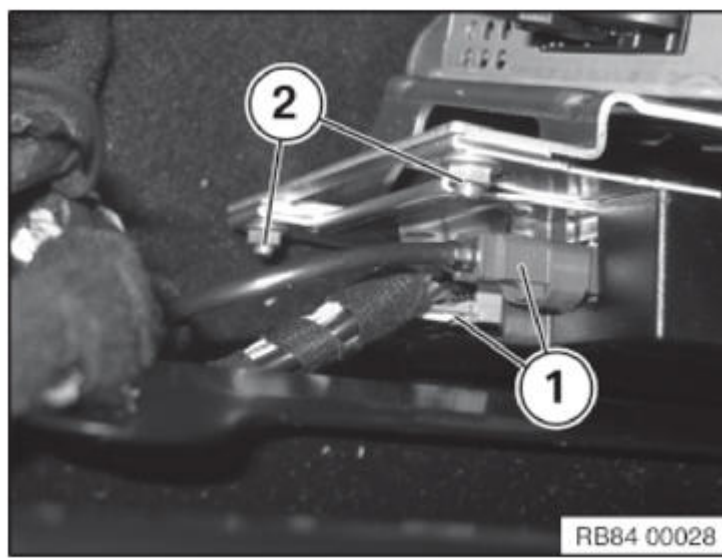
**Necessary preliminary tasks:**

- Disconnect **BATTERY EARTH LEAD**
- Remove **REAR SEAT**

Unlock and disconnect the connector (1).

Unscrew nuts (2).





**Fig. 3: Identifying Telematics Control Unit Connector And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

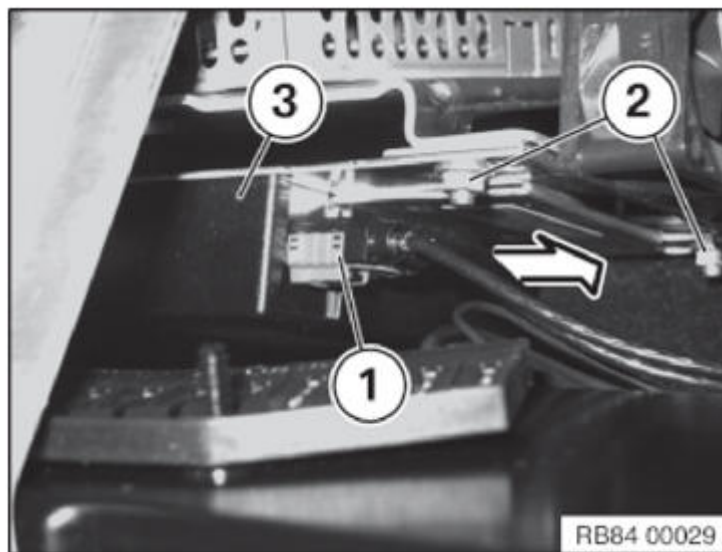
Unlock and disconnect the connector (1).

Unscrew nuts (2).

Remove the TCB (3) in direction of arrow.

*Installation note:*

Note color coding of connector.



**Fig. 4: Removing Telematics Control Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** When replacing the TCB check to determine whether the defective TCB is equipped with an **EMERGENCY BATTERY:**

- if no , then the new part is installed without an emergency battery !
- if yes , , then the new part should be equipped with a new emergency battery (ordered separately, TCB is supplied without an emergency battery!)

**Replacement:**

- Carry out **VEHICLE PROGRAMMING/ENCODING** .

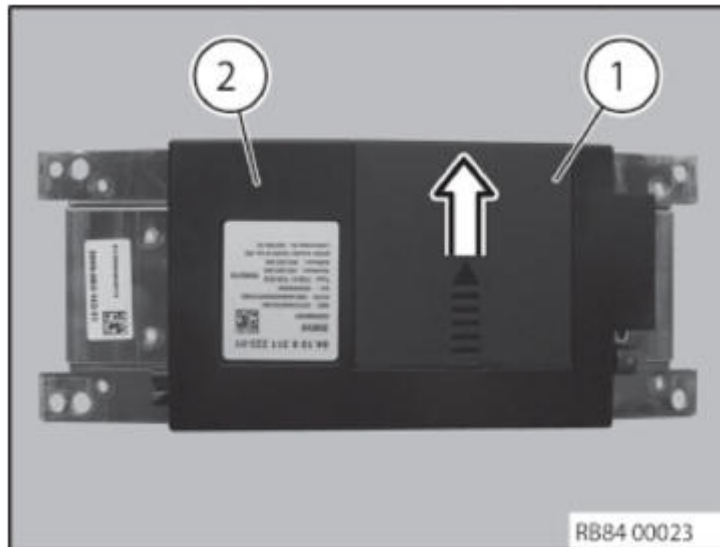
## 84 10... REPLACING EMERGENCY BATTERY FOR TELEMATIC COMMUNICATION BOX (TCB)

IMPORTANT: Read and comply with notes on [PROTECTION AGAINST ELECTRICAL DAMAGE \(ESD PROTECTION\)](#).

### Necessary preliminary tasks:

- Removing [TELEMATIC COMMUNICATION BOX](#)

Open lid (1). on TCB (2) in direction of arrow.

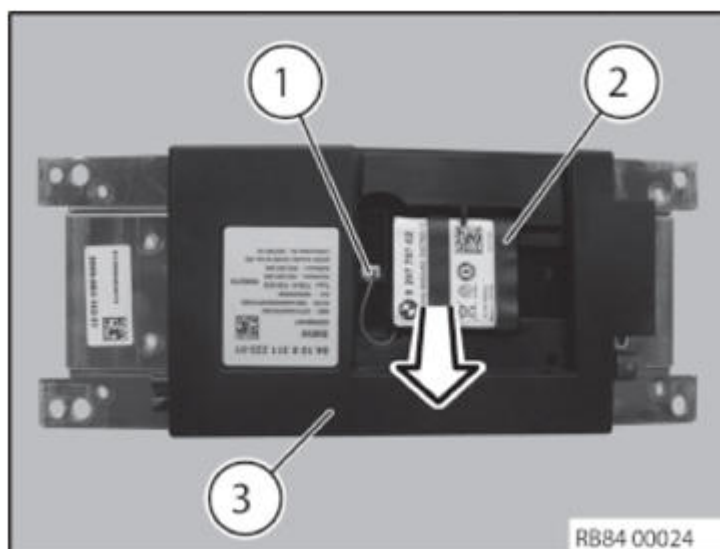


**Fig. 5: Opening TCB Lid**

Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

Remove emergency battery (2) from TCB (3).



**Fig. 6: Removing Emergency Battery From TCB**

Courtesy of BMW OF NORTH AMERICA, INC.

## HANDS-FREE SYSTEM MICROPHONE AND SPEAKER

### 84 31 550 REMOVING AND INSTALLING/REPLACING HANDS-FREE MICROPHONE, DRIVER'S/PASSENGER'S SIDE

Special tools required:

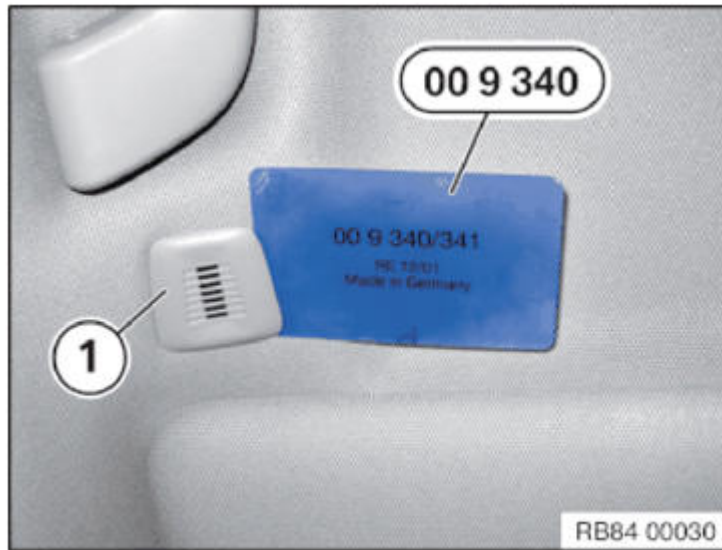
- [00 9 340](#)

### Removal:

Lever out the microphone (1) as shown using the special tool [00 9 340](#).

Pull the microphone (1) out of the headlining.

Unlock and disconnect corresponding connector.

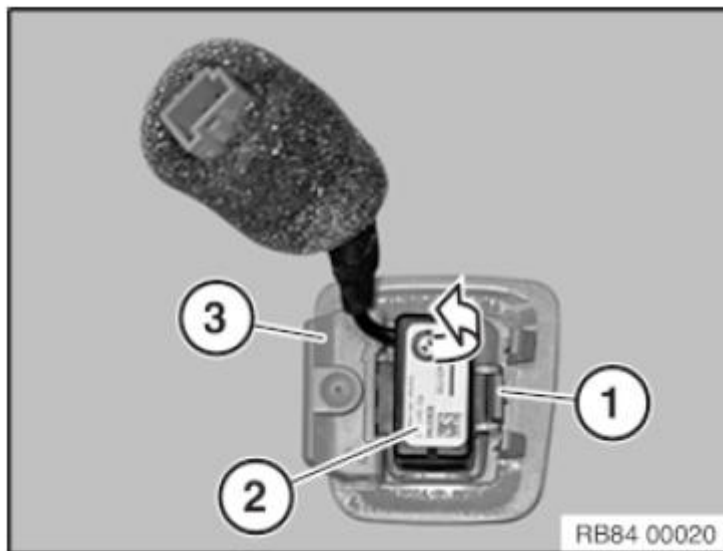


**Fig. 7: Levering Out Microphone Using Special Tool (00 9 340)**

Courtesy of BMW OF NORTH AMERICA, INC.

### Replacement:

Loosen the latch mechanism (1) and remove the microphone (2) from the trim (3).



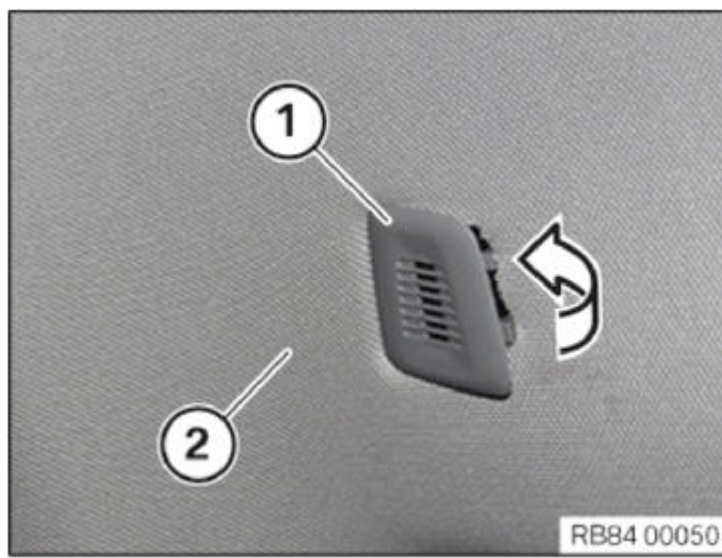
**Fig. 8: Removing Microphone From Trim**

Courtesy of BMW OF NORTH AMERICA, INC.

### Installation:

Connect the corresponding connector to the microphone (1).

Fit the microphone (1) into the headlining (2).



**Fig. 9: Fitting Microphone Into Headlining**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**84 31 020 REMOVING AND INSTALLING/REPLACING HANDS-FREE SYSTEM SPEAKER**

**Necessary preliminary tasks:**

- Remove **TRIM PANEL FOR PEDAL MECHANISM**

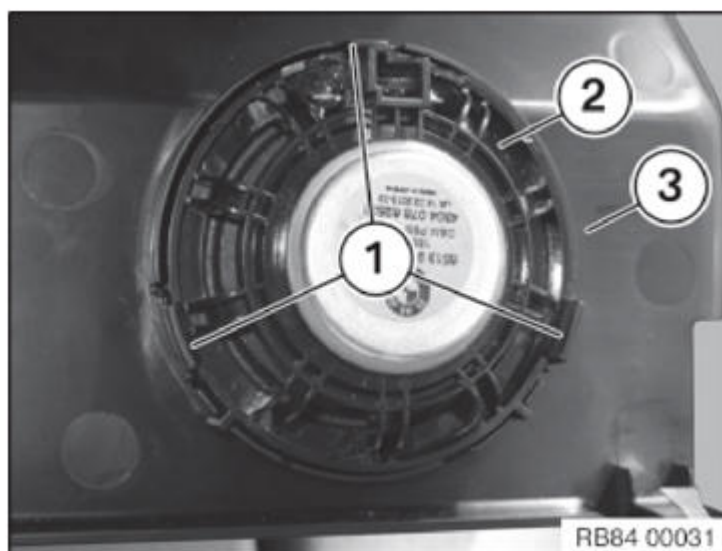
If necessary unfasten plug connection.

Unlock latch mechanisms (1) and remove speaker (2) from bracket (3).

*Installation note:*

Latch mechanisms (1) must not be damaged.

Guide lugs of bracket must be seated in grooves of speaker (2).



**Fig. 10: Identifying Speaker, Bracket And Latch Mechanisms**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Speaker (2) must engage audibly in bracket (3).

**AERIAL (ANTENNA)**

**(65 20 030 REMOVING AND INSTALLING/REPLACING EMPTY HOUSING FOR ROOF-MOUNTED AERIAL)**

## 84 50 565 REPLACING BLUETOOTH CABLE AERIAL

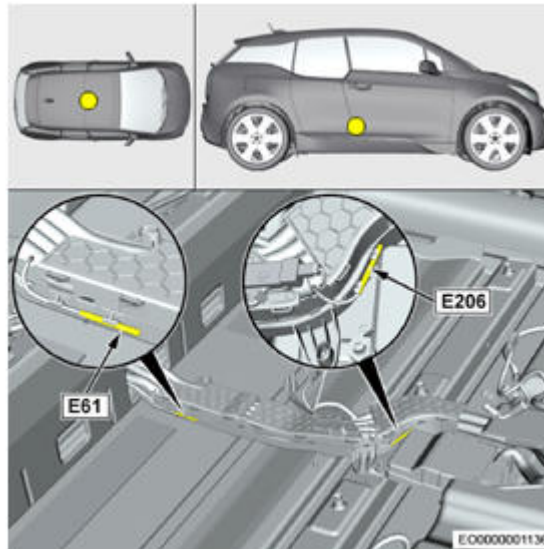
**NOTE:** When equipped with NBT/HU, the Bluetooth aerial is located in the wiring harness to NBT/HU.

Necessary preliminary tasks:

Remove [REAR SEAT](#)

Lift rear carpet

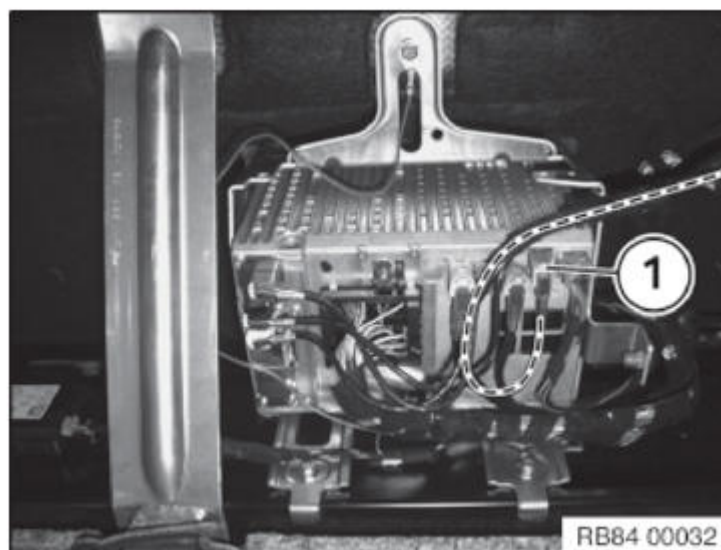
Installation location of Bluetooth aerial (E61) and Wireless Local Area Network aerial (E206).



**Fig. 11: Identifying Installation Location Of Bluetooth Aerial (E61) And Wireless Local Area Network Aerial (E206)**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect plug connection of Bluetooth cable aerial (1).

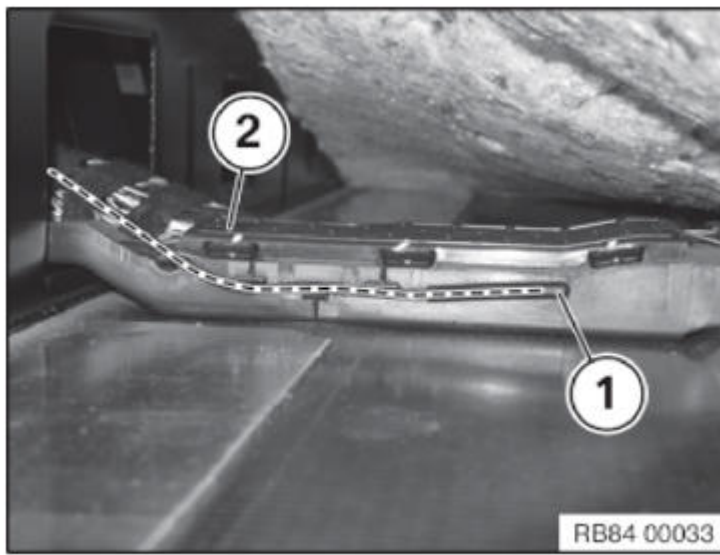


**Fig. 12: Identifying Bluetooth Cable Aerial**

Courtesy of BMW OF NORTH AMERICA, INC.

Secure Bluetooth cable aerial (1) repair kit to wiring harness (2) and close plug connection.

After successful completion of functional check, disconnect start and end of **faulty Bluetooth cable aerial** at first mounting point.



**Fig. 13: Identifying Bluetooth Cable Aerial And Wiring Harness**  
Courtesy of BMW OF NORTH AMERICA, INC.

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## ACCESSORIES AND BODY, CAB

### Distance Systems, Cruise Control - Repair - All I3 Models - i3

## PARK DISTANCE CONTROL (PDC)

### 66 20 508 REMOVING AND INSTALLING (REPLACING) CONTROL UNIT (PARK DISTANCE CONTROL)

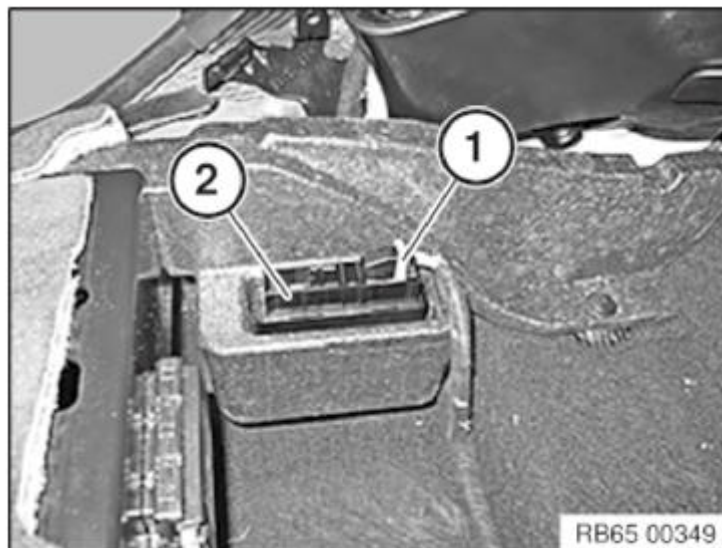
IMPORTANT: Read and comply with notes on [PROTECTION AGAINST ELECTROSTATIC DISCHARGE \(ESD PROTECTION\)](#).

#### Necessary preliminary tasks:

- Remove [REAR SEAT](#)

Unfasten plug connection (1) and disconnect.

Lift out control unit (2).



**Fig. 1: Identifying Control Unit And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

#### Replacement:

Carry out [PROGRAMMING/ENCODING](#).

### 66 20 517 REMOVING AND INSTALLING/REPLACING A FRONT CENTER LEFT (INSIDE) ULTRASONIC TRANSDUCER (PARK DISTANCE CONTROL)

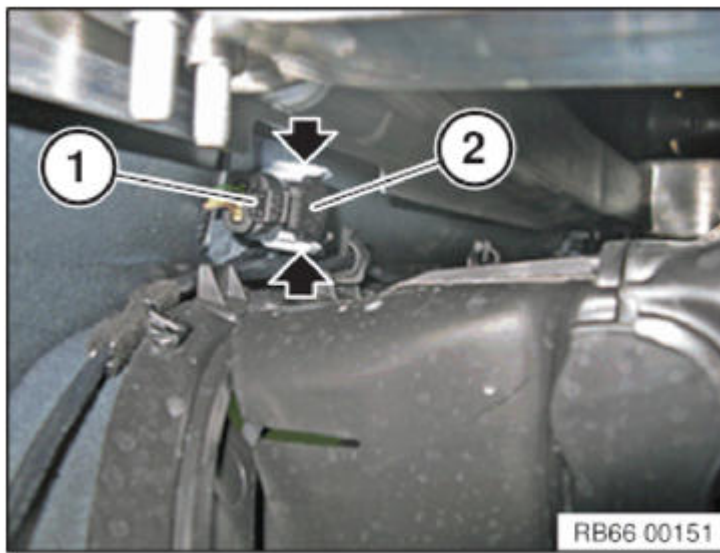
#### Necessary preliminary tasks:

- Remove [FRONT WHEEL ARCH COVER](#)

Unfasten plug connection (1) and disconnect.

Unlock latches at marked points.

Remove ultrasonic sensor (2).

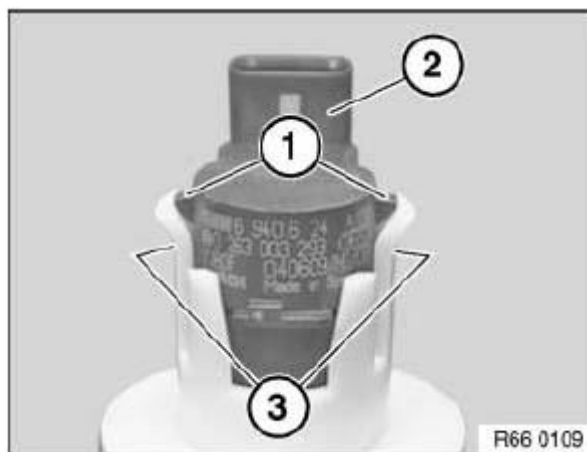


**Fig. 2: Locating Ultrasonic Sensor Latches**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Before installation of ultrasonic sensor (2) on wiring harness, clean plug connection!

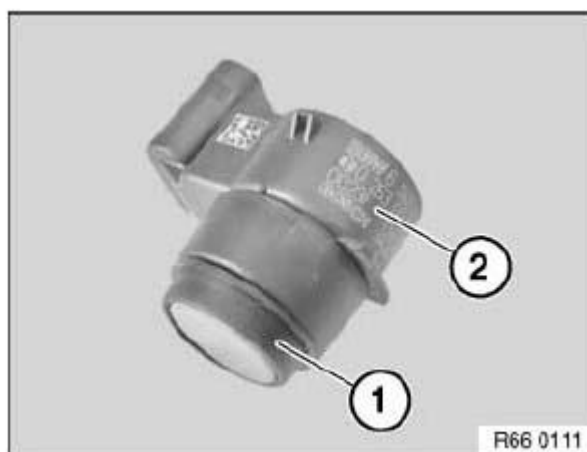
Retaining hooks (1) of ultrasonic transducer (2) must engage exactly in mountings (3).



**Fig. 3: Identifying Ultrasonic Transducer, Retaining Hooks And Mountings**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure rubber ring (1) is correctly seated on ultrasonic sensor (2).



**Fig. 4: Identifying Rubber Ring On Ultrasonic Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

**66 20 519 REMOVING AND INSTALLING/REPLACING A FRONT CENTER RIGHT (INSIDE) ULTRASONIC TRANSDUCER (PARK DISTANCE CONTROL)**

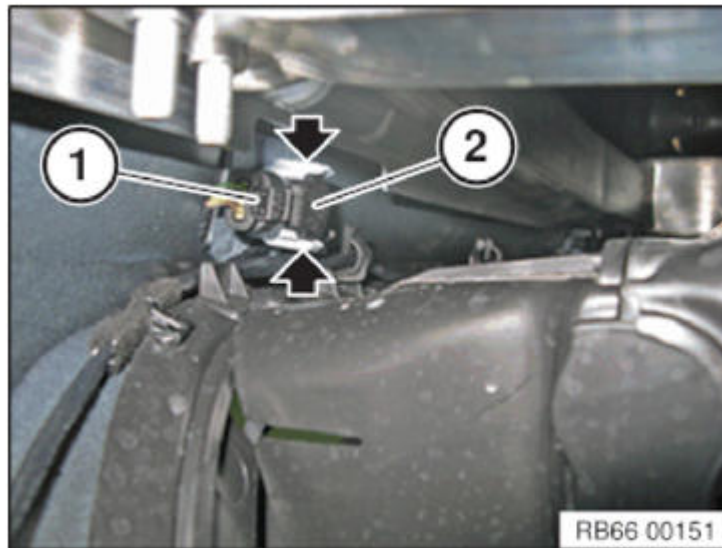
*Necessary preliminary tasks:*

- Remove **FRONT WHEEL ARCH COVER**

Unfasten plug connection (1) and disconnect.

Unlock latches at marked points.

Remove ultrasonic sensor (2).

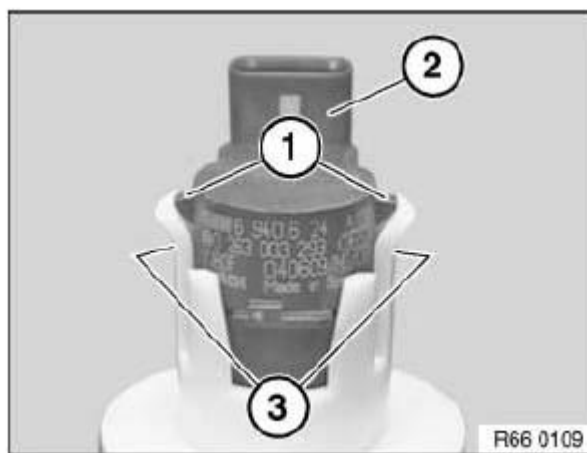


**Fig. 5: Locating Ultrasonic Sensor Latches**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Before installation of ultrasonic sensor (2) on wiring harness, clean plug connection!

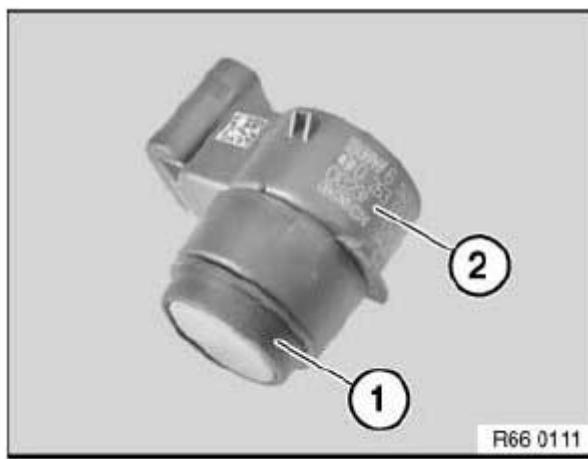
Retaining hooks (1) of ultrasonic transducer (2) must engage exactly in mountings (3).



**Fig. 6: Identifying Ultrasonic Transducer, Retaining Hooks And Mountings**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure rubber ring (1) is correctly seated on ultrasonic sensor (2).



**Fig. 7: Identifying Rubber Ring On Ultrasonic Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

**66 20 515 REMOVING AND INSTALLING/REPLACING A FRONT LEFT (OUTSIDE) ULTRASONIC TRANSDUCER (PARK DISTANCE CONTROL)**

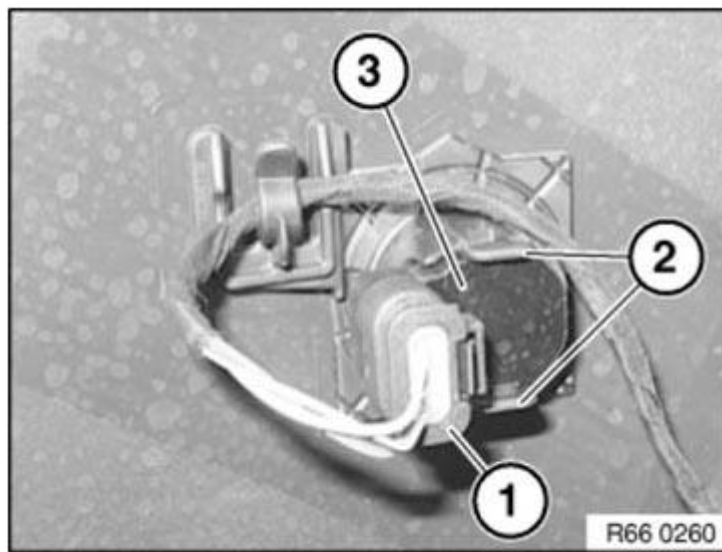
**Necessary preliminary tasks:**

- Remove **FRONT WHEEL ARCH COVER**

Unfasten plug connection (1) and disconnect.

Unlock latch mechanisms (2).

Pull ultrasonic converter (3) out of bracket.

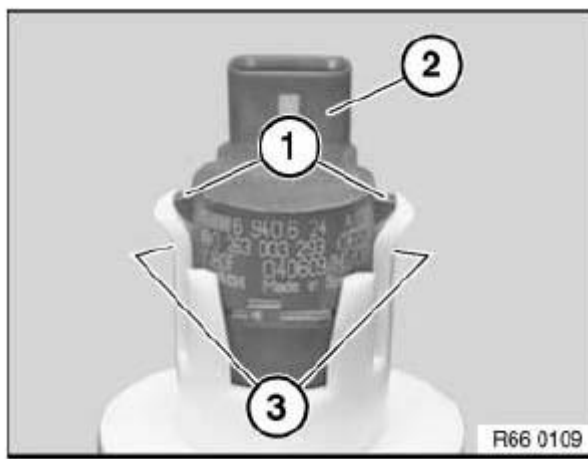


**Fig. 8: Identifying Ultrasonic Converter, Plug Connection And Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Before installation of ultrasonic sensor (2) on wiring harness, clean plug connection!

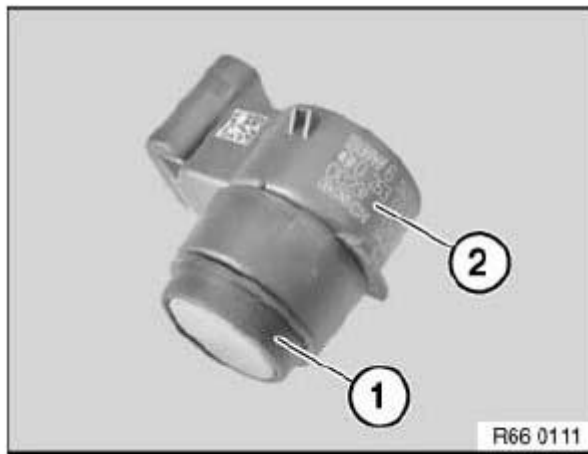
Retaining hooks (1) of ultrasonic transducer (2) must engage exactly in mountings (3).



**Fig. 9: Identifying Ultrasonic Transducer, Retaining Hooks And Mountings**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure rubber ring (1) is correctly seated on ultrasonic sensor (2).



**Fig. 10: Identifying Rubber Ring On Ultrasonic Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

**66 20 516 REMOVING AND INSTALLING/REPLACING A FRONT RIGHT (OUTSIDE) ULTRASONIC TRANSDUCER (PARK DISTANCE CONTROL)**

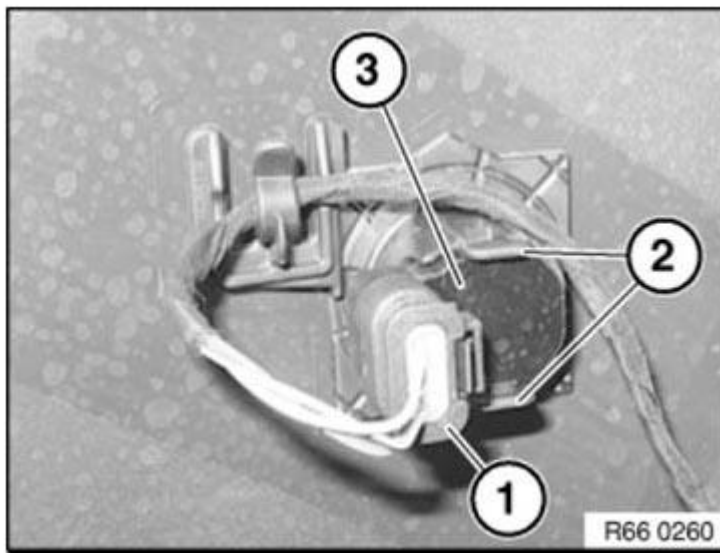
**Necessary preliminary tasks:**

- Remove **FRONT WHEEL ARCH COVER**

Unfasten plug connection (1) and disconnect.

Unlock latch mechanisms (2).

Pull ultrasonic transducer (3) out of holder.

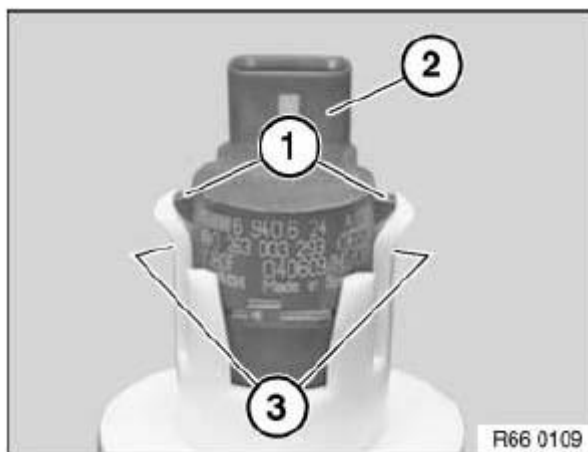


**Fig. 11: Identifying Ultrasonic Converter, Plug Connection And Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Before installation of ultrasonic sensor (2) on wiring harness, clean plug connection!

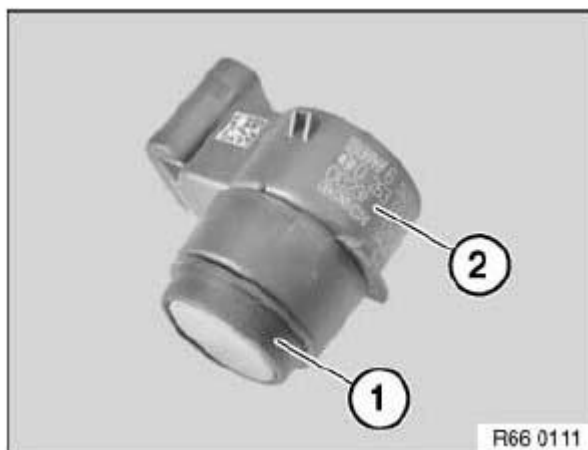
Retaining hooks (1) of ultrasonic transducer (2) must engage exactly in mountings (3).



**Fig. 12: Identifying Ultrasonic Transducer, Retaining Hooks And Mountings**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure rubber ring (1) is correctly seated on ultrasonic sensor (2).





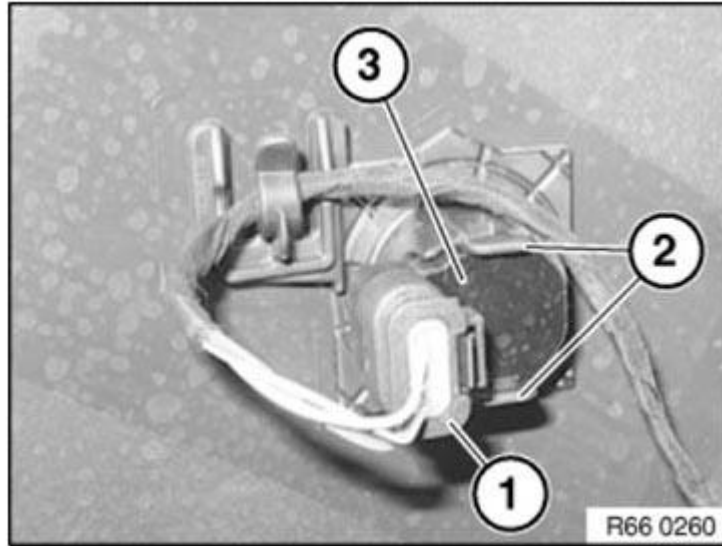
**66 20 537 REMOVING AND INSTALLING/REPLACING A REAR CENTER RIGHT ULTRASONIC TRANSDUCER (PDC)**

**Necessary preliminary tasks:**

- Remove **REAR UNDERBODY PANELLING**

Unlock plug connection (1) and disconnect.

Unlock latch mechanisms (2) and pull ultrasonic transducer (3) out of bracket.



**Fig. 14: Identifying Ultrasonic Converter, Plug Connection And Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

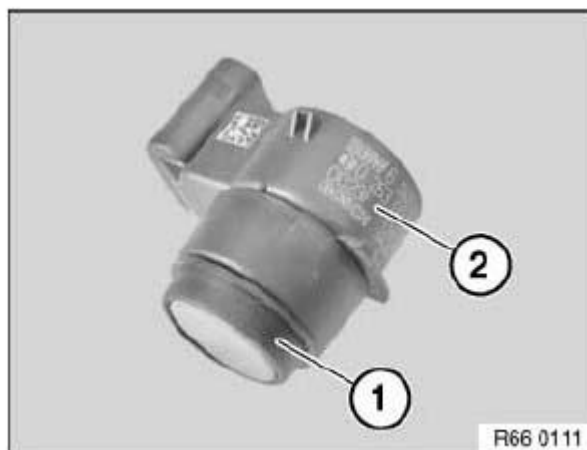
Before installation of ultrasonic sensor (3) on wiring harness, clean plug connection!

Retaining tabs (2) must not be damaged!

Make sure ultrasonic sensor is securely seated.

*Installation note:*

Make sure rubber ring (1) is correctly seated on ultrasonic sensor (2).



**Fig. 15: Identifying Rubber Ring On Ultrasonic Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

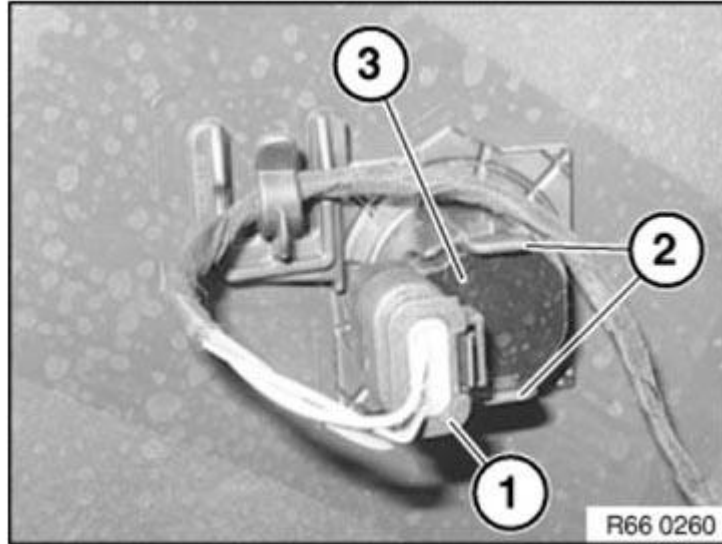
## 66 20 534 REMOVING AND INSTALLING/REPLACING A REAR LEFT ULTRASONIC TRANSDUCER (PDC)

### Necessary preliminary tasks:

- Remove **REAR UNDERBODY PANELLING**

Unlock plug connection (1) and disconnect.

Unlock latch mechanisms (2) and pull ultrasonic transducer (3) out of bracket.



**Fig. 16: Identifying Ultrasonic Converter, Plug Connection And Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Installation note:

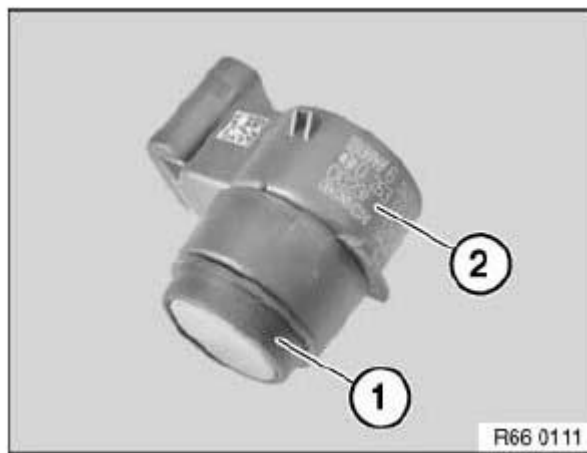
Before installation of ultrasonic sensor (3) on wiring harness, clean plug connection!

Retaining tabs (2) must not be damaged!

Make sure ultrasonic sensor is securely seated.

### *Installation note:*

Make sure rubber ring (1) is correctly seated on ultrasonic sensor (2).



**Fig. 17: Identifying Rubber Ring On Ultrasonic Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

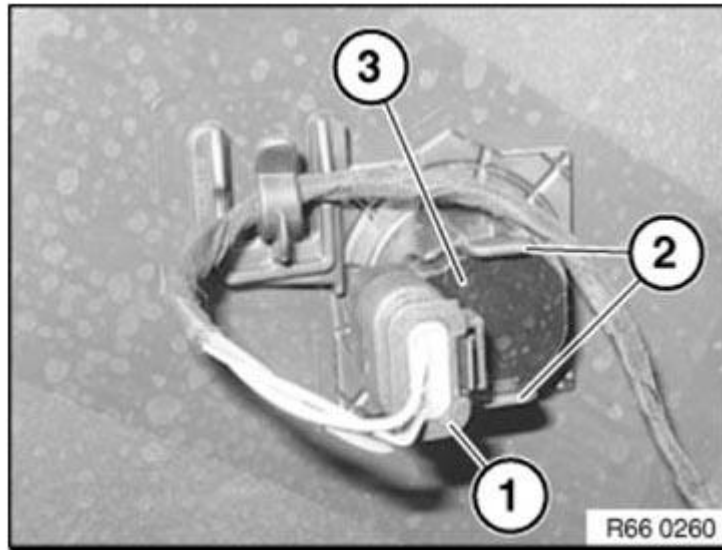
## 66 20 535 REMOVING AND INSTALLING/REPLACING A REAR RIGHT ULTRASONIC TRANSDUCER (PDC)

**Necessary preliminary tasks:**

- Remove **REAR UNDERBODY PANELLING**

Unlock plug connection (1) and disconnect.

Unlock latch mechanisms (2) and pull ultrasonic transducer (3) out of bracket.



**Fig. 18: Identifying Ultrasonic Converter, Plug Connection And Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

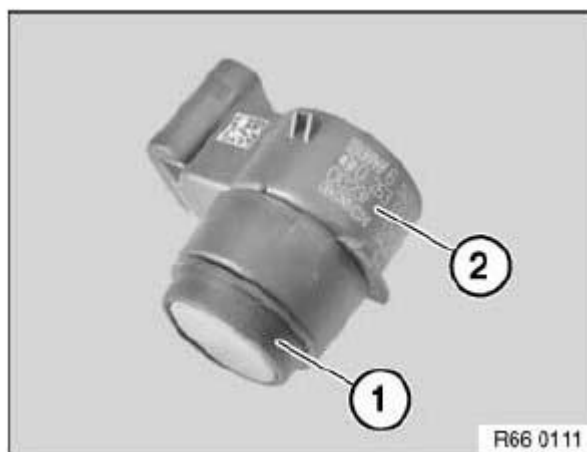
Before installation of ultrasonic sensor (3) on wiring harness, clean plug connection!

Retaining tabs (2) must not be damaged!

Make sure ultrasonic sensor is securely seated.

*Installation note:*

Make sure rubber ring (1) is correctly seated on ultrasonic sensor (2).



**Fig. 19: Identifying Rubber Ring On Ultrasonic Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

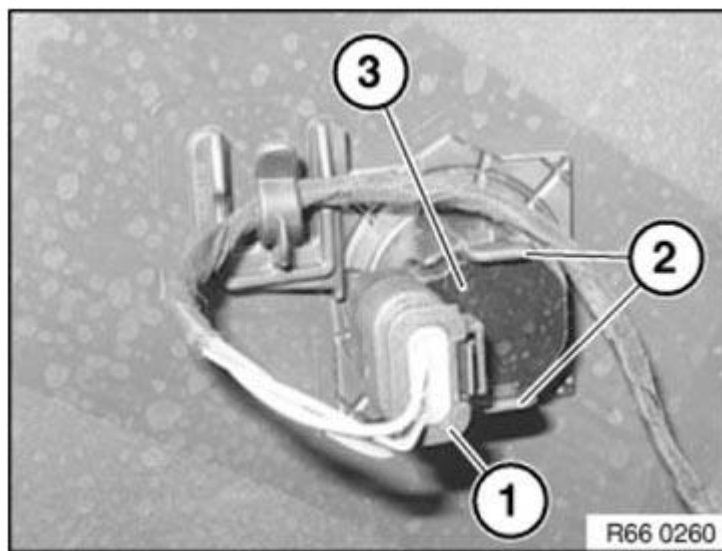
**66 20 536 REMOVING AND INSTALLING/REPLACING A REAR, CENTER LEFT ULTRASONIC TRANSDUCER (PDC)**

**Necessary preliminary tasks:**

- Remove **REAR UNDERBODY PANELLING**

Unlock plug connection (1) and disconnect.

Unlock latch mechanisms (2) and pull ultrasonic transducer (3) out of bracket.



**Fig. 20: Identifying Ultrasonic Converter, Plug Connection And Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

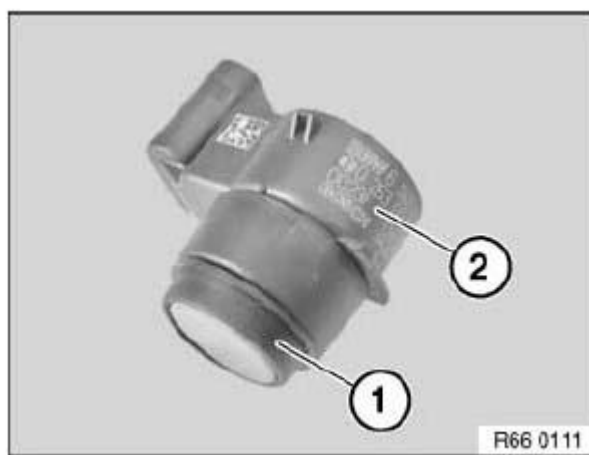
Before installation of ultrasonic sensor (3) on wiring harness, clean plug connection!

Retaining tabs (2) must not be damaged!

Make sure ultrasonic sensor is securely seated.

*Installation note:*

Make sure rubber ring (1) is correctly seated on ultrasonic sensor (2).



**Fig. 21: Identifying Rubber Ring On Ultrasonic Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **PARKING ASSIST SYSTEM**

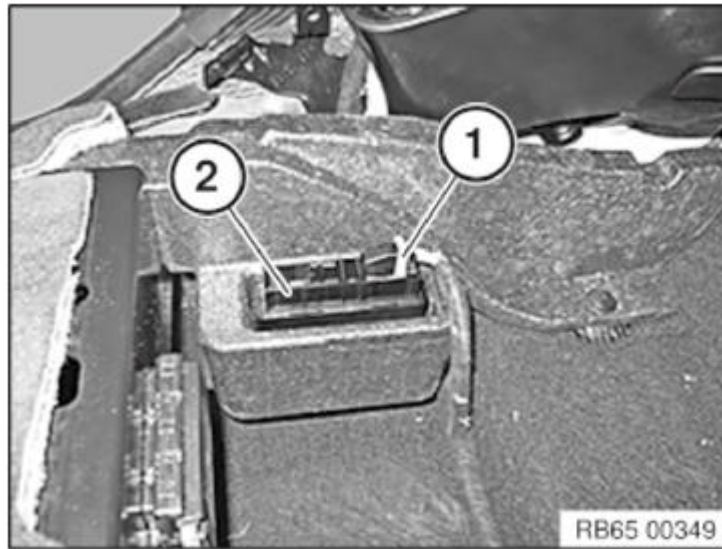
### **66 33 008 REMOVING AND INSTALLING/REPLACING PARK ASSIST CONTROL UNIT**

**Necessary preliminary tasks:**

- Remove **REAR SEAT**

Unlock plug connections (1) and disconnect.

Pull out parking assist control unit (2) towards top.



**Fig. 22: Identifying Control Unit And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **PROGRAMMING/ENCODING** .

**66 33 010 REMOVING AND INSTALLING/REPLACING ULTRASOUND SENSOR FOR PARKING ASSISTANT**

**Necessary preliminary tasks:**

- Partially remove **COVER WHEEL ARCH, FRONT LEFT OR RIGHT**

Unfasten plug connection (1) and disconnect.

Unlock latches at marked points.

Remove ultrasonic sensor (2).

*Installation note:*

Latch mechanisms must not be damaged!

Make sure ultrasonic sensor is securely seated.



## REVERSING CAMERA (RFK), SIDE VIEW CAMERA, TOP VIEW CAMERA

### 66 53 013 CALIBRATING REVERSING CAMERA

**NOTE:** Calibration of reversing camera must be carried out after the following work:

- Removal and installation/replacement of reversing camera
- Body repair work at rear end of vehicle

**Follow instructions and specifications in procedure.**

To obtain an optimum result, always adhere to the following conditions:

- IMPORTANT:**
- Vehicle standing level on headlight aiming station
  - Rear seat bench is unoccupied
  - Do not swap seats during calibration
  - Steering wheel in straight-ahead position
  - Do not move steering wheel

**NOTE:** Also switch on reversing camera by means of PDC button. Calibration can only be carried out with the BMW diagnosis system. Use of a special tool is no longer required from 03/2011!  
**Service functions:**

- Complete vehicle
- Body
- Assist systems

### 66 53 020 REMOVING AND INSTALLING/REPLACING REVERSING CAMERA

**Special tools required:**

- 2 298 505

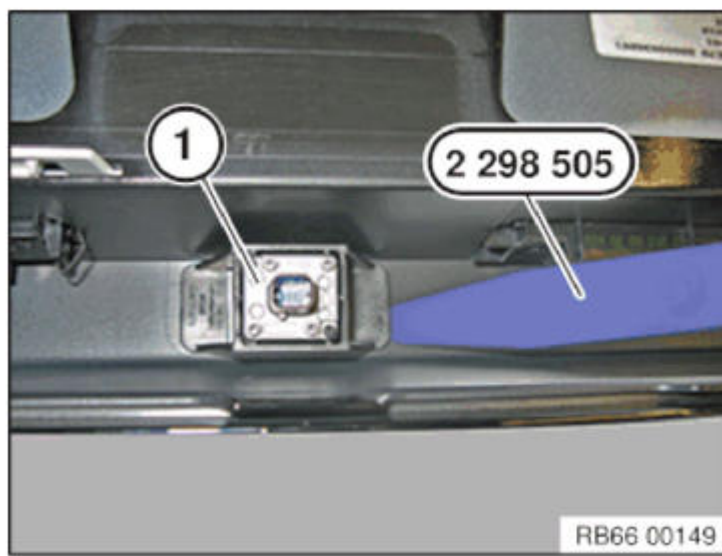
**IMPORTANT:** Read and comply with notes on PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION).

**Necessary preliminary tasks:**

- Remove REAR BUMPER PANEL

Release rear view camera (1) from adhesive strip with special tool 2 298 505.

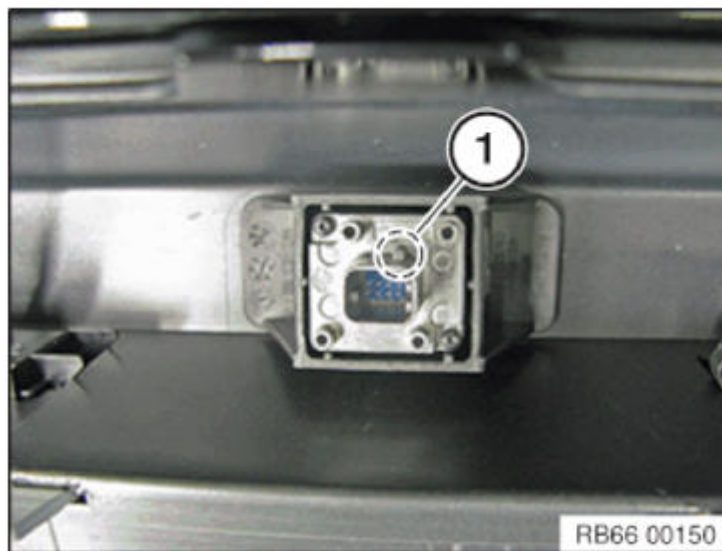




**Fig. 24: Releasing Rear View Camera From Adhesive Strip With Special Tool (2 298 505).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Connector coding (1) faces top edge of bumper.



**Fig. 25: Identifying Connector Coding**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Carry out reversing camera function check
- Calibrate **REVERSING CAMERA**

## **NIGHT VISION**

### **65 82 300 REMOVING AND REFITTING (REPLACING) TOUCHBOX**

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)**.

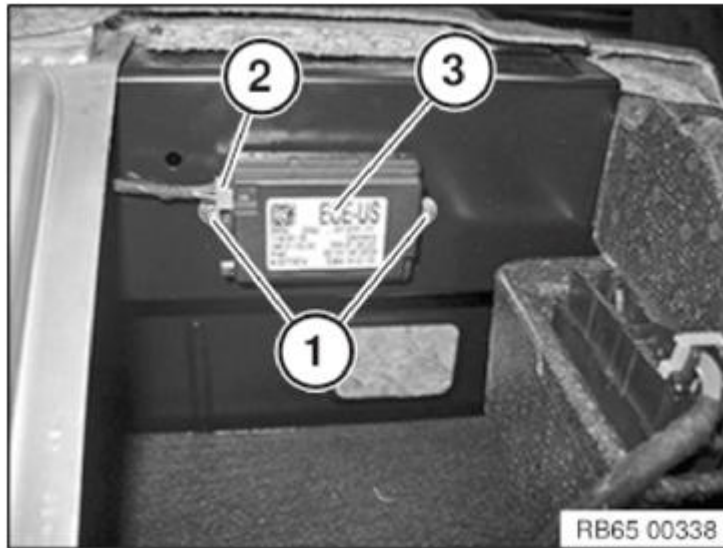
**Necessary preliminary tasks:**

- Remove **REAR SEAT**

Release screws (1).

Unfasten plug connection (2) and disconnect.

Remove touchbox (3).



**Fig. 26: Identifying Touchbox, Plug Connection And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING AND ENCODING** .

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## ACCESSORIES AND BODY, CAB

### Electrical Drives - Repair - All I3 Models - i3

## ACTUATOR DRIVES

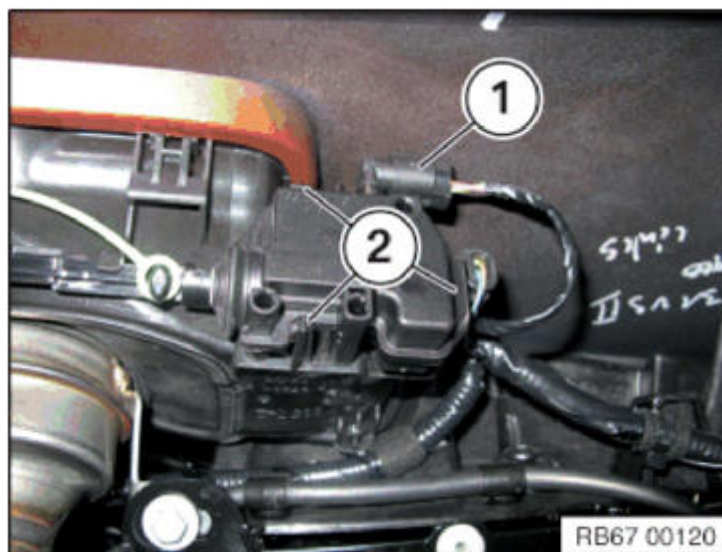
### 67 11 555 REMOVING AND INSTALLING/REPLACING ACTUATOR DRIVE FOR FUEL FILLER FLAP

Necessary preliminary tasks:

- Remove WHEEL ARCH COVER AT FRONT (REAR PART).

Unfasten plug connection (1) and disconnect.

Release catches (2).



**Fig. 1: Identifying Actuator Drive Catches And Plug Connection**

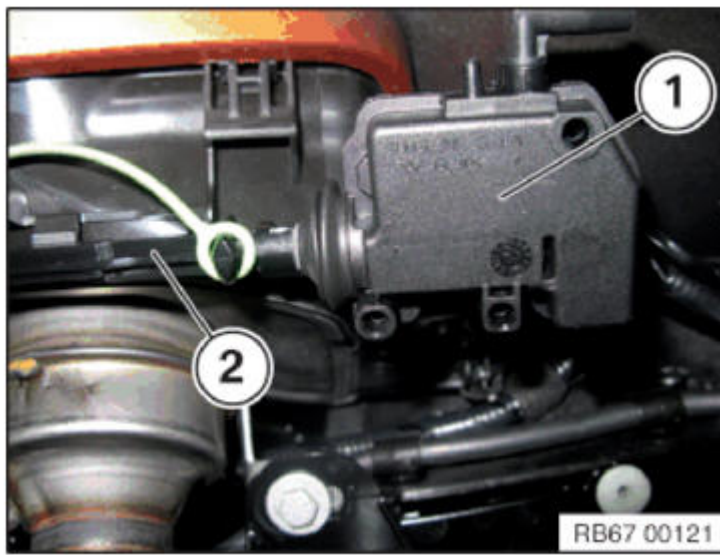
Courtesy of BMW OF NORTH AMERICA, INC.

Detach actuator drive (1) at locking pin (2) and remove.

*Installation note:*

Make sure actuator drive (1) is correctly fitted.

Make sure the setting for the actuator drive (1) for the fuel filler flap is correct. It must be possible to lock or unlock the fuel filler flap completely.



**Fig. 2: Identifying Actuator Drive And Locking Pin**

Courtesy of BMW OF NORTH AMERICA, INC.

**67 11 530 REMOVING AND INSTALLING/REPLACING ACTUATOR DRIVE FOR REAR LEFT OR RIGHT CENTRAL LOCKING**

**NOTE:** Actuator drive of central locking drive can only be replaced in conjunction with door lock.

This operation is described in:

Removing and installing/replacing **REAR DOOR LOCK**

**67 11 595 REMOVING AND INSTALLING/REPLACING CONTROLLER DRIVE FOR CHARGING POWER SOCKET**

**Special tools required:**

- **24 05 562**

**Necessary preliminary tasks:**

- Remove RIGHT REAR SIDE PANEL

**Removal:**

**US version**

**with SA4U7**

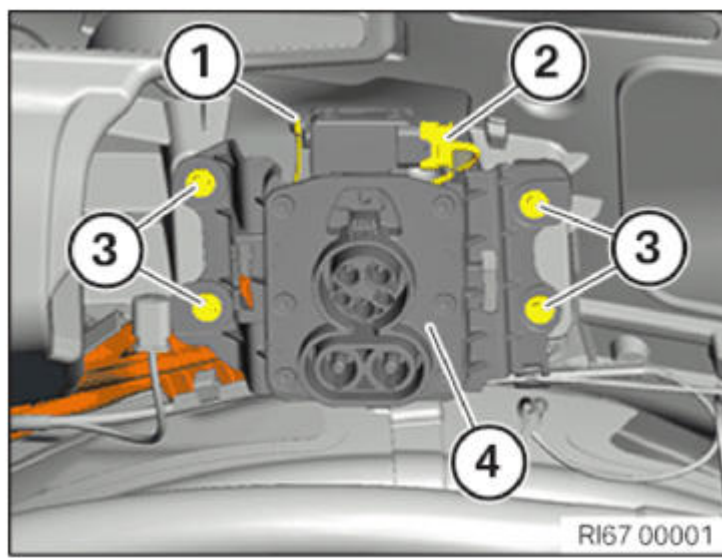
**Fast charging with direct current**

Disengage tensioning strap (1) for emergency release mechanism.

Unfasten plug connection (2) and disconnect.

Loosen screws (3).

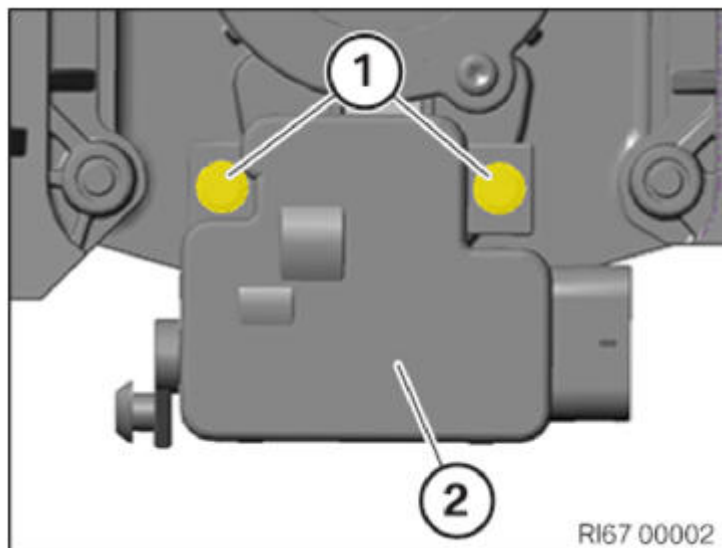
Fold the charging socket (4) forwards.



**Fig. 3: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) with special tool [24 05 562](#) .

Remove controller drive for locking the charging socket (2).



**Fig. 4: Releasing Controller Drive Screws With Special Tool (24 05 562)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**ECE version**

**with SA4U7**

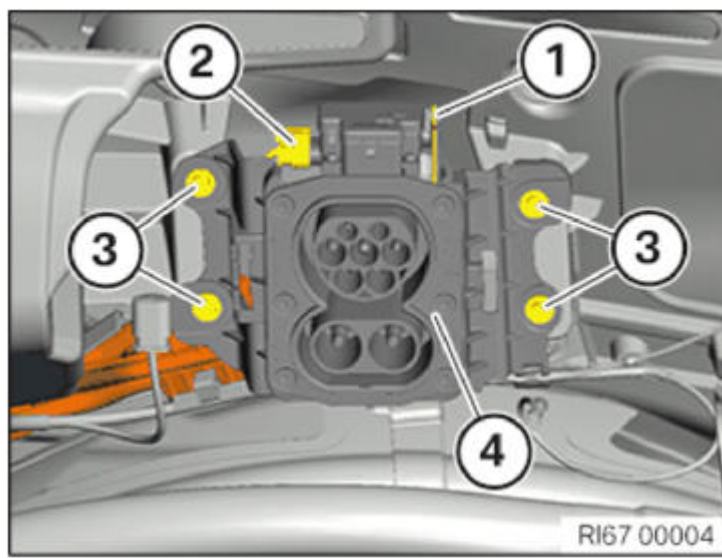
**Fast charging with direct current**

Disengage tensioning strap (1) for emergency release mechanism.

Unfasten plug connection (2) and disconnect.

Loosen screws (3).

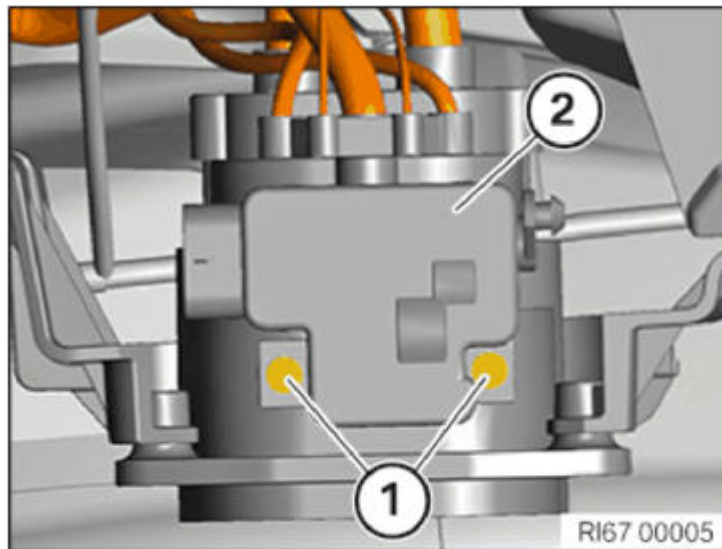
Fold the charging socket (4) forwards.



**Fig. 5: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) with special tool [24 05 562](#) .

Remove controller drive for locking the charging socket (2).



**Fig. 6: Releasing Controller Drive Screws With Special Tool (24 05 562)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **Chinese version**

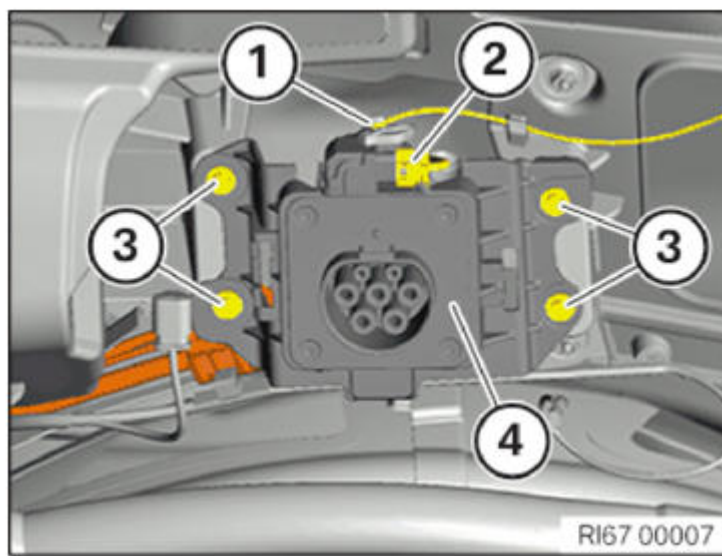
Disengage tensioning strap (1) for emergency release mechanism.

Unfasten plug connection (2) and disconnect.

Loosen screws (3).

Fold the charging socket (4) forwards.



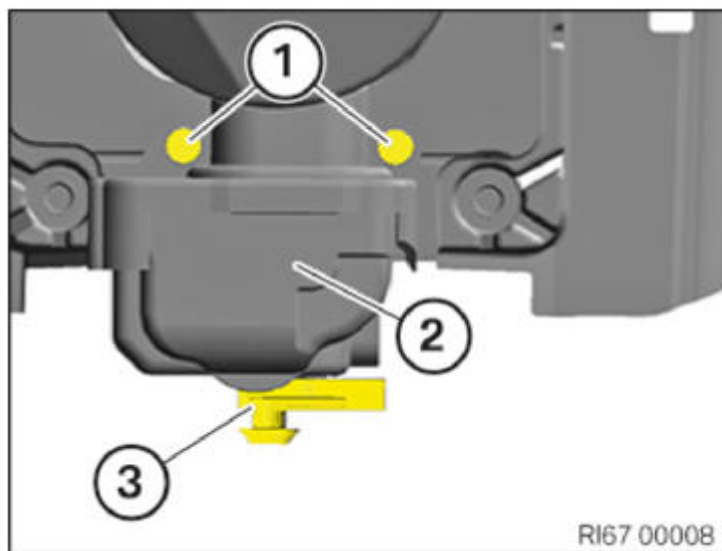


**Fig. 7: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) with special tool [24 05 562](#) .

Remove controller drive for locking the charging socket (2).

Remove lever (3).



**Fig. 8: Identifying Charging Socket, Lever And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**ECE version**

**without SA4U7**

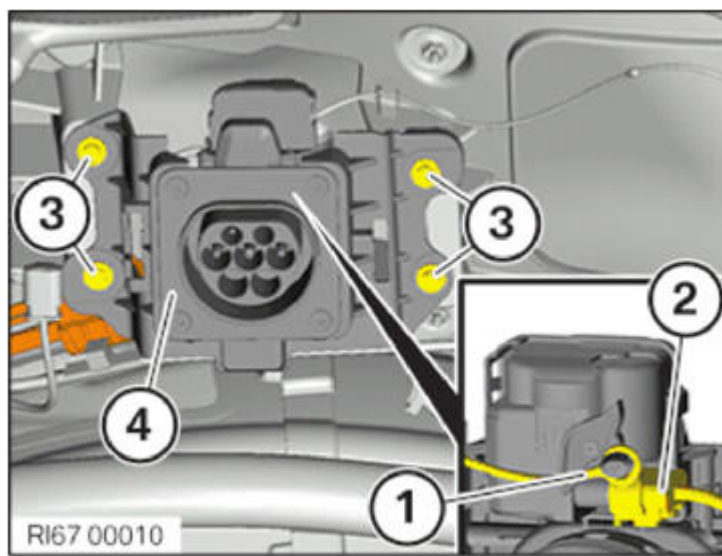
**Fast charging with direct current**

Disengage tensioning strap (1) for emergency release mechanism.

Unfasten plug connection (2) and disconnect.

Loosen screws (3).

Fold the charging socket (4) forwards.

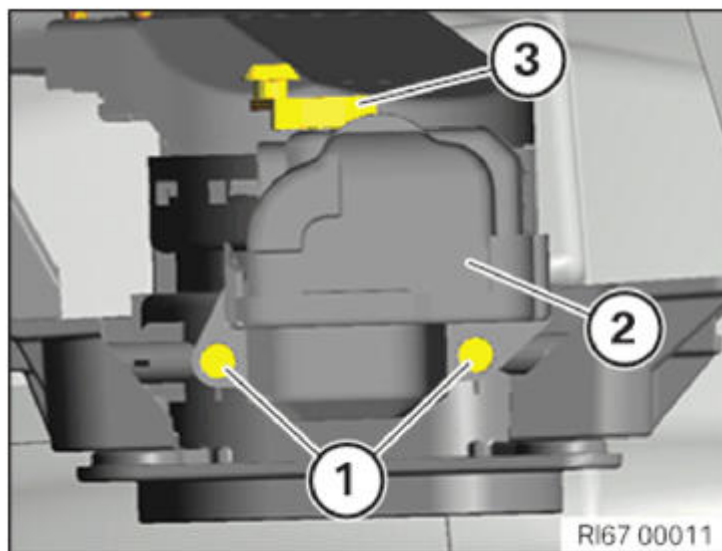


**Fig. 9: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) with special tool [24 05 562](#) .

Remove controller drive for locking the charging socket (2).

Remove lever (3).



**Fig. 10: Identifying Charging Socket, Lever And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**US version**

**without SA4U7**

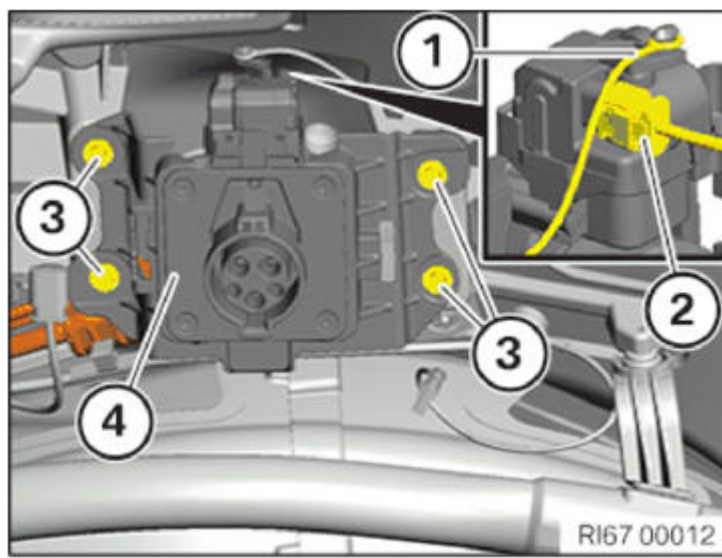
**Fast charging with direct current**

Disengage tensioning strap (1) for emergency release mechanism.

Unfasten plug connection (2) and disconnect.

Loosen screws (3).

Fold the charging socket (4) forwards.

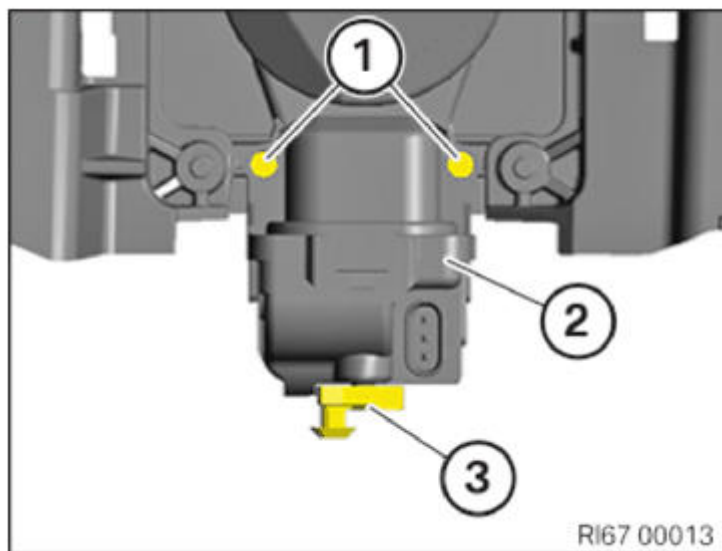


**Fig. 11: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) with special tool [24 05 562](#) .

Remove controller drive for locking the charging socket (2).

Remove lever (3).



**Fig. 12: Identifying Charging Socket, Lever And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

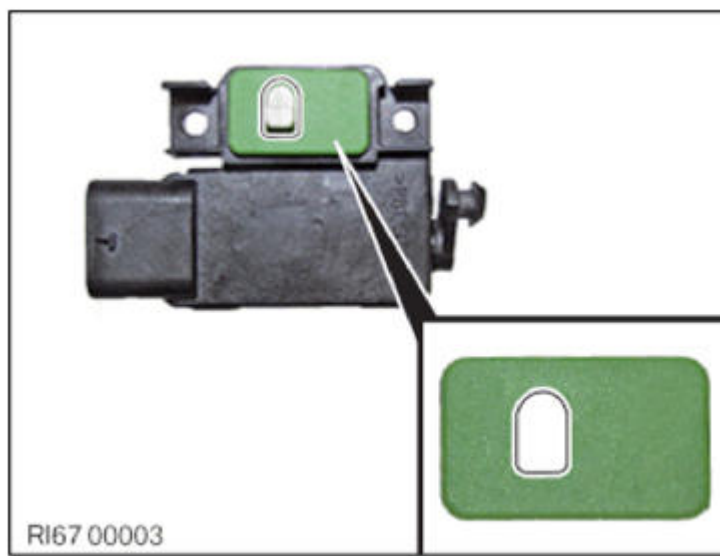
**Installation:**

**US version**

**with SA4U7**

**Fast charging with direct current**

**NOTE:**        **Gasket must be renewed.**  
                      **Ensure that gasket is correctly seated.**

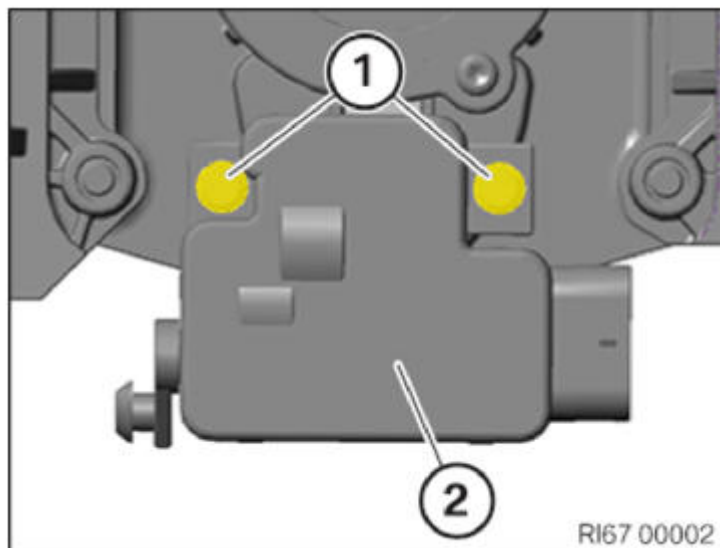


**Fig. 13: Identifying Gasket**

Courtesy of BMW OF NORTH AMERICA, INC.

Position controller drive for locking the charging socket (2) on the charging socket.

Tighten down screws (1) with special tool [24 05 562](#) .



**Fig. 14: Releasing Controller Drive Screws With Special Tool (24 05 562)**

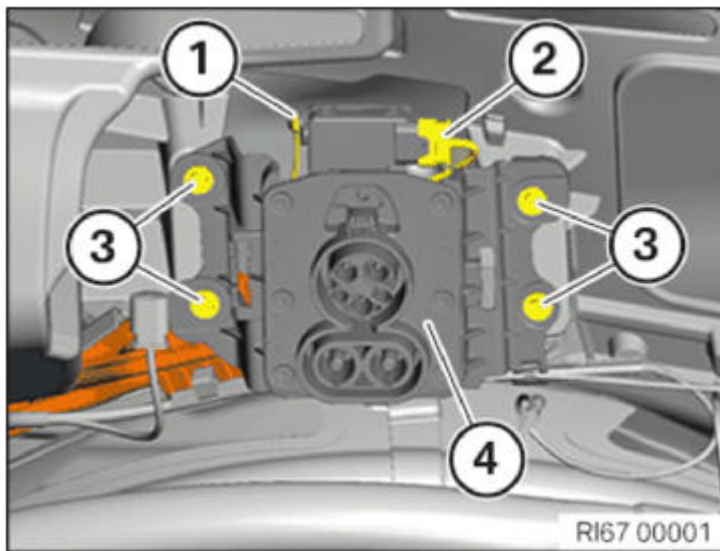
Courtesy of BMW OF NORTH AMERICA, INC.

Position charging socket (4) in the holder.

Tighten down screws (3).

Connect connector (2).

Attach tensioning strap (1) for emergency release mechanism.



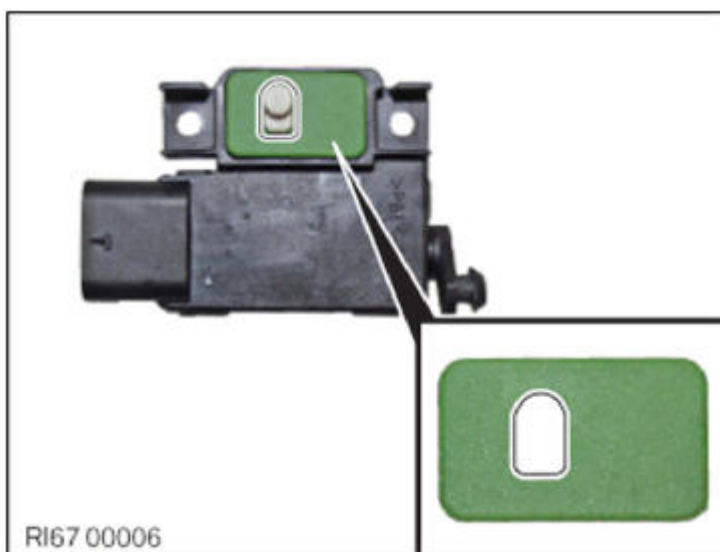
**Fig. 15: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

ECE version

with SA4U7

Fast charging with direct current

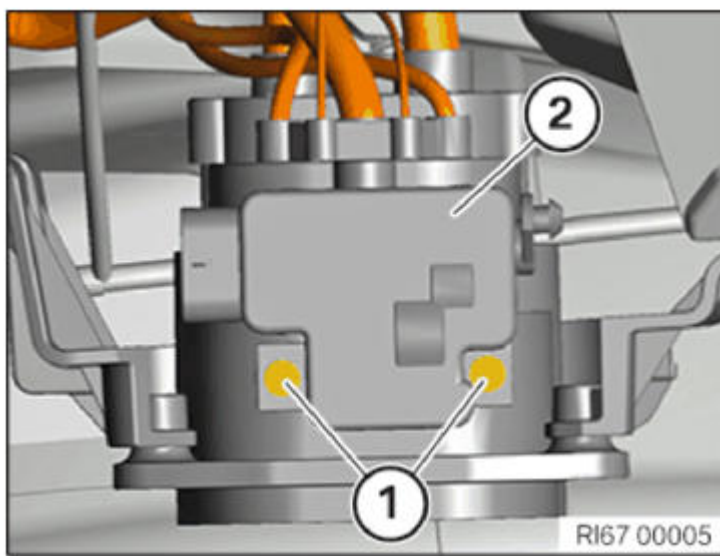
**NOTE:** Gasket must be renewed.  
 Ensure that gasket is correctly seated.



**Fig. 16: Identifying Gasket**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Position controller drive for locking the charging socket (2) on the charging socket.

Tighten down screws (1) with special tool [24 05 562](#) .



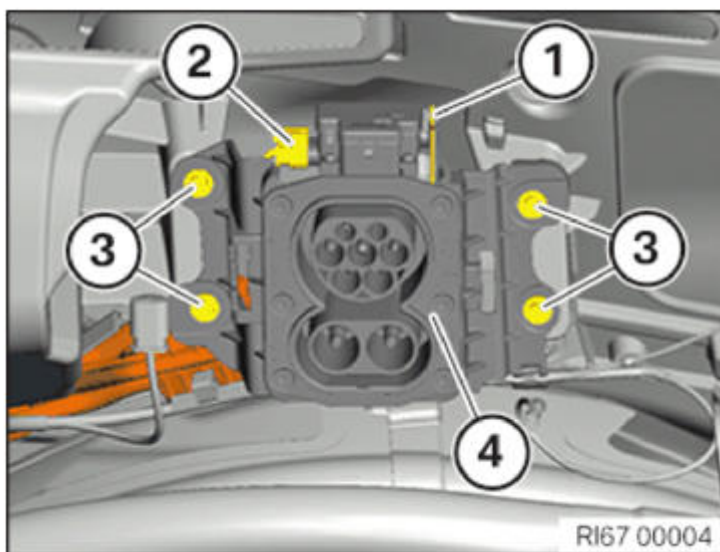
**Fig. 17: Releasing Controller Drive Screws With Special Tool (24 05 562)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Position charging socket (4) in the holder.

Tighten down screws (3).

Connect connector (2).

Attach tensioning strap (1) for emergency release mechanism.



**Fig. 18: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Chinese version

**NOTE:**

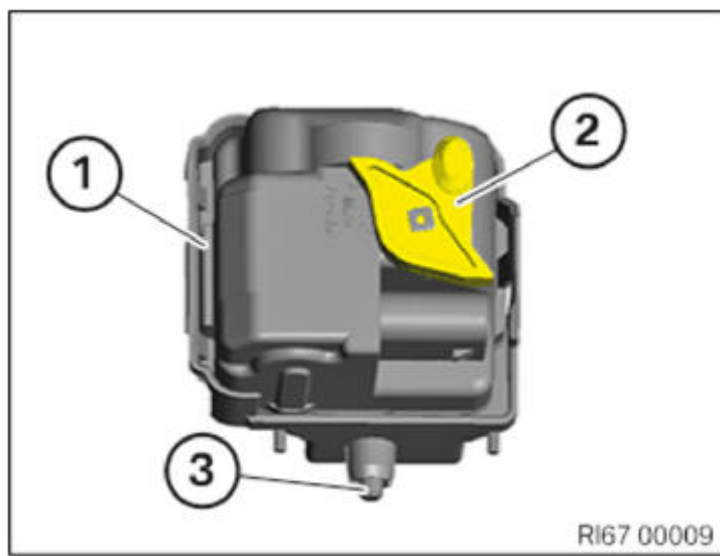
Controller drive for locking the charging socket (1) is found in the unlocked installation position as a new part.

The locking pin (3) is retracted.

As shown in the diagram, lever (2) must be positioned on the unlocked controller drive for locking the charging socket (1).

In the event of incorrect assembly a blockage can occur.



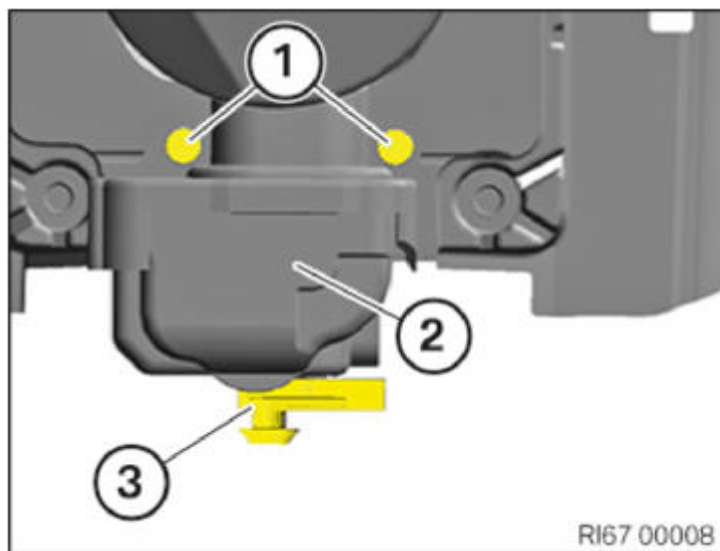


**Fig. 19: Identifying Charging Socket, Locking Pin And Lever**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect lever (3) so that it locks noticeably.

Position controller drive for locking the charging socket (2) on the charging socket.

Tighten down screws (1) with special tool [24 05 562](#) .



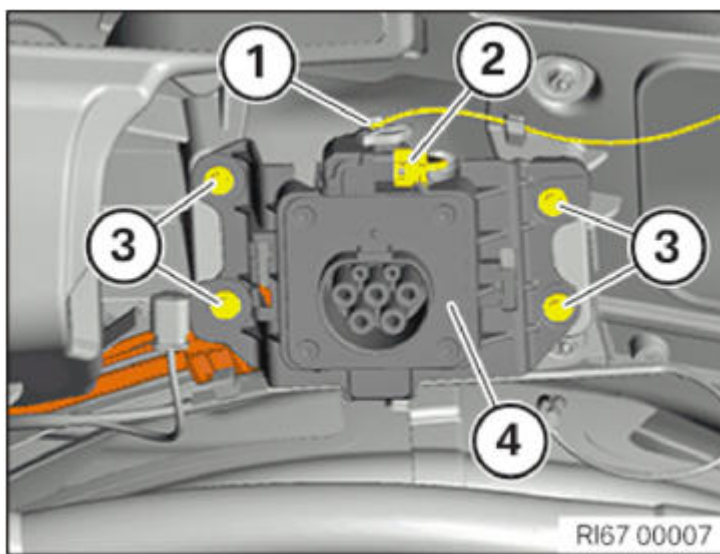
**Fig. 20: Identifying Charging Socket, Lever And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position charging socket (4) in the holder.

Tighten down screws (3).

Connect connector (2).

Attach tensioning strap (1) for emergency release mechanism.



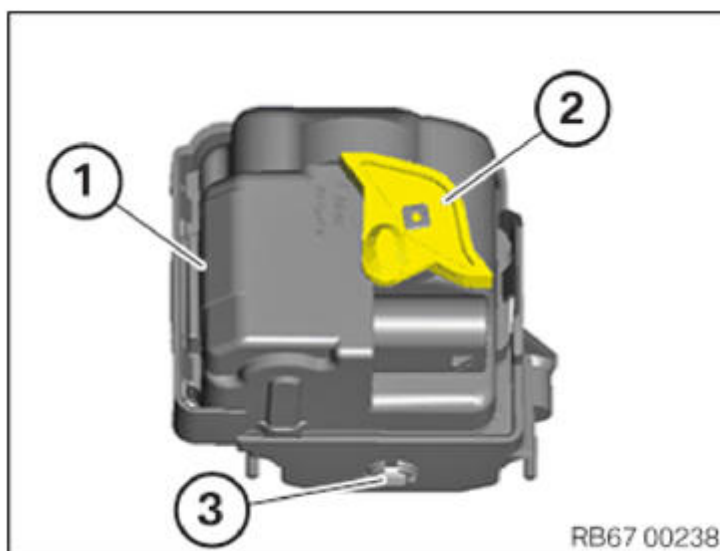
**Fig. 21: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

ECE version

without SA4U7

Fast charging with direct current

**NOTE:** Controller drive for locking the charging socket (1) is found in the unlocked installation position as a new part.  
 The locking pin (3) is retracted.  
 As shown in the diagram, lever (2) must be positioned on the unlocked controller drive for locking the charging socket (1).



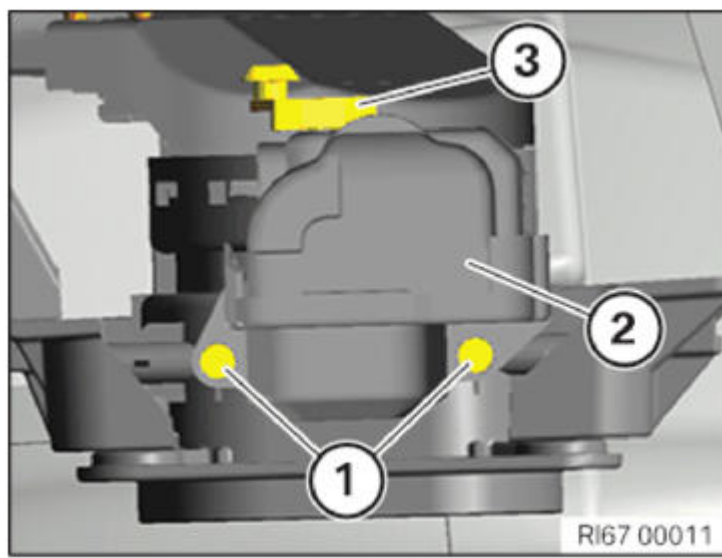
**Fig. 22: Identifying Charging Socket, Lever And Locking Pin**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**In the event of incorrect assembly a blockage can occur.**

Connect lever (3) so that it locks noticeably.

Position controller drive for locking the charging socket (2) on the charging socket.

Tighten down screws (1) with special tool [24 05 562](#) .



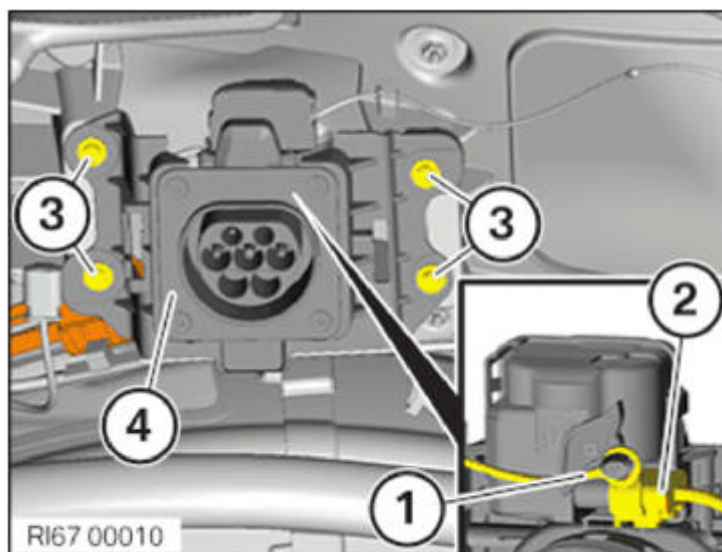
**Fig. 23: Identifying Charging Socket, Lever And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Position charging socket (4) in the holder.

Tighten down screws (3).

Connect connector (2).

Attach tensioning strap (1) for emergency release mechanism.



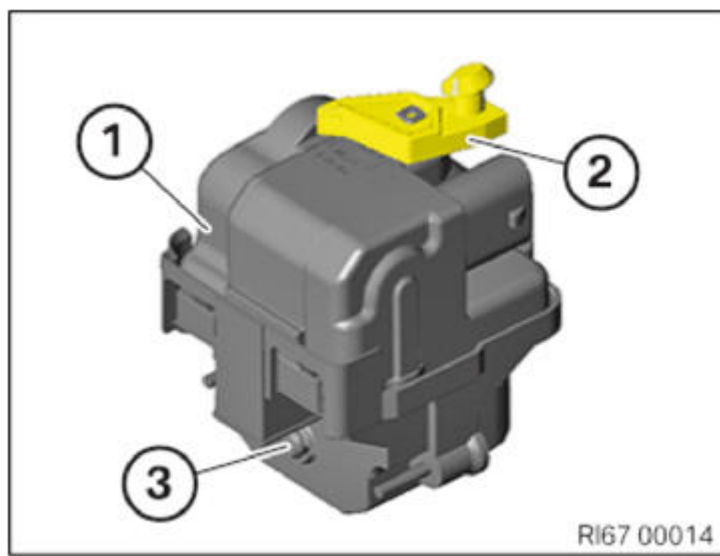
**Fig. 24: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

US version

without SA4U7

Fast charging with direct current

**NOTE:** Controller drive for locking the charging socket (1) is found in the unlocked installation position as a new part. The locking pin (3) is retracted. As shown in the diagram, lever (2) must be positioned on the unlocked controller drive for locking the charging socket (1). In the event of incorrect assembly a blockage can occur.

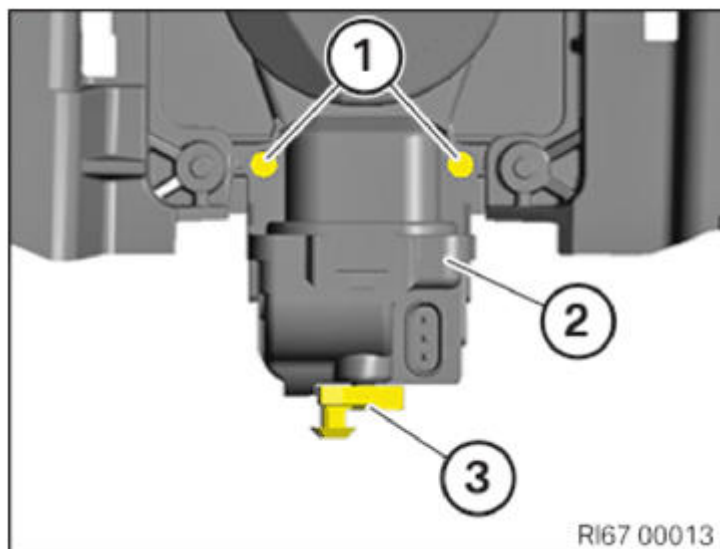


**Fig. 25: Identifying Charging Socket, Lever And Locking Pin**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect lever (3) so that it locks noticeably.

Position controller drive for locking the charging socket (2) on the charging socket.

Tighten down screws (1) with special tool [24 05 562](#) .



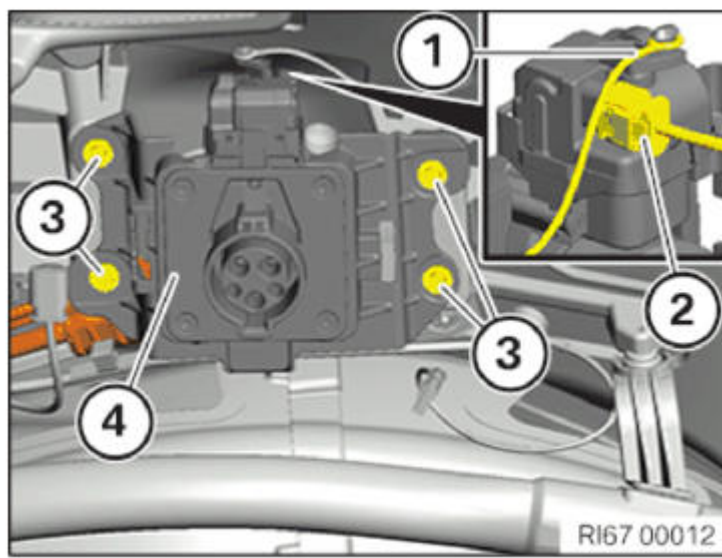
**Fig. 26: Identifying Charging Socket, Lever And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position charging socket (4) in the holder.

Tighten down screws (3).

Connect connector (2).

Attach tensioning strap (1) for emergency release mechanism.



**Fig. 27: Identifying Charging Socket, Plug Connection, Tensioning Strap And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**67 11 591 REMOVING AND INSTALLING/REPLACING CONTROLLER DRIVE FOR HIGH-VOLTAGE CHARGING SOCKET FLAP**

**Necessary preliminary tasks:**

- Remove RIGHT REAR SIDE PANEL

Unlock latch mechanisms (1).

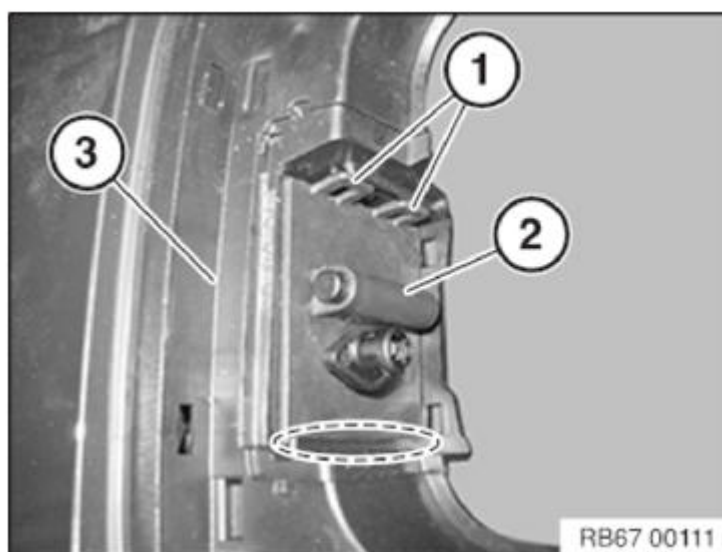
Detach emergency release.

Remove actuator drive (2) from side panel (3).

*Installation note:*

Actuator drive (2) must be engaged in marked area first. Then lock at top.

Ensure the correct setting of the actuator drive (2). It must be possible to lock or unlock the fuel filler flap completely.



**Fig. 28: Identifying Actuator Drive, Latch Mechanisms And Side Panel**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**67 11 560 REPLACING ACTUATOR DRIVE FOR TAILGATE LOCKING**

This operation is described in:

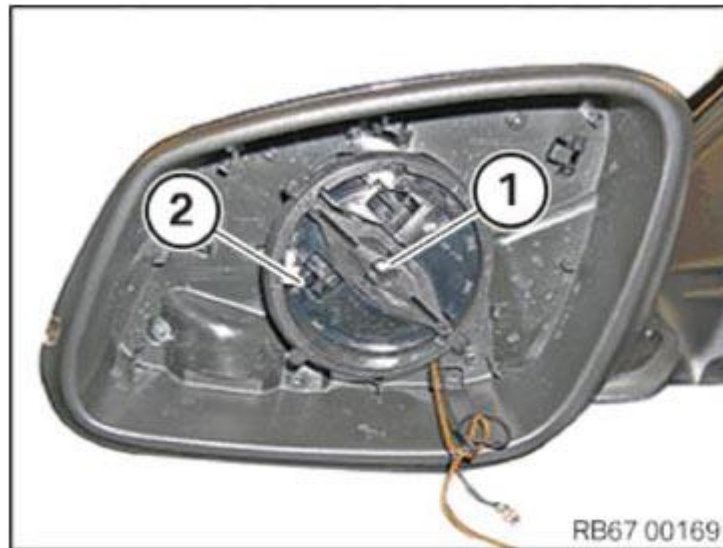
## MIRROR ADJUSTMENT DRIVE UNIT

### 67 13 001 REPLACING DRIVE UNIT FOR ELECTRICALLY OPERATED LEFT OR RIGHT EXTERIOR MIRROR

*Necessary preliminary work:*

- Remove **MIRROR GLASS** for inside mirror

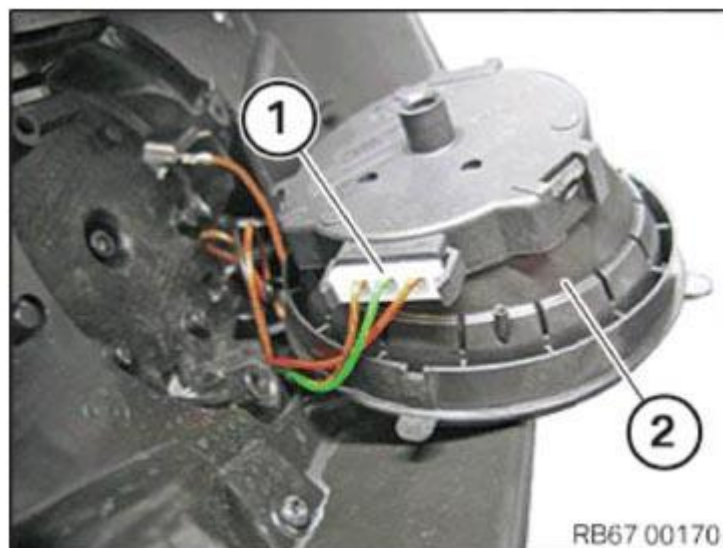
Release screw (1) and move the drive (2) slightly to the front.



**Fig. 29: Identifying Mirror Drive Unit And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

Remove electric motor (2).



**Fig. 30: Identifying Electric Motor And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

## DRIVE, SLIDE/TILT SUNROOF

### 67 61 005 REMOVING AND INSTALLING/RENEWING DRIVE WITH MECHANISM (FRONT) FOR ACTUATING SLIDE/TILT SUNROOF



## Necessary preliminary tasks:

- Remove **CONTROL UNIT FOR SLIDE/TILT SUNROOF**

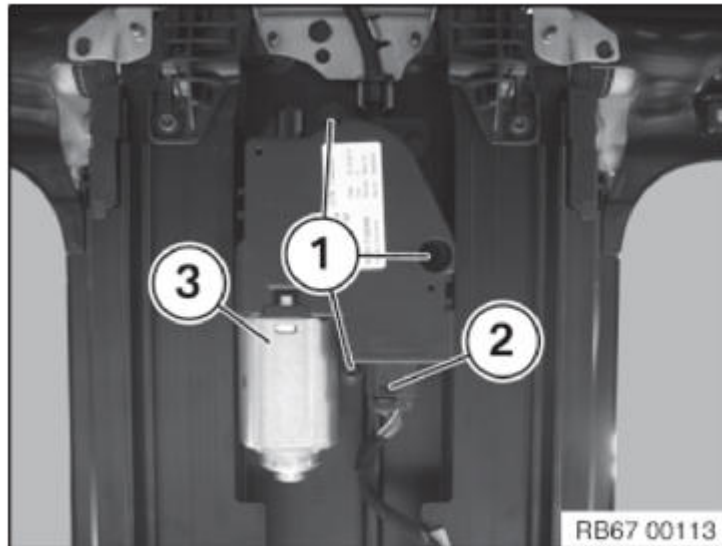
**NOTE:** Secure drive with gearbox for actuating slide/tilt sunroof (3) against falling out.

Release screws (1).

Tightening torque **54 13 1AZ** .

Unfasten plug connection (2) and disconnect.

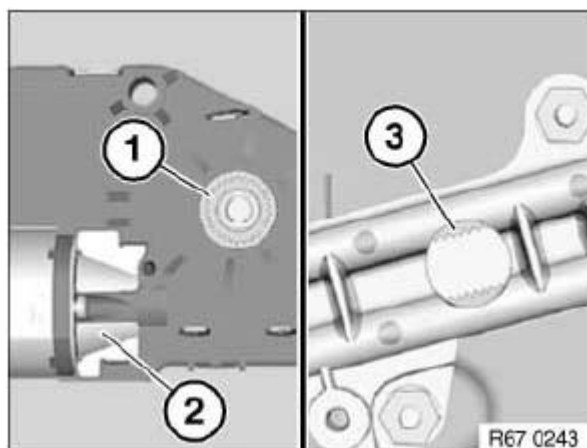
Remove drive with gearbox for actuating slide/tilt sunroof (3).



**Fig. 31: Identifying Sunroof Drive With Gearbox, Plug Connection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Insert gear (1) of electric motor with gearbox for operation of slide/tilt sunroof (2) exactly in gearing (3).



**Fig. 32: Identifying Electric Motor Gear, Sunroof And Gearing**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Initialize **SLIDE/TILT SUNROOF** .

## **DRIVE, POWER WINDOW**

**NOTE:** Initialization is performed on the power window switch of the relevant door.

Initialization comprises:

- Normalization
- Learning characteristic curve

With normalization, the mechanical end stops of the power window regulator are recorded and stored.

The characteristic curve is learned immediately after normalization.

When the characteristic curve is learned, the mechanical closing forces of the power windows are recorded and stored for correct operation of the anti-trapping mechanism.

Initialization, i.e. normalization and learning of characteristic curve, is performed in a continuous operation.

**NOTE:** An Initialization must be performed:

- In the event of malfunctions, e.g. no one-touch function, no opening or no convenience function possible.
- After the power windows drive or door module has been replaced.
- After work is carried out on the power windows mechanism.

**WARNING:** There is no anti-trap mechanism during initialization.

**Necessary preliminary work:**

- Vehicle stationary
- Sufficient battery voltage available/connect charger if necessary
- Terminal "15" switched on
- All doors closed
- F12 up to 02/2012 soft top open, from 03/2012 soft top closed

Operating procedure for initialization (manual):

**Deleting the initialization:**

- Move side window into lower end position.
- Press and hold switch in "Open one-touch function" position (second switch position) for between 15 and 25 seconds.

**NOTE:** Deletion of initialization was successful if toll function and anti-trap mechanism have been rendered inoperative.

**Performing initialization:**

- Move side window to upper end position
- Pull and hold switch in "Close one-touch function" (2nd switch position) during the entire process.

**NOTE:** Re-initialization was successful if toll function and anti-trap mechanism function flawlessly.

Alternatively, initialization of the power window regulation can also be carried out via the Service function in ISTA.

Selection via:

- Body
  - Locking and security functions
  - Power window regulator

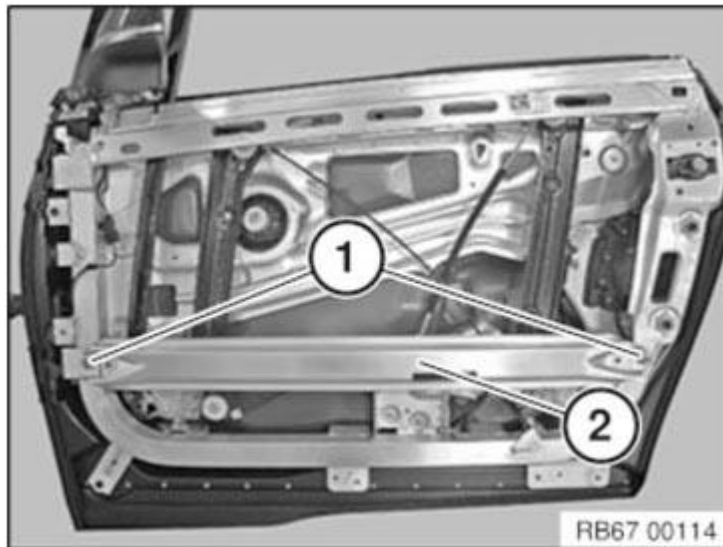
## 67 62 000 REMOVING AND INSTALLING OR POWER WINDOW REGULATOR

Necessary preliminary tasks:

- Remove FRONT DOOR OUTER SKIN

Release screws (1).

Tightening torque [41 51 4AZ](#) .

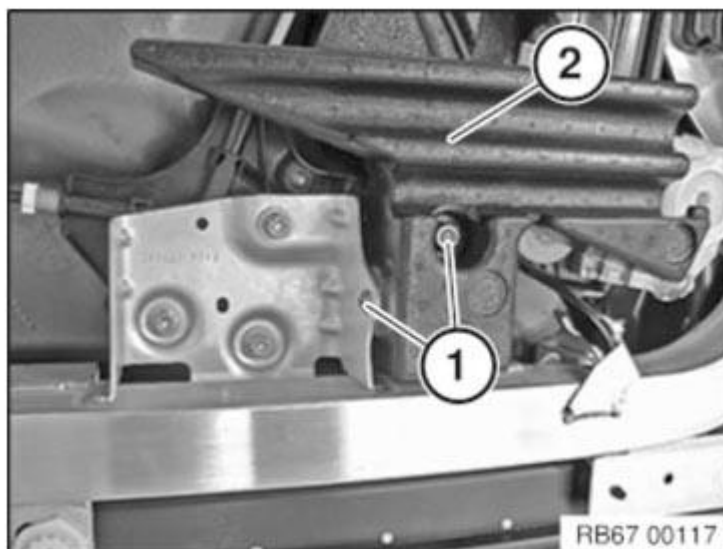


**Fig. 33: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Remove crashpad (2).



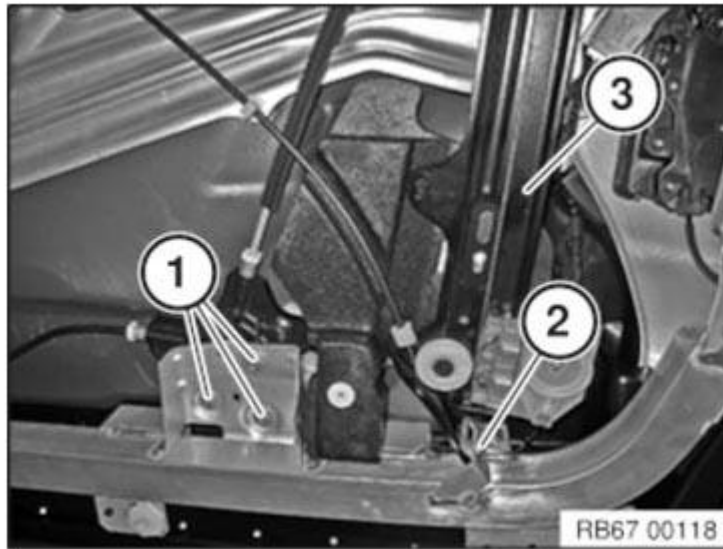
**Fig. 34: Identifying Crashpad And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release nuts (1 and 2).

Tightening torque [51 33 2AZ](#) .

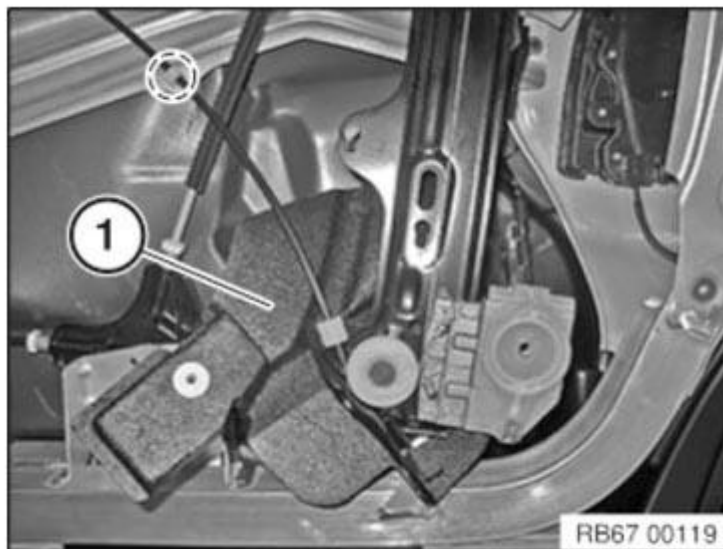
Feed out window lift rail (3) at bottom.



**Fig. 35: Identifying Window Lift Rail And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach cable in marked area.

Feed out crashpad (1).



**Fig. 36: Identifying Crashpad**  
Courtesy of BMW OF NORTH AMERICA, INC.

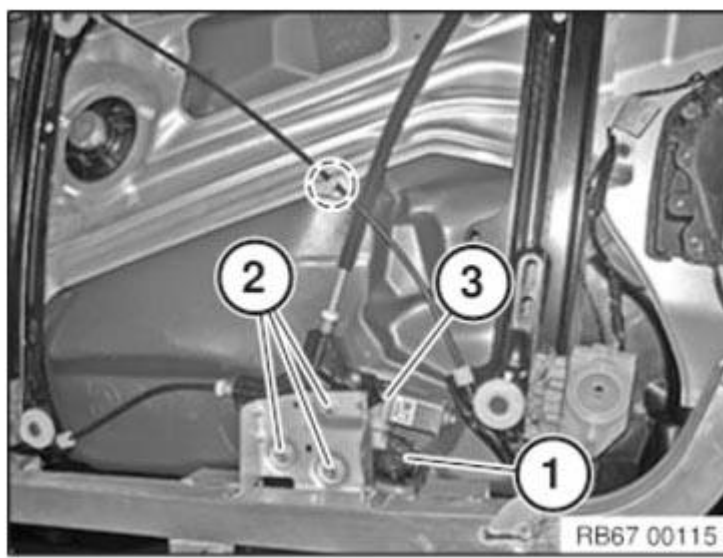
Unfasten plug connection (1) and disconnect.

Unscrew nuts (2).

Tightening torque [51 33 2AZ](#) .

Detach cable in marked area.

Feed out flat motor (3).

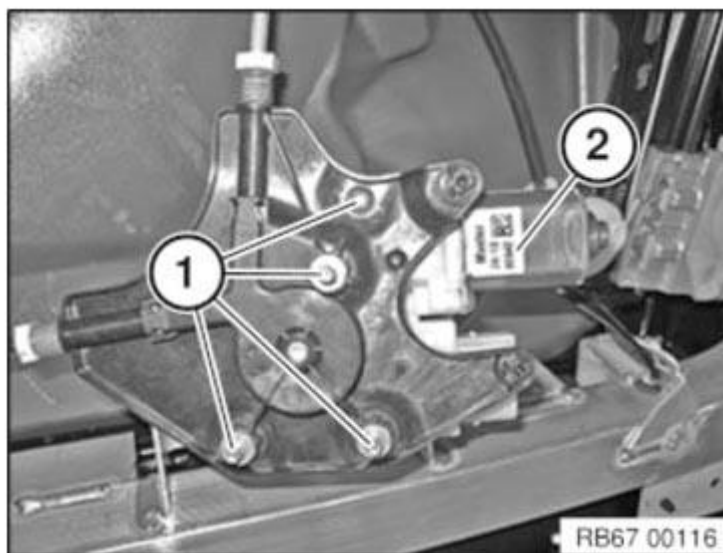


**Fig. 37: Identifying Flat Motor, Plug Connection And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [51 33 1AZ](#) .

Remove flat motor (2).



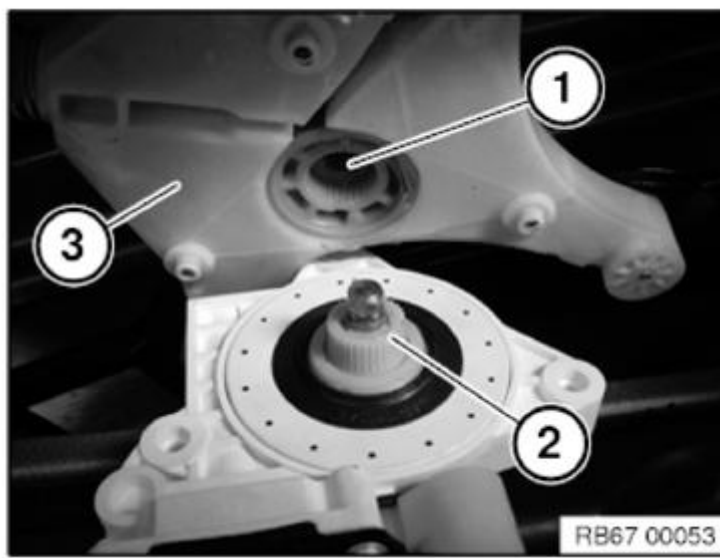
**Fig. 38: Identifying Flat Motor And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Diagram similar.

*Installation note:*

Make sure drive shaft (2) is correctly seated in mounting (1) at power window regulator (3)!

Ensure that the flat motor (2) is assembled without tension.



**Fig. 39: Identifying Power Window Regulator, Drive Shaft And Mounting**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

An initialization must be carried out in order to activate anti-trap mechanism.

Read and comply with **NOTES** on initialization of power window regulator.

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[Back To Article](#)

## ACCESSORIES AND BODY, CAB

Electrical Drives - Special Tools - All I3 Models - i3

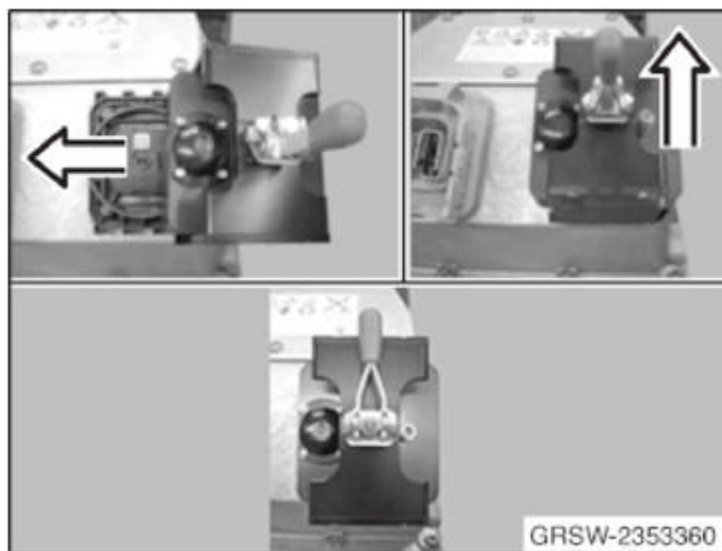
### ELECTRIC MOTOR

#### 2353360 ADAPTER MP

**NOTE:** is replaced by order number 80 30 2 365 942 Vacuum bell for connection to the venting unit of the high-voltage battery (I8) Supplementary part for EoS tester 83 30 2 353 250 Applies to: BMW i Aftersales High Voltage

SI number

02 09 13 (931)



**Fig. 1: Identifying Adapter (2353360)**

Courtesy of BMW OF NORTH AMERICA, INC.

#### 2353251 ADAPTER MP

**NOTE:** Vacuum bell for connection to the venting unit on the HV accumulator (I01) Supplementary part for EoS tester 83 30 2 353 250, valid for: BMW i Aftersales.

Storage Location

Individual

SI number

02 09 13 (931)



**Fig. 2: Identifying Adapter (2353251).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2288280 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** 2-pin I cable applies to: BMW i Aftersales Basic For measuring the temperature sensor on the electrical machine.

**Storage Location**

R202

J105

**SI number**

02 02 14 (084)



**Fig. 3: Identifying Adapter Cable (2288280).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2287951 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** 6-pin I cable applies to: BMW i Aftersales Basic For diagnosis of the rotor position sensor on the range extender electrical machine.

**Storage Location**

R203

J106

**SI number**

02 01 14 (083)



**Fig. 4: Identifying Adapter Cable (2287951)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2288281 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Applies to: BMW i Aftersales Basic six-pin I-cable for diagnosis for the electrical machine (rotor position sensor and temperature sensor)

**Storage Location**

R201

L103

**SI number**

02 03 14 (085)



**Fig. 5: Identifying Adapter Cable (2288281)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2353361 CABLE MP**

**NOTE:**

**Applies to: BMW i Aftersales High Voltage accessories/replacement for EoS diagnosis tester 2 353 250**

**Storage Location**

Individual



**Fig. 6: Identifying Cable (2353361)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2286319 LIFTING GEAR MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:**

**Valid for BMW i Aftersales Basic Lifting gear for lifting of electrical machine.**

**Storage Location**

Individual

**SI number**

01 46 13 (035)



**Fig. 7: Identifying Lifting Gear (2286319)**

Courtesy of BMW OF NORTH AMERICA, INC.

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ACCESSORIES AND BODY, CAB  
Instruments - Repair - All I3 Models - i3

## INSTRUMENT PANEL

### 62 11 280 REMOVING AND INSTALLING/REPLACING INSTRUMENT PANEL

**WARNING:** High-voltage system - danger to life:

The following points must be strictly observed *prior to starting work*:

**DE-ENERGIZE** the high-voltage system.

Observe **SAFETY INFORMATION** for handling electric vehicles.

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

#### Necessary preliminary tasks:

- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Move steering column completely rearwards
- Removing top steering column shroud
- Removing steering column cover

Unclip cover (1) in direction of arrow.



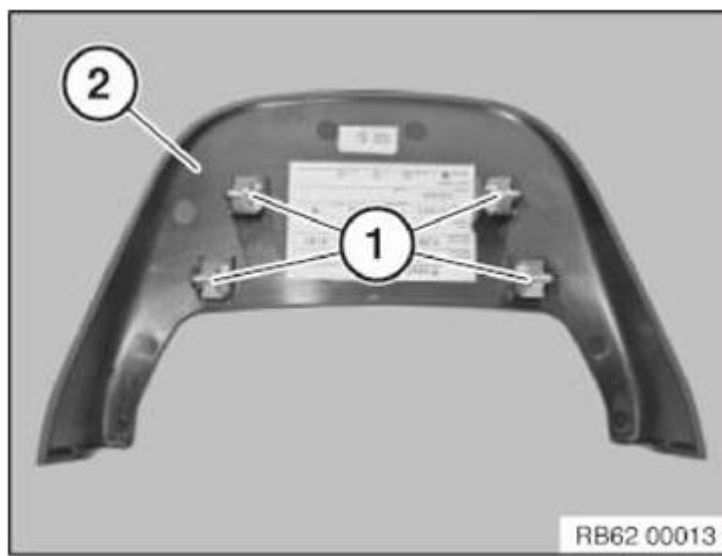
**Fig. 1: Removing Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Clamps (1) on trim (2) must not be damaged or missing.





**Fig. 2: Identifying Clamps On Trim**

Courtesy of BMW OF NORTH AMERICA, INC.

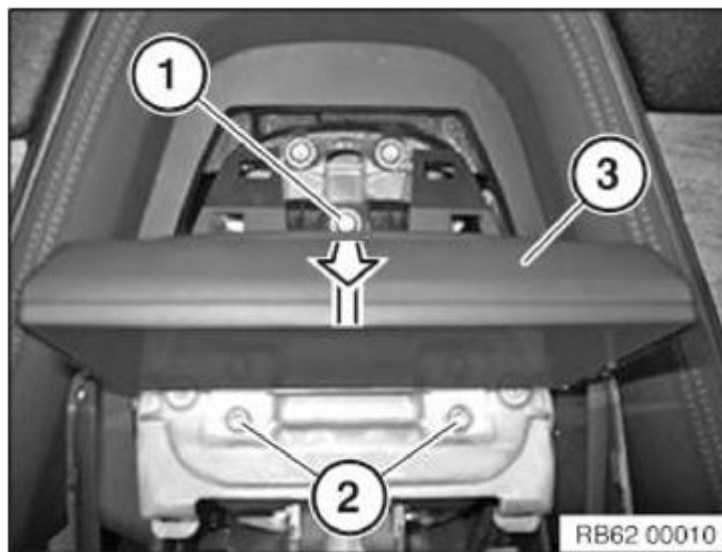
Release screw (1).

Tightening torque [62 11 1AZ](#) .

Slacken screws (2)

Tightening torque [62 11 1AZ](#) .

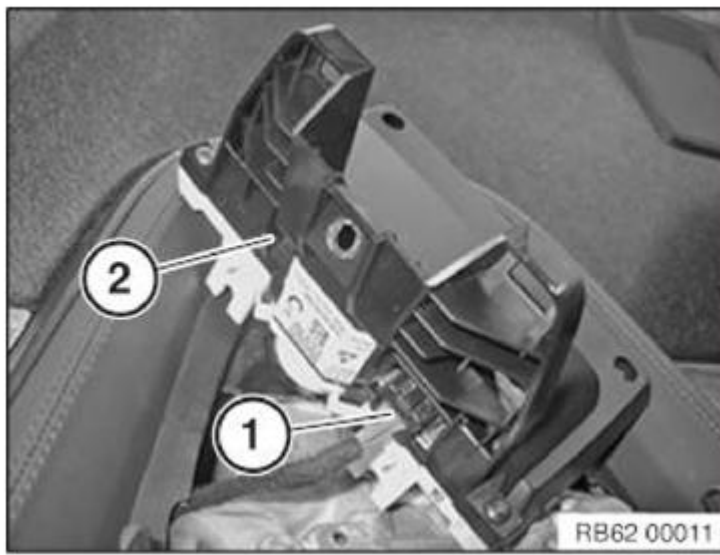
Pry out instrument panel in direction of arrow.



**Fig. 3: Prying Out Instrument Panel**

Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1) and remove instrument panel (2).



**Fig. 4: Identifying Plug Connection And Instrument Panel**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/ENCODING**.

Check values for Condition Based Service (**CBS**) and correct if necessary.

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## ACCESSORIES AND BODY, CAB

Instruments - Special Tools - All I3 Models - i3

### INSTRUMENTS

#### 621231 ADAPTER CABLE AM

**NOTE:** (V adapter cable) for clock spring and airbag unit; for Rolls-Royce this cable only; available as part of set of special tools 62 1 230 = 83 30 0 493 030 only - as of 30.11.2011

#### Storage Location

O 201

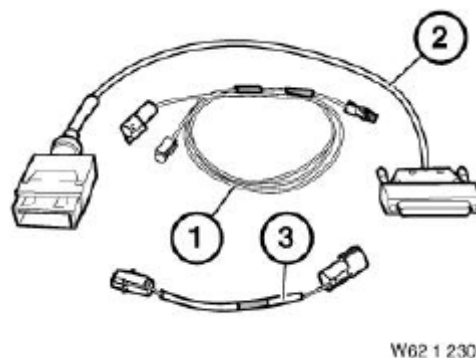
#### 621233 ADAPTER CABLE AM

**NOTE:** For igniter - driver's airbag up to model year 94 - available as part of set of special tools 62 1 230 = 83 30 0 493 030 only - as of 30.11.2011

#### Storage Location

O 203

#### 621239 OPERATING INSTRUCTIONS AM



**Fig. 1: Identifying Operating Instructions (621239)**

Courtesy of BMW OF NORTH AMERICA, INC.

#### 621232 TEST CABLE AM

**NOTE:** For MRS/airbag control unit - basic gas generator/central gas generator available as part of set of special tools 62 1 230 = 83 30 0 493 030 only - as of 30.11.2011

#### Storage Location

N205

D113

#### 621230 TEST CABLE AM

**NOTE:** (Test cable set) For airbag for checking, troubleshooting and ignition - model year: up to 94

## Storage Location

Individual

## SI number

02 02 94 (807)

Consisting of:

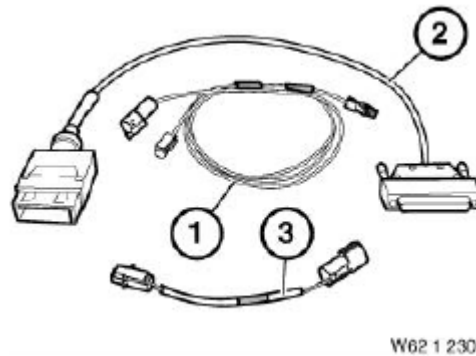
1 = 0493031 Adapter cable

**NOTE:** (V adapter cable) for clock spring and airbag unit; for Rolls-Royce this cable only; available as part of set of special tools 62 1 230 = 83 30 0 493 030 only - as of 30.11.2011

2 = 0493032 Test cable

**NOTE:** For MRS/airbag control unit - basic gas generator/central gas generator available as part of set of special tools 62 1 230 = 83 30 0 493 030 only - as of 30.11.2011

3 = 0493033 Adapter cable



**Fig. 2: Identifying Test Cable (621230)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** For igniter - driver's airbag up to model year 94 - available as part of set of special tools 62 1 230 = 83 30 0 493 030 only - as of 30.11.2011

9 = 0493034 Operating instructions

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## ACCESSORIES AND BODY, CAB

### Instruments - Tightening Torques - All I3 Models - i3

## INSTRUMENT CLUSTER

### 62 11 INSTRUMENT CLUSTER I 01, I 12

#### TIGHTENING TORQUE SPECIFICATION - INSTRUMENT CLUSTER I 01, I 12

Â	Type	Thread	Tightening specifications	Dimension
1AZ Instrument cluster to carrier support	I 01	Â	Â	6.8 Nm
	I 12	Â	Â	2.4 Nm

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## **HEADLIGHT ADJUSTMENT**

### **63 10 004 ADJUSTING HEADLIGHTS**

Comply with [TEST PREREQUISITES](#) for headlight adjustment.

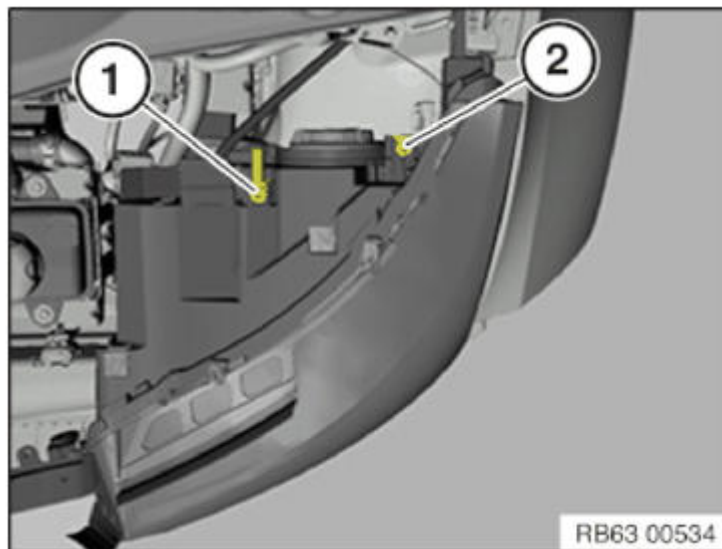
**IMPORTANT:** Do not damage adjusting screws when adjusting headlights.

Carry out headlight adjustment at adjusting screws (1) and (2).

1. Adjusting screw primarily for vertical adjustment
2. Adjusting screw primarily for lateral adjustment

#### **After headlight adjustment:**

Perform reference run. For this purpose, switch off and on the headlights. Check again headlight adjustment.



**Fig. 1: Identifying Headlight Adjustment Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **63 10 034 ADJUSTING HIGH-BEAM HEADLIGHT**

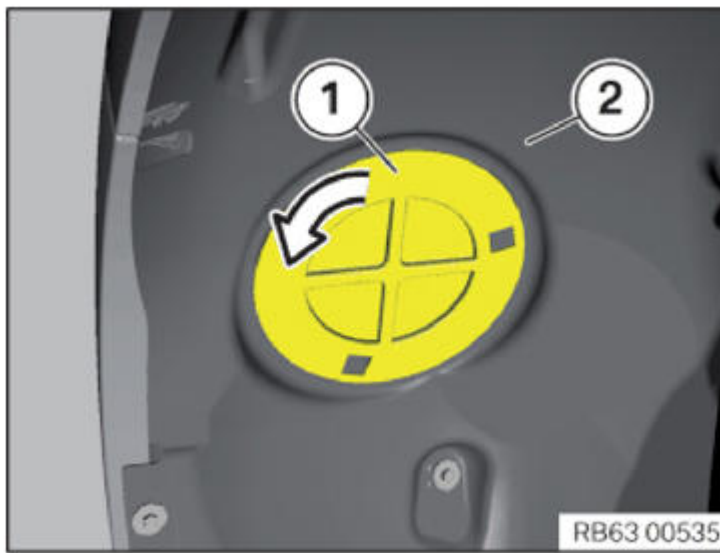
Observe [TEST PREREQUISITES FOR ADJUSTING HEADLIGHTS](#).

**IMPORTANT:** Do not damage adjusting screws when adjusting headlights.

#### **Left side:**

Turn cover (1) in direction of arrow and remove from wheel arch panel (2).



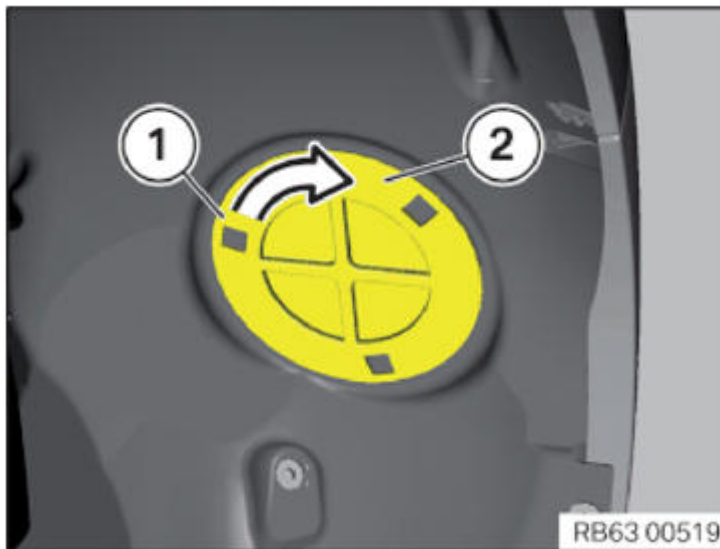


**Fig. 2: Turning Cover (Left Side)**

Courtesy of BMW OF NORTH AMERICA, INC.

**Right side:**

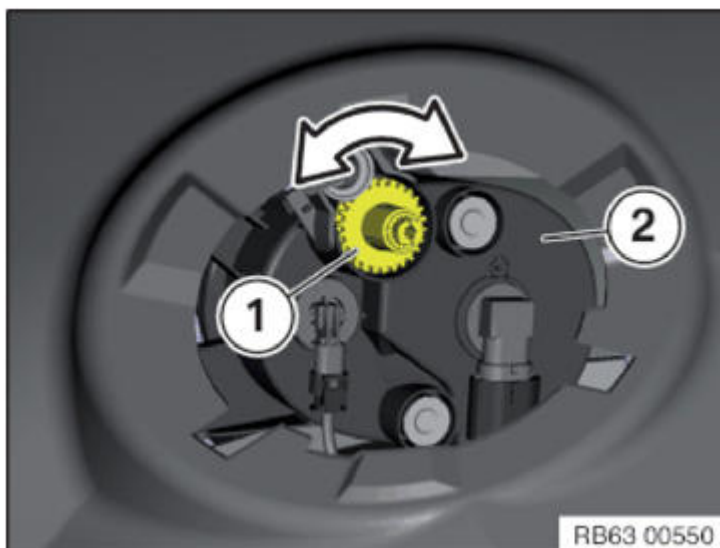
Turn cover (1) in direction of arrow and remove from wheel arch panel (2).



**Fig. 3: Turning Cover (Right Side)**

Courtesy of BMW OF NORTH AMERICA, INC.

Perform headlight adjustment at adjusting screw (1).



### **63 10... LIGHT PATTERNS FROM DIFFERENT LOW-BEAM HEADLIGHT TYPES**

The following equipment-specific and model-specific headlight types are used in BMW Group vehicles:

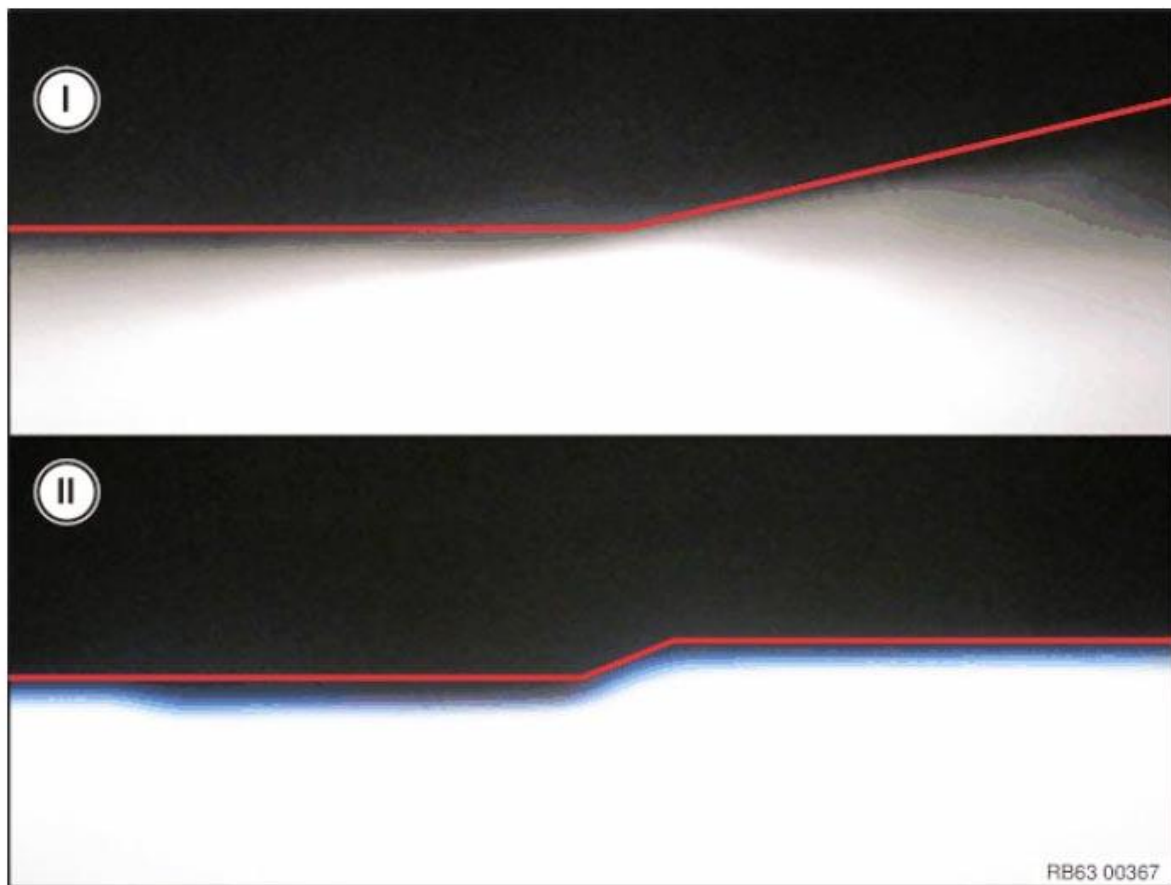
- Halogen headlights (low-beam and high-beam headlights)
- Xenon headlights (low-beam and high-beam headlights)
- LED headlights (low-beam and high-beam headlights)
- Laser headlights (high-beam headlight booster, low-beam and high-beam headlights are lit by LEDs)

Every headlight type has its specific transparent screen for the low-beam headlight. In spite of these differences, all headlight types meet statutory specifications.

The images below show transparent screens from the left headlight in the low-beam headlight switch position projected onto a wall (**no automatic setting!** ).

The transparent screens from the right headlight are the same.

The transparent screens correspond with those in an accumulator box of a headlight adjusting device.



**Fig. 5: Display - Headlight Transparent Screens**  
Courtesy of BMW OF NORTH AMERICA, INC.

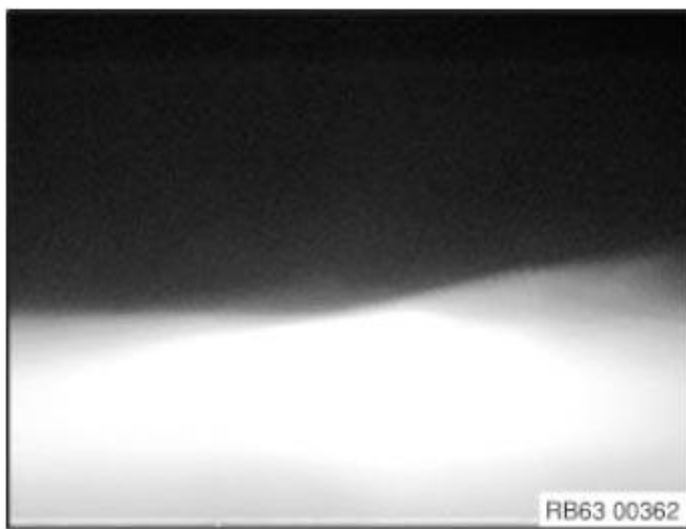
**IMPORTANT:** For headlight adjustment with electronic headlight adjusting devices, it is essential to determine the light pattern type!

**Type I:** Light pattern shows a continuous increase in the light/dark boundary.

**Type II:** Light pattern screen shows a short increase in the light/dark boundary.

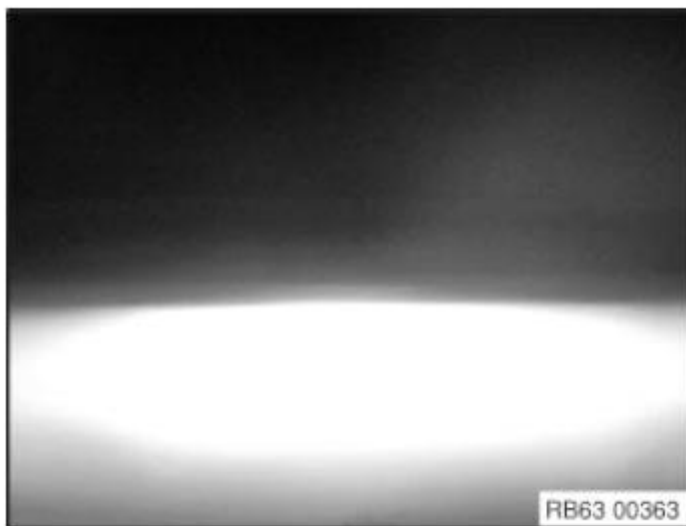
1. Halogen headlight

#### **Type I**



**Fig. 6: Display - Halogen Headlight Screen (Type 1)**  
Courtesy of BMW OF NORTH AMERICA, INC.

2. Halogen headlight US version R60 only



**Fig. 7: Display - Halogen Headlight Screen (US Version R60 Only)**  
Courtesy of BMW OF NORTH AMERICA, INC.

3. Xenon headlights

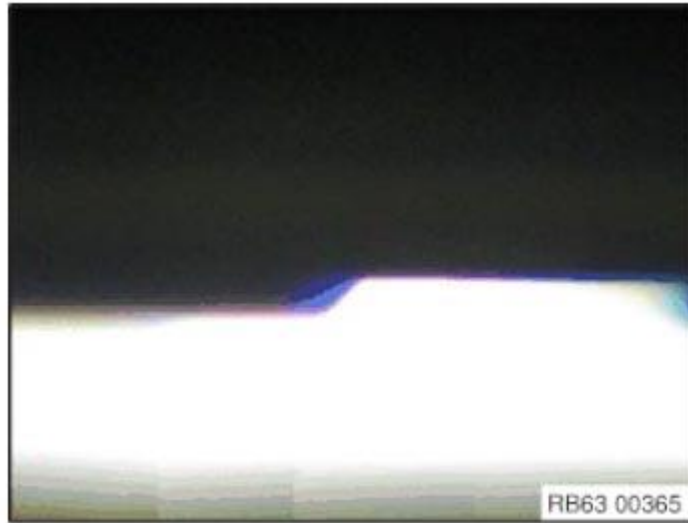
**Type II**



**Fig. 8: Display - Xenon Headlights Screen (Type II)**  
Courtesy of BMW OF NORTH AMERICA, INC.

4. LED headlight e.g. F01, F02, F03

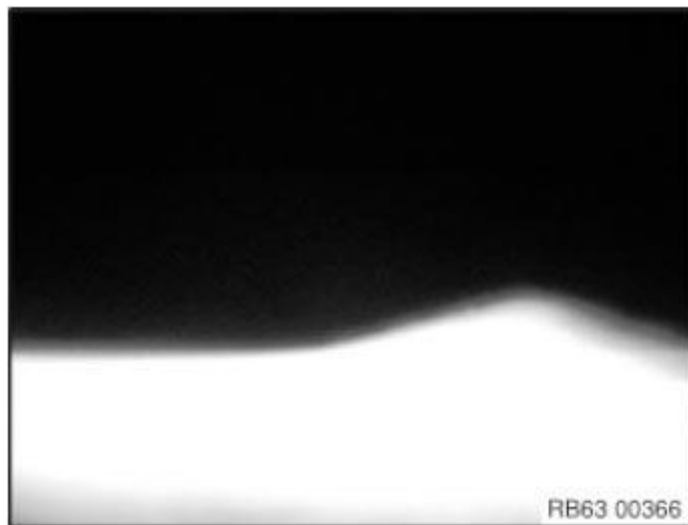
**Type II**



**Fig. 9: Display - LED Headlight Screen (F01, F02, F03)**  
Courtesy of BMW OF NORTH AMERICA, INC.

5. LED headlight e.g. F06, F12, F13, E71

**Type I**



**Fig. 10: Display - LED Headlight Screen (F06, F12, F13, E71)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**63 10... NOTES ON HEADLIGHT ADJUSTMENT (OVERVIEW OF ADJUSTMENT OPTIONS OF THE LIGHTING FUNCTIONS)**

The following light-related components are used in BMW Group vehicles on an equipment-specific and model-specific basis:

*Headlight types:*

- Halogen headlights (low-beam and high-beam headlights)
- Xenon headlights (low-beam and high-beam headlights)
- LED headlights (low-beam and high-beam headlights)
- Laser headlights (high-beam booster)

**Headlight:**

- Headlight (low beam and high beam; cornering light, daytime driving lights, adaptive headlight, laser high-beam booster, dynamic marker light)
- High-beam headlight\*
- Fog light (fog light, cornering light)
- Headlight dynamic marker light (dynamic marker light, no fog light)

**Light functions:**

Lighting function	Setting possible	Setting tool
Low-beam headlights	Yes	<ul style="list-style-type: none"> <li>• Non-electronic headlight adjusting device</li> <li>• Electronic headlight adjusting device</li> </ul>
High-beam headlight	No, Adjusted with the low-beam headlight <sup>(1)</sup> .	Â
Automatic high beam (main-beam assistant)	No, Adjusted with the low-beam headlight <sup>(1)</sup> .	Â
Non-dazzle high beam headlight	Yes, Adjusted with the low-beam headlight	<ul style="list-style-type: none"> <li>• Non-electronic headlight adjusting device</li> <li>• Electronic headlight adjusting device</li> </ul>
	Yes (with test module)	Adjustment aid for headlight
Additional laser headlight	No, Adjusted with the low-beam headlight	Â
Adaptive Headlight	No, Adjusted with the low-beam headlight	Â
Fog lights	Yes	<ul style="list-style-type: none"> <li>• Non-electronic headlight adjusting device</li> <li>• Electronic headlight adjusting device</li> </ul>
Dynamic marker light (to F-series)	Yes (with the test module)	<ul style="list-style-type: none"> <li>• Non-electronic headlight adjusting device</li> <li>• Electronic headlight adjusting device</li> </ul> Adjustment aid for headlight
Dynamic marker light (from G-series)	No, Adjusted with the low-beam headlight	Â
Cornering light	No	Â
Daytime driving lights	No	Â
(1) A setting is only possible for models with a separate housing for the high beam (E52, I01, MINI additional headlight).		

**IMPORTANT:** All lighting functions specified above can be adjusted **both with a non-electronic as well as with an electronic headlight adjusting device.**

## **63 10... TEST REQUIREMENTS FOR HEADLIGHTS VERTICAL AIM ADJUSTMENT**

**IMPORTANT:** Do not perform headlight adjustment immediately after lowering the vehicle on the vehicle hoist. In this case, move the vehicle for approx. 15 m on its own wheels before headlight adjustment.

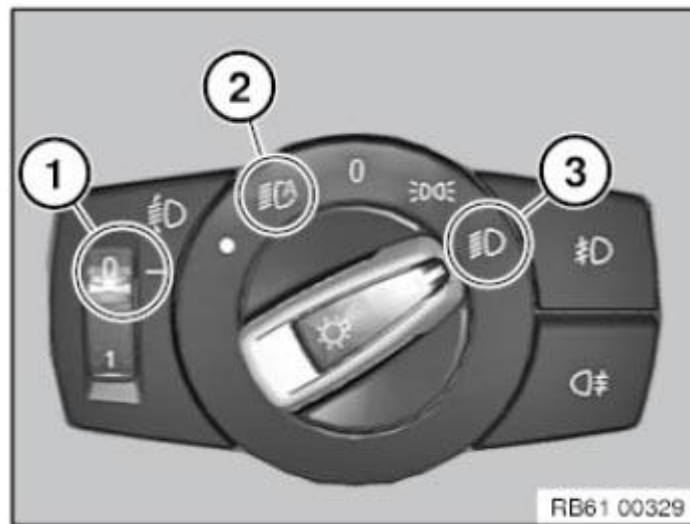
**IMPORTANT:** Refer to the manufacturer's operating instructions for the headlight adjustment device.

- Park vehicle on flat and even surface.
- Replace faulty glass and mirrors and blackened light bulbs.
- Check correct adjustment of headlights in relation to engine compartment lid (gap dimensions).
- Check tire pressure and correct if necessary.

### **Only halogen headlight, fog light and headlight for Dynamic Light Spot:**

- Apply load equivalent to one person on driver's seat (approx. 75 kg).
- Vehicle with full fuel tank or appropriate additional weight in luggage compartment.
- Switch the ignition on.
- Manual headlight beam throw adjustment: Move handwheel to neutral position (1).
- **Light switch must be in "low beam/driving light" position (3).**
- **Do not carry out the headlight adjustment in the "automatic driving lights control" light switch position (2).**
- **Version with Xenon or LED (automatic headlight beam throw adjustment):**

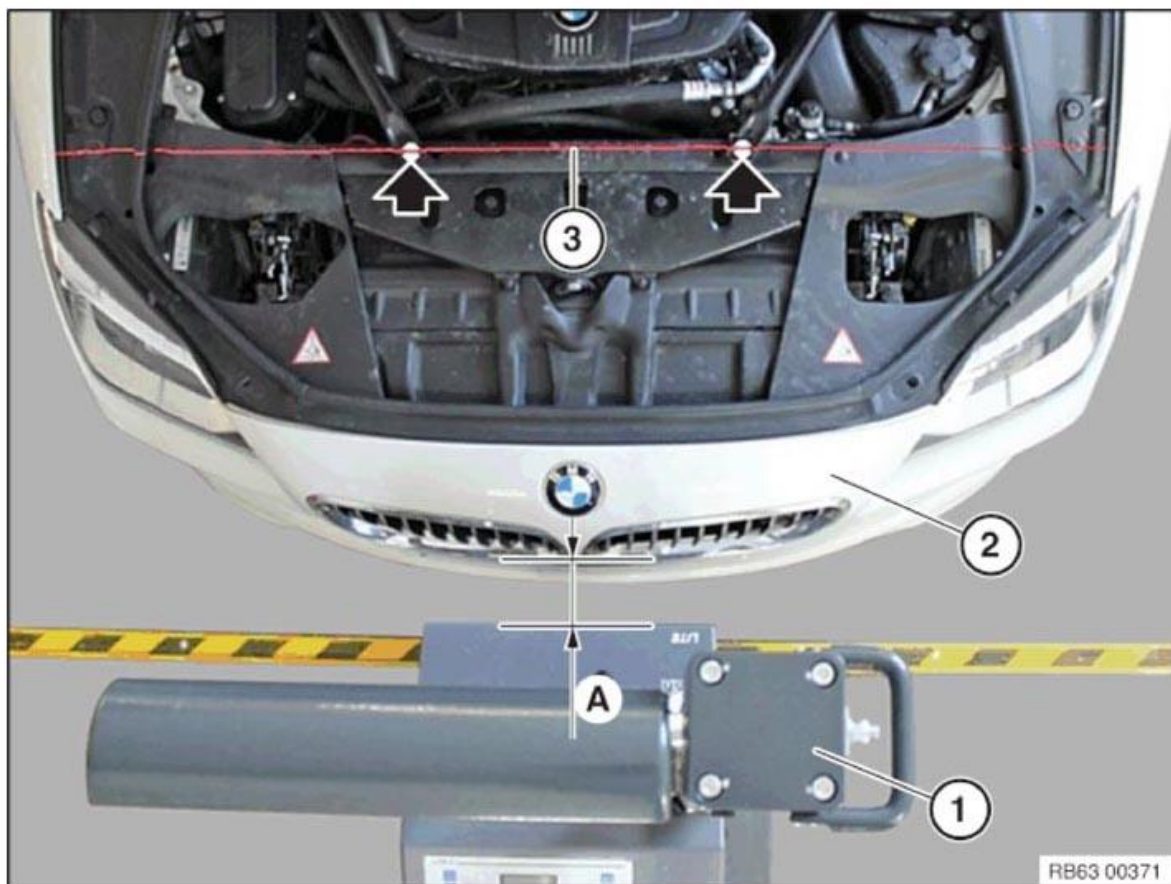
Wait 80 s after switching on lights. During this time, do not move the vehicle and avoid vibrations.



**Fig. 11: Identifying Headlight Beam Throw Adjustment Position**  
Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Do not move the vehicle and steering wheel during the measuring and adjustment procedures!  
Wheels must be in the straight-ahead position!





**Fig. 12: Checking Distance Between Vehicle And Headlight Adjustment Device**  
 Courtesy of BMW OF NORTH AMERICA, INC.

A correct measurement/adjustment requires exact positioning of the headlight adjustment device (1)!

**IMPORTANT:** Headlight adjustment device (1) must stand vertically to the vehicle longitudinal axis!  
 This applies to all headlights!

Position headlight adjustment device (1) centrally in front of vehicle (2) at distance (A) = **10 cm.**

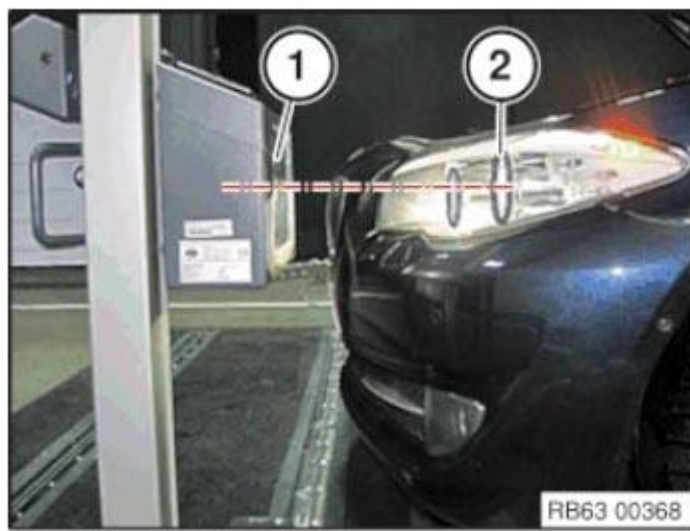
Align headlight adjustment device (1) by laser beam (3). Laser beam (3) must hit two suitable points, e.g. marked by arrows.

Points must be vehicle proof!

**IMPORTANT:** Points must be separated as wide as possible!  
 Trim panels are not suitable!

If the headlight adjustment device (1) does not have a laser beam (3), complete the alignment analogous with the line in the mirror.

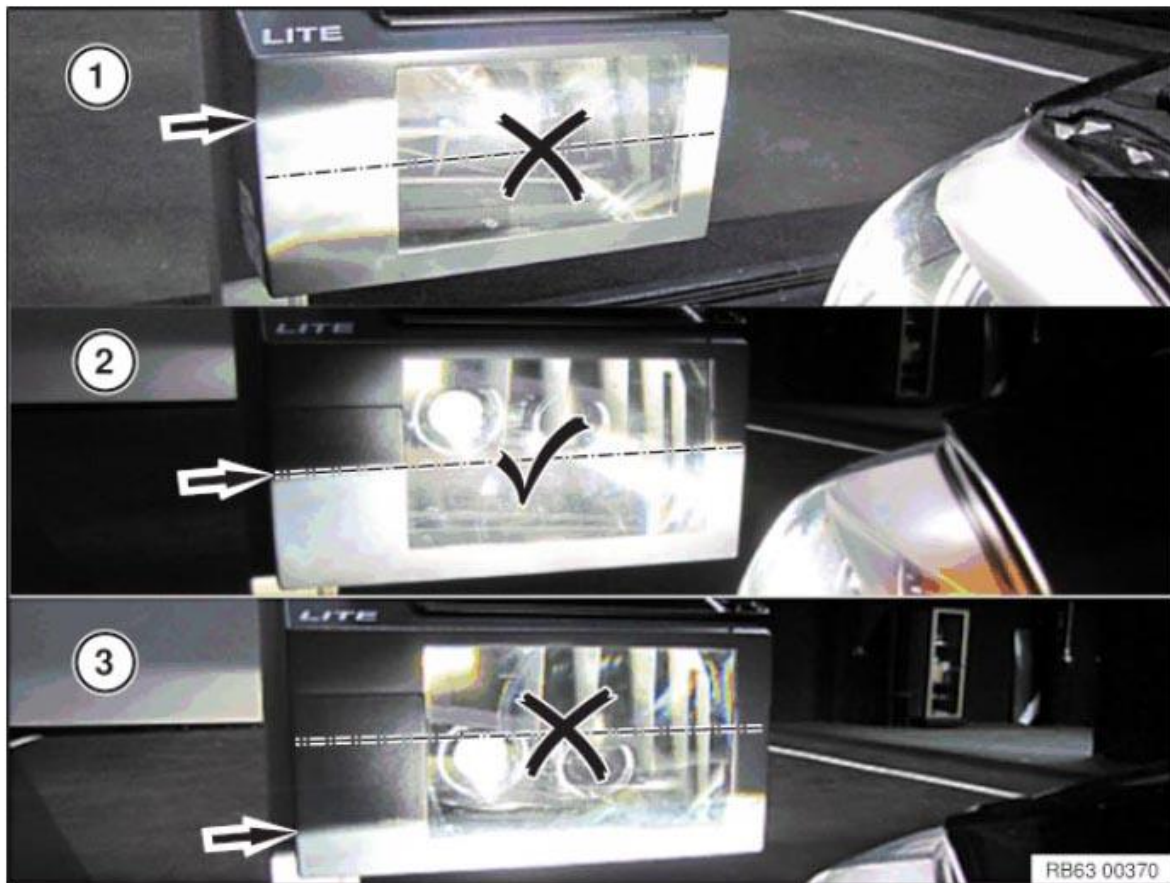
**IMPORTANT:** Always perform positioning of the headlight adjustment device (1) at the outer headlight (2).



**Fig. 13: Aligning Center Of Collecting Lens Match Of Headlight**  
 Courtesy of BMW OF NORTH AMERICA, INC.

The center of the collecting lens (1) must match the center of headlight (2) horizontally.

Corrections are made by raising or lowering the headlight adjustment device.



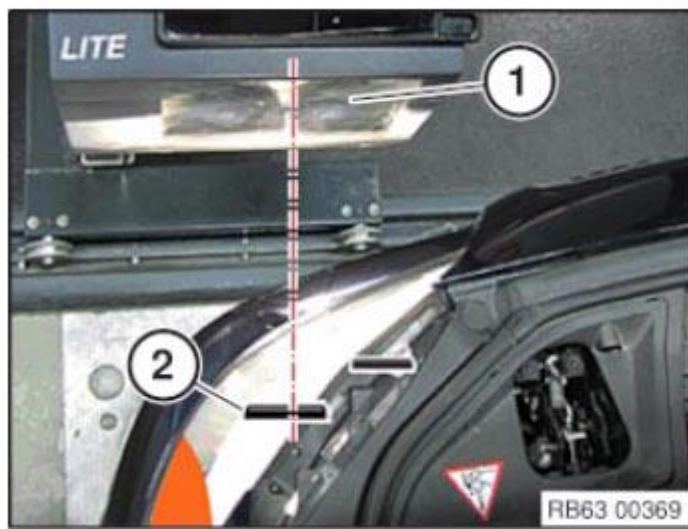
**Fig. 14: Identifying Headlight Adjusting Device Correct And Incorrect Positions**  
 Courtesy of BMW OF NORTH AMERICA, INC.

When positioned correctly, the light/dark boundary of the headlight (marked with arrow) must hit the collecting lens of the adjusting device in the center:

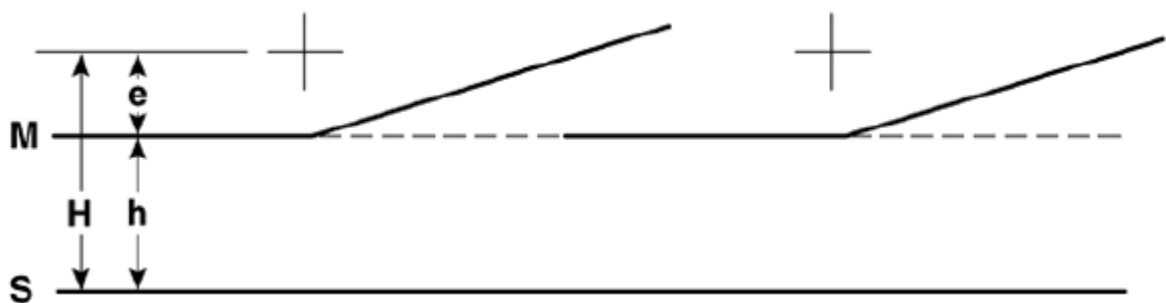
1. The headlight adjusting device is too low.
2. The headlight adjusting device is positioned correctly.
3. The headlight adjusting device is too high.

The center of the collecting lens (1) must match the center of headlight (2) vertically.

Corrections are made by sliding the side of the headlight adjusting device to the left or right.



**Fig. 15: Aligning Collecting Lens And Headlight Center (Vertical).**  
 Courtesy of BMW OF NORTH AMERICA, INC.



3063067

**Fig. 16: Identifying Headlight Adjustment Device Setting Dimension**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** The figure shows an example for the transparent screen of halogen headlights.

See [OVERVIEW OF TRANSPARENT SCREENS OF DIFFERENT HEADLIGHT TYPES](#).

Set marker line {M} on aimer to {e}. Scale graduations on the headlight adjustment device are equal to a gradient in cm at a distance of 10 meters.

#### Light/dark boundary of headlights in the headlight adjustment device

##### {e} Setting dimension, headlights:

- Value is indicated on the **headlight housing** and on vehicles with production date up to 2011 on the **type plate** in %.

(e.g.: **1.0 %** = -10 cm/10 m = - **1.0 %** on the headlight adjusting device)

- Value **1.0 %** (adjustment value - **1.0 %** ) applies to all BMW Group vehicles.
- Exception: E53, E70, E71, E72, E83, F15, F16, F25, F26, R60, R61. For these vehicles, value **1.1%** (adjustment value - **1.1%** ) applies.

##### Setting dimension, fog lights:

- Value **2.0 %** = -20 cm/10 m = - **2.0 %** on the headlight adjusting device applies to all BMW Group vehicles.

### Setting dimension, dynamic light spot headlight:

- Value **0.0 %** = 0 cm/10 m = **0 %** on the headlight adjusting device applies to all BMW Group vehicles.

{H} Height of headlight center above parking surface

{h} {H} - {e} = height of marking line above parking surface

+ Central mark = center point of high beam headlight.

{M} Marker line of the headlight adjustment device

{S} Standing surface of the vehicle and headlight adjustment device

**Adjustment dimension {e} is only valid for EUR. Observe differing national regulations.**

## **63 10... TEST REQUIREMENTS FOR HEADLIGHTS VERTICAL AIM ADJUSTMENT**

### **Attention!**

**Do not perform headlight adjustment immediately after lowering the vehicle on the vehicle hoist. In this case, move the vehicle for approx. 15 m on its own wheels before headlight adjustment.**

### **Attention!**

**Observe the operating instructions for the headlight adjusting device!**

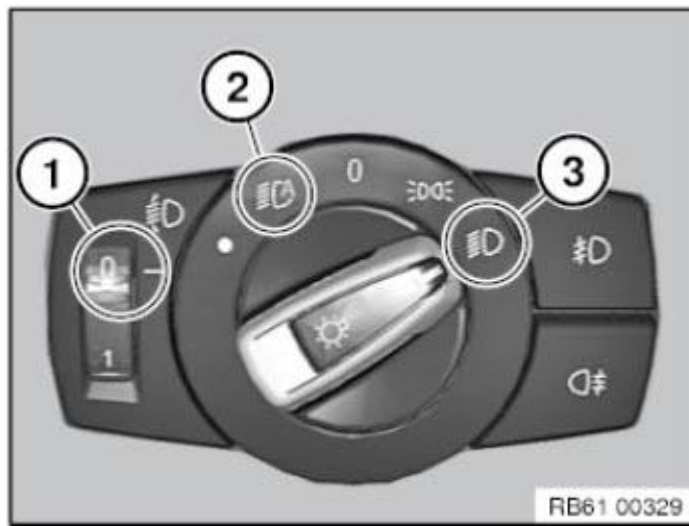
**The headlight adjustment location must meet the specifications according to ISO 10604!**

- Park vehicle on flat and even surface.
- Replace faulty glass and mirrors and blackened light bulbs.
- Check correct adjustment of headlights in relation to engine compartment lid (gap dimensions).
- Check tire pressure and correct if necessary.

### **Halogen headlights, fog lights only:**

- Apply load equivalent to one person on driver's seat (approx. 75 kg).
- Vehicle with full fuel tank or appropriate additional weight in luggage compartment.
- Switch the ignition on.
- Manual headlight beam throw adjustment: Move handwheel to neutral position (1).
- **Light switch must be in "low beam/driving light" position (3).**
- **Do not carry out the headlight adjustment in the "automatic driving lights control" light switch position (2).**
- **Equipment specification with Xenon or LED (automatic headlight beam throw adjustment) :** Wait 80 s after switching on lights. During this time, do not move the vehicle and avoid vibrations.



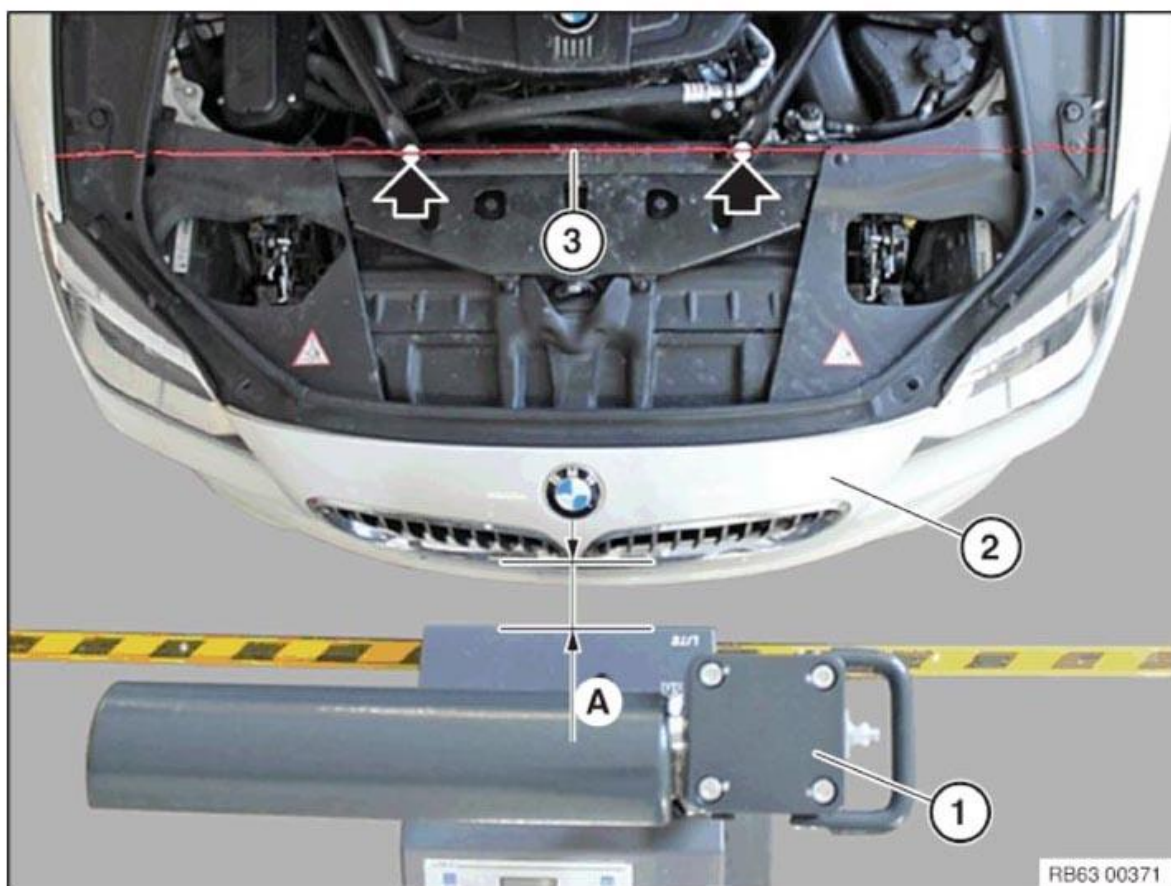


**Fig. 17: Identifying Headlight Beam Throw Adjustment Position**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

**Do not move the vehicle and steering wheel during the measuring and adjustment procedures!**

**Wheels must be in the straight-ahead position!**



**Fig. 18: Checking Distance Between Vehicle And Headlight Adjustment Device**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

**A correct measurement/adjustment requires exact positioning of the headlight adjusting device (1)!**

**The headlight adjusting device (1) must stand vertically to the vehicle longitudinal axis!**

**This applies to all headlights!**

Position the headlight adjusting device (1) centrally in front of the vehicle (2) at distance (A) = **10 cm**.

Align the headlight adjusting device (1) by laser beam (3). Laser beam (3) must hit two suitable points, e.g. marked by arrows.

**Attention!**

**Points must be vehicle proof!**

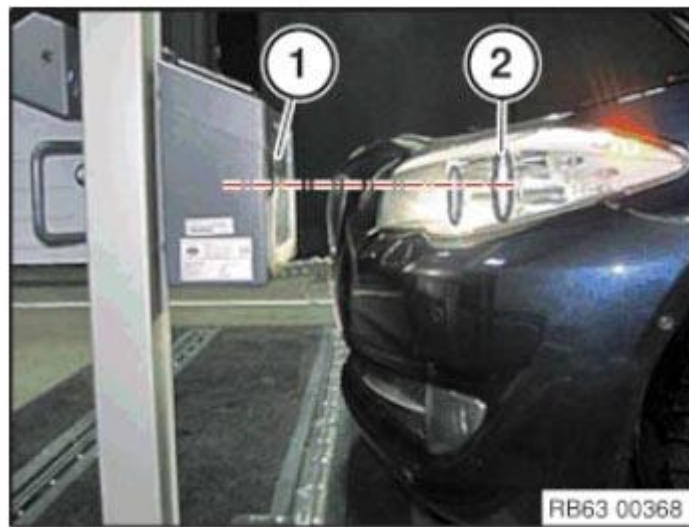
**Points must be separated as wide as possible!**

**Trim panels are not suitable!**

If the headlight adjusting device (1) does not have a laser beam (3), complete the alignment analogous with the line in the mirror.

**Attention!**

**Always perform positioning of the headlight adjusting device (1) at the outer headlight (2)!**



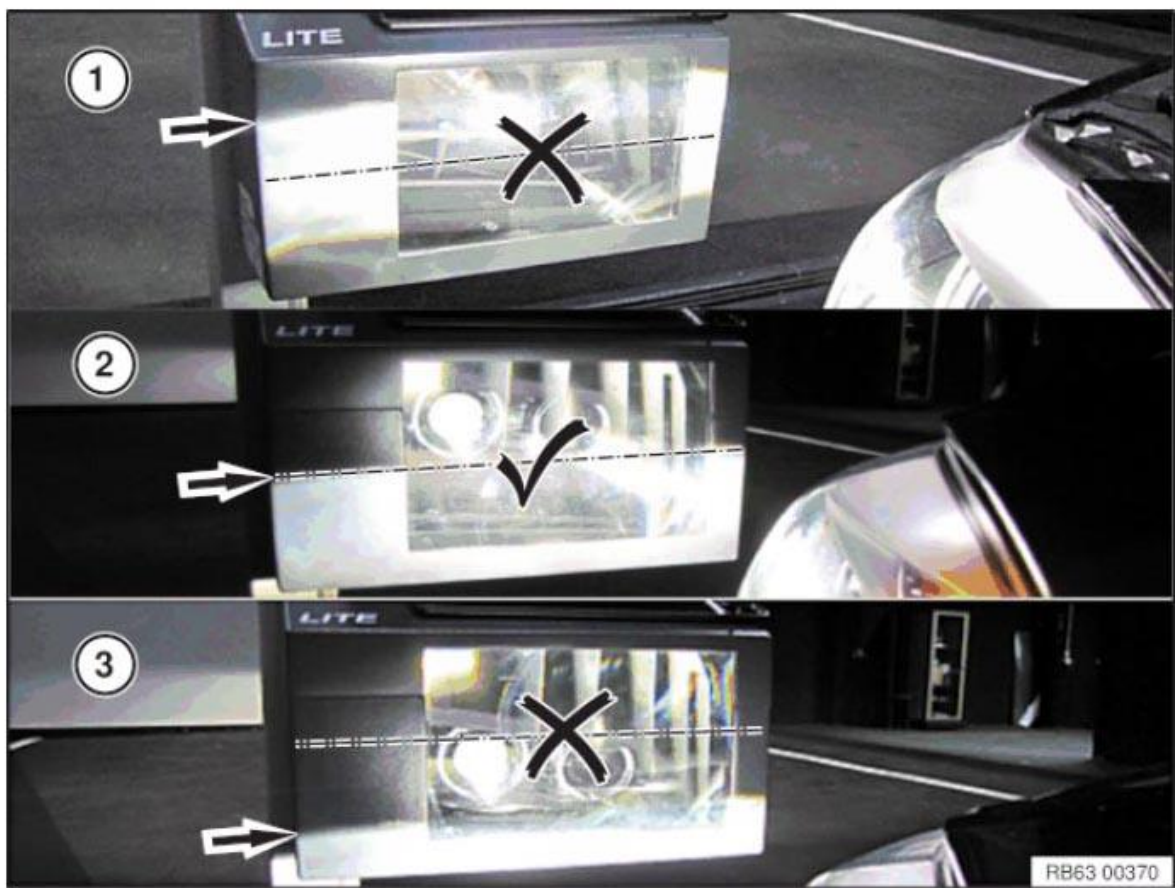
**Fig. 19: Aligning Center Of Collecting Lens Match Of Headlight**

**Courtesy of BMW OF NORTH AMERICA, INC.**

The center of the collecting lens (1) must match the center of headlight (2) horizontally.

Corrections are made by raising or lowering the headlight adjusting device.





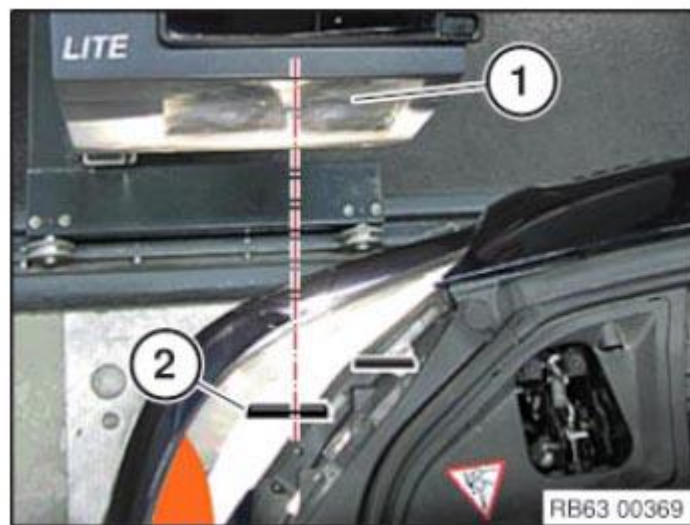
**Fig. 20: Identifying Headlight Adjusting Device Correct And Incorrect Positions**  
 Courtesy of BMW OF NORTH AMERICA, INC.

When positioned correctly, the light/dark boundary of the headlight (marked with arrow) must hit the collecting lens of the adjusting device in the center:

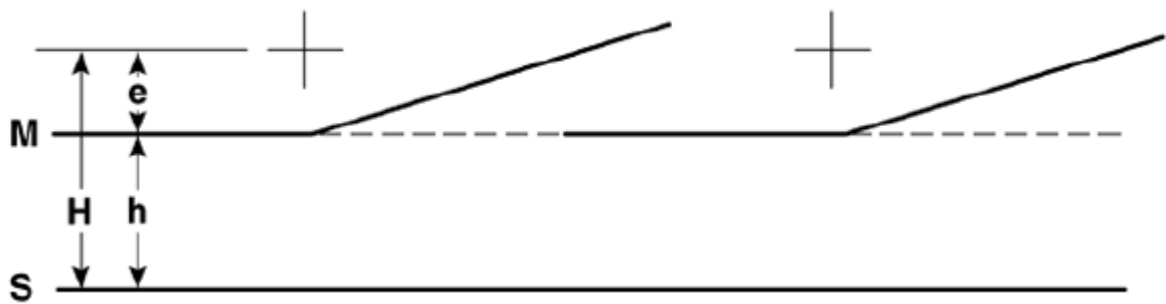
1. The headlight adjusting device is too low.
2. The headlight adjusting device is positioned correctly.
3. The headlight adjusting device is too high.

The center of the collecting lens (1) must match the center of headlight (2) vertically.

Corrections are made by sliding the side of the headlight adjusting device to the left or right.



**Fig. 21: Aligning Collecting Lens And Headlight Center (Vertical)**  
 Courtesy of BMW OF NORTH AMERICA, INC.



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**Fig. 22: Identifying Headlight Adjustment Device Setting Dimension**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** The figure shows an example for the transparent screen of halogen headlights.

See [OVERVIEW OF TRANSPARENT SCREENS OF DIFFERENT HEADLIGHT TYPES](#).

Set the marker line {M} on the headlight adjusting device to dimension {e}. Scale graduations on the headlight adjusting device are equal to a gradient in cm at a distance of 10 meters.

#### Light/dark boundary of headlights in headlight adjusting device

##### {e} Setting dimension, headlights:

- The value is indicated in % on the **headlight housing**.

(e.g.: **1.0 %** = -10 cm/10 m = - **1.0 %** on the headlight adjusting device)

##### Setting dimension, fog lights:

- **2.0 %** = -20 cm/10 m = - **2.0 %** on the headlight adjusting device.

{H} Height of headlight center above parking surface

{h} {H} - {e} = height of marking line above parking surface

+ Central mark = center point of high beam headlight.

{M} Marker line of the headlight adjusting device

{S} Standing surface of the vehicle and headlight adjusting device

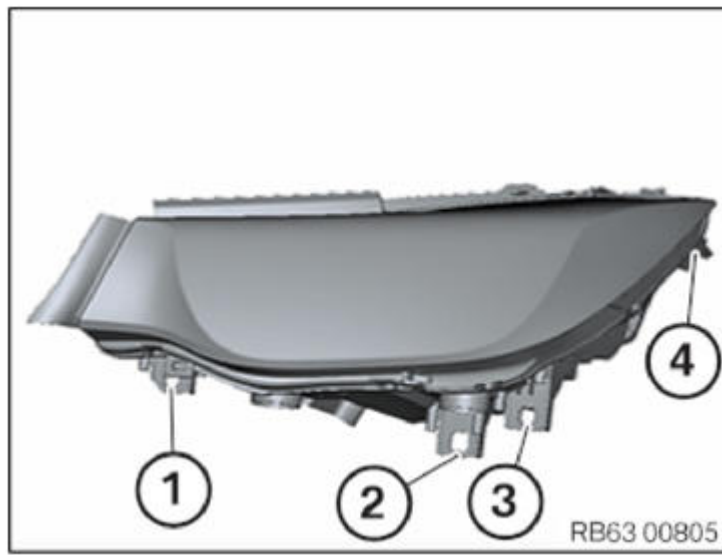
## FRONT LIGHTS

### 63 11... INSTALLING HEADLIGHT REPAIR KIT

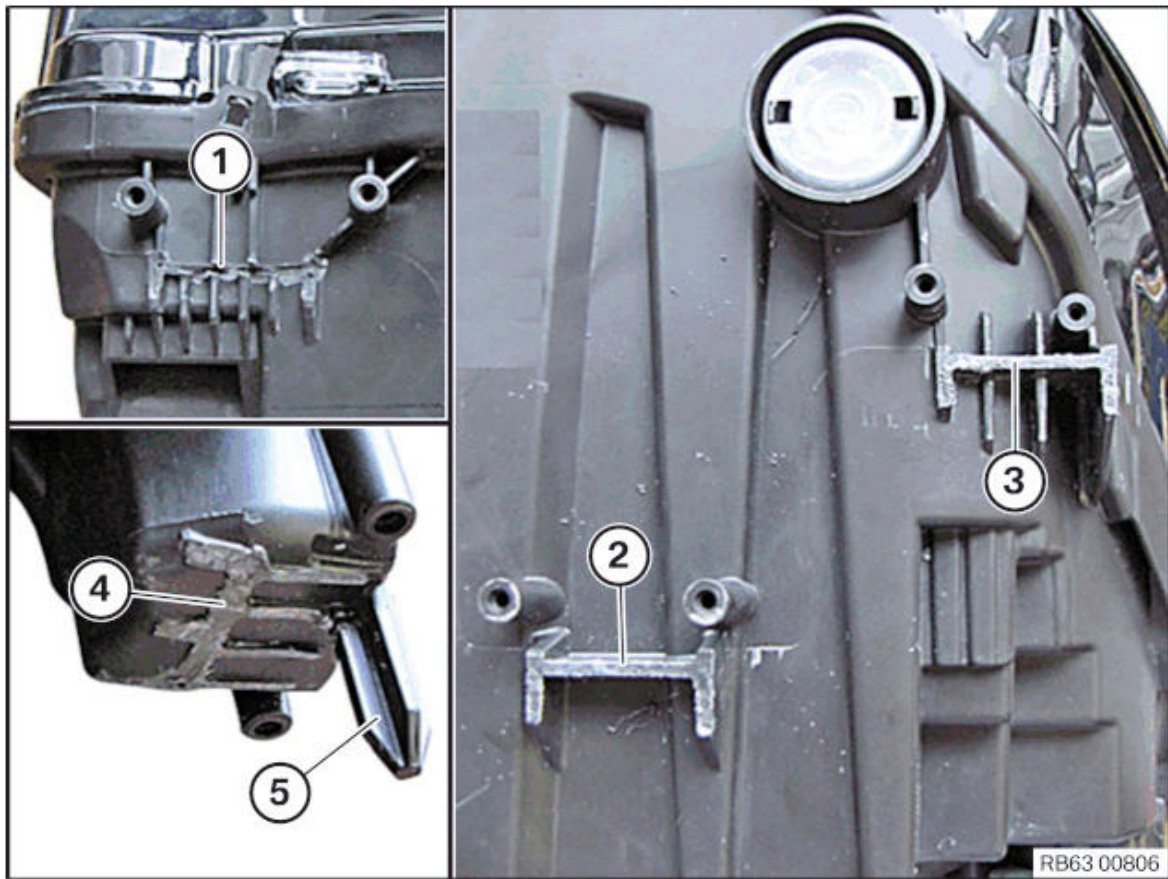
#### Necessary preliminary work:

- Remove [HEADLIGHT](#)

**NOTE:** Damaged holders (1, 2, 3, 4) can be replaced with the repair kit. Replacement of headlight is not required!



**Fig. 23: Identifying Headlight Damaged Holders**  
Courtesy of BMW OF NORTH AMERICA, INC.

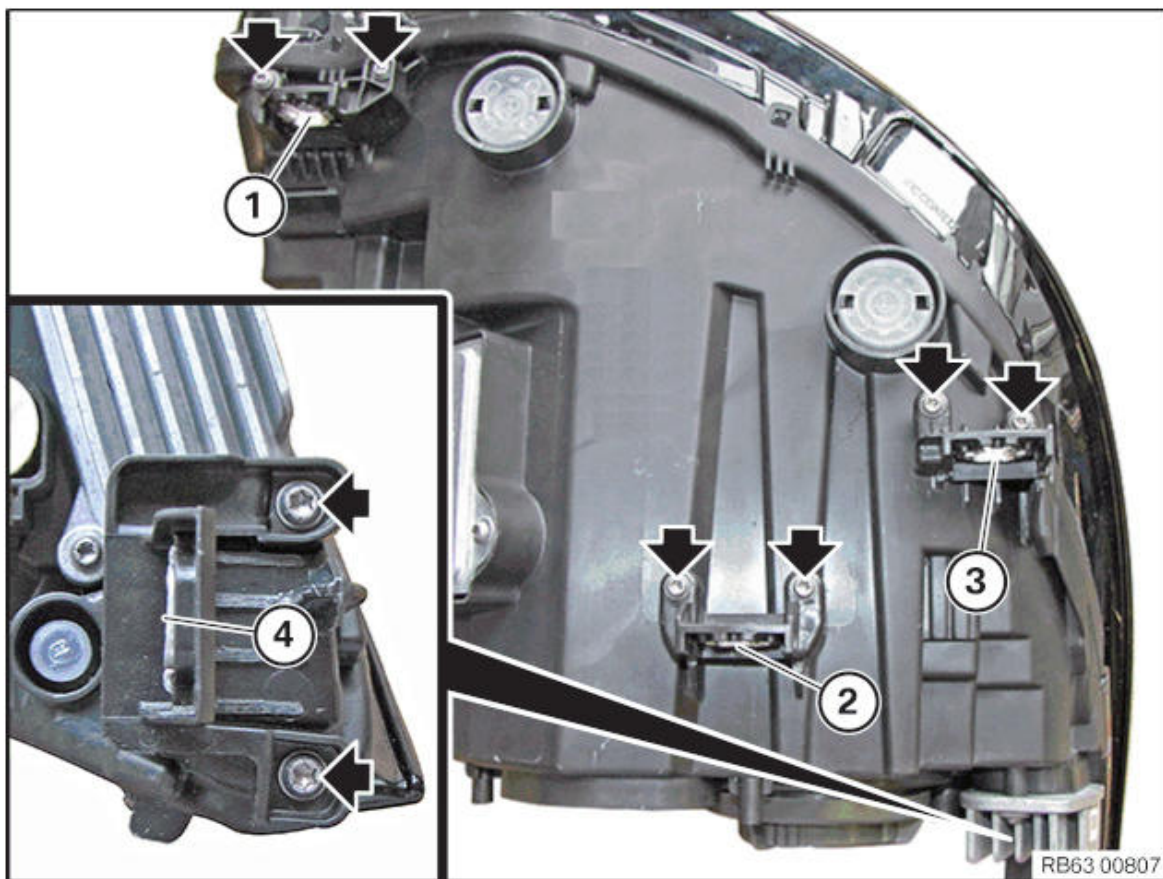


**Fig. 24: Removing Headlight Damaged Holders**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove damaged holders (1, 2, 3, 4) as shown above.

IMPORTANT: Do not damage/remove guide pin (5)!





**Fig. 25: Locating Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Mount holder from the repair kit (1, 2, 3, 4) as shown above and tighten by means of enclosed screws (see arrows).

**After the repair**

- Install **HEADLIGHT**
- Adjust headlights

**63 11 760 REPLACE FLEL CONTROL UNIT**

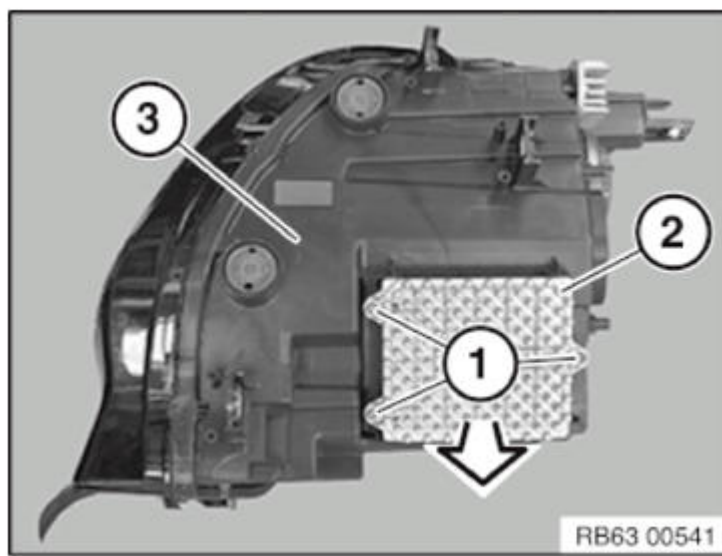
**Attention!**

Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

**Necessary preliminary tasks:**

- Remove **HEADLIGHT WITH LED TECHNOLOGY** on the left.

Release screws (1) and pull control unit of front light electronics (2) out of headlight (3).

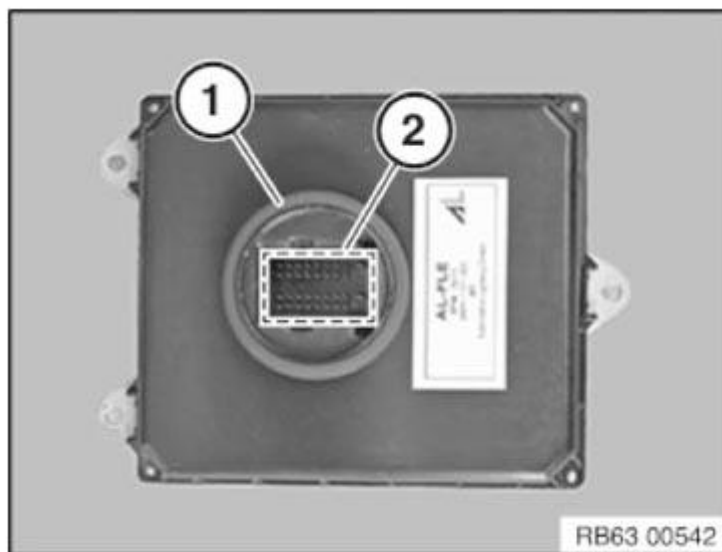


**Fig. 26: Pulling Control Unit Of Front Light Electronics**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Gasket (1) on control unit of front light electronics must not be damaged and must be installed free from grease.

Plug-in contacts (2) on control unit of front light electronics must not be damaged or missing.



**Fig. 27: Identifying Front Light Electronics Control Unit Gasket**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING** .

**63 11 741 REPLACE LEFT DAYTIME DRIVING LIGHTS CONTROL UNIT**

**Attention!**

Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

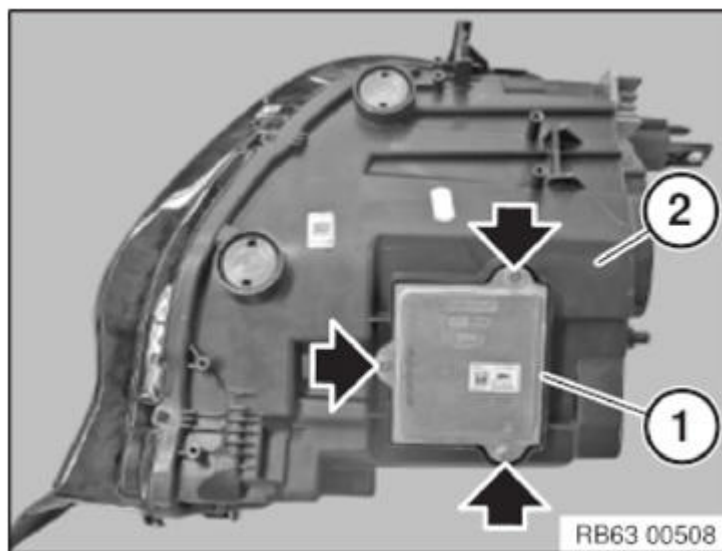
**Necessary preliminary tasks:**

- Remove left **HEADLIGHT**

Release screws and pull daytime driving lights control unit (1) out of headlight (2).

Unlock plug connection behind and disconnect.

Remove daytime driving lights control unit (1).



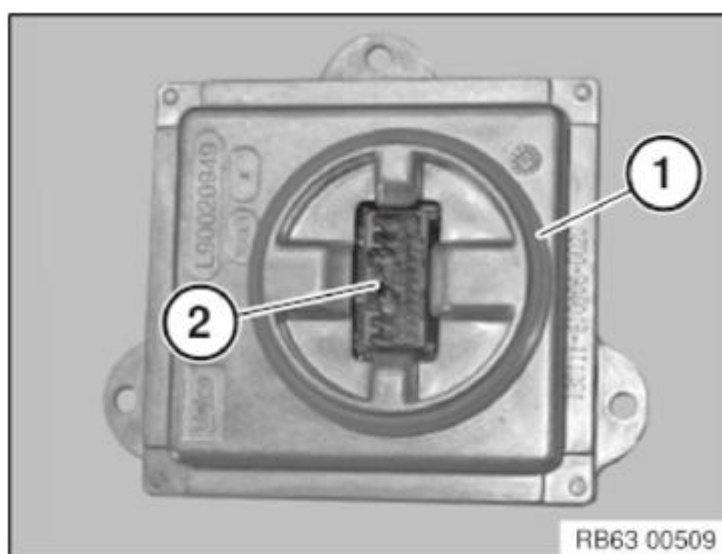
**Fig. 28: Locating Daytime Driving Lights Control Unit Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Gasket (1) on daytime driving lights control unit must not be damaged and must be installed free from grease.

Plug-in contacts (2) on daytime driving lights control unit must not be damaged or missing.



**Fig. 29: Identifying Gasket On Daytime Driving Lights Control Unit**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING** .

**63 11 731 REPLACING LED MODULE FOR DAYTIME DRIVING LIGHTS (ICONS), LEFT**

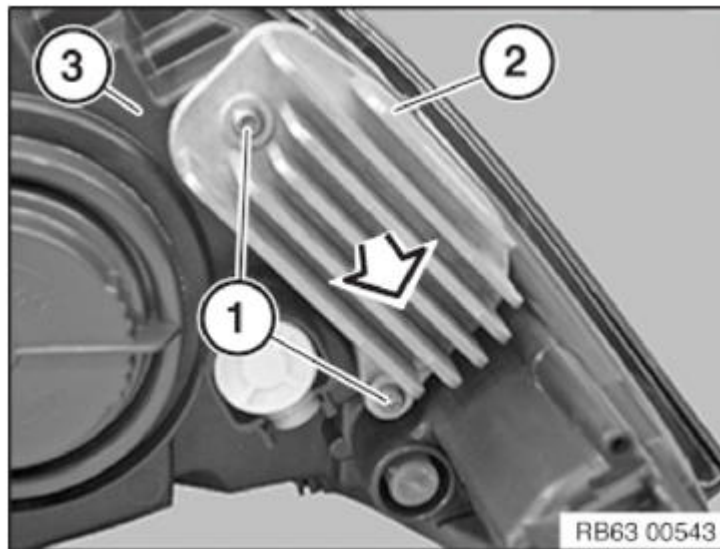
**Attention!**

Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

**NOTE:** Headlight is shown removed for purposes of clarity.



Release screws (1) and pull LED daytime running light module (2) from headlight (3).



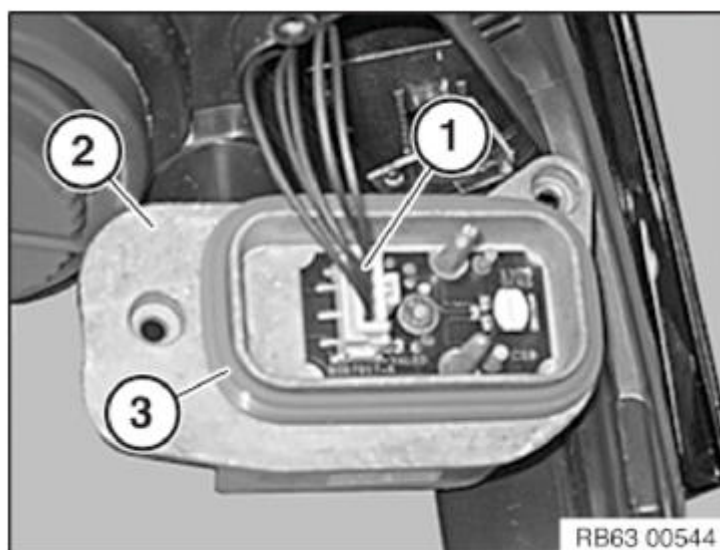
**Fig. 30: Pulling LED Daytime Running Light Module From Headlight**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

Remove LED daytime running light module (2).

*Installation note:*

Gasket (3) on LED daytime running light module (2) must not be damaged and must be installed free from grease.



**Fig. 31: Identifying LED Daytime Running Light Module And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING** .

## **HEADLIGHTS**

### **63 12... HEADLIGHT FOGGING FAULT PATTERN**

**NOTE:** Certain weather conditions can lead to fogging on the inside of the headlight lens.  
This is not necessarily a fault that requires replacement of the headlight.



**Fig. 32: Identifying Headlight Fogging Fault Pattern**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Top row (A): Permissible fogging. **Headlight does not need to be replaced.**

Bottom row (B): Impermissible fogging. Replace the headlight.

### **63 12 003 REMOVING AND INSTALLING (REPLACING) LEFT/RIGHT HEADLIGHT**

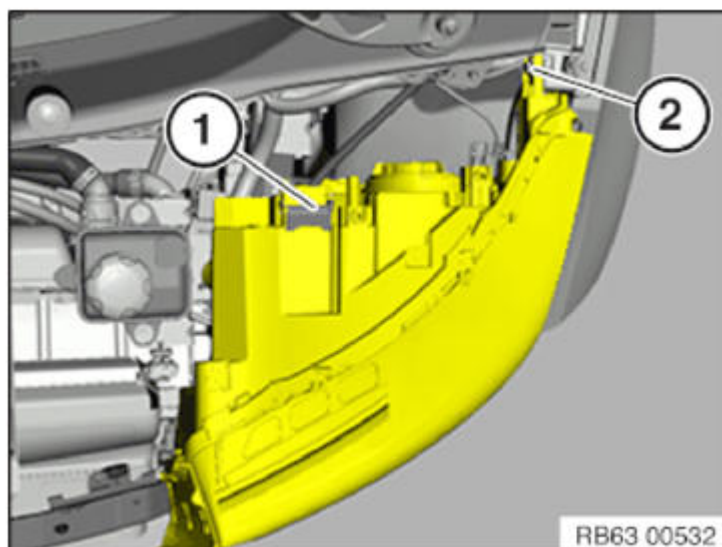
**Necessary preliminary tasks:**

- Remove **FRONT BUMPER PANEL**

Unfasten plug connection (1) and disconnect.

Release screw (2).

Tightening torque **63 12 2AZ** .



**Fig. 33: Identifying Left Headlight And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

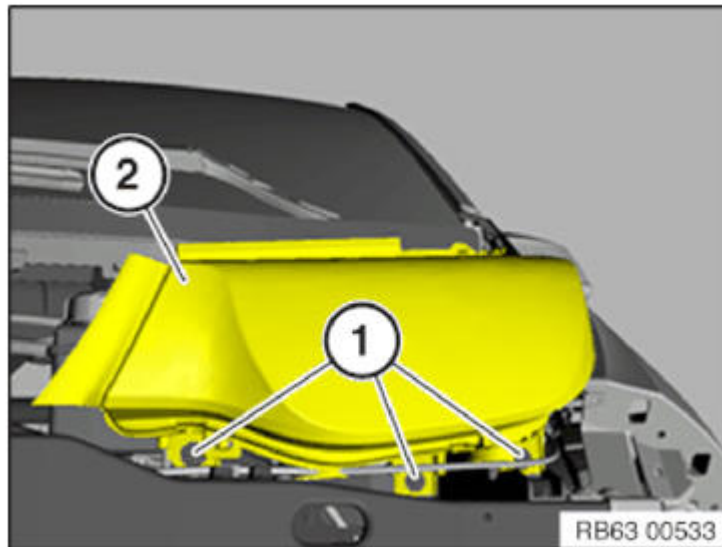
Release screws (1).

Tightening torque **63 12 1AZ** .

Carefully remove headlight (2).

*Installation note:*

**ADJUST HEADLIGHT.**



**Fig. 34: Identifying Headlight And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**63 12 140 REMOVING AND INSTALLING (REPLACING) LEFT/RIGHT HEADLIGHT - LED TECHNOLOGY -**

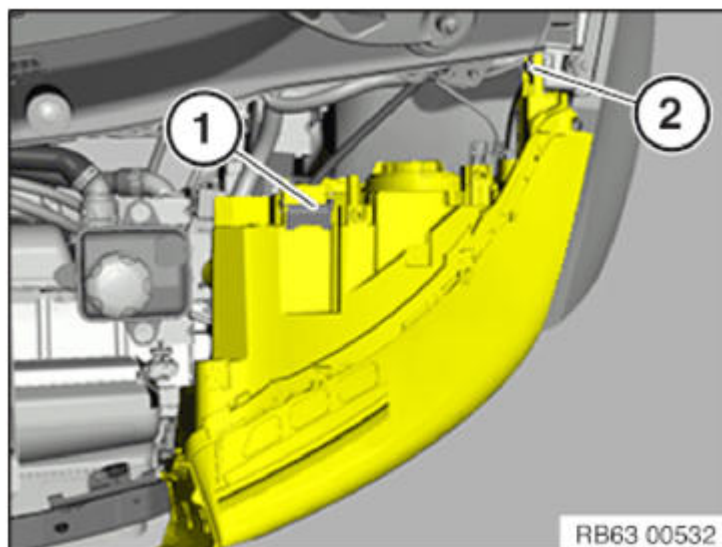
**Necessary preliminary tasks:**

- Remove **FRONT BUMPER PANEL**

Unfasten plug connection (1) and disconnect.

Release screw (2).

Tightening torque **63 12 2AZ** .



**Fig. 35: Identifying Left Headlight And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

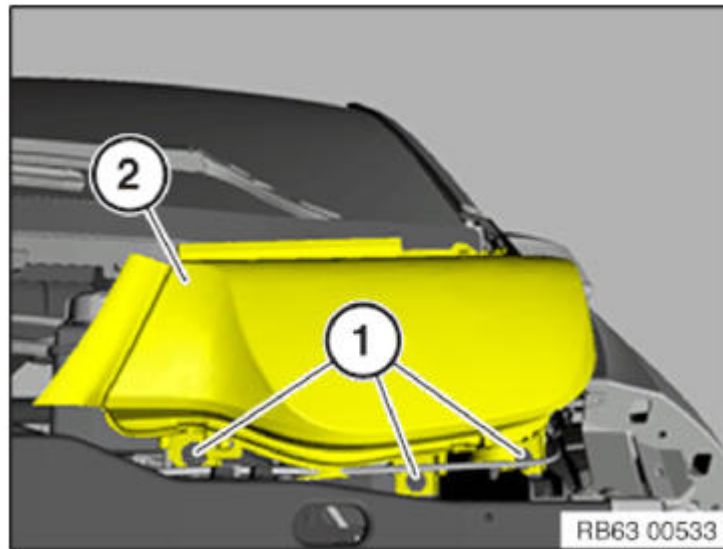
Release screws (1).

Tightening torque **63 12 1AZ** .

Carefully remove headlight (2).

*Installation note:*

**ADJUST HEADLIGHT.**



**Fig. 36: Identifying Headlight And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

- Remount **FRONT LIGHT ELECTRONICS CONTROL UNIT**
- Remount **DAYTIME DRIVING LIGHTS LED MODULE (ICON)**

### **63 12... REPAIRING HEADLIGHTS**

**It is possible to repair the following damage:**

- Deformed or broken holders can be replaced using the available repair kits.

Replacement of headlight is **not required!**

For reasons of pedestrian safety it is **not permitted** to use adhesive or reinforcements to repair broken holders!

**NOTE:**      **Headlight repair kits are not available for every vehicles.  
Follow the vehicle-specific repair instructions.**

**It is not possible to repair the following damage:**

- Deformed or broken headlight housing.
- Scratched or damaged headlight lenses

The standard coating of headlight lens cannot be restored. Commercially available repair systems are unable to provide sufficient protection from ultraviolet radiation and external influences (stone chipping).

## **TURN SIGNAL INDICATOR LIGHTS**

## 63 13 250 REMOVING AND INSTALLING/REPLACING FRONT LEFT OR RIGHT SIDE REPEATER MIRROR

### Necessary preliminary tasks:

- Remove [HOUSING ON DOOR MIRROR](#)

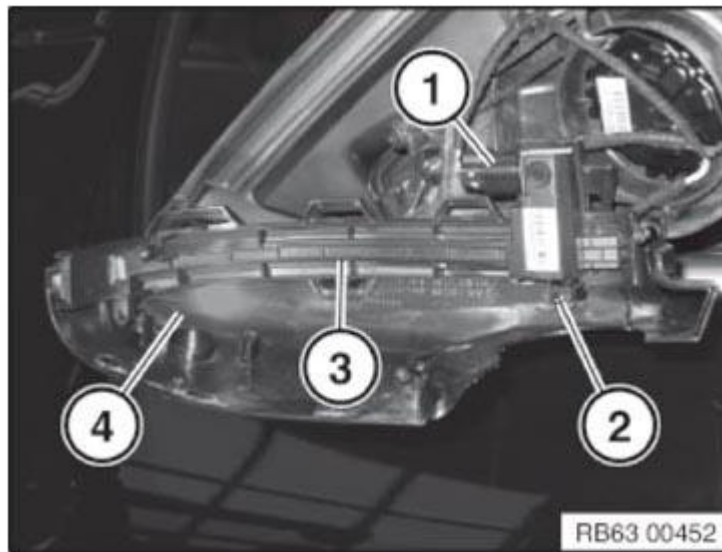
If necessary, unlock plug connection (1) and disconnect.

Release screw (2).

Remove side repeater (3) from exterior mirror housing (4).

### Installation note:

Make sure side repeater (3) is correctly seated on exterior mirror housing (4).



**Fig. 37: Identifying Side Repeater Turn Indicator On Exterior Mirror Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

## CLEARANCE AND SIDE MARKER LAMPS

### 63 14 070 REMOVING AND INSTALLING/REPLACING REAR LEFT OR RIGHT SIDE MARKER

#### Special tools required:

- [00 9 325](#)

#### Necessary preliminary tasks:

- Partially remove [WHEEL ARCH COVER AT REAR](#)

**NOTE:** Minimum object temperature of side marker and bumper panel  $\geq 18 \text{ }^{\circ}\text{C}$ .  
If this temperature is not achieved, the components must be preheated.

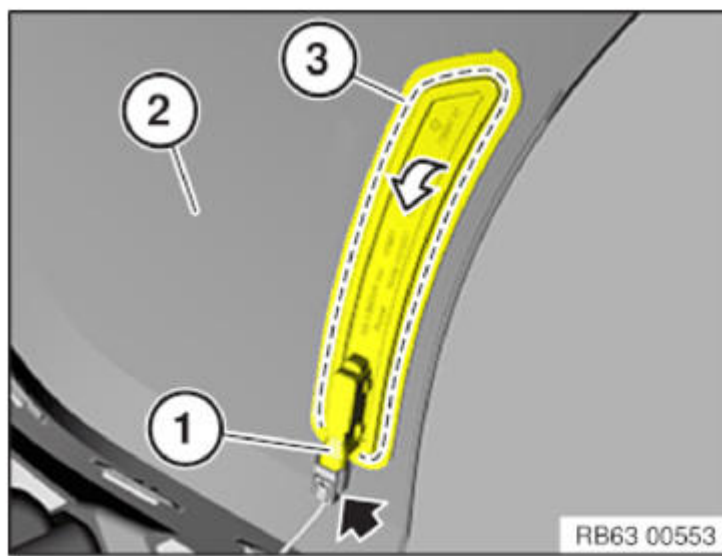
#### Remove side marker:

Unfasten plug connection and disconnect.

Carefully preheat side marker (1) in area (3) using hot air blower and use special tool [00 9 325](#) to release it from the bumper panel (2).

**NOTE:** The side marker (1) cannot be used again.





**Fig. 38: Removing Side Marker**

Courtesy of BMW OF NORTH AMERICA, INC.

**Clean bumper panel:**

To clean use a lint-free disposable cloth or a clean cleaning cloth.

Clean bonding surface of bumper panel using spirits.

Air drying time at least 1 minute.

Do not grip bonding surface.

**Install side marker:**

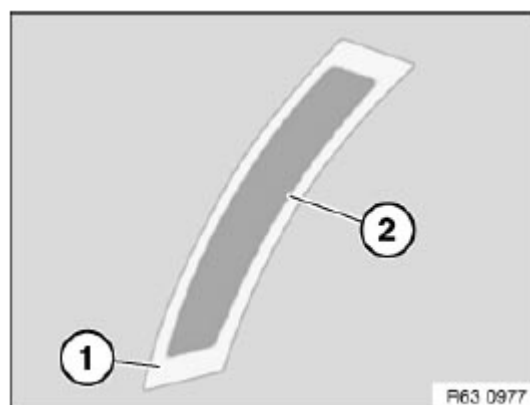
Release liner\* (1) and lightly press side marker (2) to bumper panel.

Check position and realign, if necessary.

The minimum contact pressure is achieved by firmly pressing your thumbs or the balls of your hands over the entire joining area (holding time approx 1 second).

Firm thumb pressure approx.  $35 \text{ N/cm}^2$ .

\* Liner is protective film at new side marker.



**Fig. 39: Identifying Bumper Panel Side Marker And Liner**

Courtesy of BMW OF NORTH AMERICA, INC.

**63 14 060 REMOVING AND INSTALLING/REPLACING THE FRONT LEFT OR RIGHT SIDE MARKER**

**Special tools required:**



- [00 9 325](#)

### Necessary preliminary tasks:

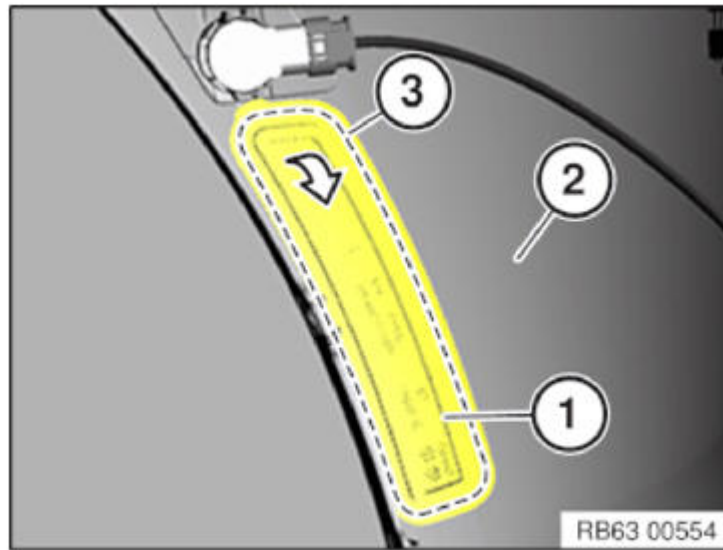
- Partially remove **FRONT WHEEL ARCH COVER** (front section)

**NOTE:** Minimum object temperature of side marker and bumper panel  $\geq 18 \text{ }^{\circ}\text{C}$ .  
If this temperature is not achieved, the components must be preheated.

### Remove side marker:

Carefully preheat side marker (1) in area (3) using hot air blower and use special tool [00 9 325](#) to release it from the bumper panel (2).

**NOTE:** The side marker (1) cannot be used again.



**Fig. 40: Removing Side Marker**

Courtesy of BMW OF NORTH AMERICA, INC.

### Clean bumper panel:

To clean use a lint-free disposable cloth or a clean cleaning cloth.

Clean bonding surface of bumper panel using spirits.

Air drying time at least 1 minute.

Do not grip bonding surface.

### Install side marker:

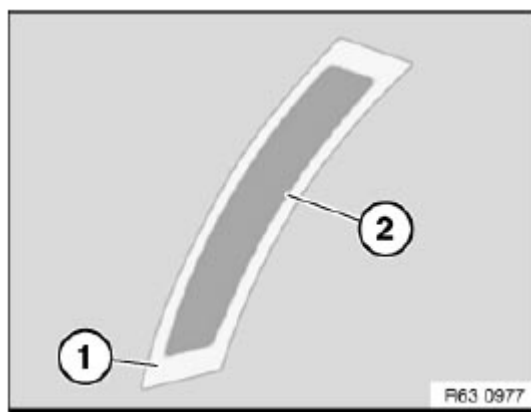
Release liner\* (1) and lightly press side marker (2) to bumper panel.

Check position and realign, if necessary.

The minimum contact pressure is achieved by firmly pressing your thumbs or the balls of your hands over the entire joining area (holding time approx 1 second).

Firm thumb pressure approx.  $35 \text{ N/cm}^2$ .

\* Liner is protective film at new side marker.



**Fig. 41: Identifying Bumper Panel Side Marker And Liner**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## FOG LIGHTS, AUXILIARY LIGHTS

### 63 17 092 REMOVING AND INSTALLING/REPLACING LEFT/RIGHT HIGH-BEAM HEADLIGHT

Necessary preliminary tasks:

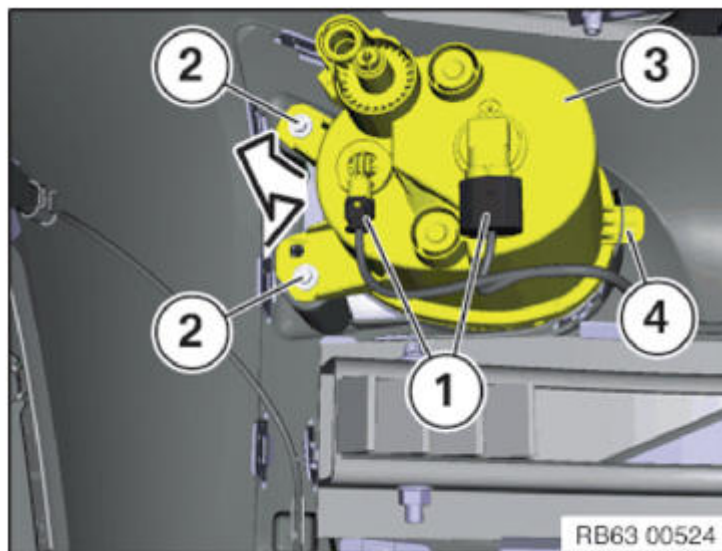
- Partially detach **FRONT WHEEL ARCH PANEL**

Disconnect plug connection (1; 2).

Release screws (3) and feed out high-beam headlight (4).

Replacement:

- If necessary, remount **BULB**.

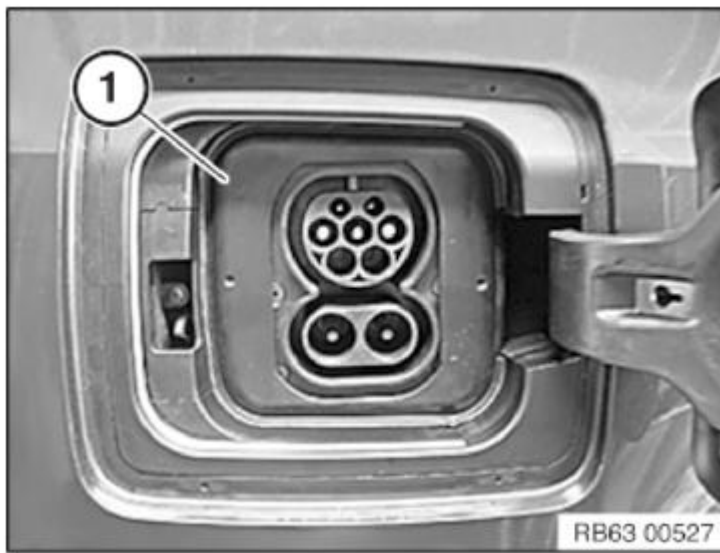


**Fig. 42: Disconnecting Plug Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## REAR LIGHT CLUSTER

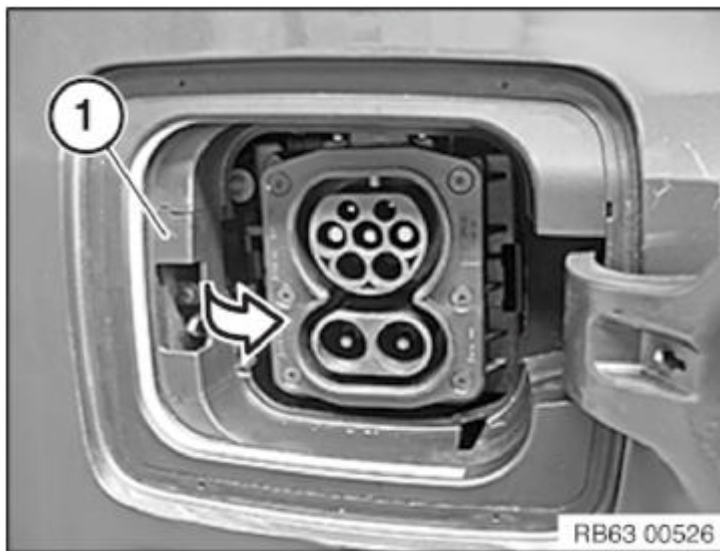
### 63 21... REMOVING AND INSTALLING/REPLACING CHARGING SOCKET LIGHT UNIT

Remove trim (1) at charging plug.



**Fig. 43: Identifying Trim Charging Plug**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip cover (1) and swivel to the side.



**Fig. 44: Removing Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip charging socket light unit (1) in a counter clockwise direction, beginning at position (A).

Remove charging socket light unit (1) and unlock and disconnect the corresponding plug connection.



## **63 21 260 REMOVING AND INSTALLING/REPLACING LEFT/RIGHT REAR LIGHT (BUMPER PANEL)**

### **Necessary preliminary tasks:**

- Remove **COVER ON REAR BUMPER PANEL**

Unlock associated plug connection and disconnect.

Release screws (1).

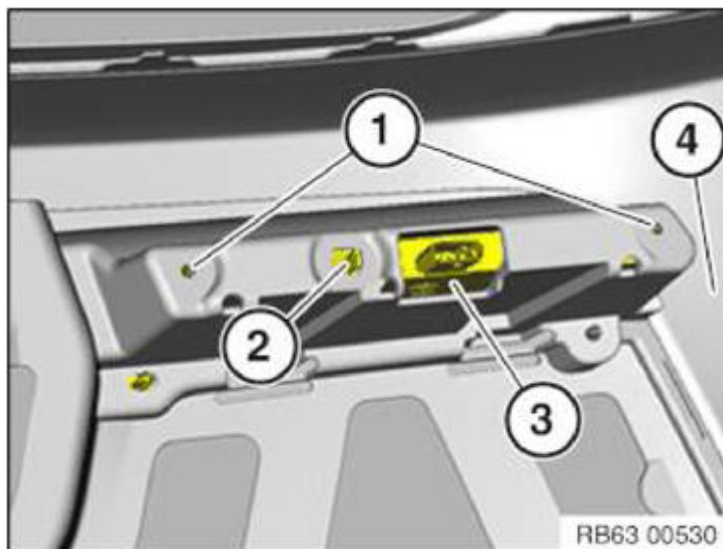
Tightening torque **63 21 1AZ** .

Release latch mechanism (2) and remove rear light (3) from bumper panel (4) towards the rear.

### *Installation note:*

Make sure rear light (3) is correctly seated on bumper panel (4).

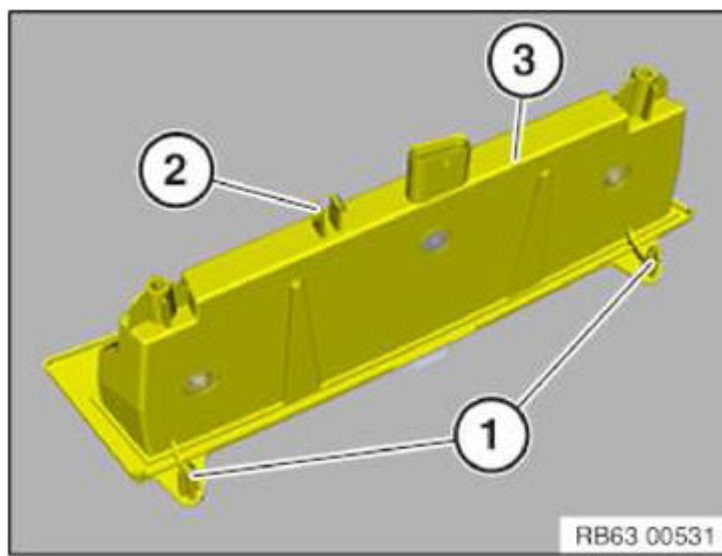
Ensure correct locking of plug connection on rear light (3).



**Fig. 46: Identifying Rear Light, Bumper Panel And Latch Mechanism**  
Courtesy of BMW OF NORTH AMERICA, INC.

### *Installation note:*

Guides (1) and latch mechanism (2) on rear light (3) must not be damaged or missing.



**Fig. 47: Identifying Guides And Latch Mechanism On Rear Light**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**63 21 800 REMOVING AND INSTALLING/REPLACING LEFT REAR LIGHT PRINTED CIRCUIT BOARD**

**Attention!**

Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

**Necessary preliminary tasks:**

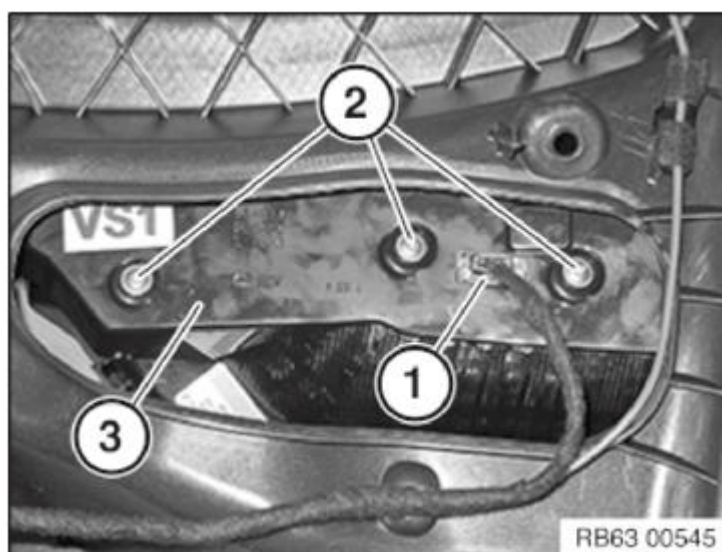
- Remove the bottom **TRIM FOR THE REAR LID**

Unfasten plug connection (1) and disconnect.

Unfasten screws (2).

Tightening torque **63 21 1AZ** .

Feed out rear light cover (3).

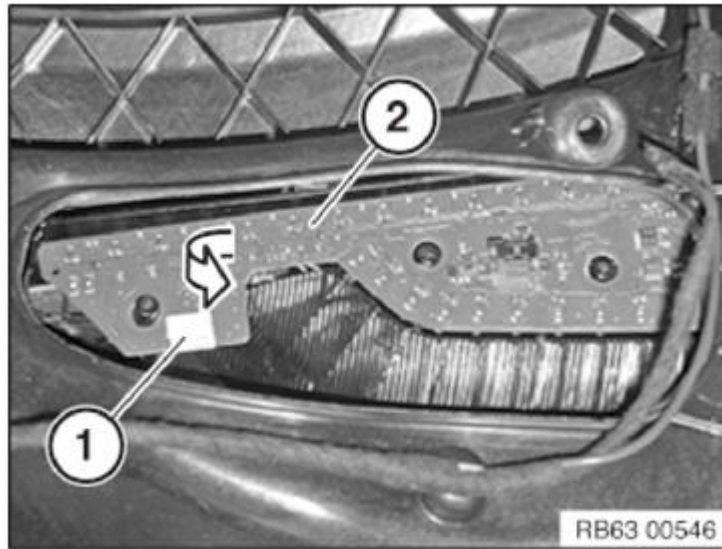


**Fig. 48: Identifying Rear Light Cover And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1) and feed out rear light printed circuit board (2).

*Installation note:*

Make sure printed circuit board of rear light (2) is correctly seated.



**Fig. 49: Disconnecting Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **BRAKE LIGHTS**

### **63 25 003 REMOVING AND INSTALLING/REPLACING ADDITIONAL BRAKE LIGHT**

Necessary preliminary tasks:

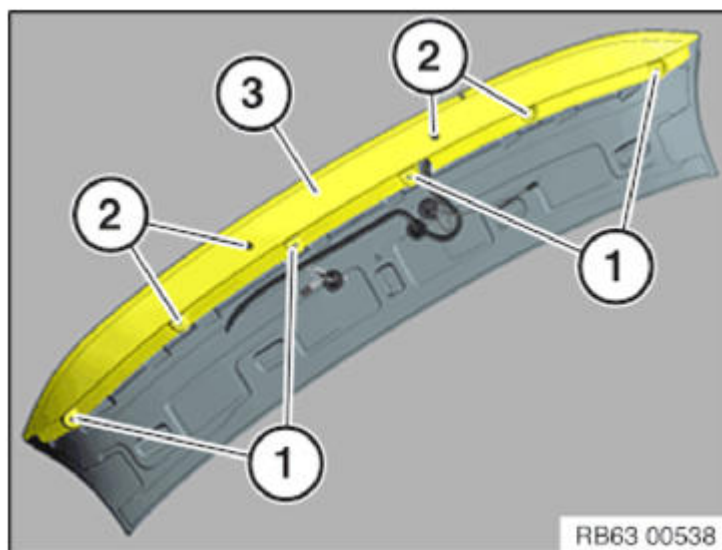
- Remove **REAR SPOILER**

Release expanding rivet (1).

Unfasten screws (2).

Tightening torque **63 25 1AZ** .

Remove trim (3) from rear spoiler.



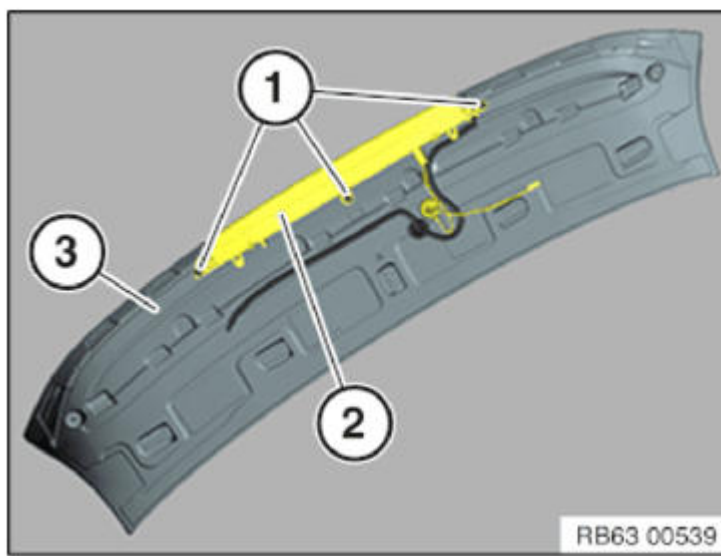
**Fig. 50: Identifying Expanding Rivet And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque **63 25 1AZ** .

Remove additional brake light (2) from rear spoiler (3).





**Fig. 51: Identifying Additional Brake Light And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

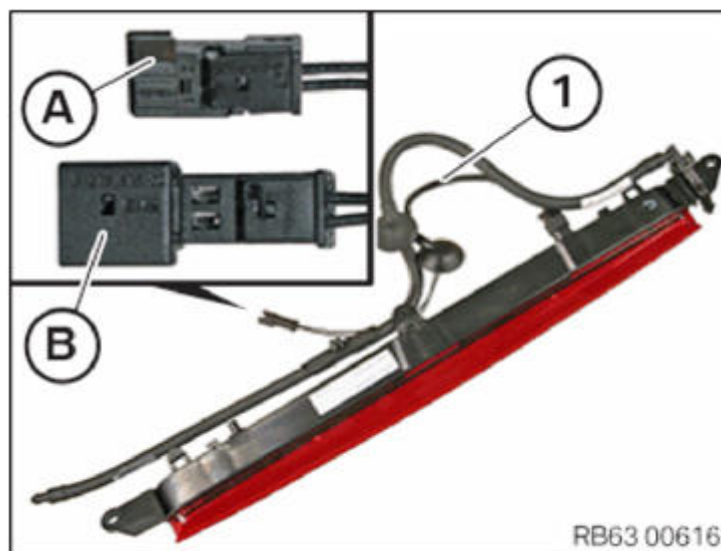
**Replacement:**

Remounting **WASHER JET FOR REAR WINDOW WASHER SYSTEM**

As from version 03/2014, adapter cable (1) is installed on additional brake light with connector (A), wiring harness on vehicle installed correspondingly with bush (B).

Up to version 03/2014, adapter cable (1) is installed on additional brake light with bush (B), wiring harness on vehicle installed correspondingly with connector (A).

If the additional brake light is replaced up to version 03/2014, the previous adapter cable must still be used.



**Fig. 52: Installing Adapter Cable On Additional Brake Light With Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

In the event of malfunctions due to the previous adapter cable (1), the new part as from 03/2014 must be used, but in this case the (A) pin contacts and pin housing (6 925 626) must be replaced by (B) socket contacts and socket housing (8 373 575).

Refer to **SPECIAL TOOLS FOR WIRING HARNESS REPAIR** .

**LICENCE PLATE LIGHTS**

## 63 26 000 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT NUMBER/LICENSE PLATE LIGHT

### Special tools required:

- [64 1 020](#)

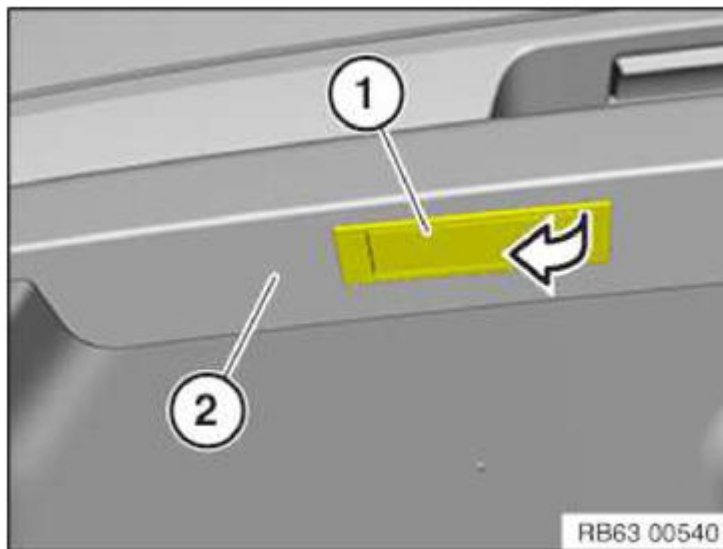
**WARNING:** Follow instructions for handling light bulbs ([EXTERIOR LIGHTS](#)).

Lever out number plate light (1) from bumper panel (2) in direction of arrow using special tool [64 1 020](#).

Disconnect corresponding plug connection and remove number plate light (1).

### Replacement:

- Note bulb type.



**Fig. 53: Removing Number Plate Light**

Courtesy of BMW OF NORTH AMERICA, INC.

## INTERIOR LIGHTING

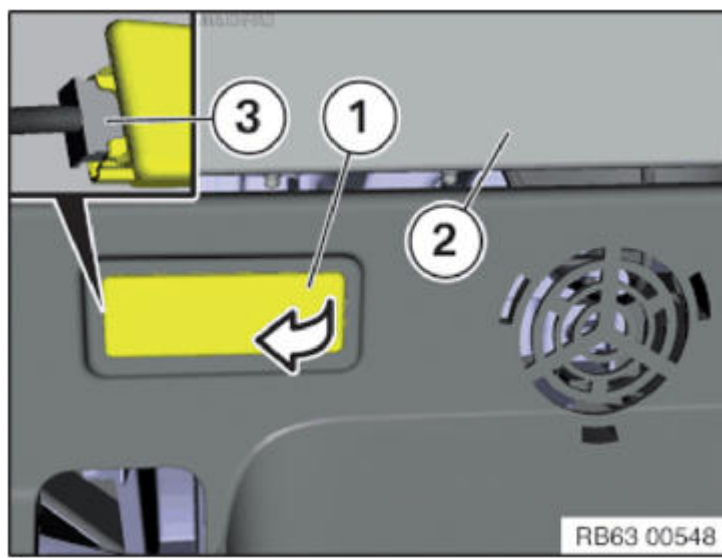
### 63 31 020 REMOVING AND INSTALLING/RENEWING FOOTWELL LIGHT

IMPORTANT: Follow instructions for [HANDLING LIGHT BULBS \(INTERIOR LIGHTING\)](#).

#### Footwell, left/right:

Lever footwell light (1) in direction of arrow out of trim panel (2).

Disconnect plug connection behind and remove footwell light (1).



**Fig. 54: Removing Footwell Light**

Courtesy of BMW OF NORTH AMERICA, INC.

**Door, left/right:**

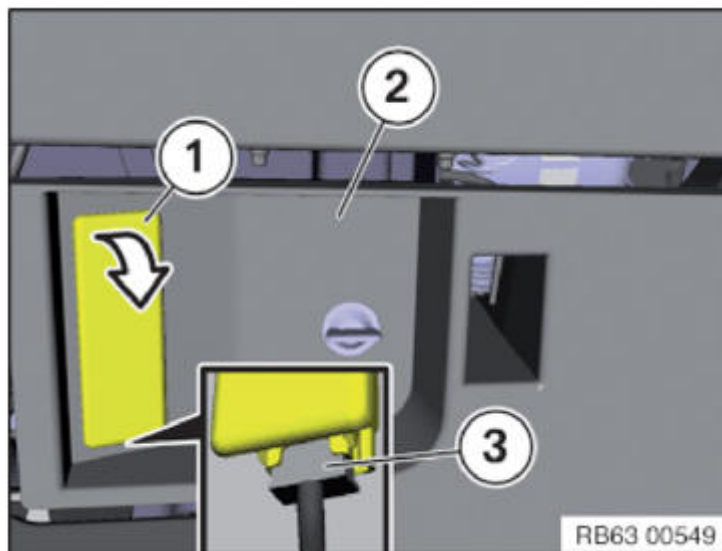
Lever footwell light (1) in direction of arrow out of door trim panel (2).

Disconnect plug connection behind and remove footwell light (1).

Replacement:

- If necessary, remove bulb, note **BULB TYPE**

**The footwell light in LED technology must be completely replaced!**



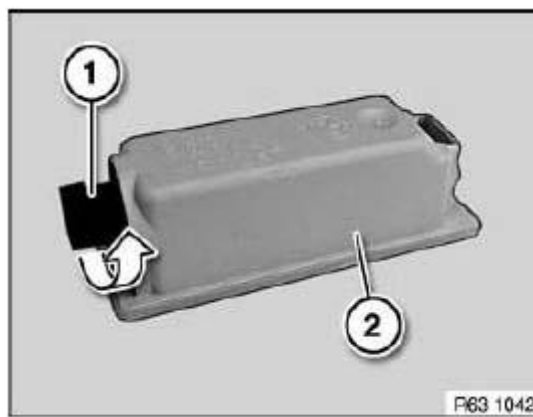
**Fig. 55: Removing Footwell Light**

Courtesy of BMW OF NORTH AMERICA, INC.

Turn bulb holder (1) in direction of arrow and pull out of footwell light (2).

*Installation note:*

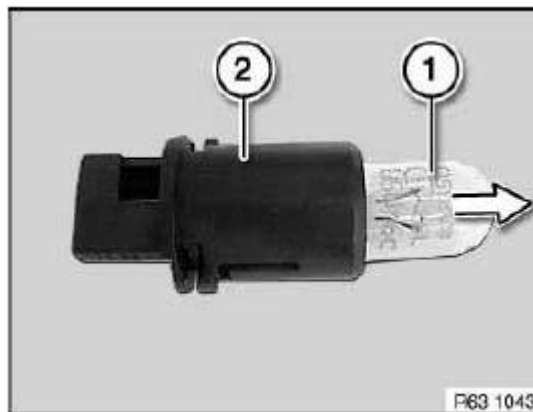
Make sure bulb holder (1) is correctly seated and latched on footwell light (2).



**Fig. 56: Turning Bulb Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

Pull bulb (1) in direction of arrow out of bulb holder (2).



**Fig. 57: Pulling Bulb Out Of Bulb Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

**63 31 000 REMOVING AND INSTALLING/REPLACING COMPLETE INTERIOR ROOF LIGHT (FRONT)**

**Special tools required:**

- [00 9 325](#)

IMPORTANT: Follow instructions for [HANDLING LIGHT BULBS \(INTERIOR LIGHTING\)](#).

IMPORTANT: Read and comply with notes on [PROTECTION AGAINST ELECTROSTATIC DAMAGE \(ESD PROTECTION\)](#).

**Necessary preliminary tasks:**

**Only version with roof switch cluster:**

- Remove [ROOF SWITCH CLUSTER](#)

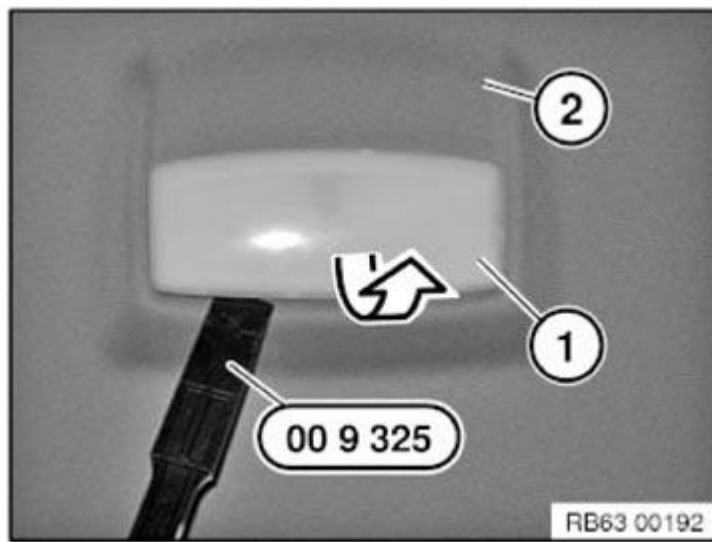
**For interior roof light equipment:**

Carefully lever out interior roof light (1) with special tool [00 9 325](#) in direction of arrow.

Unlock and disconnect associated plug connection, remove interior roof light (1).

*Installation note:*

Make sure interior roof light (1) is correctly seated.



**Fig. 58: Removing Interior Roof Light**

Courtesy of BMW OF NORTH AMERICA, INC.

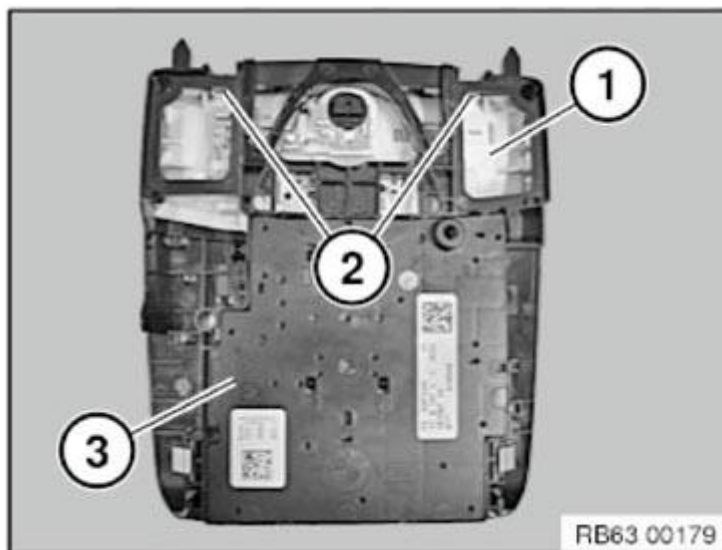
**For roof switch cluster equipment:**

Release interior roof light (1) at clamps (2) and feed out of roof switch cluster (3).

*Installation note:*

Clips (2) must not be missing or damaged.

Make sure interior roof light (1) is correctly seated in roof switch cluster (3).



**Fig. 59: Identifying Interior Roof Light, Clamps And Roof Switch Cluster**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

- If necessary, convert **BULB**.
- Note **BULB TYPE**

**63 31 003 REMOVING AND INSTALLING/REPLACING COMPLETE INTERIOR ROOF LIGHT (REAR)**

**Special tools required:**

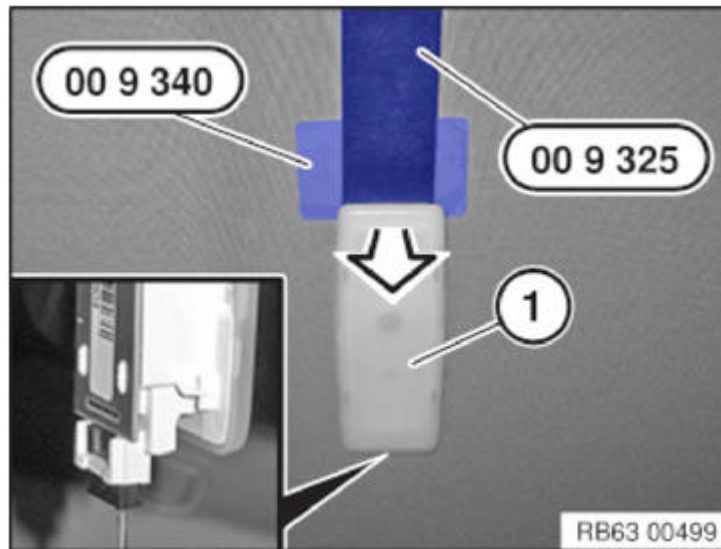
- **00 9 340**
- **00 9 325**

IMPORTANT: Follow instructions for [HANDLING LIGHT BULBS \(INTERIOR LIGHTING\)](#).

IMPORTANT: Risk of damage, protect headlining using special tool [00 9 340](#) as shown!

Lever out interior roof light (1) in direction of arrow using special tool [00 9 325](#).

Unlock and disconnect associated plug connection, remove interior roof light (1).



**Fig. 60: Removing Interior Roof Light**

Courtesy of BMW OF NORTH AMERICA, INC.

Removal of interior roof light not possible without causing damage (deformation of retaining clips).

The interior roof light **must** therefore be replaced!

### **63 31 150 REMOVING AND INSTALLING/REPLACING GLOVEBOX LIGHT**

IMPORTANT: Follow notes for [HANDLING LIGHT BULBS \(INTERIOR LIGHTS\)](#).

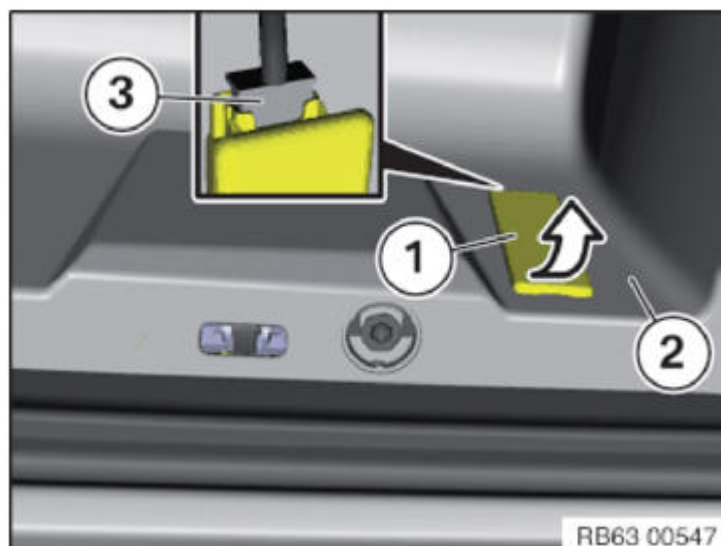
Lever out glove box light (1) from glove box (2) in direction of arrow.

Unfasten plug connection (3) and disconnect.

Remove glove box light (1).

#### **Replacement:**

- If necessary, [REMOUNT BULB](#), check [BULB TYPE](#)





### **Fig. 61: Removing Glove Box Light**

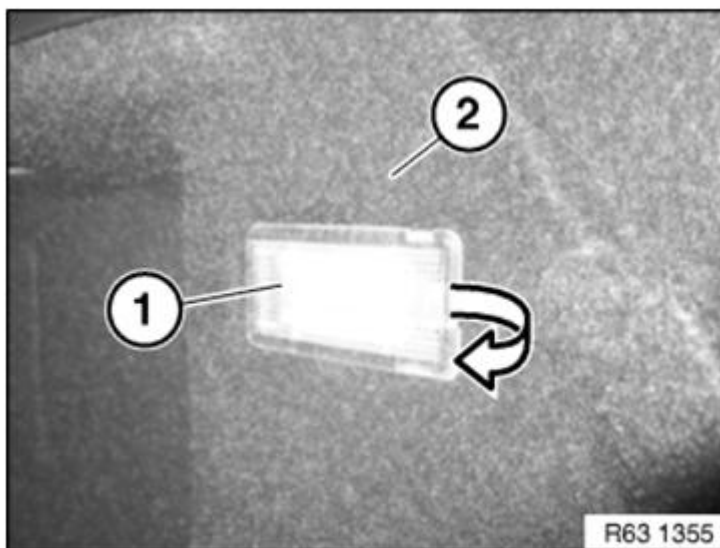
Courtesy of BMW OF NORTH AMERICA, INC.

## **63 31 080 REMOVING AND INSTALLING/REPLACING LUGGAGE COMPARTMENT LIGHT**

IMPORTANT: Follow notes for **HANDLING LIGHT BULBS (INTERIOR LIGHTS)**.

Lift luggage compartment light (1) out of luggage compartment trim panel (2) in direction of arrow.

Disconnect associated plug connection and remove luggage compartment light (1).



### **Fig. 62: Removing Luggage Compartment Light**

Courtesy of BMW OF NORTH AMERICA, INC.

#### **Replacement:**

- If necessary, modify bulbs, observe **BULB TYPE**

**Luggage compartment light in LED technology must be completely replaced!**

## **63 31 050 REMOVING AND INSTALLING/REPLACING MIRROR LIGHT**

#### **Special tools required:**

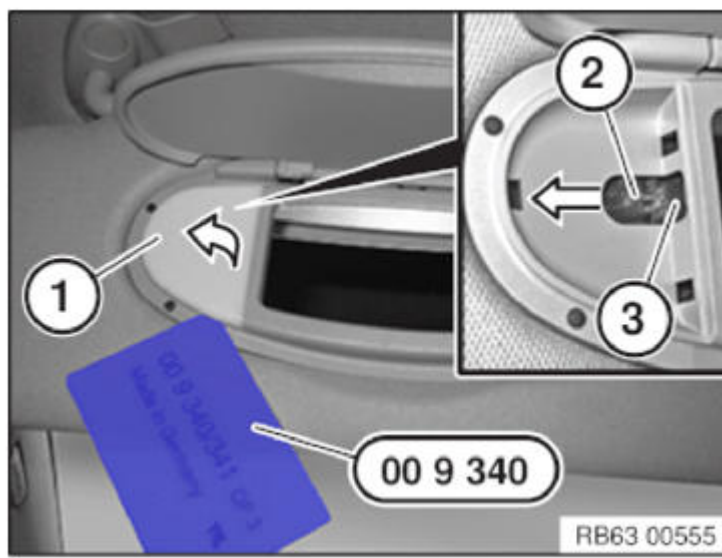
- **00 9 340**

IMPORTANT: Follow notes for **HANDLING LIGHT BULBS (INTERIOR LIGHTS)**.

Lever out vanity mirror light (1) with special tool **00 9 340** in direction of arrow.

Pull bulb (2) out of bulb holder (3) in direction of arrow.

**NOTE:** LED technology lights can only be replaced completely.



**Fig. 63: Pulling Bulb Out Of Bulb Holder**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**63 31... REPLACE LED MODULE (INTERIOR LIGHTING)**

Unclip cover (1) in direction of arrow.

Release LED module (1) from bracket (2).

Carefully release latch mechanism (3) on LED module (1) with a suitable tool.

Pull LED module (1) off fibre-optic conductor (4) in direction of arrow.

*Installation note:*

Make sure that the fibre-optic conductor (4) latches correctly in LED module (1).

Bracket (2) and latch mechanisms (3) must not be missing or damaged.



**Fig. 64: Removing Cover**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out test module:

- Service functions
- Body
- Lights

- Interior lighting
- Ambient light and interior lighting with light package

### **63 31 320 REPLACING LED MODULE (FRONT DOOR TRIM PANEL)**

#### **Necessary preliminary tasks:**

- Remove **FRONT DOOR TRIM PANEL**

Release LED module (1) from bracket.

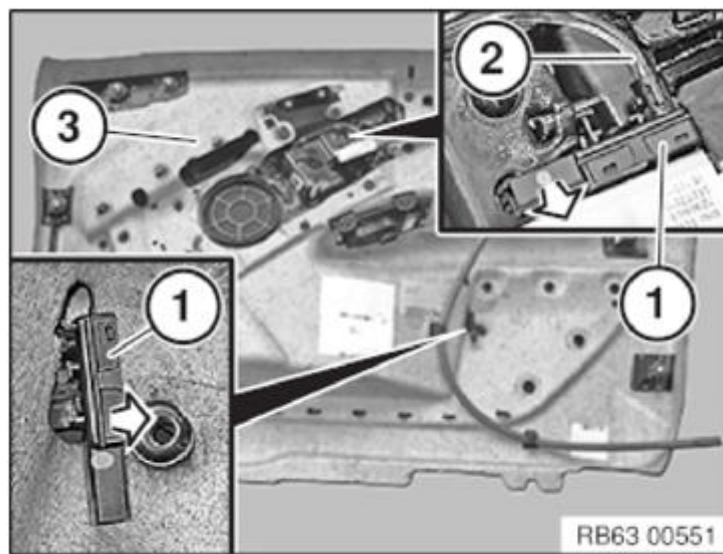
Carefully release latch mechanism on LED module (1) with a suitable tool.

Pull LED module (1) off fibre-optic conductor (2) in direction of arrow.

#### *Installation note:*

Make sure that the fibre-optic conductor (2) latches correctly in LED module (1).

Brackets and latch mechanisms must not be damaged or missing.



**Fig. 65: Pulling LED Module Off Fibre-Optic Conductor**  
 Courtesy of BMW OF NORTH AMERICA, INC.

#### **Replacement:**

Carry out test module:

- Service functions
- Body
- Lights
- Interior lighting
- Ambient light and interior lighting with light package

### **63 31 325 REPLACING LED MODULE (REAR DOOR TRIM)**

#### **Necessary preliminary tasks:**

- Remove **REAR DOOR TRIM PANEL**

Fold open protective non-woven fabric (1) in direction of arrow.

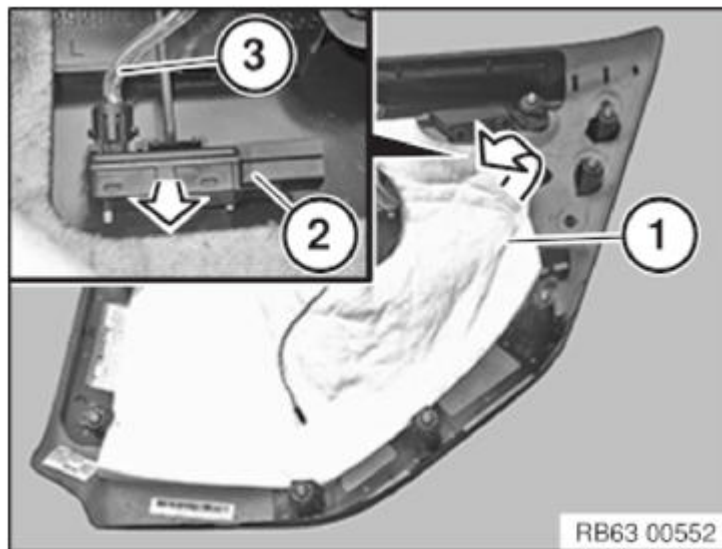
Release LED module (2) from bracket.

Pull LED module (2) off fibre-optic conductor (3) in direction of arrow.

*Installation note:*

Make sure that fibre-optic conductor (3) latches correctly in LED module (2).

Bracket and latch mechanisms must not be missing or damaged.



**Fig. 66: Folding Open Protective Non-Woven Fabric**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out test module:

- Service functions
- Body
- Lights
- Interior lighting
- Ambient light and interior lighting with light package

**LIGHT BULBS**

**63 99... NOTES FOR REPLACING THE PROTECTIVE CAP OF THE HEADLIGHT**

**Risk of damage!**

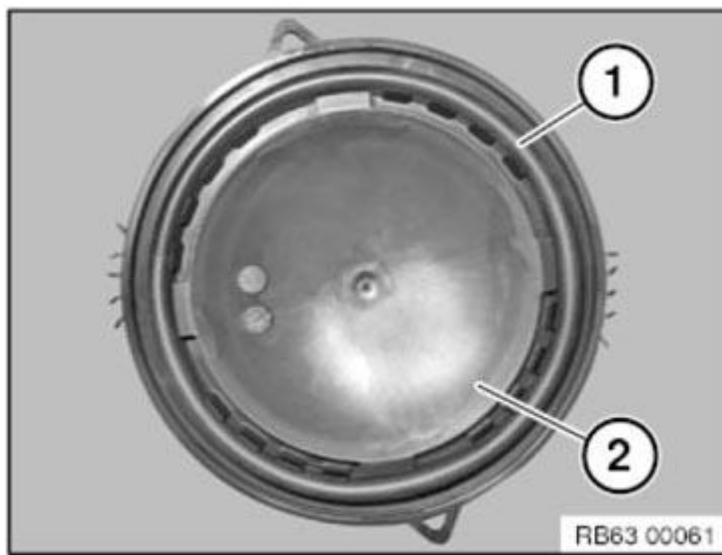
**IMPORTANT:** Damaged seals on the protective caps will lead to moisture penetration into the headlight.  
This will in turn cause porous cable insulations and malfunctioning of the headlight.

When working on the headlight system, check the protective cap seals.

Replace the protective cap in the event of damage!

Example: screwed protective cap

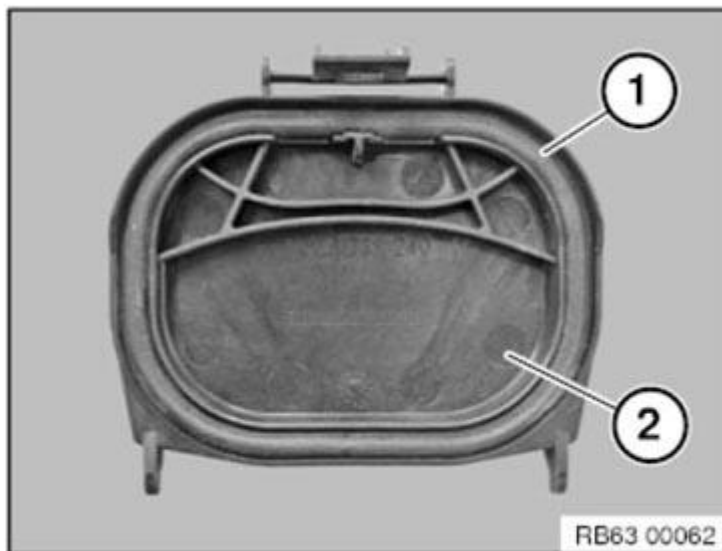
Seal (1) on protective cap (2).



**Fig. 67: Identifying Headlight Protective Cap And Seal (Screwed)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Example: latchable protective cap

Seal (1) on protective cap (2).



**Fig. 68: Identifying Headlight Protective Cap And Seal (Latchable)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **63 99 431 REPLACING BULB FOR FRONT INTERIOR ROOF LIGHT**

**WARNING:** Follow notes for **HANDLING LIGHT BULBS (INTERIOR LIGHTS)**.

Necessary preliminary tasks:

Version with roof switch cluster:

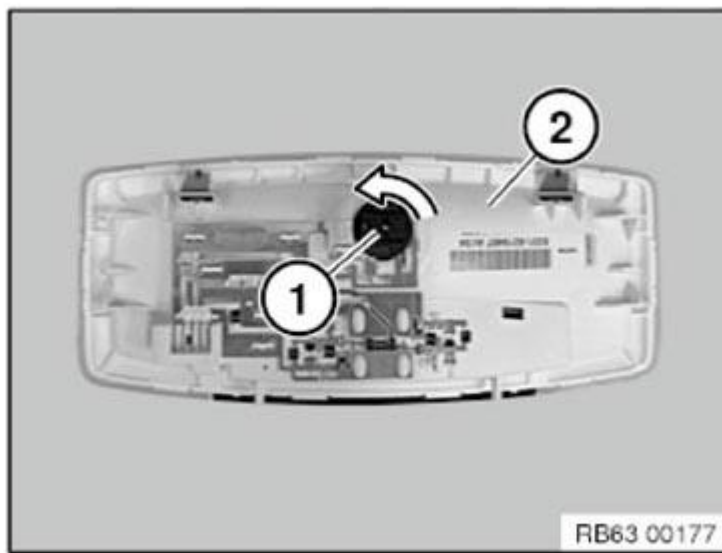
- Partially remove **ROOF SWITCH CLUSTER**

Version with interior roof light only:

- Partially remove **INTERIOR ROOF LIGHT**

**NOTE:** Interior roof light shown removed for purposes of clarity.

Turn bulb holder (1) in direction of arrow and pull out of interior roof light (2).



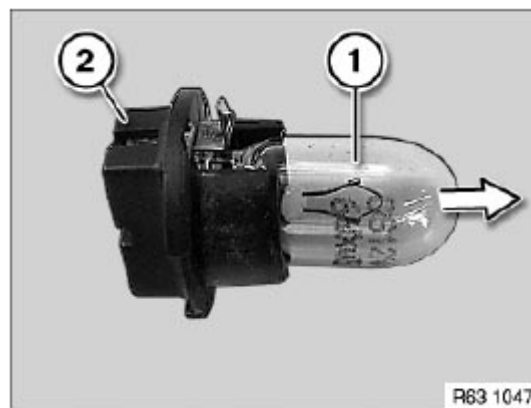
**Fig. 69: Turning Bulb Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

Pull bulb (1) in direction of arrow out of bulb holder (2).

*Installation note:*

Note **BULB TYPE** .



**Fig. 70: Pulling Bulb Out Of Bulb Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

### **63 99 461 REPLACING BULB FOR GLOVE BOX LIGHT**

**WARNING:** Follow instructions for handling light bulbs (**INTERIOR LIGHTS**).

**Necessary preliminary tasks:**

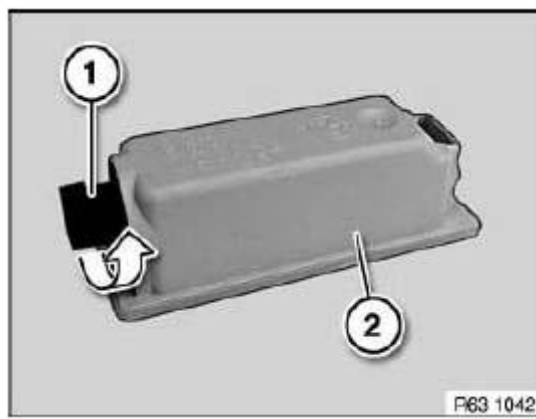
- Remove **GLOVEBOX LIGHT**

Turn bulb holder (1) in direction of arrow and pull out of light (2).

*Installation note:*

Make sure bulb holder (1) is correctly seated and engaged in light (2).





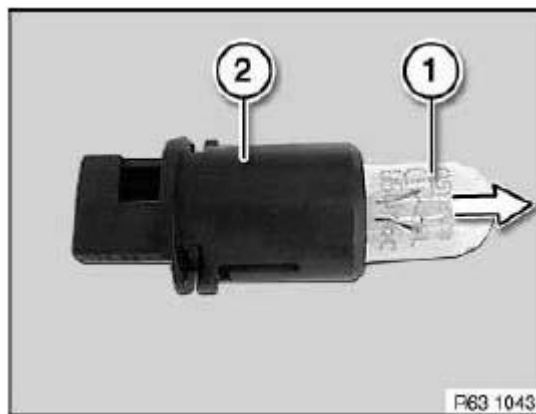
**Fig. 71: Turning Bulb Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

Remove bulb (1) from bulb holder (2) in direction of arrow.

*Installation note:*

Note **BULB TYPE** .



**Fig. 72: Pulling Bulb Out Of Bulb Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** LED technology lights can only be replaced completely!

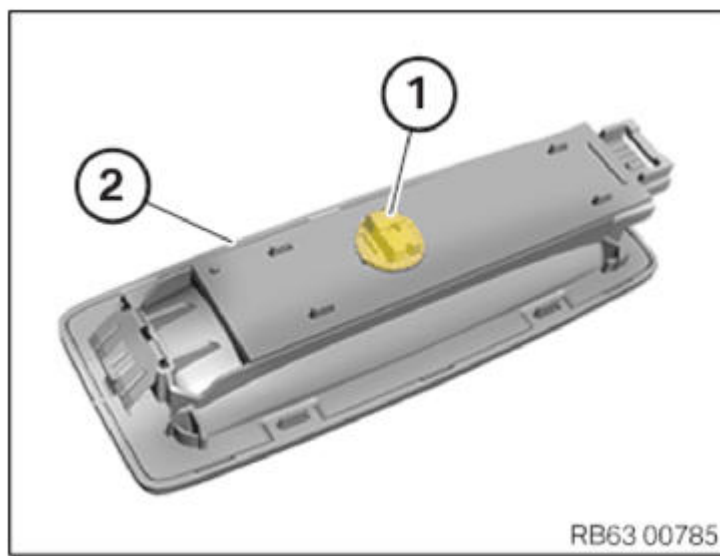
**63 99 432 REPLACING BULB FOR INTERIOR ROOF LIGHT (REAR)**

**WARNING:** Follow **NOTES ON HANDLING BULBS (INTERIOR LIGHTING)**.

Necessary preliminary tasks:

- Remove **REAR INTERIOR ROOF LIGHT**

Turn bulb holder (1) in direction of arrow and pull out of interior roof light (2).

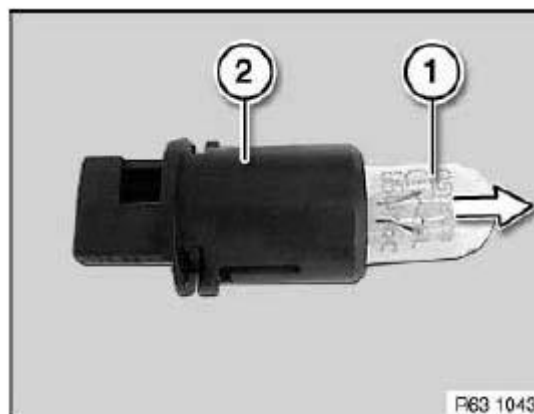


**Fig. 73: Identifying Interior Roof Light And Bulb Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove bulb (1) from bulb holder (2) in direction of arrow.

*Installation note:*

Note **BULB TYPE** .



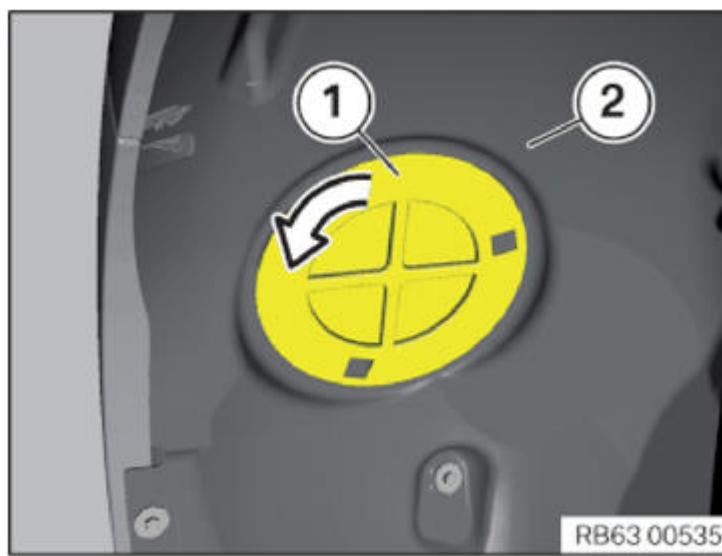
**Fig. 74: Pulling Bulb Out Of Bulb Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **63 99 273 REPLACING BULB FOR TURN INDICATOR, FRONT LEFT**

**WARNING:** Follow instructions for handling light bulbs (**EXTERIOR LIGHTS**).

Rotate cover (1) and remove from wheel arch panel (2).

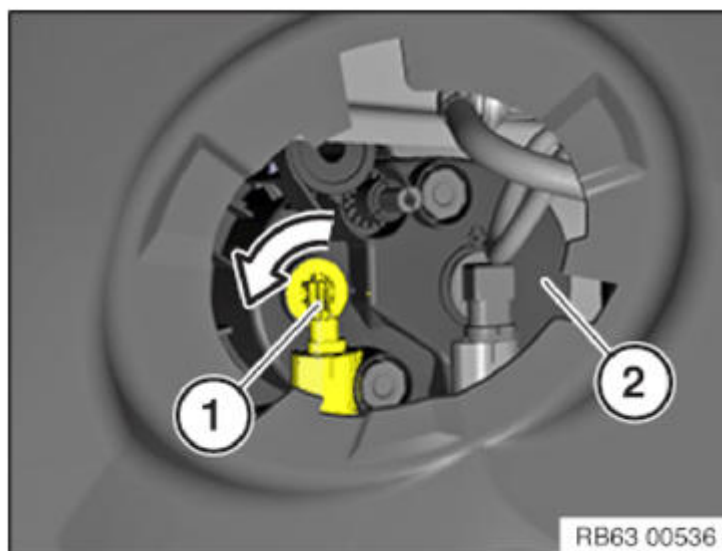
**NOTE:** Rotate cover on left-hand side of vehicle to the left to open.  
Rotate cover on right-hand side of vehicle to the right to open.



**Fig. 75: Turning Cover (Left Side)**

Courtesy of BMW OF NORTH AMERICA, INC.

Turn bulb holder (1) in direction of arrow and remove towards rear from headlight (2).



**Fig. 76: Turning Bulb Holder**

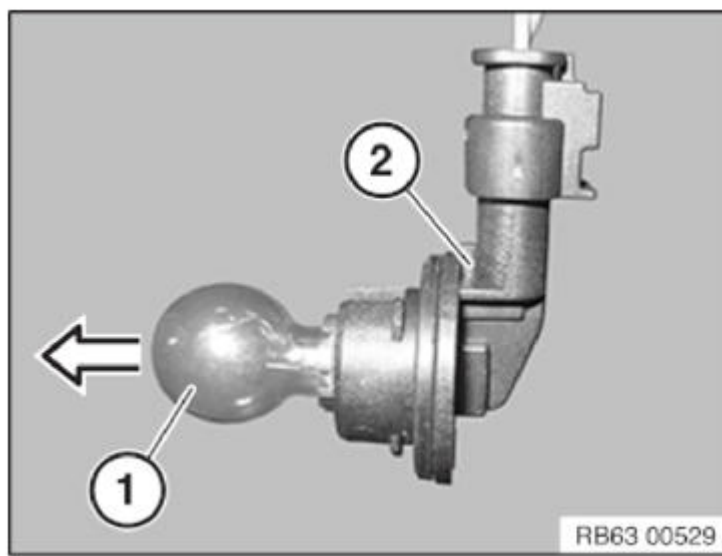
Courtesy of BMW OF NORTH AMERICA, INC.

Pull bulb (1) in direction of arrow out of bulb holder (2).

*Installation note:*

Make sure bulb (1) is correctly seated on bulb holder (2).

Note **BULB TYPE** .



**Fig. 77: Pulling Bulb**

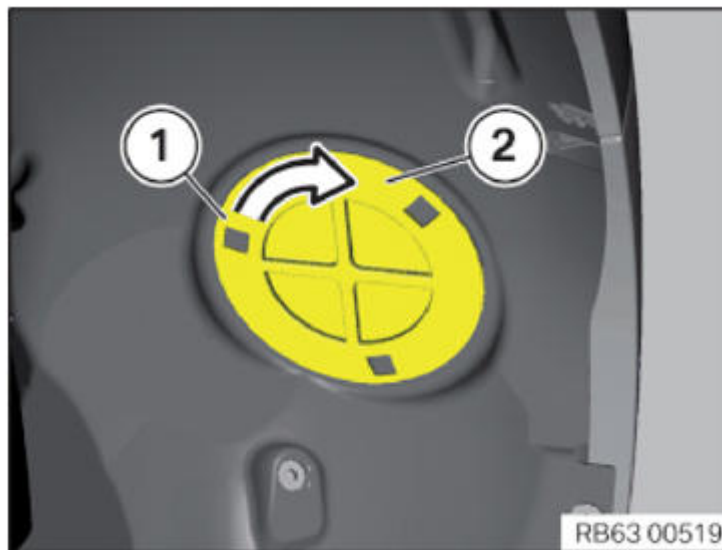
Courtesy of BMW OF NORTH AMERICA, INC.

**63 99 273 REPLACING BULB FOR TURN INDICATOR, FRONT RIGHT**

**WARNING:** Follow instructions for handling light bulbs (**EXTERIOR LIGHTS**).

Rotate cover (1) and remove from wheel arch panel (2).

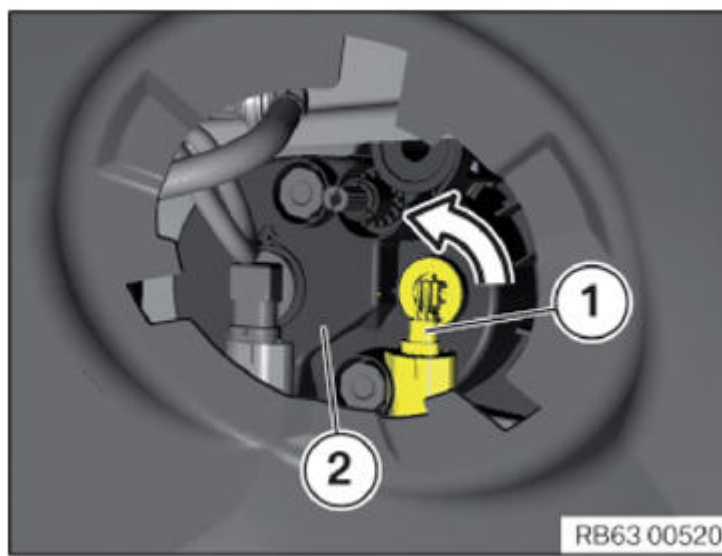
**NOTE:** Rotate cover on left-hand side of vehicle to the left to open.  
Rotate cover on right-hand side of vehicle to the right to open.



**Fig. 78: Turning Cover (Right Side)**

Courtesy of BMW OF NORTH AMERICA, INC.

Turn bulb holder (1) in direction of arrow and remove towards rear from headlight (2).



**Fig. 79: Turning Bulb Holder**

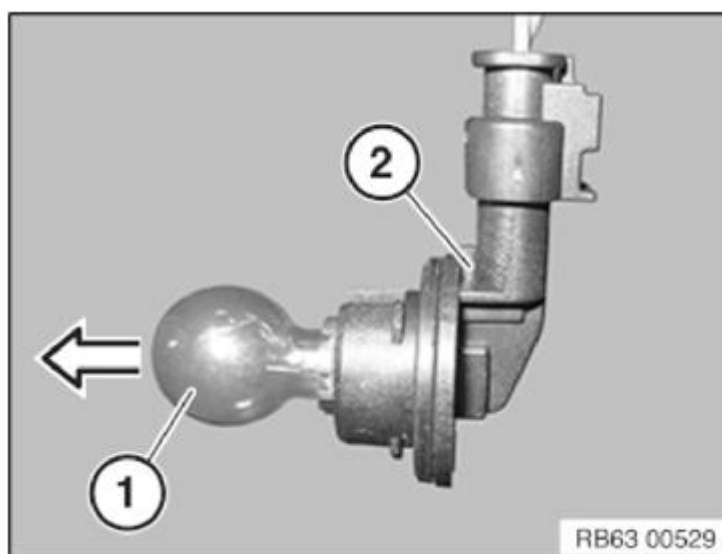
Courtesy of BMW OF NORTH AMERICA, INC.

Pull bulb (1) in direction of arrow out of bulb holder (2).

*Installation note:*

Make sure bulb (1) is correctly seated on bulb holder (2).

Note **BULB TYPE** .



**Fig. 80: Pulling Bulb**

Courtesy of BMW OF NORTH AMERICA, INC.

**63 99 072 REPLACING HALOGEN BULB FOR HEADLIGHT ON LEFT**

**WARNING:** Follow instructions for handling light bulbs (**EXTERIOR LIGHTS**).

Turn protective cap (1) counterclockwise and remove.

Disconnect plug connection (2).

Unlock and fold out wire spring clip (3) by pressing on it.

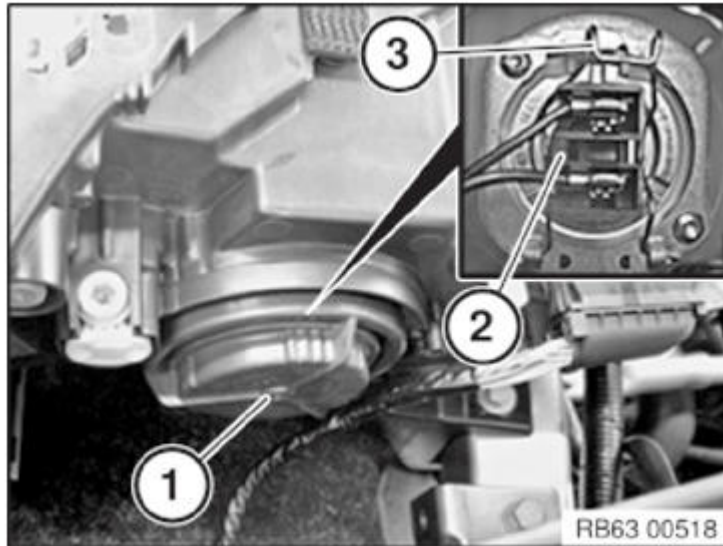
Take halogen bulb out of headlight.

**IMPORTANT: Risk of damage due to moisture penetration!**

Installation note:

Check seal. Replace protective cap (1) if necessary.

Comply with **INSTRUCTIONS FOR REPLACING THE PROTECTIVE CAP**.  
Protective cap (1) must lock correctly!  
Turn protective cap (1) clockwise to limit position.



**Fig. 81: Turning Protective Cap**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Note **BULB TYPE** .

Recommendation:

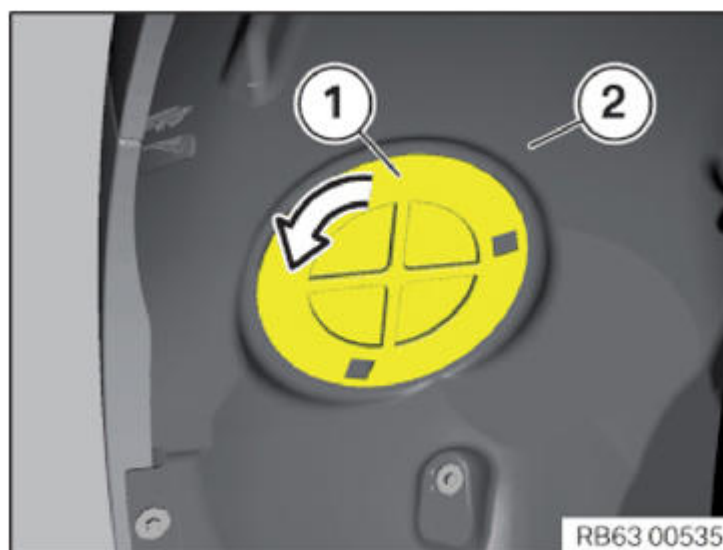
Check **HEADLIGHT ADJUSTMENT**, correct if necessary.

### **63 99 002 REPLACING HALOGEN BULB FOR HIGH BEAM HEADLIGHT ON LEFT**

**WARNING:** Follow instructions for **HANDLING LIGHT BULBS (EXTERIOR LIGHTS)**.

Rotate cover (1) and remove from wheel arch panel (2).

**NOTE:** Rotate cover on left-hand side of vehicle to the left to open.  
Rotate cover on right-hand side of vehicle to the right to open.



**Fig. 82: Turning Cover (Left Side)**  
Courtesy of BMW OF NORTH AMERICA, INC.

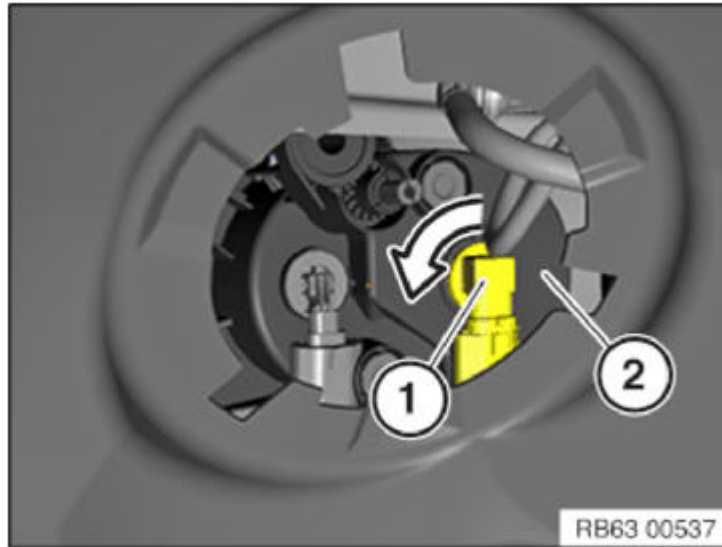
Turn bulb holder (1) in direction of arrow and pull rearward out of headlight (2).



Unlock plug connection for bulb holder and disconnect.

*Installation note:*

Make sure bulb holder (1) is correctly seated in headlight (2).

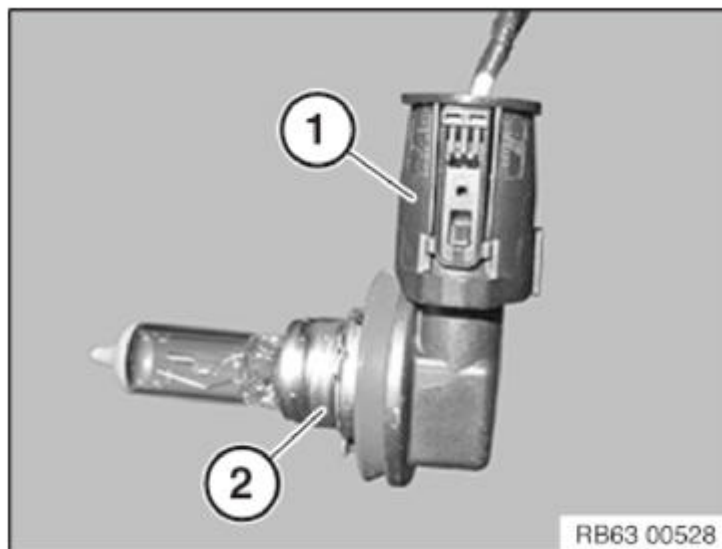


**Fig. 83: Turning Bulb Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug connection (1) and remove bulb (2).

Note **BULB TYPE** .



**Fig. 84: Identifying Bulb And Plug Connection**

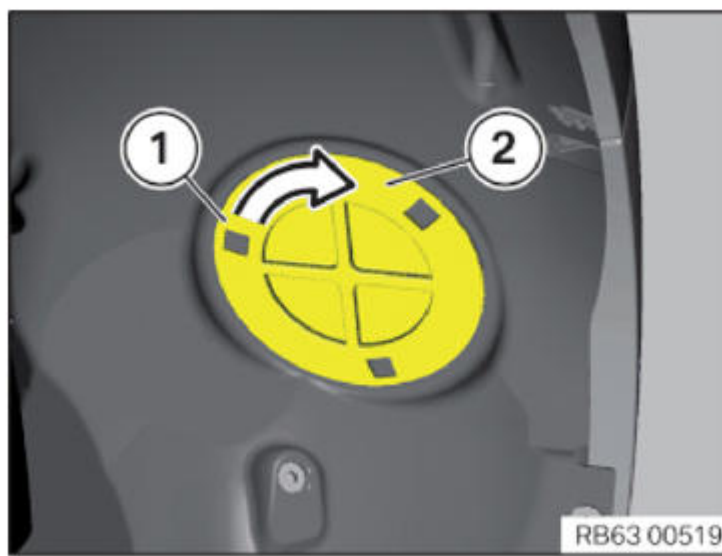
Courtesy of BMW OF NORTH AMERICA, INC.

### **63 99 003 REPLACING HALOGEN BULB FOR HIGH BEAM HEADLIGHT ON RIGHT**

**WARNING:** Follow instructions for **HANDLING LIGHT BULBS (EXTERIOR LIGHTS)**.

Rotate cover (1) and remove from wheel arch panel (2).

**NOTE:** Rotate cover on left-hand side of vehicle to the left to open.  
Rotate cover on right-hand side of vehicle to the right to open.



**Fig. 85: Turning Cover (Right Side)**

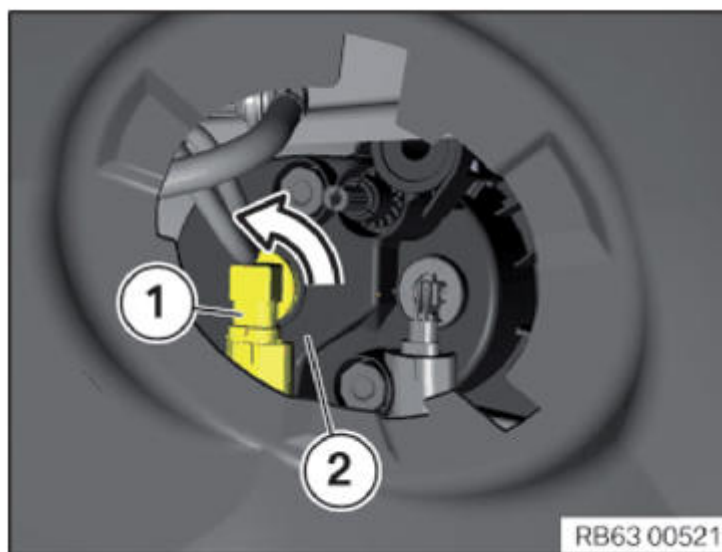
Courtesy of BMW OF NORTH AMERICA, INC.

Turn bulb holder (1) in direction of arrow and pull rearward out of headlight (2).

Unlock plug connection for bulb holder and disconnect.

*Installation note:*

Make sure bulb holder (1) is correctly seated in headlight (2).

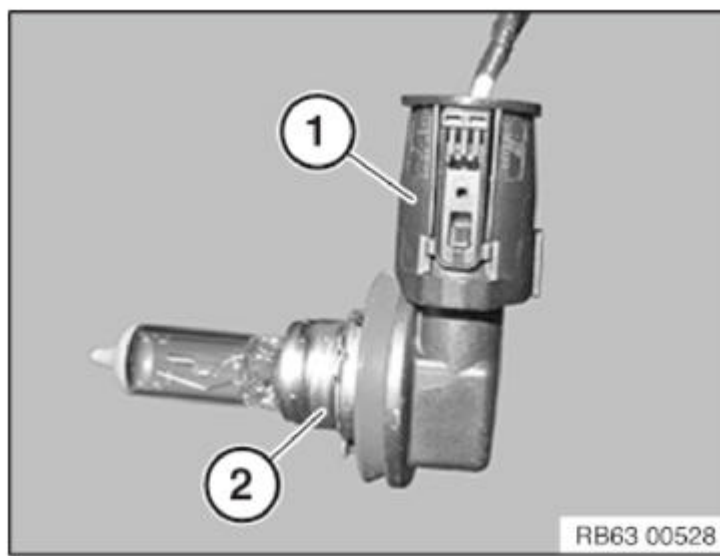


**Fig. 86: Turning Bulb Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug connection (1) and remove bulb (2).

Note **BULB TYPE** .



**Fig. 87: Identifying Bulb And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **63 99... SAFETY INFORMATION FOR EXCHANGING BULBS (INTERIOR LIGHTING)**

**IMPORTANT:** To avoid short circuits, disconnect bulbs from the power supply before replacing them (lighting system and ignition off).

Do not touch the glass bulbs in new lights bulbs as even the slightest contamination will burn in and reduce bulb service life.

Only touch light bulbs with clean gloves or a clean cloth.

Do not expose light bulbs to mechanical vibrations.

Use only recommended light bulbs.

Follow the light bulb manufacturer's notes without fail.

### **63 99... SAFETY INFORMATION FOR HANDLING BULBS/LIGHT SOURCES (EXTERIOR LIGHTS)**

**WARNING:** All headlight types, regardless of the type of light sources used, can be dangerous due to their dazzling effect!  
Do not look directly and for long periods of time into the light.

**WARNING:** Laser, LED and Xenon headlights in particular can be very dangerous due to their dazzling effect:  
Do not look directly and unprotected into the light.

**WARNING:** Xenon headlight: Danger to life due to high voltage!  
Disconnect all components from voltage supply before removal.  
Work on the entire xenon lighting system (ignition device, control unit and xenon bulb) may only be carried out by qualified personnel.

**WARNING:** Halogen bulbs are under pressure:  
To avoid injury, wear protective goggles and gloves.

To avoid short circuits:

**IMPORTANT:** Disconnect bulbs/light sources from the voltage supply before changing them (lighting system and ignition off).

Do not touch glass bulbs with bare hands, as even the smallest amount of contamination will burn in and reduce bulb service life.

Only touch light bulbs with clean gloves or a clean cloth.

Do not expose light bulbs to mechanical vibrations.

Use only recommended light bulbs.

Follow the light bulb manufacturer's notes without fail.

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[Back To Article](#)

**ACCESSORIES AND BODY, CAB**  
**Lights - Special Tools - All I3 Models - i3**

**LIGHTS**

**2334974 TESTER MP**

**NOTE:** Tester for trailer socket. For the diagnosis of the trailer module an electrical consumer is required on the trailer socket.

**Storage Location**

universal

**SI number**

02 04 13 (981)



**Fig. 1: Identifying Tester (2334974)**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

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## ACCESSORIES AND BODY, CAB

### Lights - Technical Data - All I3 Models - i3

## HEADLIGHT

### 63 12 HEADLIGHT I 01

#### HEADLIGHT I 01 SPECIFICATION

Light bulb - turn indicator	Type	PWY 24W, 12V 24W
Bulb - low-beam headlight (halogen headlight)	Type	H7 12V 55W
Light bulb - high-beam headlight (halogen headlight)	Type	H11 12V 55W
Bulb - side lights (halogen headlight)	Type	.LED?
Bulb - Fog lights (halogen headlight)	Type	.?
Bulb - daytime driving lights (halogen headlight)	Type	.LED?

## INTERIOR LIGHTING

### 63 31 INTERIOR LIGHTING I 01

#### INTERIOR LIGHTING I 01 SPECIFICATION

Interior light, front	Type	W 6W 12V 6W xenon
Interior reading light, front	Type	W 6W 12V 6W xenon
Interior reading light, rear	Type	W 6W 12V 6W xenon
Footwell, front	Type	W 5W 12V 5W
Mirror light	Type	T5 12V 2.3W
Glove box	Type	W 5W 12V 5W
Luggage compartment light	Type or	12V 10W festoon W 8W 12V 8W
Interior LED technology lights can only be replaced completely!		

## REAR LIGHT CLUSTER

### 63 21 REAR LIGHT CLUSTER I 01

#### REAR LIGHT CLUSTER I 01 SPECIFICATION

Light bulb - turn indicator	Type	LED
Light bulb - brake light	Type	LED
Bulb - rear light	Type	LED
Light bulb - rear fog light	Type	LED
Light bulb - reversing light	Type	LED
Light bulb - 3rd brake light	Type	LED

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**ACCESSORIES AND BODY, CAB****Lights - Tightening Torques - All I3 Models - i3****BRAKE LIGHTS****63 25 BRAKE LIGHTS****TIGHTENING TORQUE SPECIFICATION - BRAKE LIGHTS**

Part	Type	Thread	Tightening specifications	Dimension
1AZ Mounting bolt, additional brake light	i01	Ø	Ø	1.1 Nm
	i12	Oval-head screw	Ø	2.5 Nm

**CONTROL UNITS I****61 35 CONTROL UNITS I 01, I 12****TIGHTENING TORQUE SPECIFICATION - CONTROL UNITS I 01, I 12**

Part	Type	Thread	Tightening specifications	Dimension
1AZ Control unit BDC	I 01	Screw	Ø	1.7 Nm
	I 12	M5x40 screw	Ø	2.3 Nm
2AZ Control unit, hybrid drive interface module	I 01	M5x16 screw	Ø	2.0 Nm
	I 12	Plastic nut	Ø	2.0 Nm

**HEADLIGHT****63 12 HEADLIGHT (I 01)****TIGHTENING TORQUE SPECIFICATION - HEADLIGHT (I 01)**

Part	Type	Thread	Tightening specifications	Dimension
1AZ Headlight to module carrier,	I01	Ø	Use new screw	5.0 Nm
2AZ Headlight to holder, rear	I01	Ø	Ø	5.0 Nm
3AZ Headlight to trim panel, front	I01	Ø	Ø	2.5 Nm
4AZ Near field light, front	I01	Ø	Ø	1.5 Nm

**REAR LIGHTS****63 21 REAR LIGHTS (I 01)****TIGHTENING TORQUE SPECIFICATION - REAR LIGHTS (I 01)**

Part	Type	Thread	Tightening specifications	Dimension
1AZ Rear light to bumper panel	i01	Ø	Ø	3.0 Nm
2AZ Rear light to tailgate, inner	i01	Ø	Ø	2.5 Nm

---

## ACCESSORIES AND BODY, CAB

### Seats - Repair - All I3 Models - i3

## FRONT SEAT

### 52 13 001 REMOVING AND INSTALLING FRONT SEAT, DRIVER'S SIDE

**WARNING:** High-voltage system - risk of serious injury or death. The following points must be strictly observed prior to starting work:

De-energize the [HIGH-VOLTAGE SYSTEM](#) .

Observe [SAFETY INFORMATION](#) for handling electric vehicles.

#### Necessary preliminary tasks:

- Disconnect [BATTERY EARTH LEAD](#)

An airbag module and a pyrotechnical seat belt tensioner are installed in the front seat.

**IMPORTANT:** Improper handling can lead to triggering of the pyrotechnical seat belt tensioner or side airbag, resulting in injuries.

#### Installation note:

- Microencapsulated screws must be coated with Loctite if they are to be reused
- Screw connection must be completed within 20 mins. (start of curing)
- Microencapsulated screws must **not** be retightened
- Thread of nut must be cleaned beforehand in event of repeated use

Move seat to upper back position.

Release screws (1).

Tightening torque [52 10 1AZ](#) .



**[Fig. 1: Identifying Front Seat Screws](#)**

Courtesy of BMW OF NORTH AMERICA, INC.

Adjust the seat to the front top.

Release screws (1).

Tightening torque [52 10 1AZ](#) .



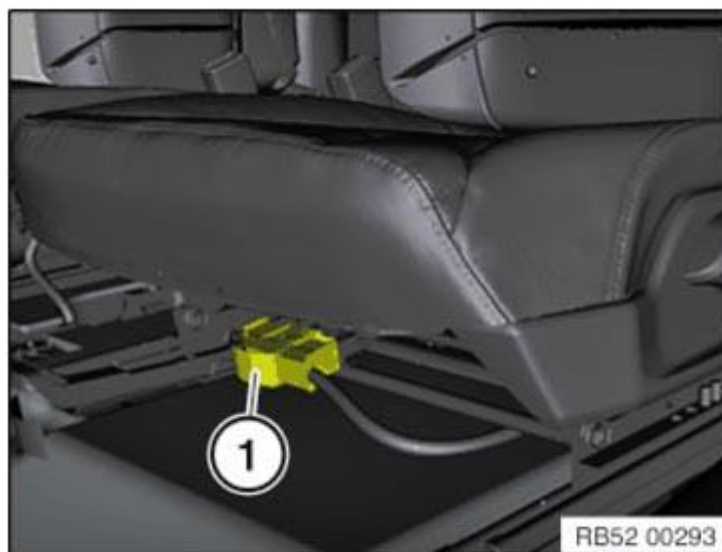
**Fig. 2: Identifying Front Seat Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock **PLUG CONNECTION** (1) and disconnect.

IMPORTANT: Cover door sill with protective covers (risk of damage).

Lift out front seat.



**Fig. 3: Identifying Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Carpet must not get between seat rails and floor panel in area of attachment points (squeaking noises)
- Insert all screws loose to avoid twisting
- Tighten down all screws to specified torque

Tightening torque [52 10 1AZ](#) .

**WARNING:** When carrying out further work on the front seat, it is absolutely imperative to observe the **SAFETY REGULATIONS** on handling airbag modules and pyrotechnical seat belt tensioners

Improper handling can lead to triggering of the pyrotechnical seat belt tensioner or side airbag, resulting in injuries.

## 52 13 002 REMOVING AND INSTALLING FRONT SEAT, PASSENGER'S SIDE

**WARNING:** High-voltage system - risk of serious injury or death. The following points must be strictly observed prior to starting work:

De-energize the HIGH-VOLTAGE SYSTEM .

Observe SAFETY INFORMATION for handling electric vehicles.

Necessary preliminary tasks:

- Disconnect BATTERY EARTH LEAD

An airbag module and a pyrotechnical seat belt tensioner are installed in the front seat.

**IMPORTANT:** Improper handling can lead to triggering of the pyrotechnical seat belt tensioner or side airbag, resulting in injuries.

*Installation note:*

- Microencapsulated screws must be coated with Loctite if they are to be reused
- Screw connection must be completed within 20 mins. (start of curing)
- Microencapsulated screws must **not** be retightened
- Thread of nut must be cleaned beforehand in event of repeated use

Move seat to upper back position.

Release screws (1).

Tightening torque 52 10 1AZ .



**Fig. 4: Identifying Front Seat Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Adjust the seat to the front top.

Release screws (1).

Tightening torque 52 10 1AZ .



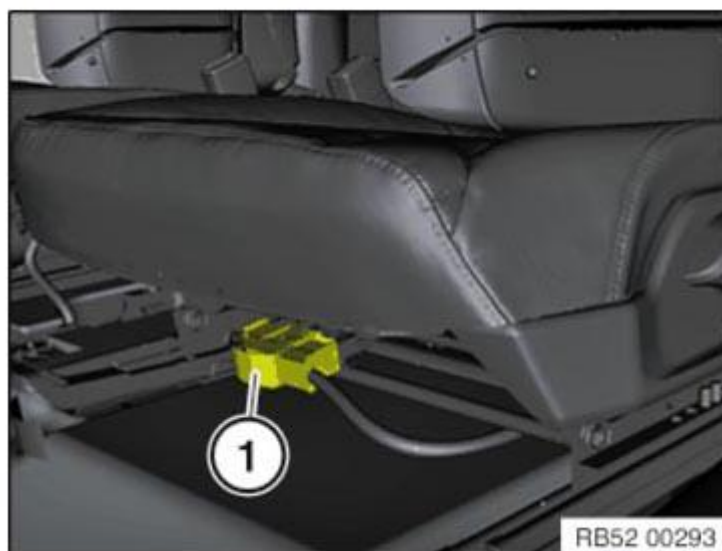
**Fig. 5: Identifying Front Seat Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock **PLUG CONNECTION** (1) and disconnect.

IMPORTANT: Cover door sill with protective covers (risk of damage).

Lift out front seat.



**Fig. 6: Identifying Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Carpet must not get between seat rails and floor panel in area of attachment points (squeaking noises)
- Insert all screws loose to avoid twisting
- Tighten down all screws to specified torque

Tightening torque **52 10 1AZ** .

**WARNING:** When carrying out further work on the front seat, it is absolutely imperative to observe the **SAFETY REGULATIONS** on handling airbag modules and pyrotechnical seat belt tensioners. Improper handling can lead to triggering of the pyrotechnical seat belt tensioner or side airbag, resulting in injuries.

## 52 13 390 REMOVING AND INSTALLING OR REPLACING FRONT LEFT OR RIGHT HEAD RESTRAINT

Necessary preliminary tasks:

- Remove [TRIM FOR RELEASE MECHANISM](#)

Pull release lever (1) and at the same time, release screw (2).



**Fig. 7: Pulling Head Restraint Release Lever**

Courtesy of BMW OF NORTH AMERICA, INC.

Release head restraint (1) from guides in marked area.

Remove head restraint (1) upwards.



**Fig. 8: Removing Head Restraint**

Courtesy of BMW OF NORTH AMERICA, INC.

## 52 13 041 REMOVING AND INSTALLING OR REPLACING INNER COVER ON LEFT OR RIGHT FRONT SEAT

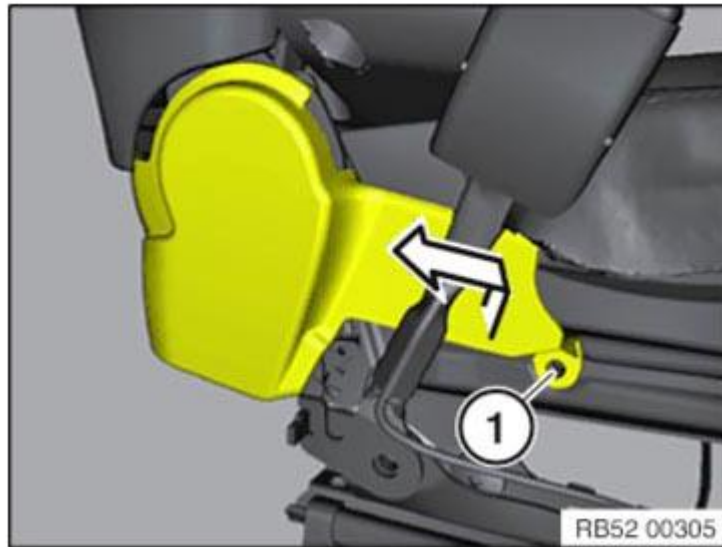
Necessary preliminary tasks:

- Remove front seat. See [REMOVING DRIVER'S SEAT](#) or [REMOVING FRONT PASSENGER'S SEAT](#).

Release screw (1).



Remove cover (2) in direction of arrow.

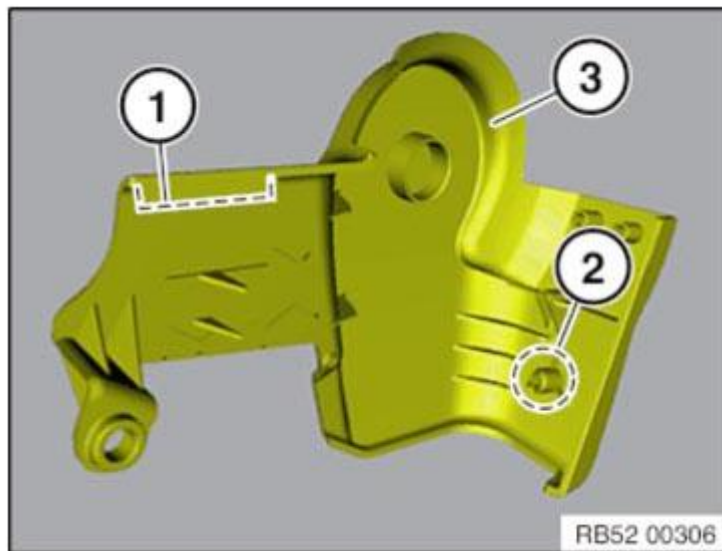


**Fig. 9: Removing Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Guides (1 and 2) on trim (3) must not be damaged.

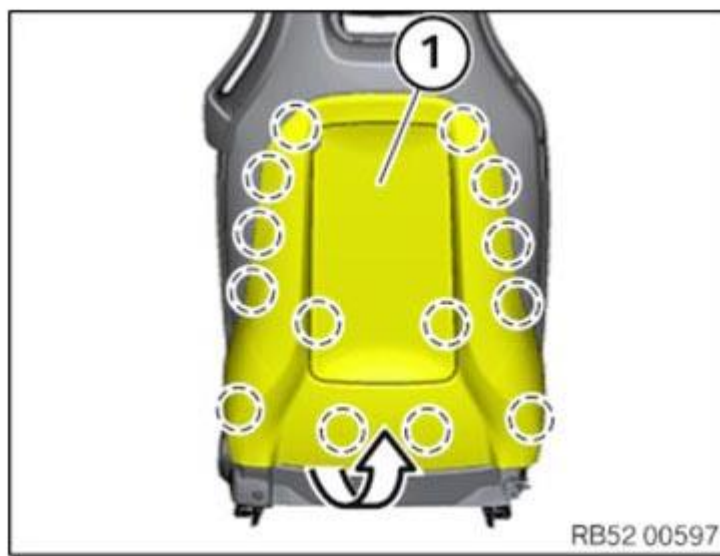


**Fig. 10: Identifying Trim With Guides**

Courtesy of BMW OF NORTH AMERICA, INC.

**52 13 198 REMOVING AND INSTALLING OR REPLACING REAR PANEL ON LEFT OR RIGHT FRONT SEAT BACKREST**

Undo rear panel (1) from backrest frame in direction of arrow at clips and clamps.



**Fig. 11: Removing Rear Panel From Backrest Frame**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Fold rear panel (1) backwards slightly.

**IMPORTANT:** Risk of damage to the rear panel (1) in the upper area!  
 Do not open the rear panel (1) too far!

Press together both hooks at clamps (2) with pliers (3).



**Fig. 12: Pressing Both Hooks At Clamps With Pliers**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

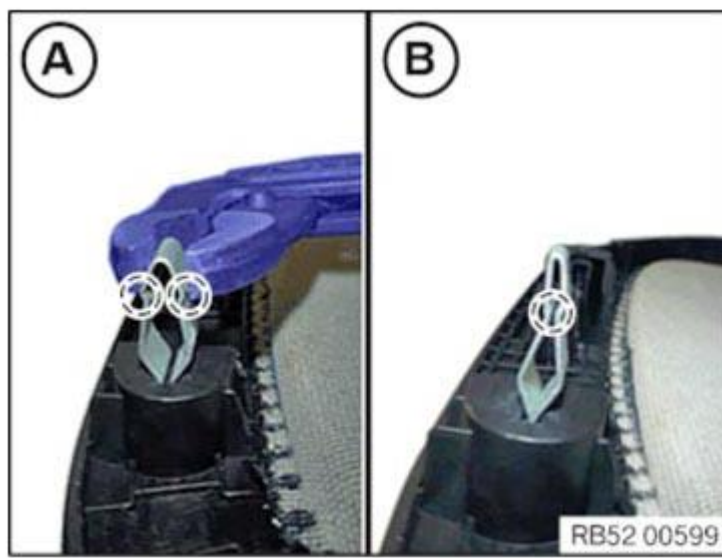
Replace both clamps (2).

A = Clamp before deformation

B = Clamp after deformation

*Installation note:*

Replace both clamps (2).



**Fig. 13: Identifying Clamp Before And After Deformation**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**52 13 029 REMOVING AND INSTALLING/REPLACING BACKREST FRAME FROM FRONT PASSENGER SEAT**

An airbag module and a pyrotechnical seat belt tensioner are installed in the front seat.  
**IMPORTANT:** Improper handling can lead to triggering of the pyrotechnical seat belt tensioner or side airbag, resulting in injuries.

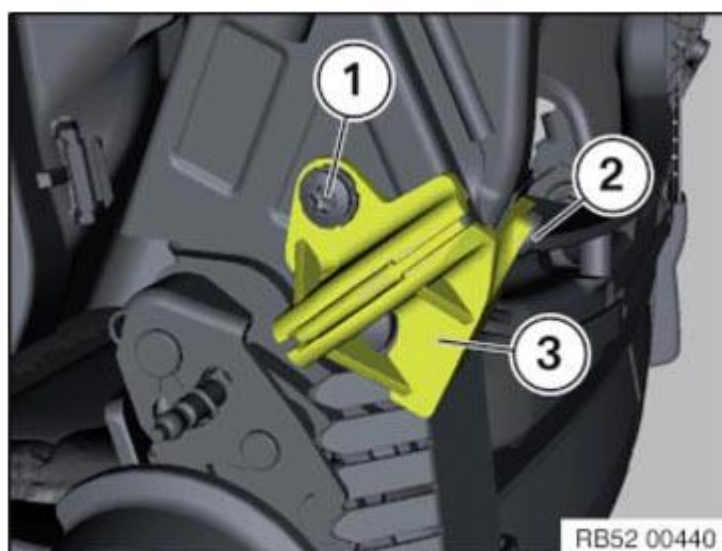
**Necessary preliminary tasks:**

- Remove **RELEASE MECHANISM**
- Remove **SIDE AIRBAG**

Release expanding rivet (1) on left and right.

Release screws (2) on left and right.

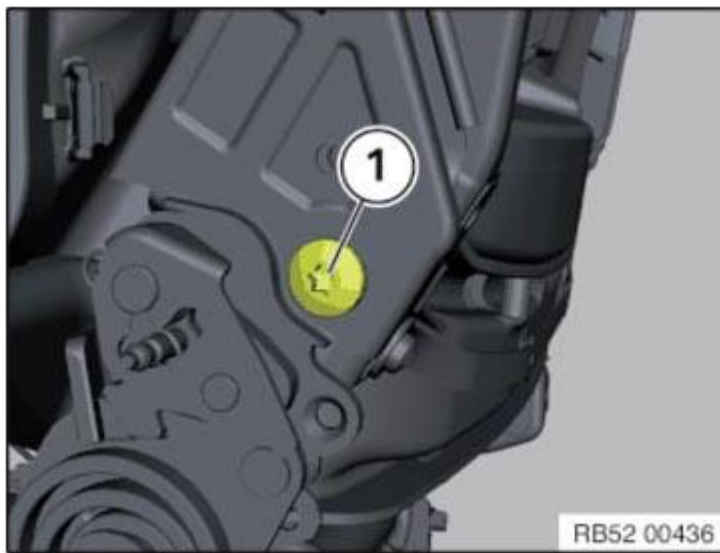
Remove guide (3) for Bowden cable.



**Fig. 14: Identifying Expanding Rivet, Screws And Guide**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque **52 10 2AZ** .



**Fig. 15: Identifying Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Remove backrest frame (1) upwards from seat mechanism (2).



**Fig. 16: Removing Backrest Frame From Seat Mechanism**

Courtesy of BMW OF NORTH AMERICA, INC.

### **52 13 028 REMOVING AND INSTALLING/REPLACING BACKREST FRAME ON DRIVER'S SEAT**

An airbag module and a pyrotechnical seat belt tensioner are installed in the front seat.  
**IMPORTANT:** Improper handling can lead to triggering of the pyrotechnical seat belt tensioner or side airbag, resulting in injuries.

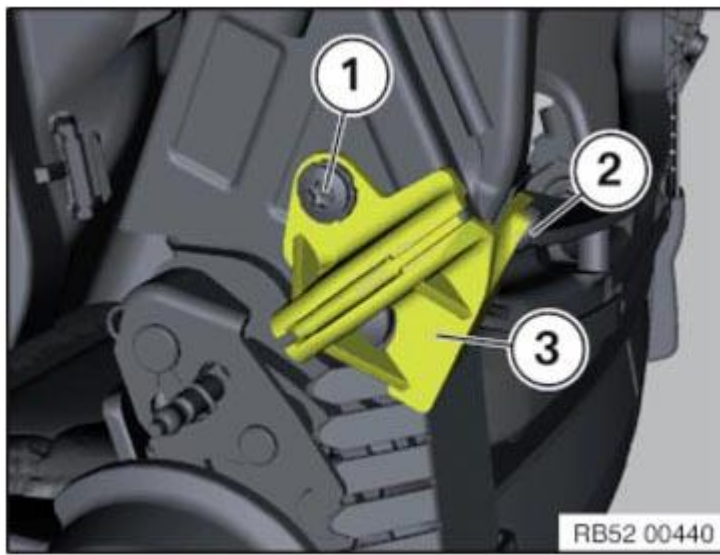
#### **Necessary preliminary tasks:**

- Remove **RELEASE MECHANISM**
- Remove **SIDE AIRBAG**

Release expanding rivet (1) on left and right.

Release screws (2) on left and right.

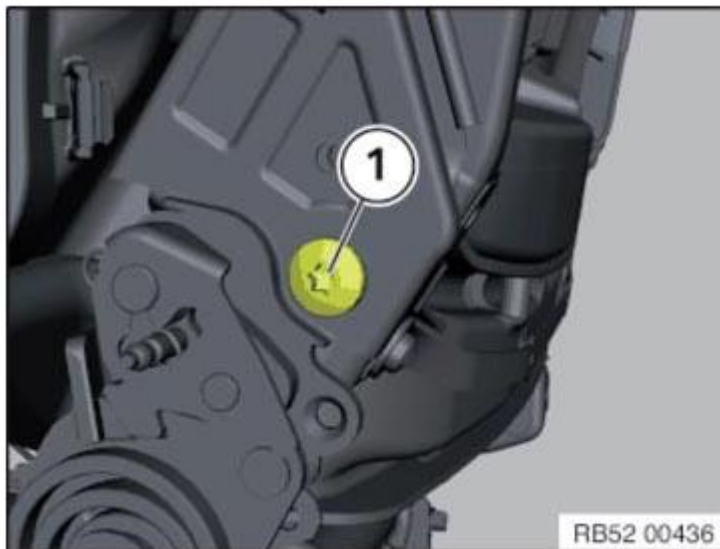
Remove guide (3) for Bowden cable.



**Fig. 17: Identifying Expanding Rivet, Screws And Guide**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

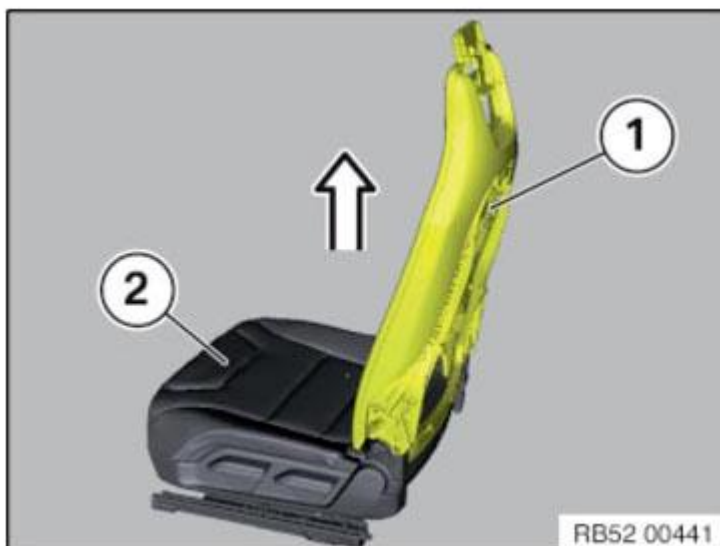
Tightening torque [52 10 2AZ](#) .



**Fig. 18: Identifying Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Remove backrest frame (1) upwards from seat mechanism (2).





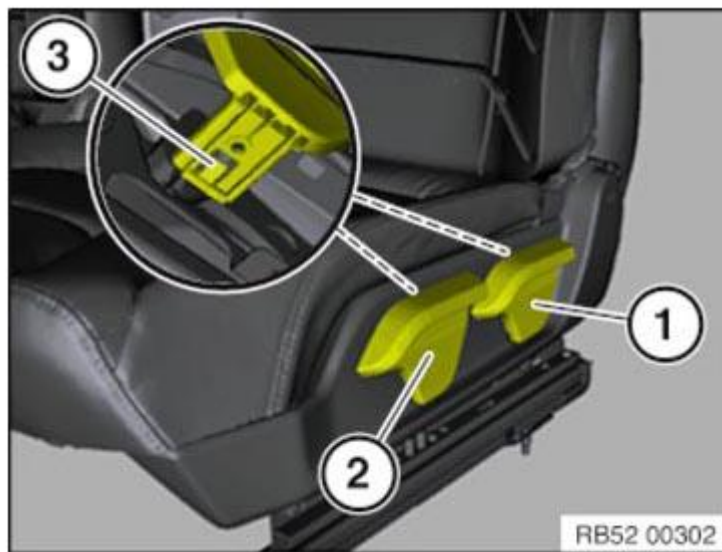
**52 13 040 REMOVING AND INSTALLING/REPLACING OUTER COVER ON LEFT OR RIGHT FRONT SEAT (NORMAL/MANUAL)**

If one of the following criteria is met, the backrest frame must be replaced. See [REPLACING BACKREST FRAME, DRIVER'S SEAT](#) or [REPLACING BACKREST FRAME, FRONT PASSENGER SEAT](#).

- IMPORTANT:
- Activated [END FITTING PRETENSIONER](#)
  - Unclipped outer cover due to an accident
  - Torn out outer cover due to an accident
  - Faulty clip connection on outer cover due to an accident

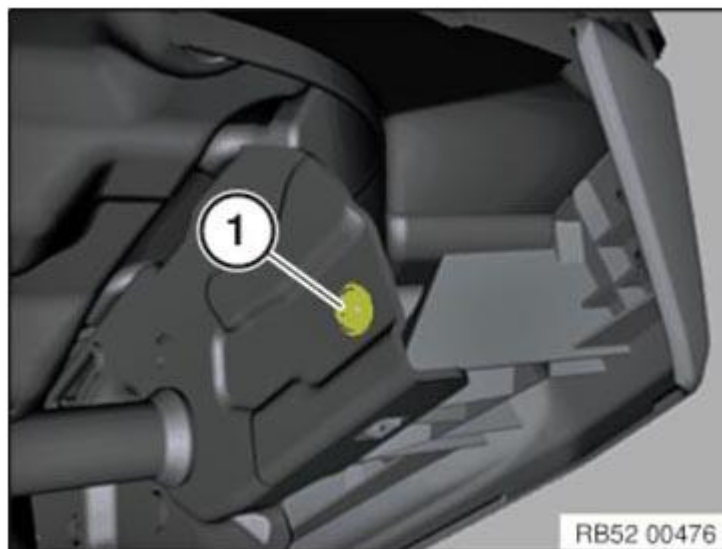
Pull the handle up and lift up lock (3).

Pull off the handle for the backrest angle adjustment (1) and handle for seat height adjustment (2).



**Fig. 20: Identifying Backrest Angle Adjustment And Seat Height Adjustment Handle**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).



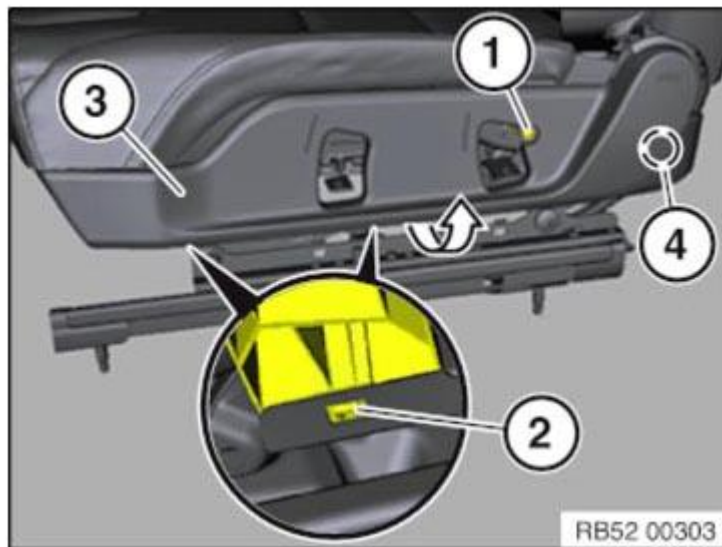
**Fig. 21: Identifying Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.



Release screw (1).

Lever latch mechanism (2) of the cover (3) out of seat mechanism in direction of arrow.

Feed out cover (3) towards rear from guide (4).



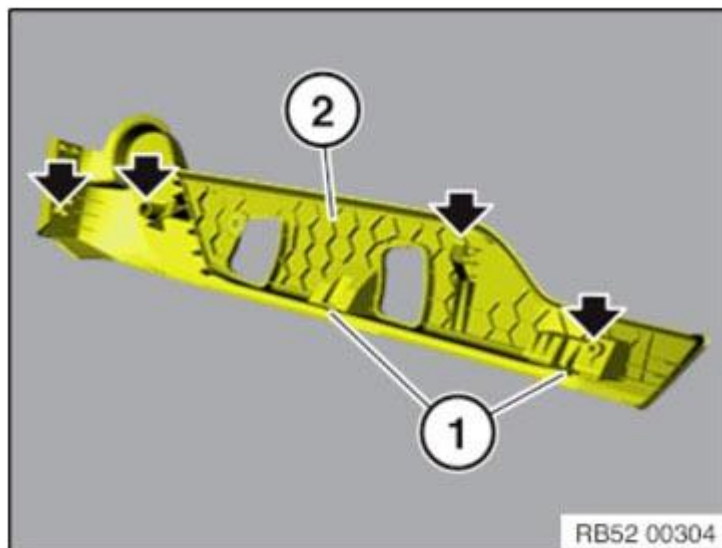
**Fig. 22: Removing Cover From Guide**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Latch mechanisms (1) and marked guides of trim (2) must not be damaged.

Replace faulty cover (2).



**Fig. 23: Locating Trim Latch Mechanisms And Guides**

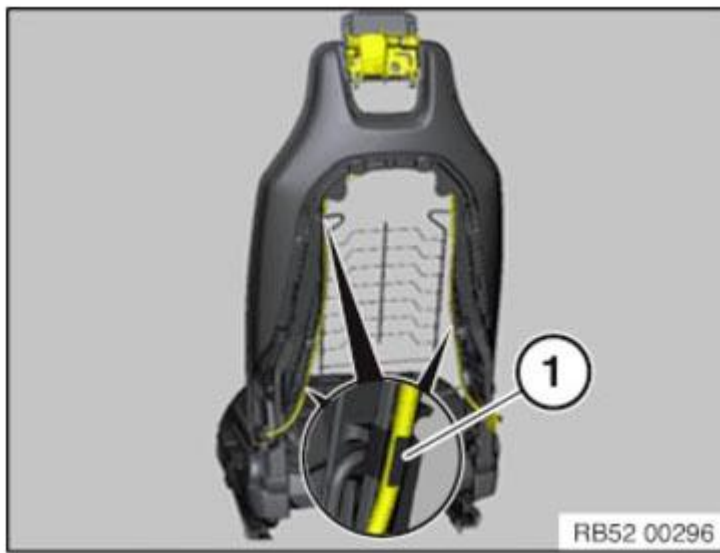
Courtesy of BMW OF NORTH AMERICA, INC.

### **52 13 034 REMOVING AND INSTALLING/REPLACING RELEASE MECHANISM ON LEFT OR RIGHT FRONT SEAT**

**Necessary preliminary work:**

- Remove backrest cover with upholstery. See [REPLACING UPHOLSTERY, DRIVER'S SEAT BACKREST](#) or [REPLACING UPHOLSTERY, FRONT PASSENGER SEAT BACKREST](#).
- Remove [HEAD RESTRAINT](#)

Feed out Bowden cables from cable clip (1).



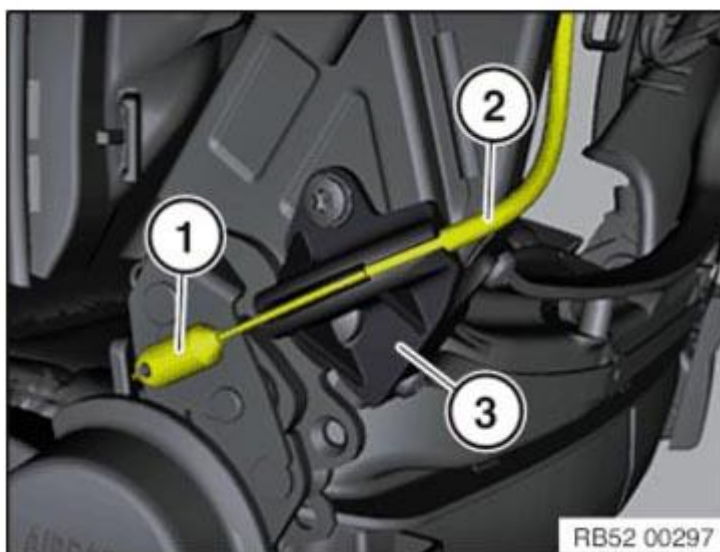
**Fig. 24: Identifying Bowden Cables Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach ball socket (1) from ball head on left and right.

*Installation note:*

Ball socket (1) must audibly snap into place.

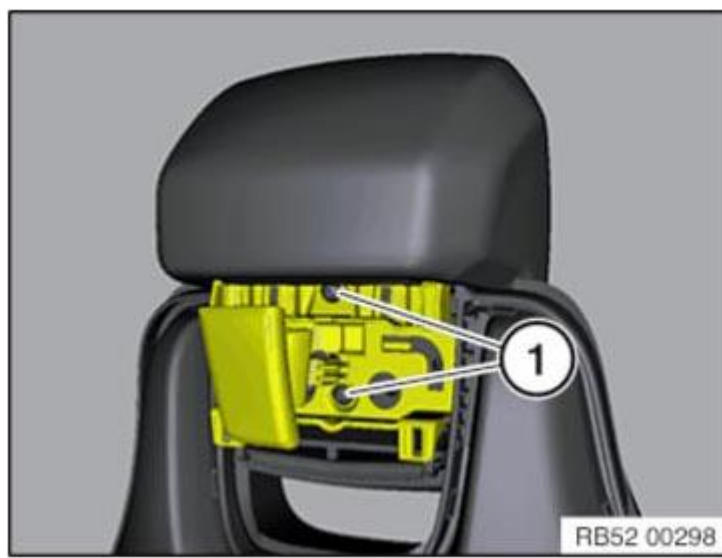
Ball socket (1) must be able to move freely on the ball head.



**Fig. 25: Identifying Ball Socket, Bowden Cable And Guide**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed out Bowden cable (2) from guide (3).

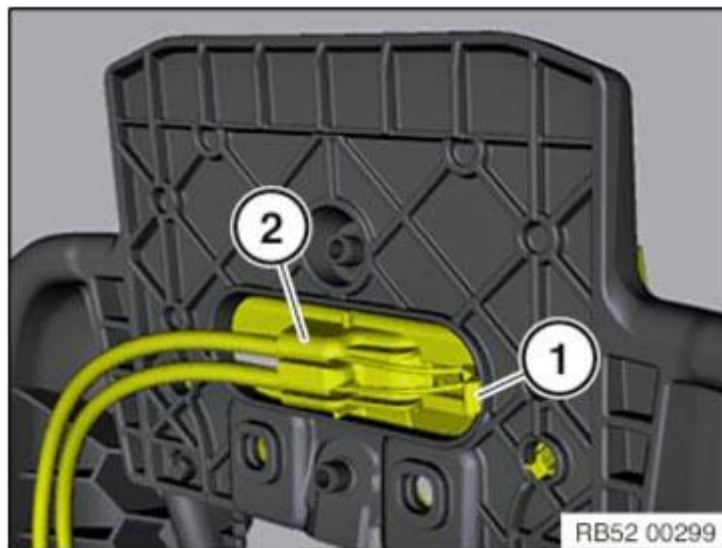
Release screws (1).



**Fig. 26: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release latch mechanism (1) and feed out release mechanism (2) with Bowden cables.



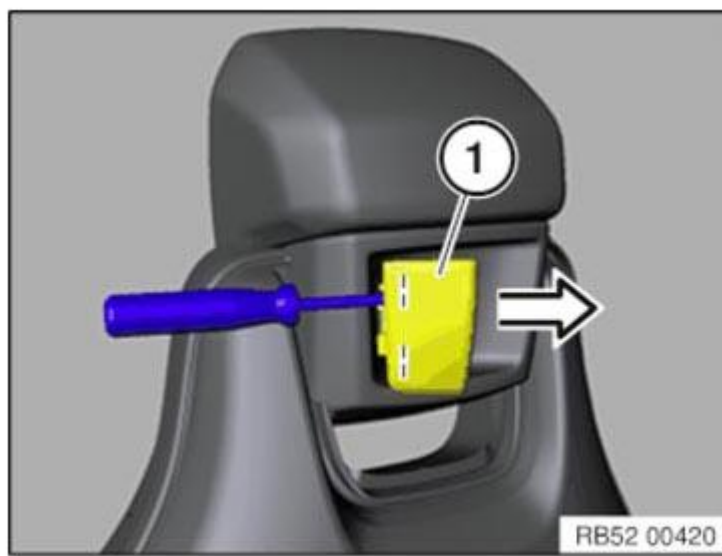
**Fig. 27: Identifying Latch Mechanism And Release Mechanism**

Courtesy of BMW OF NORTH AMERICA, INC.

### **52 13... REMOVING AND INSTALLING/REPLACING TRIM FOR RELEASE MECHANISM**

Pull trim (1) on release handle towards rear and, at the same time, unlock in marked area using screwdriver.

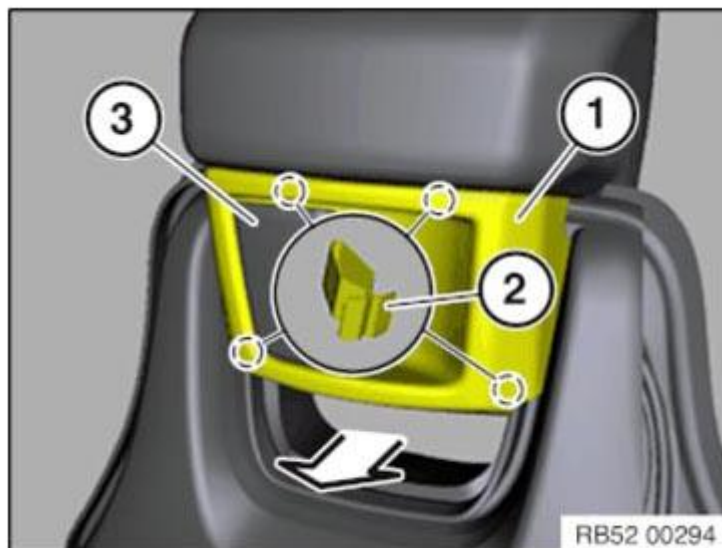
Feed out trim (1) from release handle in direction of arrow.



**Fig. 28: Unlocking Trim From Release Handle Using Screwdriver**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release trim (1) on clamps (2).

Feed out trim (1) from release lever (3) and remove towards rear.

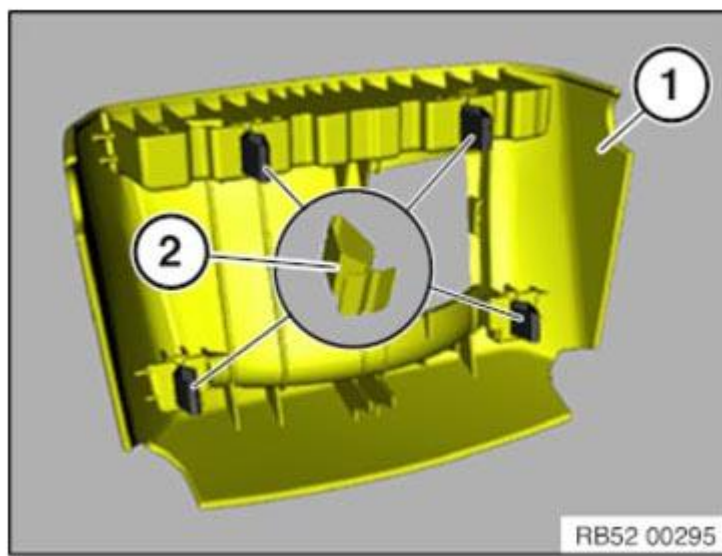


**Fig. 29: Identifying Trim, Clamps And Release Lever**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Clamps (2) on trim (1) must not be damaged or missing.

Replace faulty clamps (2).



**Fig. 30: Identifying Trim With Clamps**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**52 13 017 REMOVING OR INSTALLING/REPLACING SEAT FRAME ON DRIVER'S SEAT**

An airbag module and a pyrotechnical seat belt tensioner are installed in the front seat.  
**IMPORTANT:** Improper handling can lead to triggering of the pyrotechnical seat belt tensioner or side airbag, resulting in injuries.

**Necessary preliminary tasks:**

- Remove **REAR PANEL FROM DRIVER'S SEAT**
- Remove **SEAT COVER FOR DRIVER'S SEAT**

**Version with seat heating only:**

Unlock plug connection (1) for seat heating and disconnect.

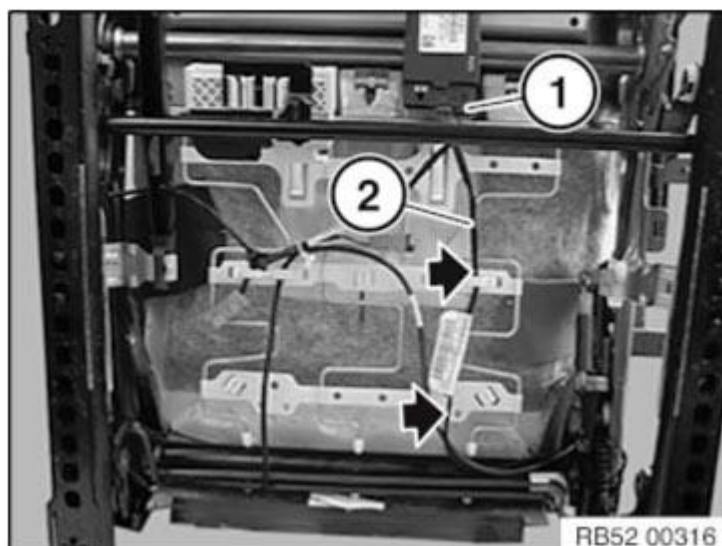
Detach cable strap.

Detach seat heater cable (2) from cable clips on seat mechanism.

*Installation note:*

Plug connection is encoded to prevent incorrect connection.

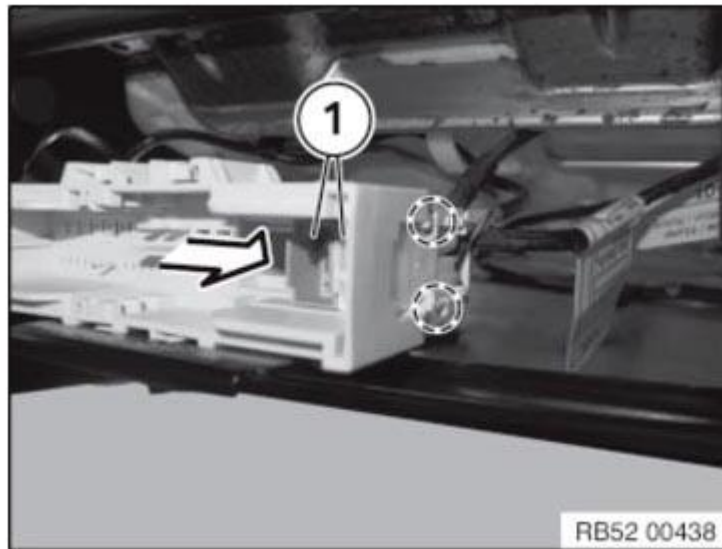
Replace cable strap.





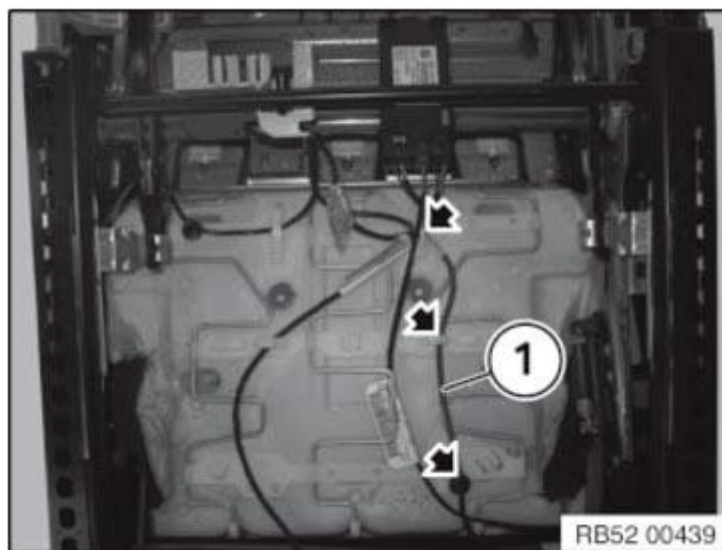
**Fig. 31: Locating Seat Heater Cable Clips On Seat Mechanism**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock connector (1) and pull out of connector housing.



**Fig. 32: Pulling Connector Out Of Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed out cable (1) for side airbag from seat mechanism



**Fig. 33: Locating Side Airbag Cable Clips On Seat Mechanism**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach ball socket (1) from ball head on left and right.

*Installation note:*

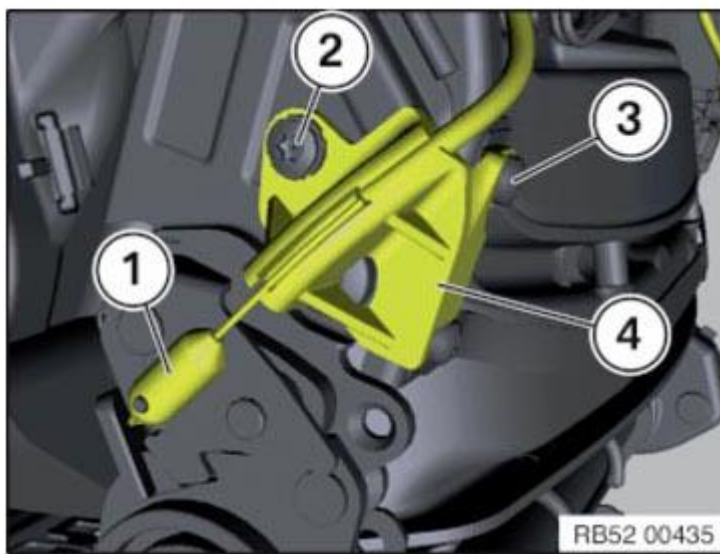
Ball socket (1) must audibly snap into place.

Release expanding rivet (2) on left and right.

Release screws (3) on left and right.

Fold guide (4) with Bowden cable to side.

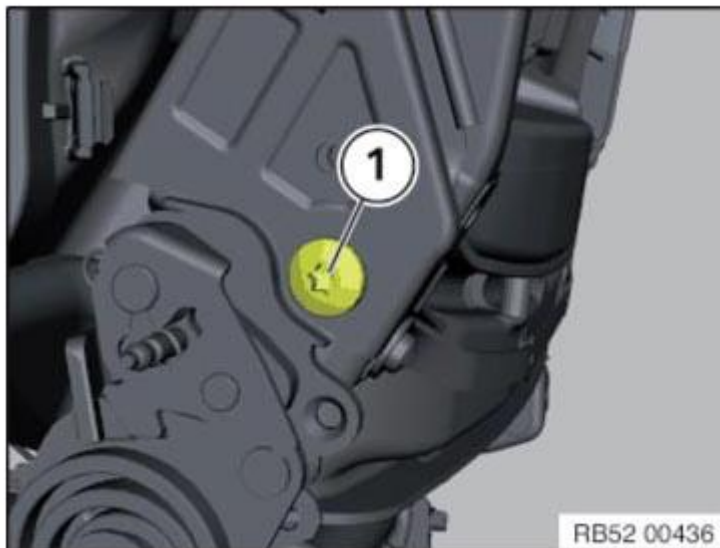




**Fig. 34: Identifying Ball Socket, Expanding Rivet, Guide And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

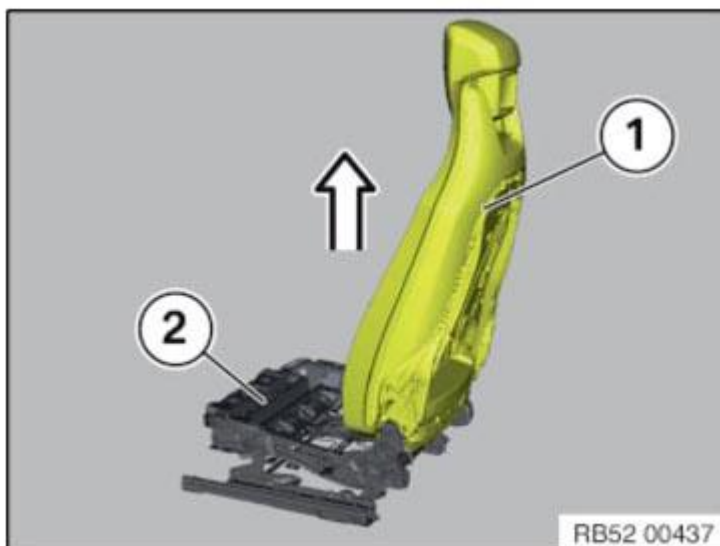
Tightening torque [52 10 2AZ](#) .



**Fig. 35: Identifying Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Feed out complete backrest (1) with upholstery upwards out of seat mechanism (2).



**NOTE: Replacement only:**

- Remove **INNER COVER**
- Removing **FRONT LOWER STRAP**
- Removing **MODULE FOR SEAT HEATING**

**52 13 018 REMOVING OR INSTALLING/REPLACING SEAT FRAME ON FRONT PASSENGER SEAT**

An airbag module and a pyrotechnical seat belt tensioner are installed in the front seat.  
**IMPORTANT:** Improper handling can lead to triggering of the pyrotechnical seat belt tensioner or side airbag, resulting in injuries.

**Necessary preliminary tasks:**

- Remove **REAR PANEL FROM FRONT PASSENGER SEAT**
- Remove **SEAT COVER FOR FRONT PASSENGER SEAT**

**Version with seat heating only:**

Unlock plug connection (1) for seat heating and disconnect.

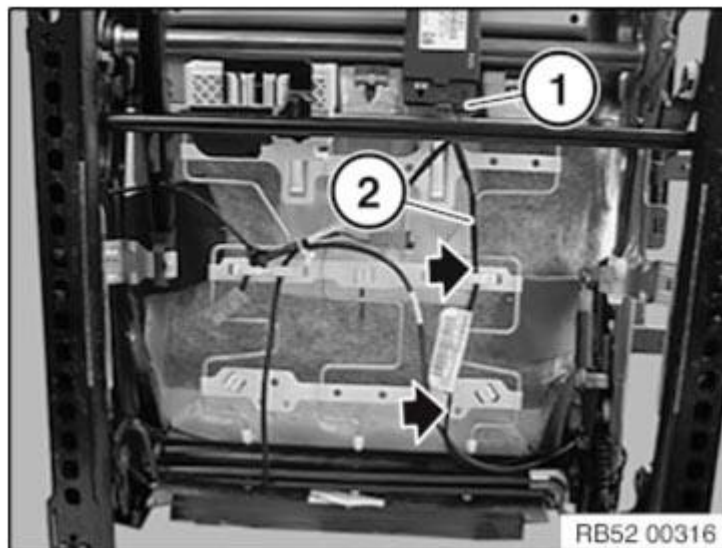
Detach cable strap.

Detach seat heater cable (2) from cable clips on seat mechanism.

*Installation note:*

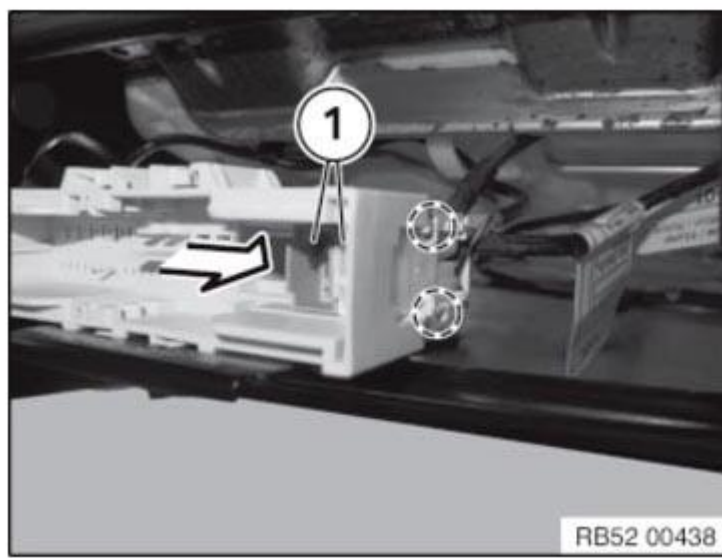
Plug connection is encoded to prevent incorrect connection.

Replace cable strap.



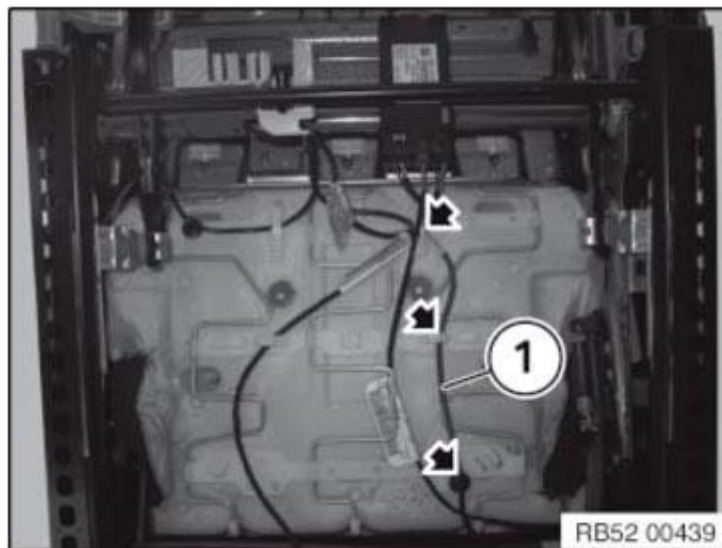
**Fig. 37: Locating Seat Heater Cable Clips On Seat Mechanism**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock connector (1) and pull out of connector housing.



**Fig. 38: Pulling Connector Out Of Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed out cable (1) for side airbag from seat mechanism.



**Fig. 39: Locating Side Airbag Cable Clips On Seat Mechanism**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach ball socket (1) from ball head on left and right.

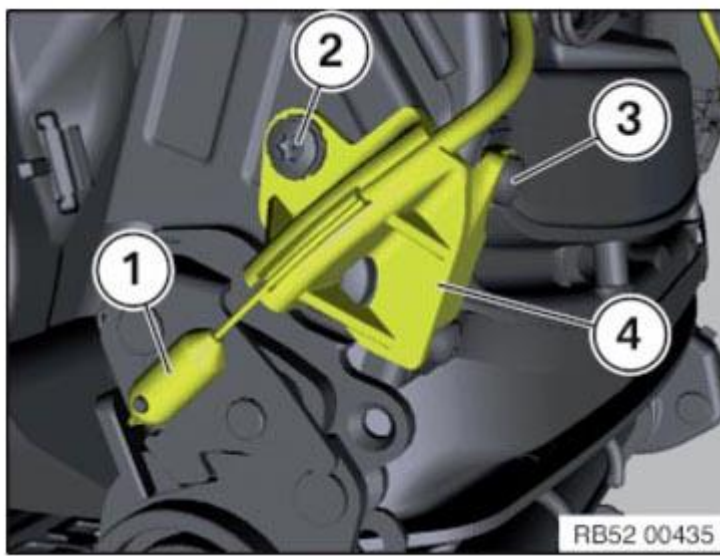
*Installation note:*

Ball socket (1) must audibly snap into place.

Release expanding rivet (2) on left and right.

Release screws (3) on left and right.

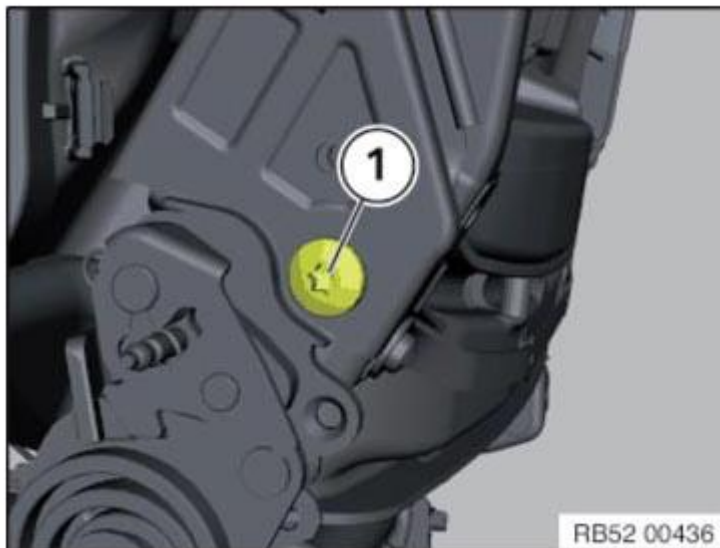
Fold guide (4) with Bowden cable to side.



**Fig. 40: Identifying Ball Socket, Expanding Rivet, Guide And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

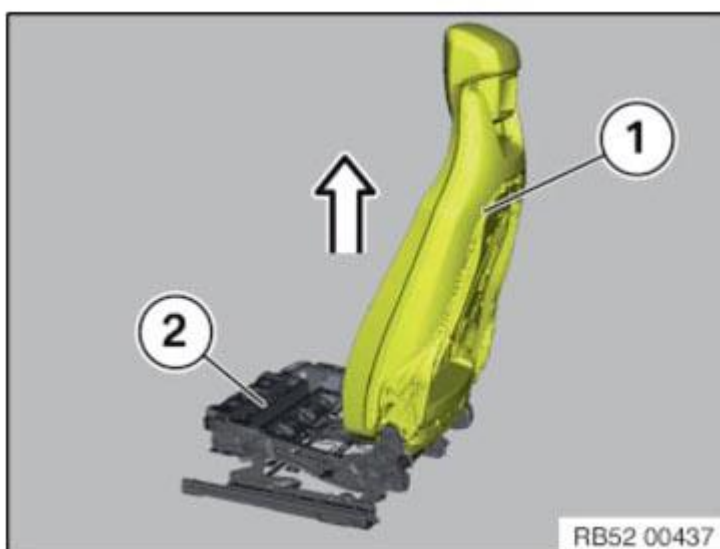
Release screw (1).

Tightening torque [52 10 2AZ](#) .



**Fig. 41: Identifying Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed out complete backrest (1) with upholstery upwards out of seat mechanism (2).



**NOTE: Replacement only:**

- Remove **INNER COVER**
- Removing **FRONT LOWER STRAP**
- Removing **MODULE FOR SEAT HEATING**

**52 13 407 REPLACING BACKREST COVER FOR DRIVER'S SEAT**

**Special tools required:**

- **64 1 020**
- 52 0 050

**Necessary preliminary tasks:**

- Remove **REAR PANEL**
- Remove **HEAD RESTRAINT**

Risk of damage on sharp-edged seat mechanism.  
Guide all cables carefully through seat and backrest mechanism.

**IMPORTANT:** Make sure cable is routed without kinks and tension.  
Make sure plug connections are correctly locked.  
Make sure connectors are correctly seated in latch mechanisms.

**Version with seat heating only:**

Unlock plug connection (1) for seat heating and disconnect.

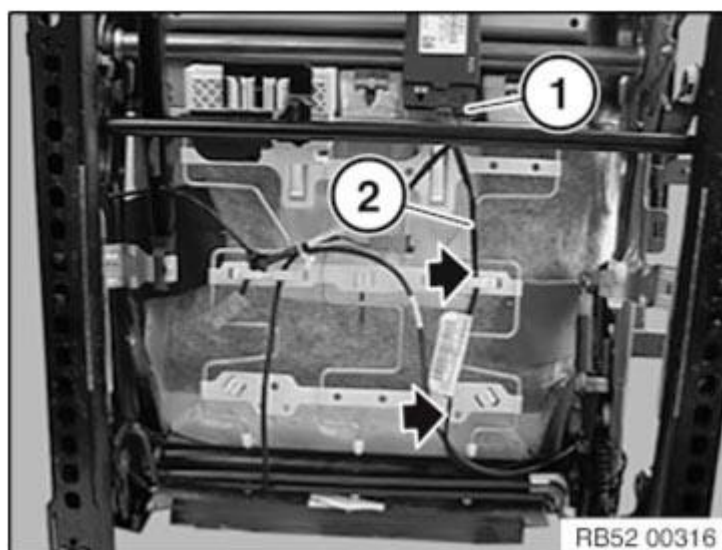
Detach cable strap.

Detach seat heater cable (2) from cable clips on seat mechanism.

*Installation note:*

Plug connection is encoded against incorrect assembly.

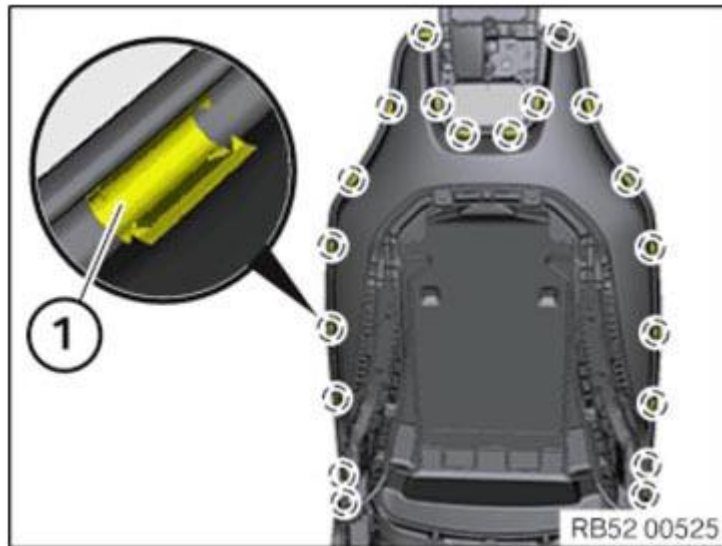
Replace cable strap.



**Fig. 43: Locating Seat Heater Cable Clips On Seat Mechanism**  
Courtesy of BMW OF NORTH AMERICA, INC.



**IMPORTANT:** Risk of damage of the backrest from sharp-edged clamps (1)!  
Clamps (1) must not be removed from backrest frame during disassembly of welt.  
Hold clamps (1) in backrest frame using special tool [64 1 020](#) if necessary.



**Fig. 44: Identifying Clamps On Backrest Frame**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lift welt out of backrest frame.

Carefully slide bracing cloth through backrest gap and seat structure.

If applicable, route cable carefully through seat and backrest mechanics as the edges of the frame may be sharp.

*Installation note:*

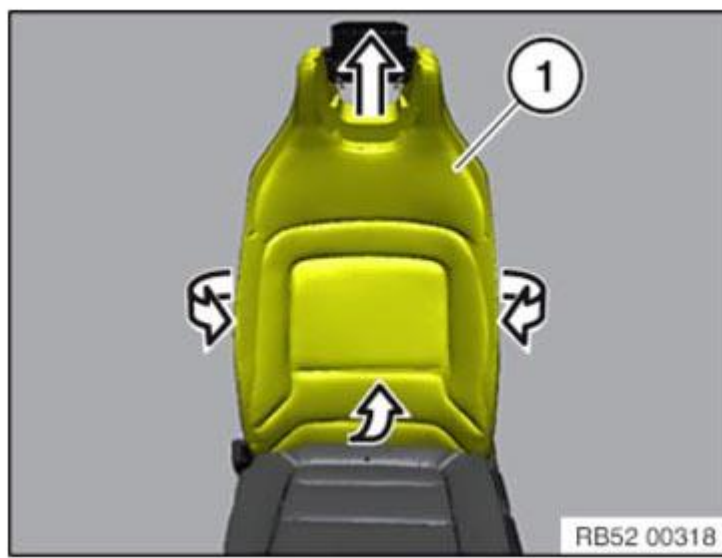
Ensure that the cable and bracing cloths are correctly fitted.



**Fig. 45: Lifting Out Welt From Backrest Frame**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull off backrest cover (1) with upholstery sideways and towards top from backrest frame.





**Fig. 46: Pulling Off Backrest Cover With Upholstery From Backrest Frame**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release all clamps in marked area.

Remove backrest cover from padding.

**NOTE:** Remove all remnants of clamps from backrest cover and upholstery.

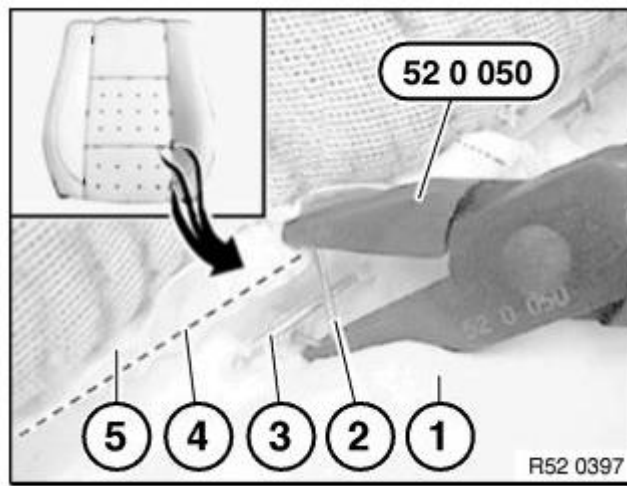


**Fig. 47: Identifying Clamps Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Bend new clamp (2) with special tool 52 0 050.

1. Upholstery
2. Clamp
3. Trim wire in upholstery
4. Trim wire in backrest cover
5. Backrest cover



**Fig. 48: Bending Clamp With Special Tool (52 0 050).**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement only:**

Pull trim wires out of backrest cover.

Cut new backrest cover to size and insert trim wires.



**Fig. 49: Identifying Trim Wires Area**

Courtesy of BMW OF NORTH AMERICA, INC.

**52 13 408 REPLACING BACKREST COVER FOR FRONT PASSENGER SEAT**

**Special tools required:**

- **64 1 020**
- 52 0 050

**Necessary preliminary tasks:**

- Remove **REAR PANEL**
- Remove **HEAD RESTRAINT**

Risk of damage on sharp-edged seat mechanism.  
Guide all cables carefully through seat and backrest mechanism.

**IMPORTANT:** Make sure cable is routed without kinks and tension.

Make sure plug connections are correctly locked.

Make sure connectors are correctly seated in latch mechanisms.

**Version with seat heating only:**

Unlock plug connection (1) for seat heating and disconnect.

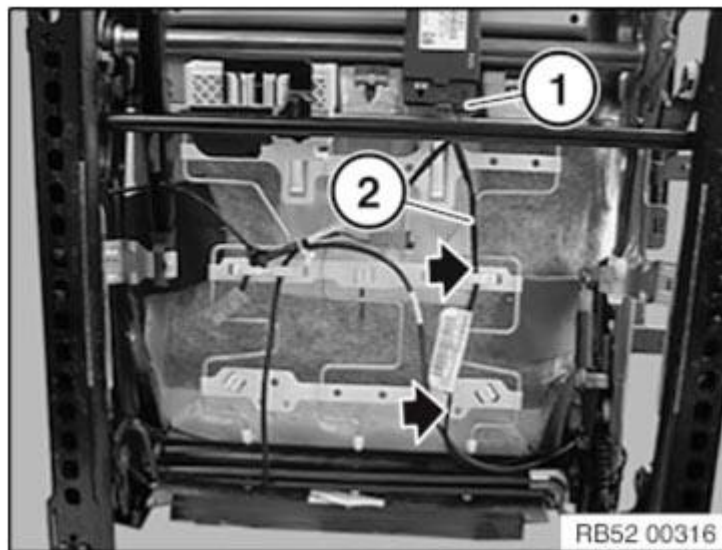
Detach cable strap.

Detach seat heater cable (2) from cable clips on seat mechanism.

*Installation note:*

Plug connection is encoded against incorrect assembly.

Replace cable strap.



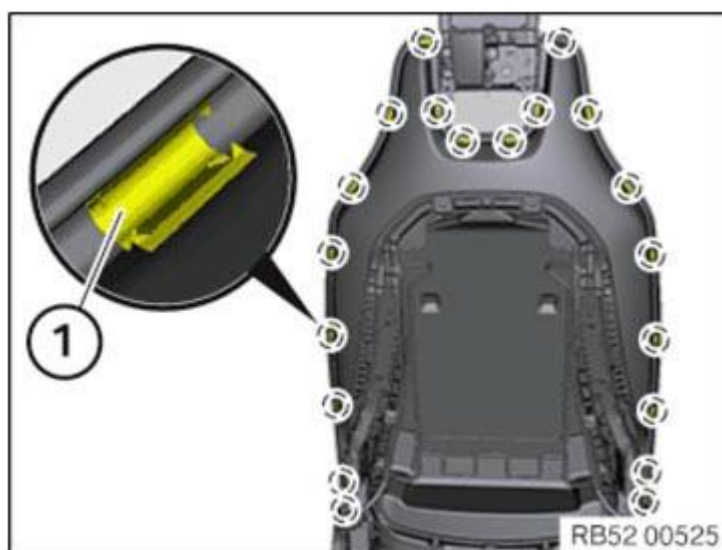
**Fig. 50: Locating Seat Heater Cable Clips On Seat Mechanism**

Courtesy of BMW OF NORTH AMERICA, INC.

Risk of damage of the backrest from sharp-edged clamps (1)!

IMPORTANT: Clamps (1) must not be removed from backrest frame during disassembly of welt.

Hold clamps (1) in backrest frame by means of special tool [64 1 020](#) , if necessary.



**Fig. 51: Identifying Clamps On Backrest Frame**

Courtesy of BMW OF NORTH AMERICA, INC.

Lift welt out of backrest frame.

Carefully slide bracing cloth through backrest gap and seat structure.

If applicable, route cable carefully through seat and backrest mechanics as the edges of the frame may be sharp.

*Installation note:*

Ensure that the cable and bracing cloths are correctly fitted.



**Fig. 52: Lifting Out Welt From Backrest Frame**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull off backrest cover (1) with upholstery sideways and towards top from backrest frame.



**Fig. 53: Pulling Off Backrest Cover With Upholstery From Backrest Frame**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release all clamps in marked area.

Remove backrest cover from padding.

**NOTE:** Remove all remnants of clamps from backrest cover and upholstery.



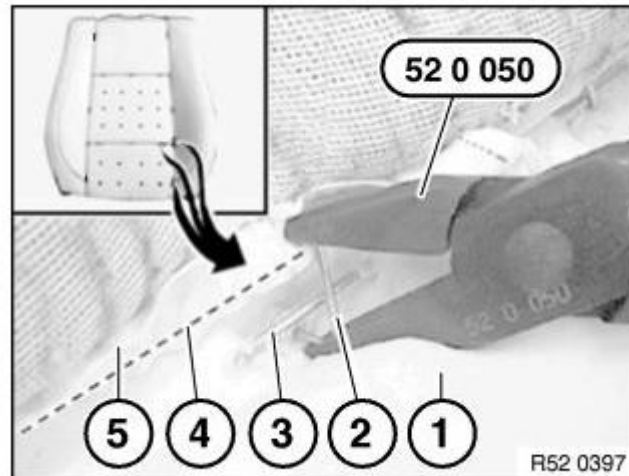
**Fig. 54: Identifying Clamps Area**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Bend new clamp (2) with special tool 52 0 050.

1. Upholstery
2. Clamp
3. Trim wire in upholstery
4. Trim wire in backrest cover
5. Backrest cover



**Fig. 55: Bending Clamp With Special Tool (52 0 050)**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement only:**

Pull trim wires out of backrest cover.

Cut new backrest cover to size and insert trim wires.



**Fig. 56: Identifying Trim Wires Area**

Courtesy of BMW OF NORTH AMERICA, INC.

### **52 13 412 REPLACING SEAT AND BACKREST COVER FOR DRIVER'S SEAT**

Operations are described in:

- Replacing **SEAT COVER FOR DRIVER'S SEAT**
- Replacing **BACKREST COVER FOR DRIVER'S SEAT**

### **52 13 413 REPLACING SEAT AND BACKREST COVER FOR FRONT PASSENGER SEAT**

Operations are described in:

- Replacing **SEAT COVER FOR FRONT PASSENGER SEAT**
- Replacing **BACKREST COVER FOR FRONT PASSENGER SEAT**

### **52 13 402 REPLACING SEAT COVER FOR DRIVER'S SEAT**

Special tools required:

- 52 0 050

Necessary preliminary tasks:

- Remove **FRONT SEAT ON THE DRIVER'S SIDE**
- Remove **OUTER COVER ON FRONT SEAT**

**WARNING:** Note **AIRBAG SAFETY REGULATIONS !**  
Incorrect handling can activate airbag and cause injury.

Risk of damage on sharp-edged seat mechanism.  
Guide all cables carefully through seat and backrest mechanism.  
IMPORTANT: Make sure cable is routed without kinks and tension.  
Make sure plug connections are correctly locked.  
Make sure connectors are correctly seated in latch mechanisms.

**Version with seat heating only:**

Unlock plug connection (1) for seat heating and disconnect.

Detach cable strap.

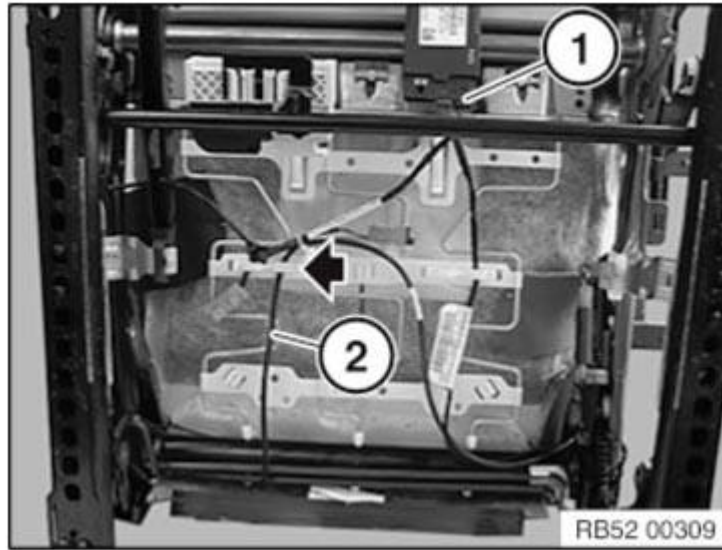
Detach seat heater cable (2) from cable clips on seat mechanism.



*Installation note:*

Plug connection is encoded to prevent incorrect connection.

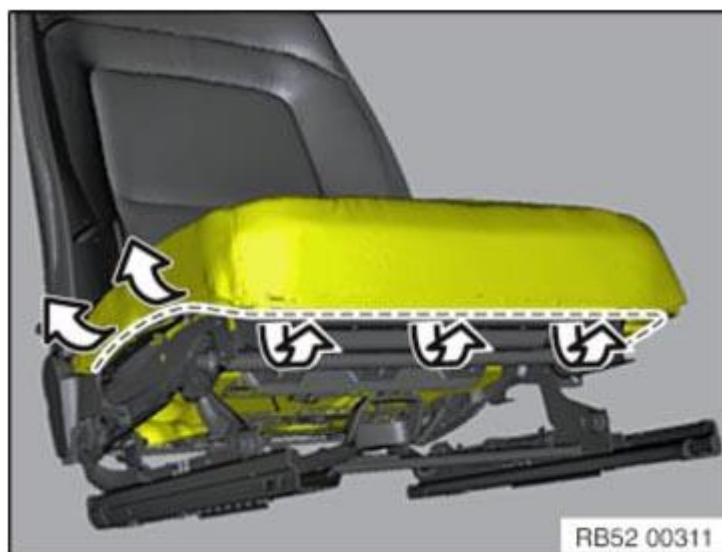
Replace cable strap.



**Fig. 57: Locating Seat Heater Cable Clips On Seat Mechanism**

Courtesy of BMW OF NORTH AMERICA, INC.

Fully lift welt of seat cover out of seat frame.



**Fig. 58: Lifting Welt Of Seat Cover Out Of Seat Frame**

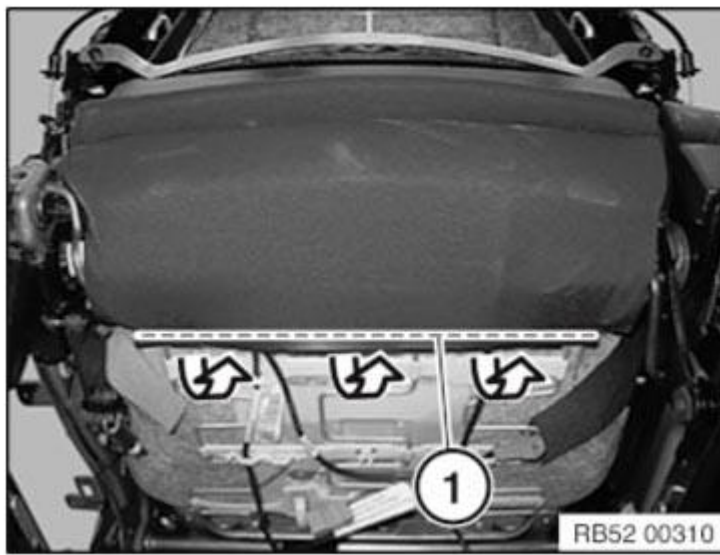
Courtesy of BMW OF NORTH AMERICA, INC.

Lift out the welt bracing cloths in the marked area in the rear.

Carefully slide bracing cloth (1) through backrest gap and seat structure.

*Installation note:*

Ensure correct installation of the bracing cloth.



**Fig. 59: Lifting Out Welt Bracing Cloths**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove seat cover (1) with padding towards front/top.

If applicable, route cable carefully through seat and backrest mechanics as the edges of the frame may be sharp.



**Fig. 60: Removing Seat Cover With Padding**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release all clamps (1) from seat cover (2).



**Fig. 61: Identifying Seat Cover And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release all clamps in marked area of trim wires.

Remove seat cover from upholstery.

**IMPORTANT:** Remove all remnants of clamps from seat cover and upholstery.



**Fig. 62: Identifying Trim Wires Clamps Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement only:**

If applicable, pull trim wires out of seat cover.

Cut new seat cover to size and insert trim wires.

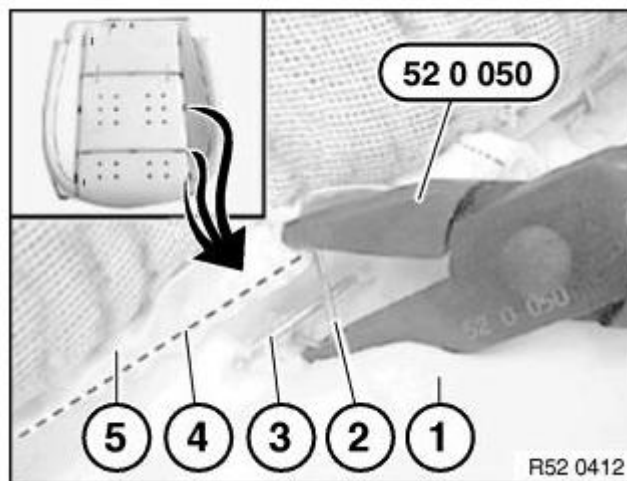


**Fig. 63: Identifying Trim Wires Area In Seat Cover**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Bend new clamps (2) with special tool 52 0 050.

1. Upholstery
2. Clamp
3. Trim wire in upholstery
4. Trim wire in cover
5. Seat cover



**Fig. 64: Bending Clamps With Special Tool (52 0 050)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **52 13 403 REPLACING SEAT COVER FOR FRONT PASSENGER SEAT**

**Special tools required:**

- 52 0 050

**Necessary preliminary tasks:**

- Remove **FRONT PASSENGER SIDE SEAT**
- Remove **OUTER COVER** on front seat

**WARNING:** Note **AIRBAG SAFETY REGULATIONS**  
 Incorrect handling can activate airbag and cause injury.

Risk of damage on sharp-edged seat mechanism.  
Guide all cables carefully through seat and backrest mechanism.  
**IMPORTANT:** Make sure cable is routed without kinks and tension.  
Make sure plug connections are correctly locked.  
Make sure connectors are correctly seated in latch mechanisms.

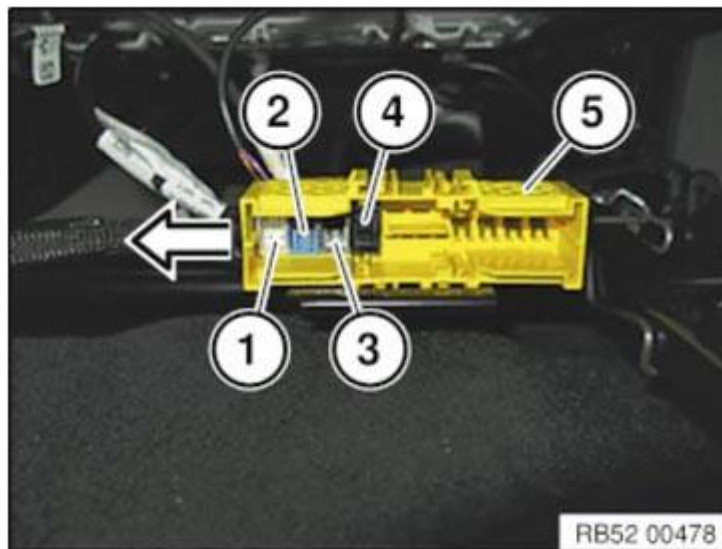
**WARNING:** **US and Canadian version of the front passenger seat (with CIS mat):**  
**The CIS mat is bonded to the entire surface of the facing and can only be removed in conjunction with the padding from the seat cover.**  
**If CIS mat or padding is defective, both parts may only be replaced together.**  
**Full functional capability can only be guaranteed with original BMW spare parts.**  
**After installation, the CIS mat must be enabled using the [BMW PROGRAMMING SYSTEM](#) .**

**US and Canadian version of the passenger seat (with CIS mat):**

Unlock connector housing (1 to 4) and pull out of connector housing (5) in direction of arrow.

*Installation note:*

Connectors are encoded against incorrect assembly.



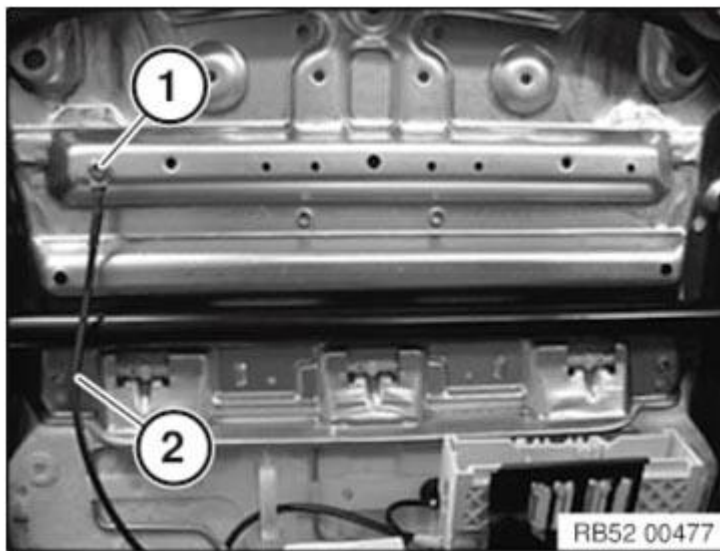
**Fig. 65: Unlocking Connector Housing**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

**US and Canadian version (with CIS mat):**

Loosen bolting point (1) of ground cable on seat frame.

Feed out ground cable (2) from seat frame.

Release associated clips if necessary.



**Fig. 66: Identifying Ground Cable And Bolting Point**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with seat heating only:**

Unlock plug connection (1) for seat heating and disconnect.

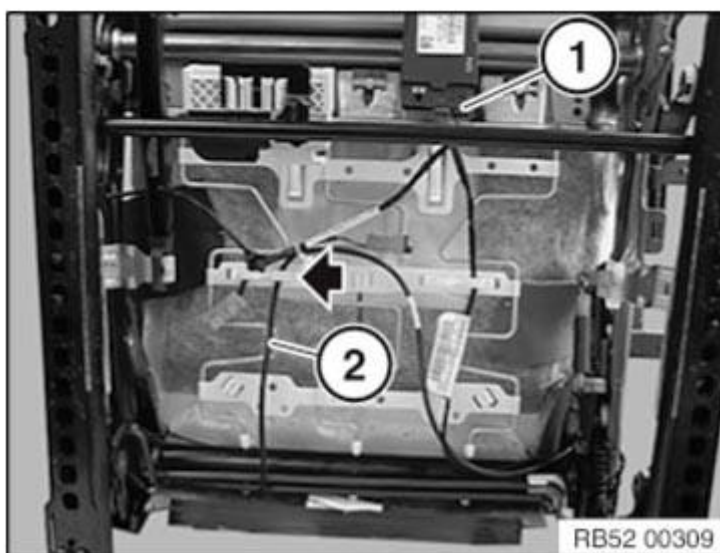
Detach cable strap.

Detach seat heater cable (2) from cable clips on seat mechanism.

*Installation note:*

Plug connection is encoded to prevent incorrect connection.

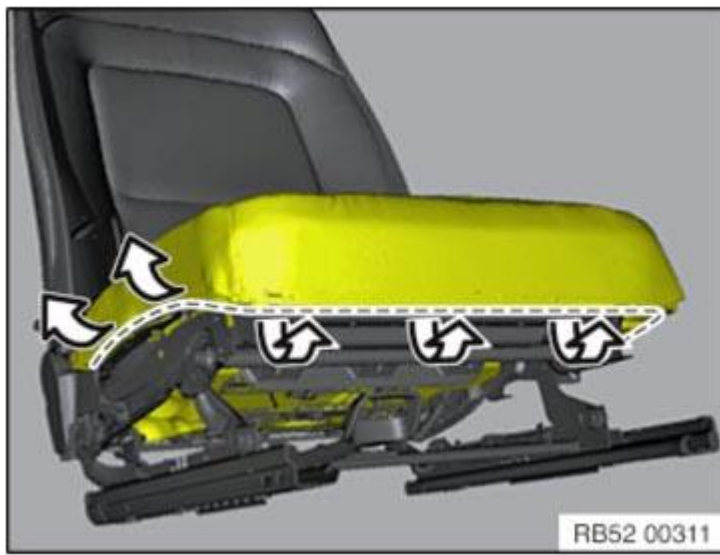
Replace cable strap.



**Fig. 67: Locating Seat Heater Cable Clips On Seat Mechanism**  
Courtesy of BMW OF NORTH AMERICA, INC.

Fully lift welt of seat cover out of seat frame.





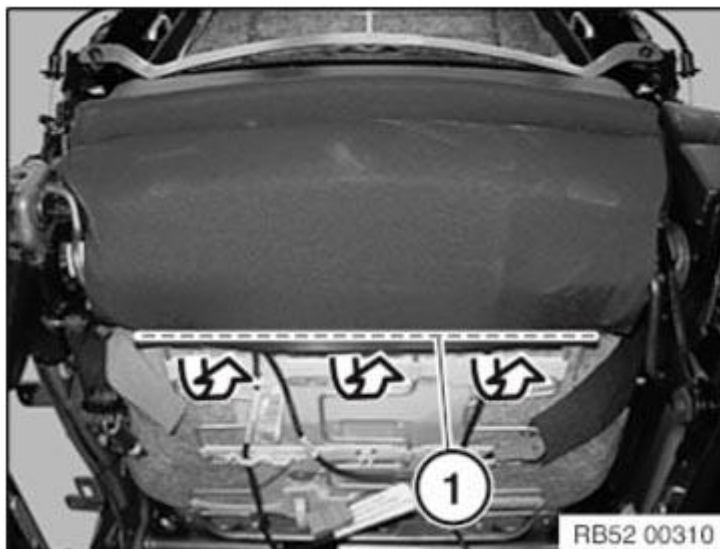
**Fig. 68: Lifting Welt Of Seat Cover Out Of Seat Frame**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lift out the welt bracing cloths in the marked area in the rear.

Carefully slide bracing cloth (1) through backrest gap and seat structure.

*Installation note:*

Ensure correct installation of the bracing cloth.



**Fig. 69: Lifting Out Welt Bracing Cloths**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove seat cover (1) with padding towards front/top.

If applicable, route cable carefully through seat and backrest mechanics as the edges of the frame may be sharp.



**Fig. 70: Removing Seat Cover With Padding**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release all clamps (1) from seat cover (2).



**Fig. 71: Identifying Seat Cover And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release all clamps in marked area of trim wires.

Remove seat cover from upholstery.

**IMPORTANT:** Remove all remnants of clamps from seat cover and upholstery.



**Fig. 72: Identifying Trim Wires Clamps Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement only:**

If applicable, pull trim wires out of seat cover.

Cut new seat cover to size and insert trim wires.

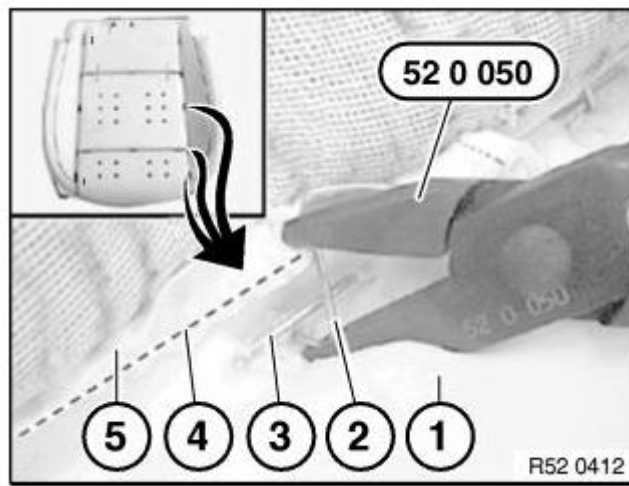


**Fig. 73: Identifying Trim Wires Area In Seat Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Bend new clamps (2) with special tool 52 0 050.

1. Upholstery
2. Clamp
3. Trim wire in upholstery
4. Trim wire in cover
5. Seat cover



**Fig. 74: Bending Clamps With Special Tool (52 0 050)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

**Enabling seat occupancy detector (CIS mat):**

- Connect **BMW PROGRAMMING SYSTEM**
- Encode airbag control unit
- Delete fault memory if necessary

### **52 13 418 REPLACING UPHOLSTERY FOR FRONT PASSENGER SEAT**

**WARNING:** US and Canadian version of the front passenger seat (with CIS mat):  
 The CIS mat is bonded to the entire surface of the facing and can only be removed in conjunction with the padding from the seat cover.  
 If CIS mat or padding is defective, both parts may only be replaced together.  
 Full functional capability can only be guaranteed with original BMW spare parts.  
 After installation, the CIS mat must be enabled with the **BMW PROGRAMMING SYSTEM** .

**Operation is described in:**

- Replacing **SEAT COVER FOR FRONT PASSENGER SEAT**

**Enabling seat occupancy detector (CIS mat):**

- Connect **BMW PROGRAMMING SYSTEM**
- Encode airbag control unit
- Delete fault memory if necessary

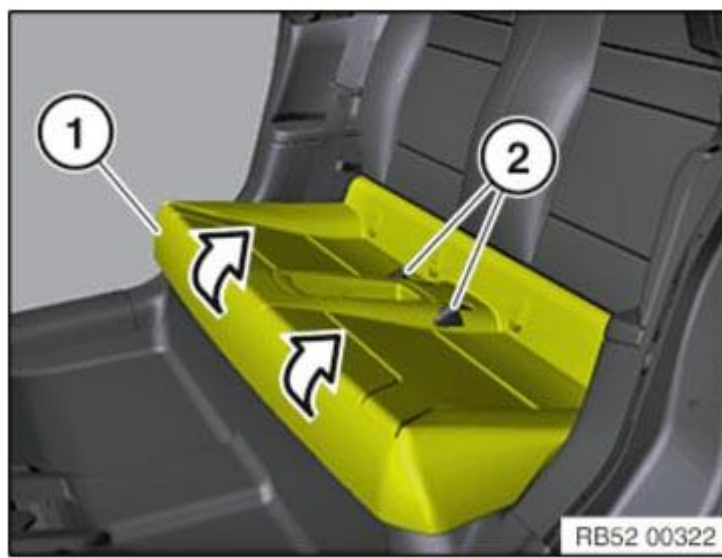
## **REAR SEAT**

### **52 26 005 REMOVING AND INSTALLING/REPLACING REAR SEAT**

Unclip rear seat (1) upwards on left and right.

*Installation note:*

Feed seat belt buckles (2) into recesses in rear seat.



**Fig. 75: Removing Rear Seat**

Courtesy of BMW OF NORTH AMERICA, INC.

**52 26... REMOVING AND INSTALLING/REPLACING ALL GUIDE SLEEVES FOR REAR HEAD RESTRAINTS**

**Special tools required:**

- [52 0 070](#)

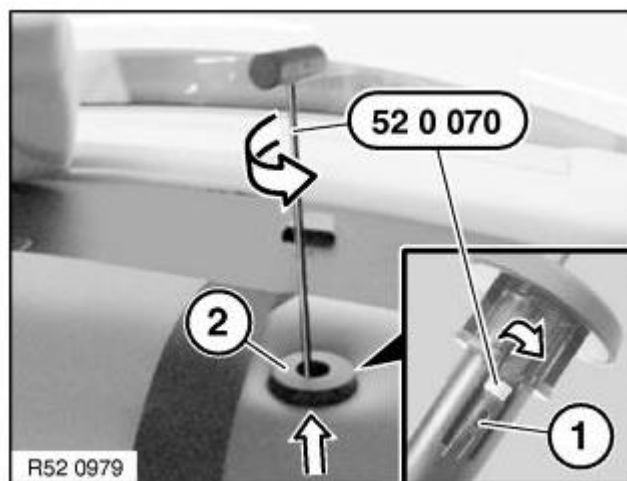
**Necessary preliminary tasks:**

- Remove **HEAD RESTRAINT** from rear seat

Insert special tool [52 0 070](#) into guide hole of sleeve (2) up to upper area of retaining lug.

Feed release tongue of special tool into rear gap on retaining lug (1).

Turn tool to release sleeve (2) and pull out by lifting upwards.



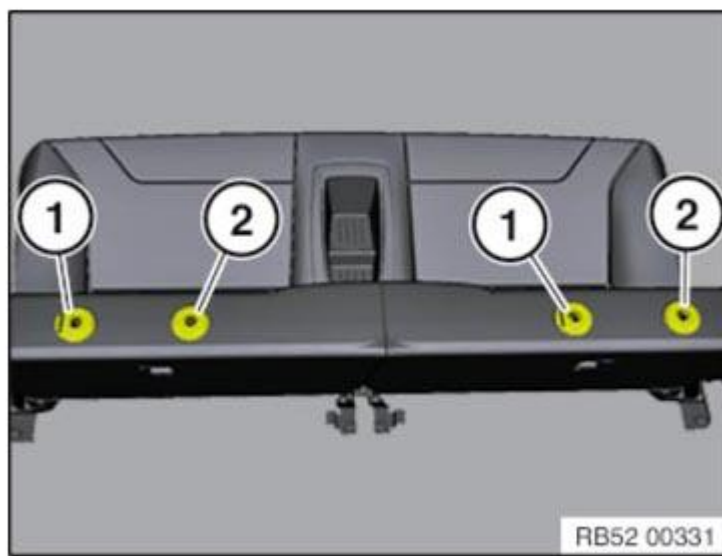
**Fig. 76: Inserting Special Tool (52 0 070) Into Guide Hole Of Sleeve**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace guide sleeves and install as follows:

1. Guide sleeves with lock
2. Guide sleeves without lock



**Fig. 77: Identifying Guide Sleeves With/Without Lock**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**52 26 011 REMOVING AND INSTALLING/REPLACING BACKREST FOR LEFT REAR SEAT**

**Necessary preliminary tasks:**

- Remove **REAR SEAT**
- Remove luggage compartment floor trim panel
- Remove storage shelf

*Installation note:*

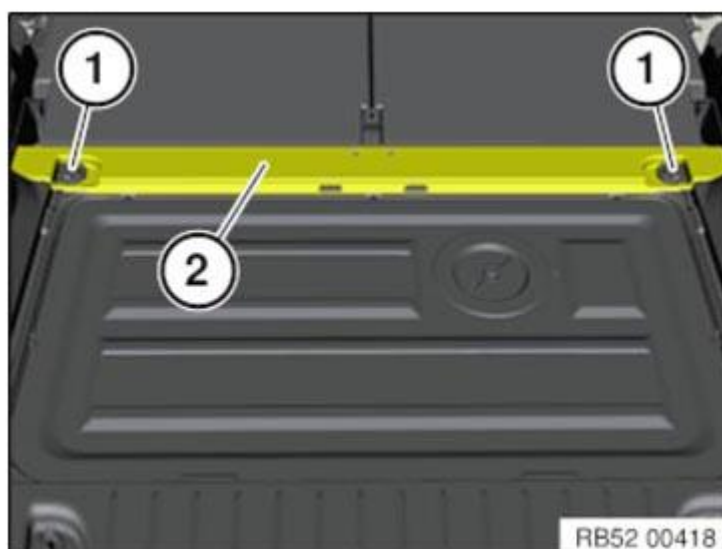
- Microencapsulated screws must be coated with Loctite if they are to be reused
- Screw connection must be completed within 20 mins. (start of curing)
- Microencapsulated screws must **not** be retightened
- Thread of nut must be cleaned beforehand in event of repeated use

Unclip covers (1) and loosen the screws underneath.

Tightening torque **51 47 1AZ** .

Remove the lashing eyes.

Remove cross member trim panel (2) upwards.

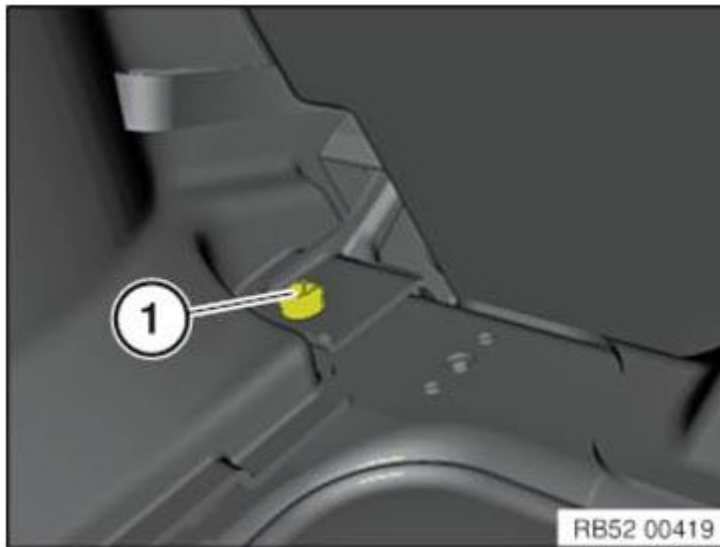




**Fig. 78: Identifying Cross Member Trim Panel And Covers**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque [52 26 1AZ](#) .



**Fig. 79: Identifying Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque [52 26 1AZ](#) .

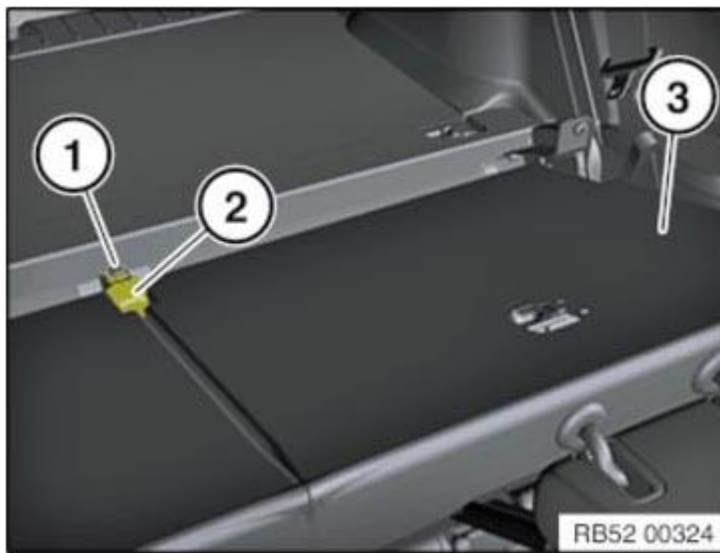


**Fig. 80: Identifying Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Loosen the screw (1) and remove the lid (2).

Tightening torque [52 26 2AZ](#) .

Remove backrest (3).



**Fig. 81: Identifying Backrest, Lid And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**52 26 012 REMOVING AND INSTALLING/REPLACING BACKREST FOR RIGHT REAR SEAT**

**Necessary preliminary tasks:**

- Remove **REAR SEAT**
- Remove luggage compartment floor trim panel
- Remove storage shelf

*Installation note:*

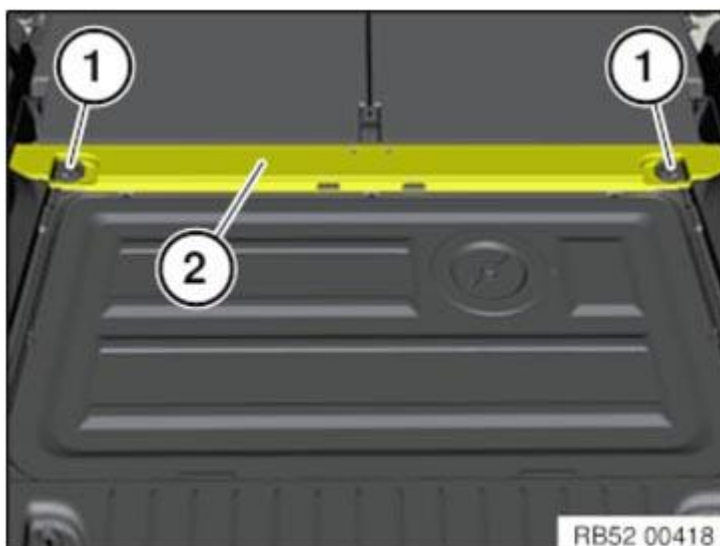
- Microencapsulated screws must be coated with Loctite if they are to be reused
- Screw connection must be completed within 20 mins. (start of curing)
- Microencapsulated screws must **not** be retightened
- Thread of nut must be cleaned beforehand in event of repeated use

Unclip covers (1) and loosen the screws underneath.

Tightening torque **51 47 1AZ**.

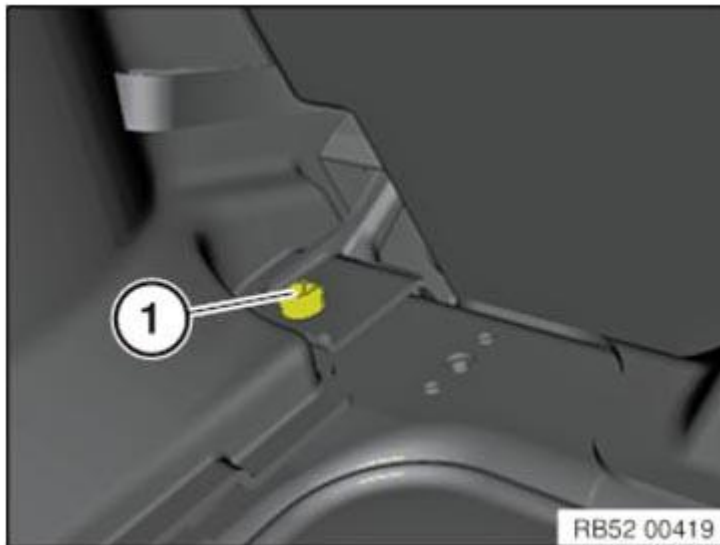
Remove the lashing eyes.

Remove cross member trim panel (2) upwards.



**Fig. 82: Identifying Cross Member Trim Panel And Covers**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).



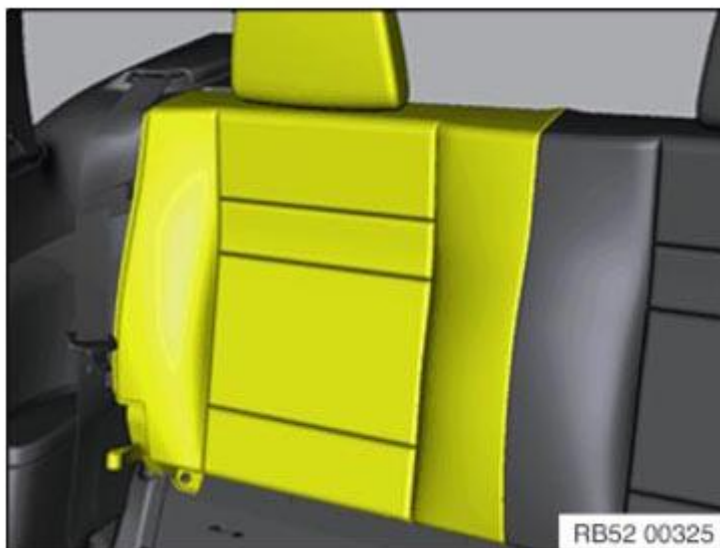
**Fig. 83: Identifying Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

*Installation note:*

Replace screw (1).

Tightening torque **52 26 1AZ** .



**Fig. 84: Identifying Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

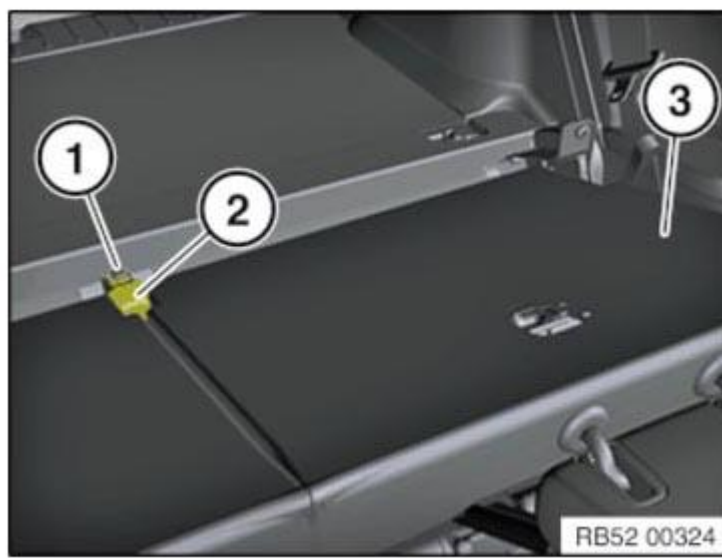
Release screw (2) and remove holder (2).

Remove backrest (3).

*Installation note:*

Replace screw (1).

Tightening torque **52 26 1AZ** .

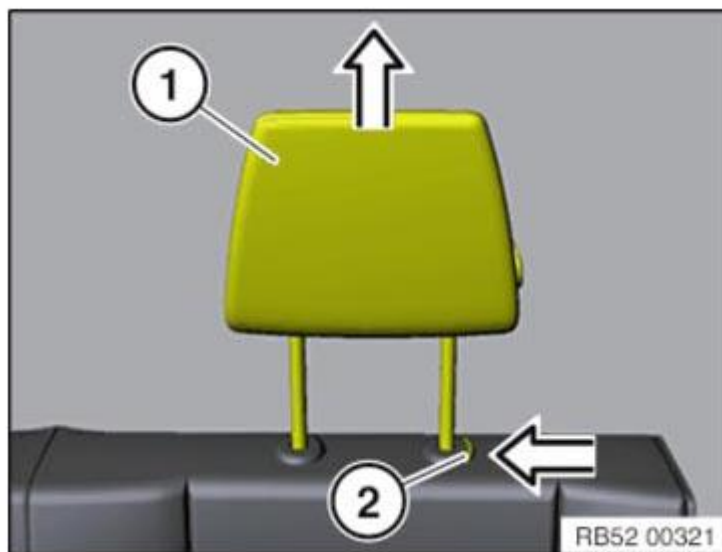


**Fig. 85: Identifying Backrest, Lid And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**52 26 210 REMOVING AND INSTALLING/REPLACING HEADREST FOR LEFT OR RIGHT REAR SEAT**

Fold the rear seat backrest forward and adjust the headrest (1) to the maximum top position.

Press lock (2) and pull upwards and out head restraint (1).



**Fig. 86: Removing Rear Seat Headrest**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**52 26 411 REPLACING BACKREST COVER FOR LEFT REAR SEAT**

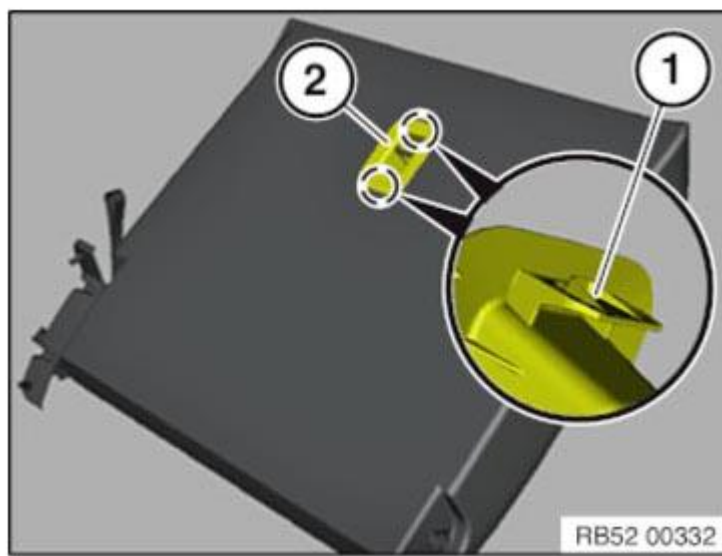
**Special tools required:**

- **64 1 020**
- 52 0 050

**Necessary preliminary tasks:**

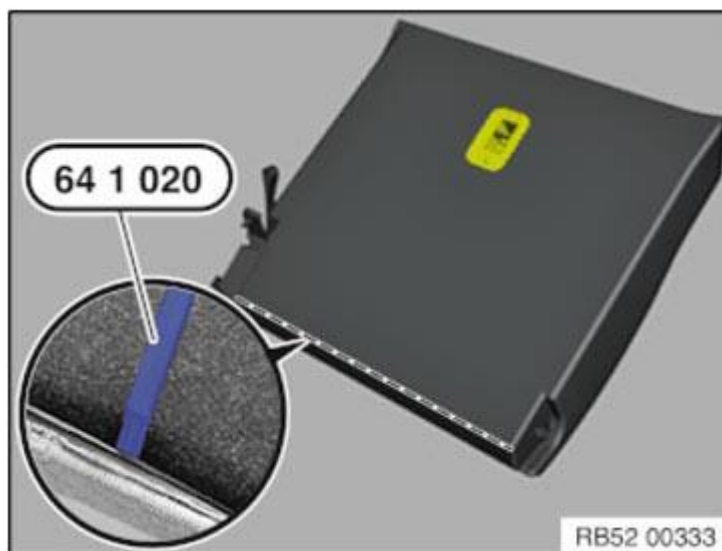
- Remove left **BACKREST**
- Remove **GUIDE SLEEVES** on left

Unlock retaining lugs (1) and remove cover (2).



**Fig. 87: Identifying Cover And Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pry out welt in marked area using special tool [64 1 020](#) .



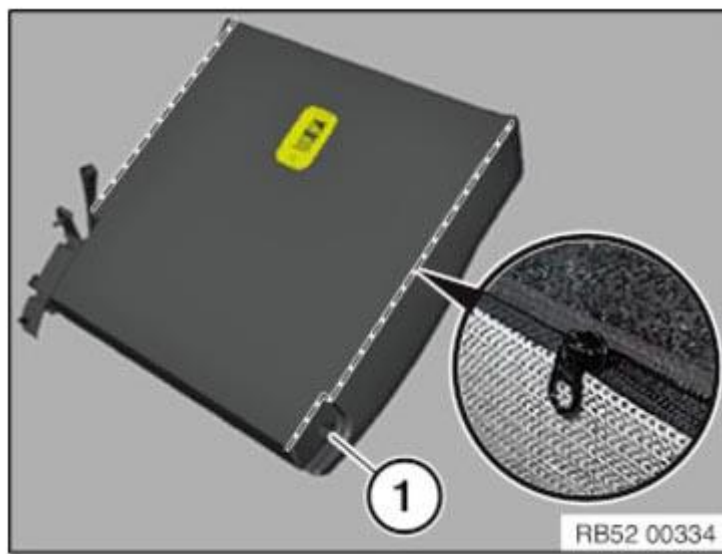
**Fig. 88: Levering Out Welt In Marked Area Using Special Tool (64 1 020)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open zip fasteners on left and right.

Feed out backrest cover from bearing (1) and completely remove together with upholstery from backrest frame.

*Installation note:*

Make sure zip fastener ends are correctly laid.



**Fig. 89: Identifying Bearing**

Courtesy of BMW OF NORTH AMERICA, INC.

**Detaching cover and upholstery:**

- Separate all clamps on trim wires
- Remove cover from upholstery
- Remove remaining clamps from cover and upholstery

**Replacing cover:**

- Remove all trim wires from cover
- If necessary, cut pockets in new cover for trim wires
- Push trim wires into cover pockets



**Fig. 90: Identifying Trim Wires And Clamps Area (Marked Area)**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

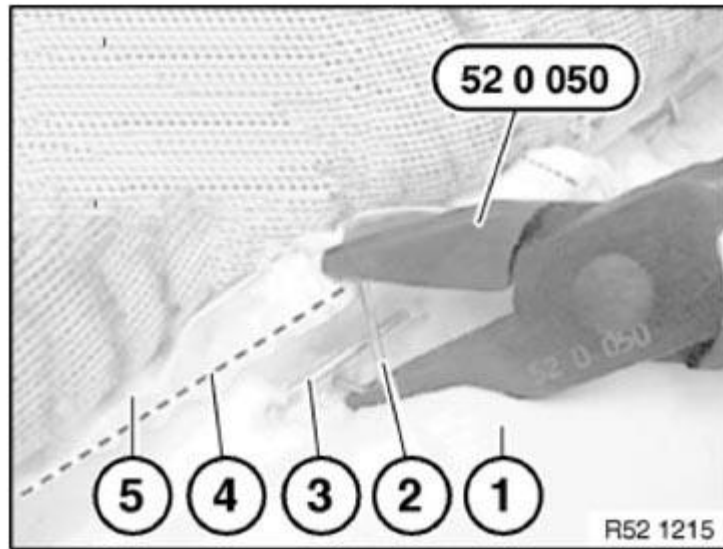
Insert new clamp (2) with special tool 52 0 050.

In so doing, enclose wire in padding and trim wire of cover and bend closed.

1. Upholstery
2. Clamp
3. Trim wire in upholstery



4. Trim wire in seat cover
5. Backrest cover



**Fig. 91: Inserting Clamp With Special Tool (52 0 050)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **52 26 412 REPLACING BACKREST COVER FOR RIGHT REAR SEAT**

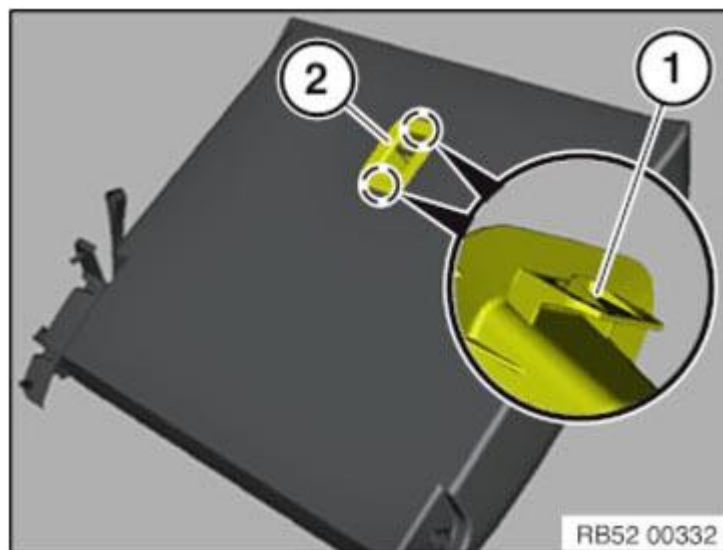
**Special tools required:**

- **64 1 020**
- 52 0 050

**Necessary preliminary tasks:**

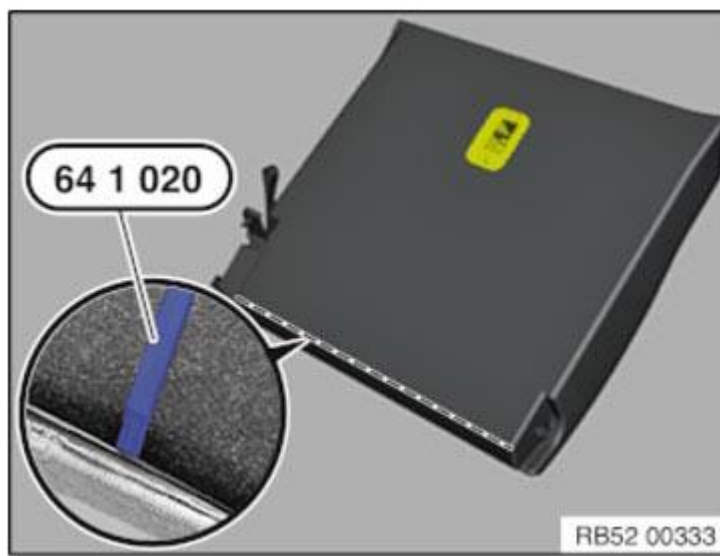
- Remove right **BACKREST**
- Remove **GUIDE SLEEVES** on right

Unlock retaining lugs (1) and remove cover (2).



**Fig. 92: Identifying Cover And Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

Using special tool **64 1 020** , lift out welt in marked area.



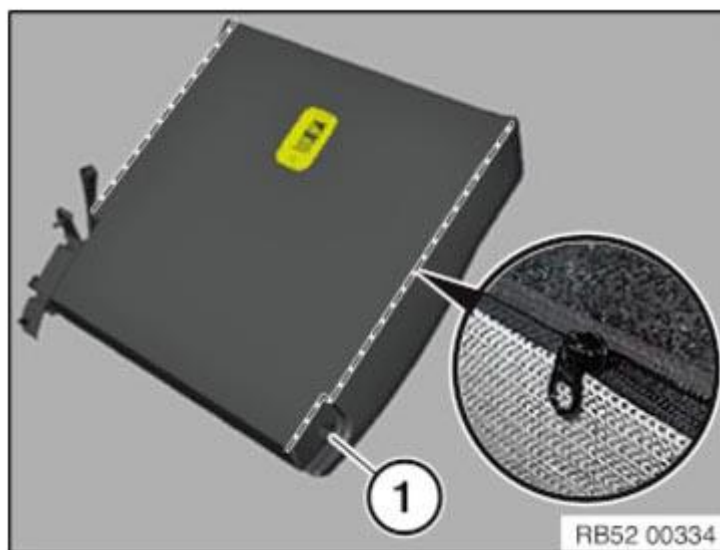
**Fig. 93: Levering Out Welt In Marked Area Using Special Tool (64 1 020)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Open zip fasteners on left and right.

Feed out backrest cover from bearing (1) and completely remove together with upholstery from backrest frame.

*Installation note:*

Make sure zip fastener ends are correctly laid.



**Fig. 94: Identifying Bearing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Detaching cover and upholstery:**

- Separate all clamps on trim wires
- Remove cover from upholstery
- Remove remaining clamps from cover and upholstery

**Replacing cover:**

- Remove all trim wires from cover
- If necessary, cut pockets in new cover for trim wires
- Push trim wires into cover pockets

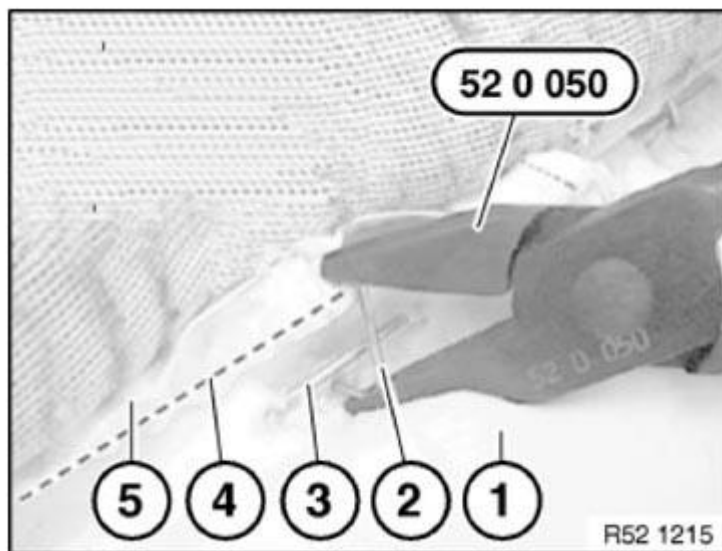


**Fig. 95: Identifying Trim Wires And Clamps Area (Marked Area)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Insert new clamp (2) with special tool 52 0 050 and bend closed.

1. Upholstery
2. Clamp
3. Trim wire in upholstery
4. Trim wire in backrest cover
5. Backrest cover



**Fig. 96: Inserting Clamp With Special Tool (52 0 050)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **52 26 400 REPLACING SEAT COVER FOR REAR SEAT**

**Special tools required:**

- 52 0 050

**Necessary preliminary tasks:**

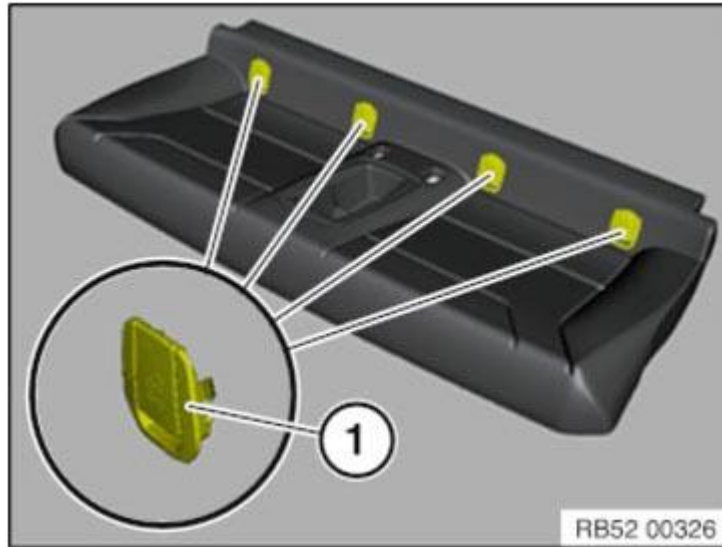
- Remove **REAR SEAT**

Unclip ISOFIX cover cap.

*Installation note:*

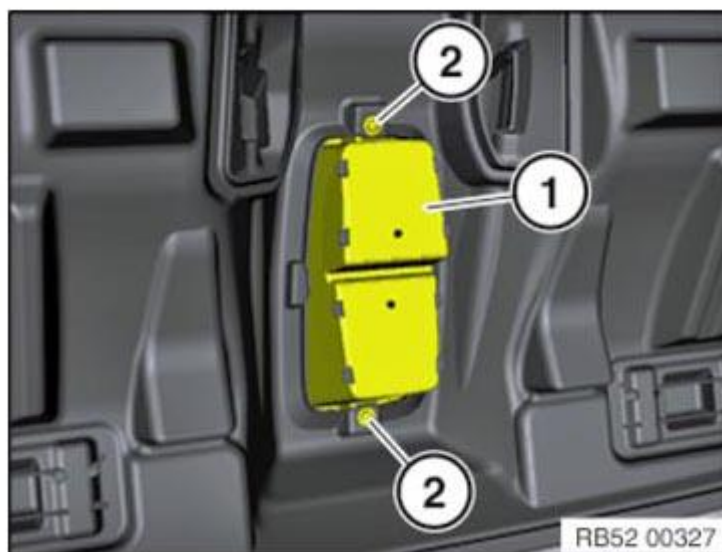
Pull cover straps through foam part into Isofix openings.

Make sure Isofix protective caps are correctly engaged.



**Fig. 97: Identifying ISOFIX Cover Caps**  
Courtesy of BMW OF NORTH AMERICA, INC.

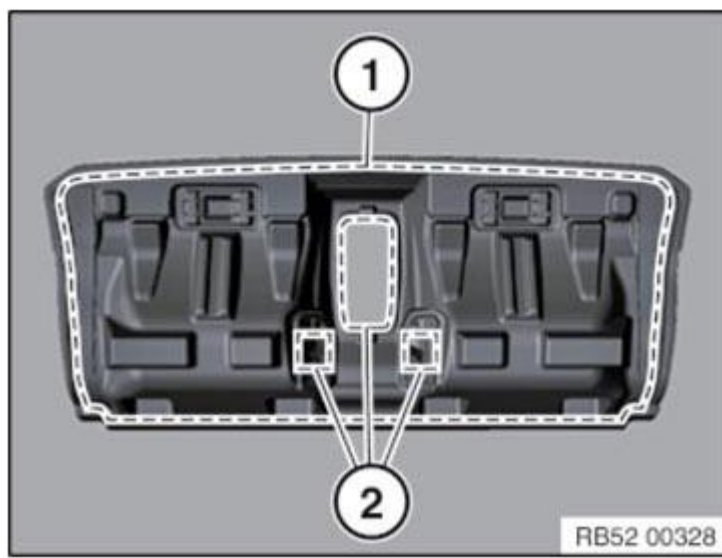
Release screws (2) and remove storage compartment.



**Fig. 98: Identifying Storage Compartment And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lever out welt in area (1) with plastic wedge.

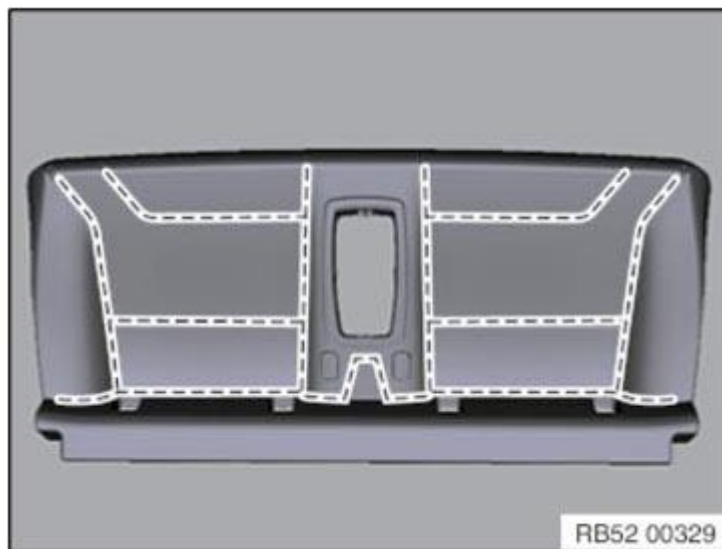
Unhook seat cover in area (2).



**Fig. 99: Identifying Welt And Seat Cover Hook Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Detaching cover and upholstery:**

- Release all clamps on trim wires.
- Remove seat cover from upholstery
- Remove remaining clamps from cover and upholstery

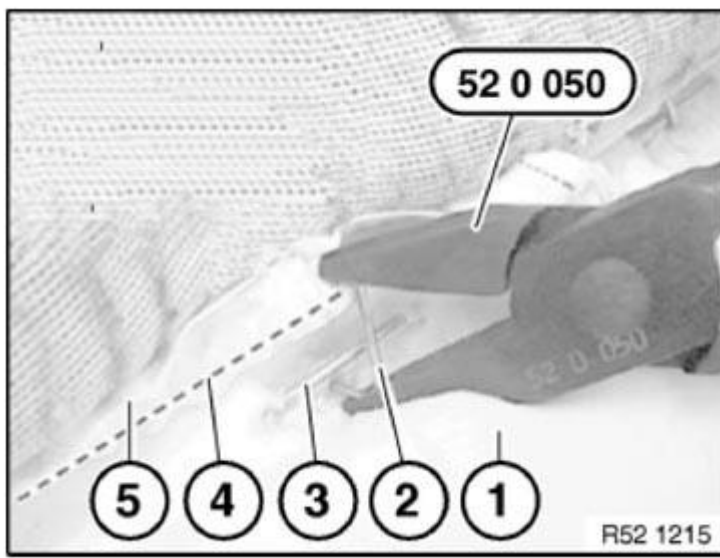


**Fig. 100: Identifying Clamps And Trim Wires Area (Marked)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Insert new clamps with special tool 52 0 050.

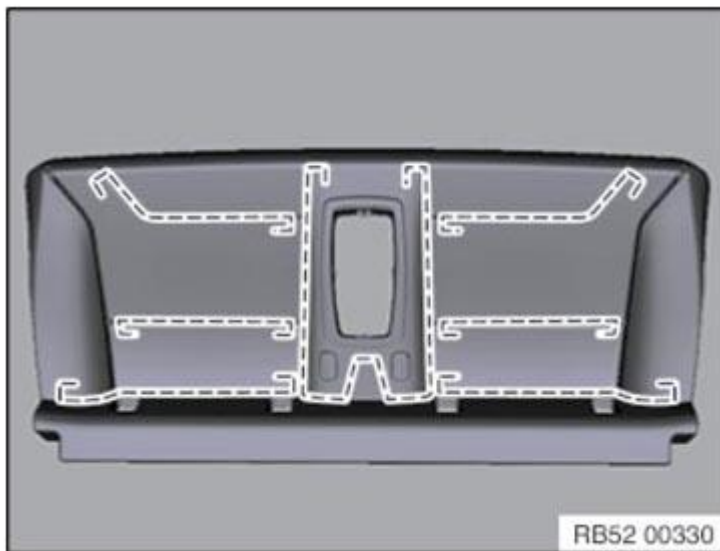
1. Upholstery
2. Clamp
3. Trim wire in upholstery
4. Trim wire in seat cover
5. Seat cover



**Fig. 101: Inserting Clamp With Special Tool (52 0 050)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement only:**

- Push trim wires into new seat cover
- If necessary, cut in mounting for trim wires of new cover



**Fig. 102: Identifying Trim Wires Area (Marked Area)**  
Courtesy of BMW OF NORTH AMERICA, INC.

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[Back To Article](#)

**ACCESSORIES AND BODY, CAB**  
**Seats - Special Tools - All I3 Models - i3**

**SEATS**

**2154711 FITTING AID AM**

**NOTE:** This universal seat fixture is intended for professional repairs of vehicle seats. Universal seat fixture to be used only in conjunction with engine assembly stand 00 2 300.

**SI number**

08 18 08 (495)



**Fig. 1: Identifying Fitting Aid (2154711)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**520070 HOOK MECHANICAL TOOL**

**NOTE:** (Release hook) For removing the head restraint guides

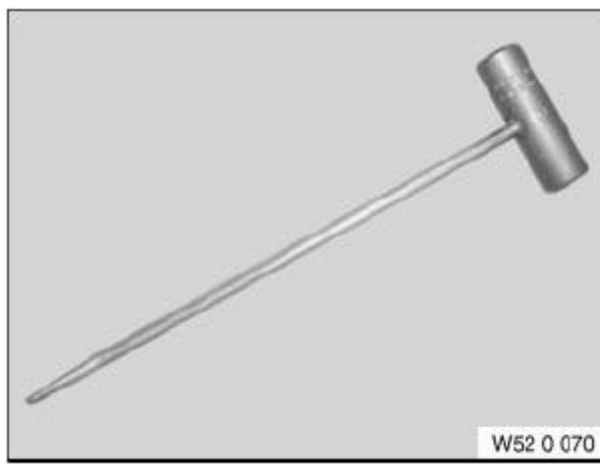
**Storage Location**

A47

B47

**SI number**

01 08 03 (988)



**Fig. 2: Identifying Hook (520070)**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

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## ACCESSORIES AND BODY, CAB

### Seats - Tightening Torques i3

## FRONT SEATS

### 52 10 FRONT SEATS

#### TIGHTENING TORQUE SPECIFICATION - FRONT SEATS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Seat to body	I01 / I12	M10	Replace screw	42 Nm
2AZ Backrest frame to seat mechanism	I01 / I12	Â	Replace screw	34 Â± 2 Nm

## REAR SEATS

### 52 26 REAR SEATS

#### TIGHTENING TORQUE SPECIFICATION - REAR SEATS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Outer mount, backrest to body	I01	M8	Microencapsulated screw	19 Nm
2AZ End cover, center mount	I01	M8	Microencapsulated screw	19 Nm

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[Back To Article](#)

## **ACCESSORIES & BODY, CAB**

### **Seats Operating Fluids**

#### **1.0 SEAT LEATHER CARE**

"Karneol" leather care cleans the leather upholstery of mild stains or dirt. It also provides conditioners to prevent drying out. Not suitable for suede.

BMW Part No. 81 22 9 400 901.

#### **2.0 PREMIUM LEATHER CARE KIT**

BMW Part No. 81 11 024 455.

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## ACCESSORIES AND BODY, CAB

### Slide/Tilt Roof - Repair - All I3 Models - i3

## SLIDE/TILT SUNROOF

### 54 10... NOTES ON GLASS SLIDE/TILT SUNROOF (INITIALIZATION/NORMALIZATION/LEARNING OF CHARACTERISTIC CURVE)

**Initialization** comprises:

- Normalization
- Learning characteristic curve

The mechanical end positions are recorded and stored during normalization.

The characteristic curve is learned immediately after normalization.

When the characteristic curve is learned, the mechanical closing forces of the glass sunroof are recorded and stored for correct operation of the anti-trap mechanism.

Initialization is started and implemented by pressing and holding switch in "Lift" direction.

Initialization depends on installed roof system and software used.

Then carry out **initialization**:

- if the glass sunroof has been mechanically moved by means of the emergency operation
- In the event of malfunctions, e.g. no one-touch function, no opening or no comfort function possible
- after disengagement of the drive unit
- after repair work is carried out on the mechanism of the glass sunroof
- after exchange of the control unit
- after replacement of circumferential gasket

**WARNING:** The anti-trapping mechanism is not active during initialization.

For correct initialization and function, the following preconditions must be met:

- Ignition ON
- at room temperature ( $23 \hat{A}^{\circ}\text{C} \hat{A}\pm 5 \hat{A}^{\circ}\text{C}$ )
- No direct solar radiation
- only when vehicle is at a standstill
- Fully charged vehicle battery
- in addition, for US vehicles, let engine run to enable key, if necessary

**NOTE:** Subsequently described processes relate to a completely closed roof system. However, initialization can be started from any position.

**Initialization:**

- Operate switch in "Lift" direction and hold (roof system moves to "Lift" position)
- In the event of delayed start or sudden stop of the glass sunroof, continue operating the switch in the "Lift" direction

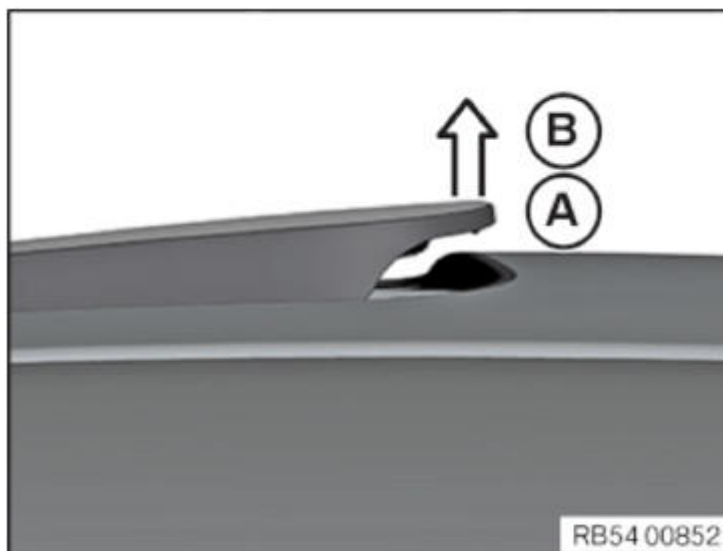


**Fig. 1: Operating Roof System Switch In Lift Direction**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Hold switch depressed for entire process.

- After reaching the fully raised position (A), keep the switch further pressed for approx. 30 seconds (initialization starts)
- Glass sunroof moves briefly from fully raised position (A) in direction of position (B)
- Shading system (sliding head liner) closes completely
- Shading system (sliding head liner) closes completely
- Glass sunroof moves to "Closed" position
- Glass sunroof then moves to "Open" end position and immediately back to "Closed" position
- After a brief pause, shading system closes completely



**Fig. 2: Initializing Sunroof**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Once glass sunroof and shading system have closed completely, initialization is finished. Button can be released.

**NOTE:**

- If the switch is released in the meantime, the entire procedure must be repeated
- On completion of successful initialization, the corresponding messages in the check control and the control display go out



- Carry out function check (one-touch function, anti-trapping protection and, if necessary, comfort function)

## 54 10... REPAIR INSTRUCTIONS FOR BONDED SEALS

### Special tools required:

- [00 9 327](#)

#### 1. General remarks on handling rubber seal profiles:

- If seals reveal partly detached protective film on delivery, they must not be bonded.
- Store seals at 5 °C to 40 °C.
- If, during the handling, the protective film has come off before bonding, it can still be bonded.
- Bonding at room and object temperature 25 °C ± 5 °C. Temperatures between 40 and 50 °C significantly increase initial adhesion.
- Seals, which are subjected to temperatures above 80 °C after bonding, will be very difficult to remove.
- Maximum storage time for replacement: see identification of the expiry date on packaging

#### 2. Damage pattern, repair and replacement

A partially released bonding (rubber part adhesive tape or adhesive tape paint) up to 120 mm may be finished. Continue with Point 2.1.

A partially released bonding (rubber part adhesive tape or adhesive tape paint) above 120 mm may **not** be finished. Gasket must be replaced. Continue with Point 2.2.

#### 2.1 Repair of partially released bonding (adhesive tape rubber part or adhesive tape paint

##### 2.1.1 Clean faulty areas

- Release adhesive area of paint side from recesses and degrease with [CLEANING AGENT R2](#). Stick to air drying time > of 1 minute. Never use paint thinner!
- This will usually partially destroy intact edge adhesive areas.
- When removing, it is important to wipe off the adhesive area of the adhesive tape with a lint-free disposable cloth. (e.g. blue Kimtex)
- Carefully wipe off the adhesive areas.

**NOTE:** Use necessary cotton- or fluff-free paper towel once only.  
Do not touch the adhesive area after cleaning.

##### 2.1.2 Apply adhesive

- Apply [PROFILE RUBBER ADHESIVE](#) evenly as a thin layer first on the gasket and then on the painted surface.
- Stick to air drying time of 2 to 3 minutes.

#### **Attention:**

Avoid contact with skin!

Do not apply adhesive to visible painted surfaces.

##### 2.1.3 Press in rubber seal

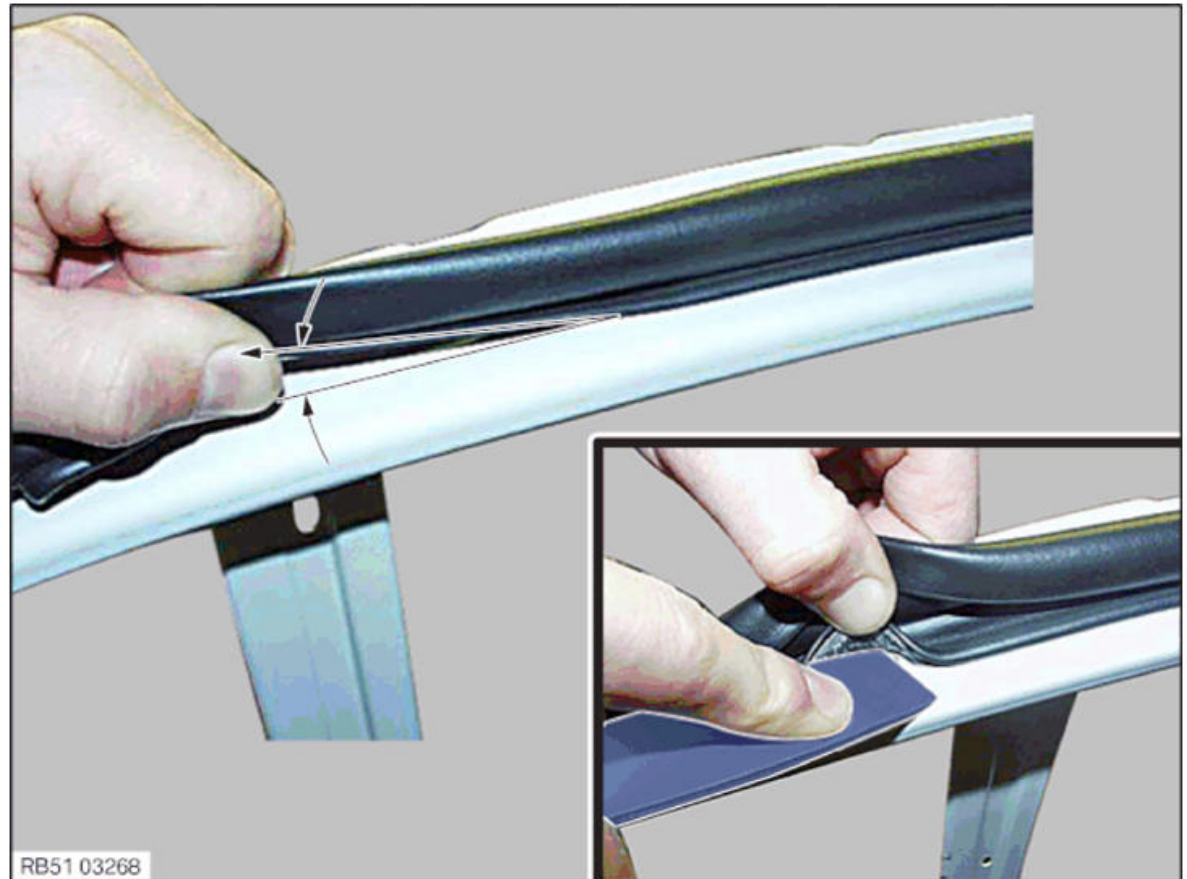
- Press down gasket using contact pressure (forced pressure not necessary) for > 1 minute.

#### **Attention:**

Load can be applied to the bonding only after a period of 2 minutes. This waiting time is absolutely essential.

## 2.2 Replacement

### 2.2.1 Peeling off the faulty rubber seal



**Fig. 3: Peeling Off Faulty Rubber Seal**

Courtesy of BMW OF NORTH AMERICA, INC.

- Remove bonded connection with fingers or cleaning agent liner [00 9 327](#) .
- Overstretch gasket below an angle of maximum 20° very slowly under even tensile stress.

If the gasket is pulled off too quickly, the adhesive tape can tear off and remain on the painted surface.

The adhesive tape remaining on the painted surface must be removed with high cleaning costs.

**NOTE:** When the adhesive tape separates from the gasket, the adhesive tape remaining on the paint must be fully separated at one location by approx. 10 mm until it is easy to grip. Pull off the adhesive tape by pulling strongly at an angle of approx. 20°. When existing gaskets are being peeled off with a hot air blower: Do not damage paintwork.

### 2.2.2 Clean bonding surface

- if required, remove adhesive remains with [ERASER DISK](#) or [CLEANING AGENT R2](#) . do not damage paint. Stick to air drying time > of 1 minute.
- Before a new bond, treat the entire adhesive area with [SIKA AKTIVATOR 205](#) . Stick to air drying time > of 1 minute.

**NOTE:** Use necessary cotton- or fluff-free paper towel once only. Do not touch the adhesive area after cleaning.

### 2.2.3 Pull off protective film of the bonding surface

- Pull off the protective film off of the new gasket by approx. 15 cm using the tab.

**Attention:**

Once the protective film has been removed, do not under any circumstances touch the exposed bonding surface.

2.2.4 Apply rubber seal

- Press on the gasket by hand continuously while pulling off the liner slightly at the same time.

**NOTE:**        **If positioned incorrectly, the gasket can still be pulled off, repositioned and pressed on again. Always ensure that you do not touch the bonding surface with your fingers or contaminate it in any way.**

- Press gasket while moving in a straight line without compression or over-stretching.
- Compress the gasket the corners; never stretch it. (critical area)

2.2.5 Establish sealing joint

- Where the beginning and end meet, a mark is created from pressing the loose end onto the beginning of the gasket.

Cut off the gasket vertically along the marked line (use sharp knife or special scissors) and press in place.

- Visually check the pre-bonded gasket.

**NOTE:**        **Small areas of gasket can remain stuck to adhesive tape of loose end.**

2.2.6 Press gasket

- Always press gasket vertically to the bonding surface
- Press gasket by hand or hand roller
- Adhesive tape width up to 5 mm, contact pressure  $> 5 \text{ N/cm}^2$
- Adhesive tape width up to 10 mm, contact pressure  $> 10 \text{ N/cm}^2$

**NOTE:**        **Firm thumb pressure has approx.  $35 \text{ N/cm}^2$**

3. Checking the rubber seal

- Check the bonded gaskets for correct positioning and perfect adhesion. The bonding can be checked by pressing back the sealing lip.
- The peel strength of the gasket must be greater than  $10 \text{ N/cm}^2$  for about 15 min after bonding.

**54 13... NOTES ON GREASING SLIDE/TILT SUNROOF**

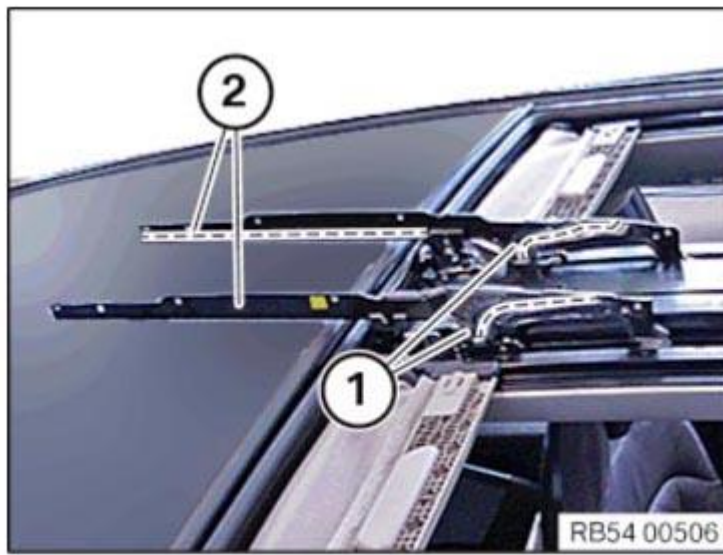
Use only RHF 1 lubricating grease to grease the slide/tilt sunroof.

One packet contains 20 g and is enough for the entire roof.

**NOTE:**        **Remove the old grease without fail before applying the new grease. Apply grease only in the relevant area (new parts).**

Grease both plastic gates (1) on the inside and on the outside.

Grease inside of both metal gates (2).



**Fig. 4: Identifying Plastic And Metal Gates**  
Courtesy of BMW OF NORTH AMERICA, INC.

Grease slider and guide rail.



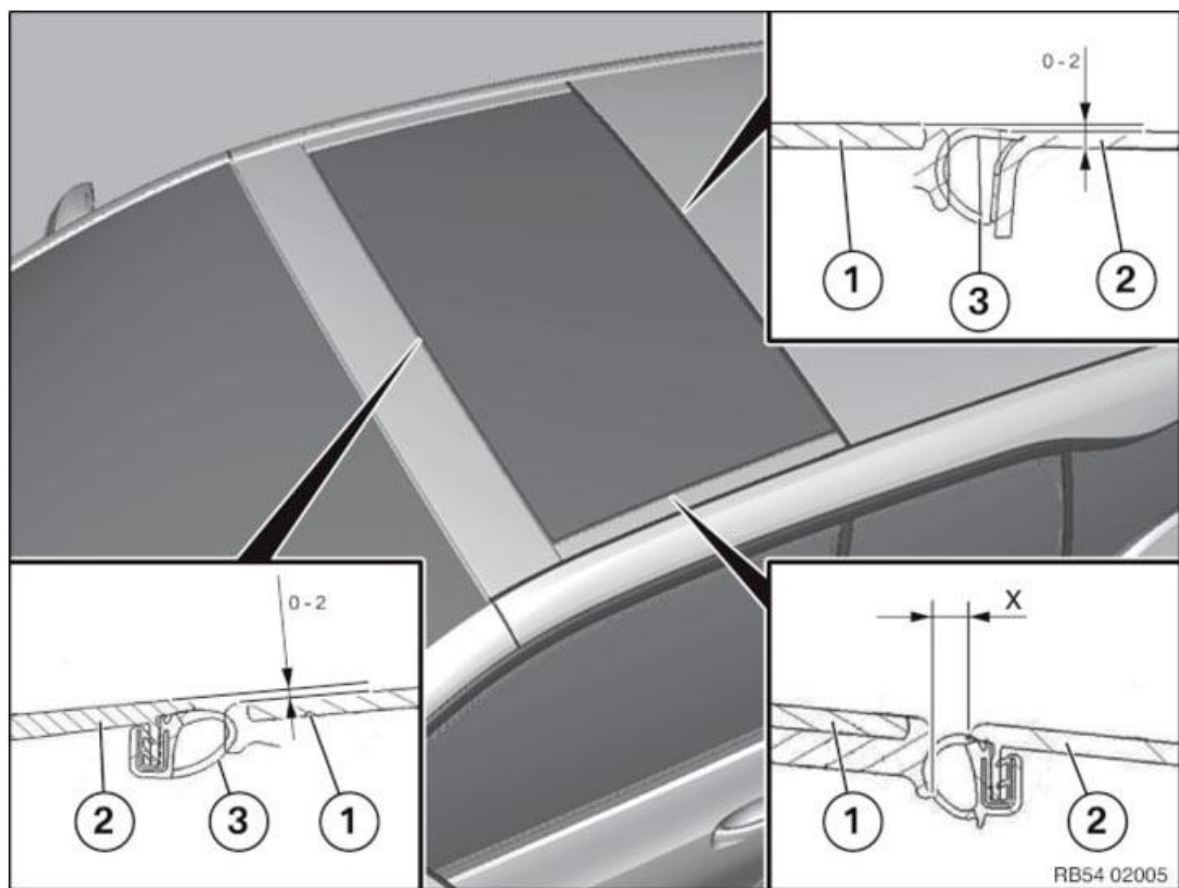
**Fig. 5: Locating Slider And Guide Rail**  
Courtesy of BMW OF NORTH AMERICA, INC.

**54 12 003 ADJUSTING GLASS SLIDE/TILT SUNROOF PANEL**

Special tools required:

- [00 9 315](#)

Ideal setting:



- (1) Slide/tilt sunroof lid
- (2) Roof
- (3) Seal

**Fig. 6: Identifying Slide/Tilt Sunroof Lid, Roof And Seal**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- 1. Slide/tilt sunroof lid
- 2. Roof
- 3. Seal

**NOTE:**

- Measure front and rear height adjustment over the entire cover width.

Height over the entire cover width must lie within tolerance.

- The lateral distance (XY) between the slide/tilt sunroof lid (1) and the roof (2) must be approximately the same on the left and right.

Setting can only be made by rebonding the **TRIMS ON THE ROOF FRAME** .

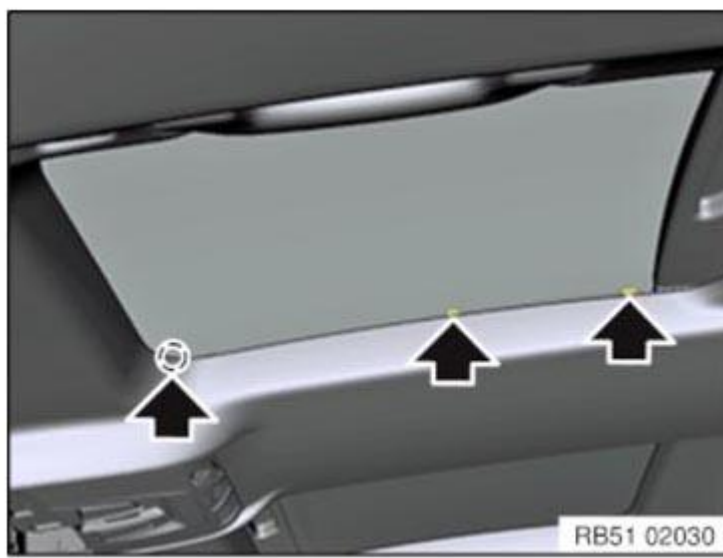
- Slide/tilt sunroof lid (1) must rest against the gaskets (3) at the front and rear with even pressure.

When the slide/tilt sunroof lid (1) is closed, it must be possible to pull out a sheet of paper at the front and rear with the same resistance.

Slacken screws on the left and right until glass slide/tilt sunroof panel can just be adjusted.

Tightening torque **54 12 01AZ** .





**Fig. 7: Locating Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

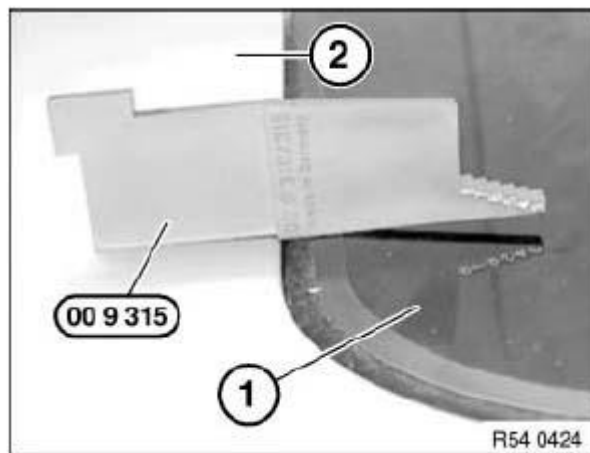
**Height adjustment:**

Check height of glass slide/tilt sunroof panel (1) in relation to roof (2) with special tool [00 9 315](#).

Press glass slide/tilt sunroof panel upwards and downwards until the ideal position has been reached.

**Adjustment of distance at front/rear:**

Slide/tilt sunroof lid (1) must rest against the gaskets at the front and rear with even pressure.



**Fig. 8: Checking Height Of Glass Slide/Tilt Sunroof Lid**

Courtesy of BMW OF NORTH AMERICA, INC.

When the slide/tilt sunroof lid (1) is closed, it must be possible to pull out a sheet of paper at the front and rear with the same resistance.

Slide glass slide/tilt sunroof panel forward and back until ideal setting is reached.

Check function and adjustment.

**INITIALIZE** glass slide/tilt sunroof.

**54 12 115 REMOVING AND INSTALLING GLASS SLIDE/TILT SUNROOF PANEL**

Raise glass slide/tilt sunroof approx. 2 cm until all screws are accessible.

Release screws on left and right.

Remove glass slide/tilt sunroof panel towards top.



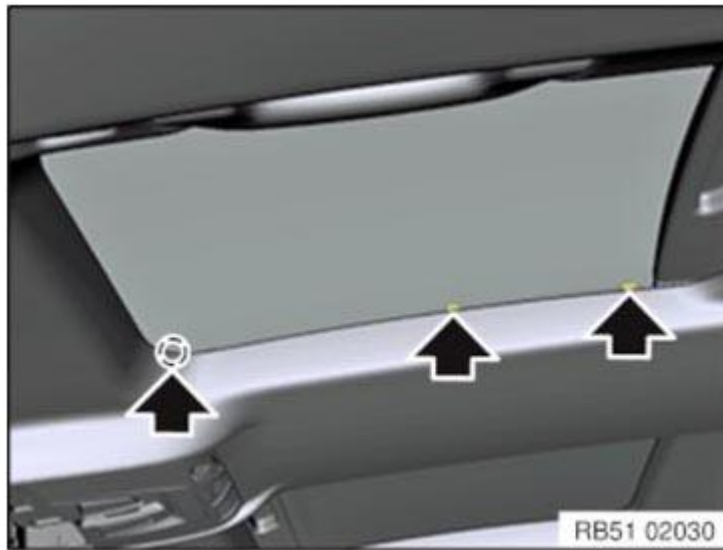
*Installation note:*

Replace screws or coat with Loctite (medium strength).

**ADJUST** glass slide/tilt sunroof panel.

Tightening torque **54 12 01AZ** .

**INITIALIZE** glass slide/tilt sunroof.



**Fig. 9: Locating Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

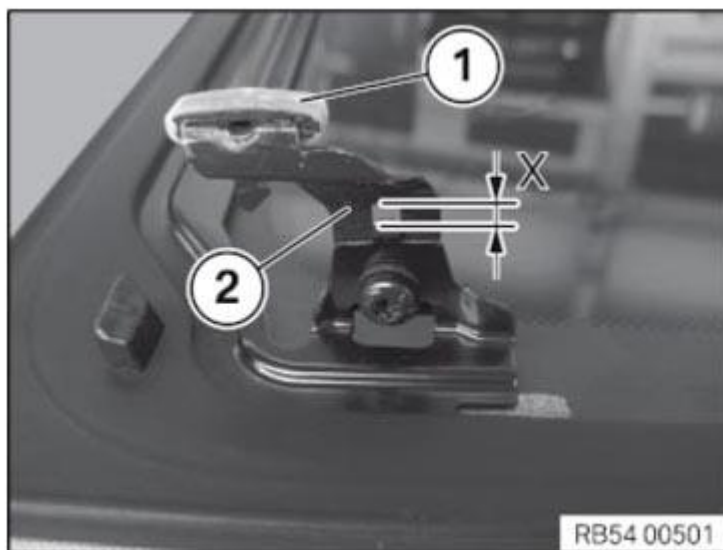
Sliders (1) must not be missing or damaged.

Support (2) must be adjusted to dimension (X).

(X) = 3 mm

**Replacement:**

Remount the support (2).



**Fig. 10: Identifying Support Dimension**

Courtesy of BMW OF NORTH AMERICA, INC.

## 54 12... REMOVING AND INSTALLING/REPLACING RAIL FOR LEFT OR RIGHT ROLLER SUNBLIND SUNBLIND

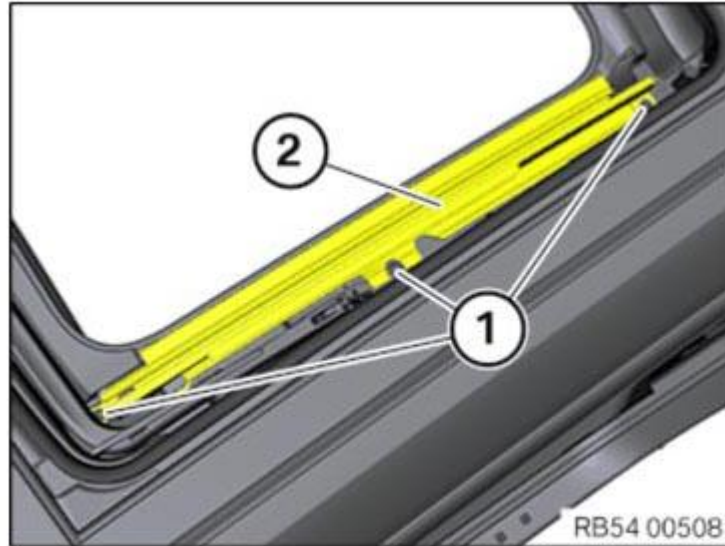
### Necessary preliminary tasks:

- Remove SLIDE/TILT SUNROOF ROLLER SUNBLIND

### REMOVAL:

Release screws (1).

Detach rail (2).



**Fig. 11: Identifying Rail And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

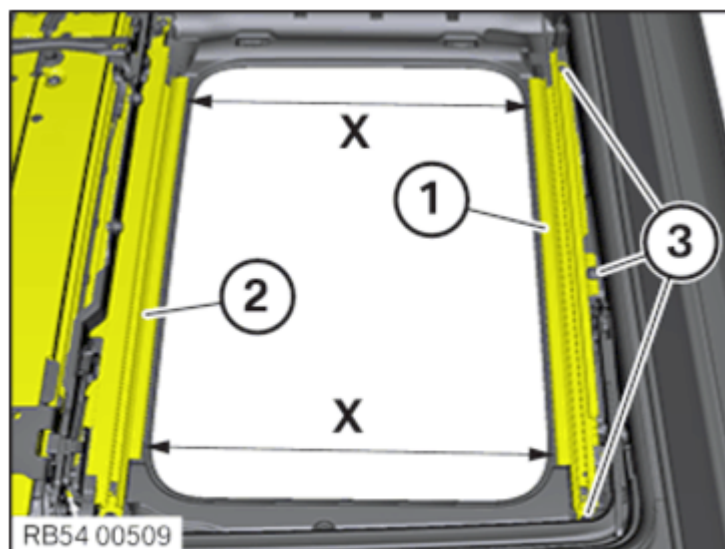
### INSTALLATION:

Insert rail (1).

Adjust front and rear distance (X) to control unit (2).

(X) =  $320 \pm 1$  mm

Tighten down screws (3).



**Fig. 12: Adjusting Rail Front And Rear Distance To Control Unit**

Courtesy of BMW OF NORTH AMERICA, INC.

## Required follow-up work:

- Install [SLIDE/TILT SUNROOF ROLLER SUNBLIND](#)

## 54 12 350 REMOVING AND INSTALLING/REPLACING ROLLER SUNBLIND OF SLIDE/TILT SUNROOF ON LEFT OR RIGHT

### Special tools required:

- [64 1 020](#)

### Risk of damage!

Because of its delicate design, work on the roller sunblind must be performed with the utmost of care.

### Necessary preliminary tasks:

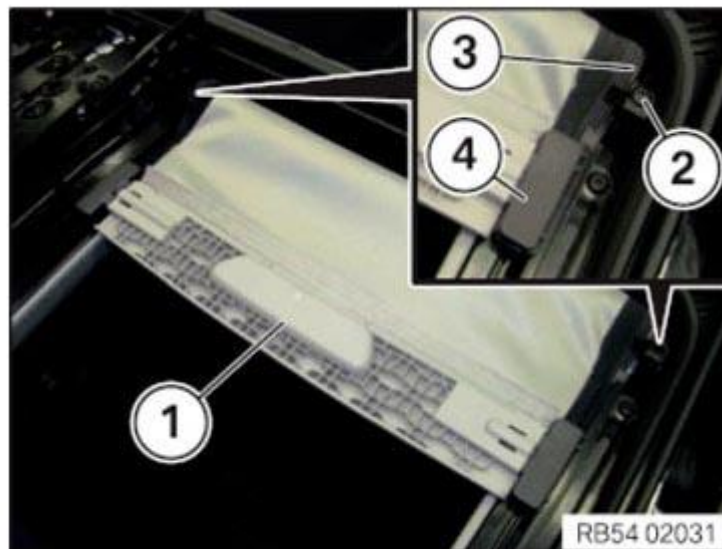
- Remove [GLASS SLIDE/TILT SUNROOF PANEL](#)

### Removal:

Close roller sunblind (1) approx. 5 cm.

Unfasten screws (2).

First feed out roller sunblind (1) at holder (3) toward the rear and then feed out slider (4).



**[Fig. 13: Identifying Roller Sunblind, Holder, Slider And Screws](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.

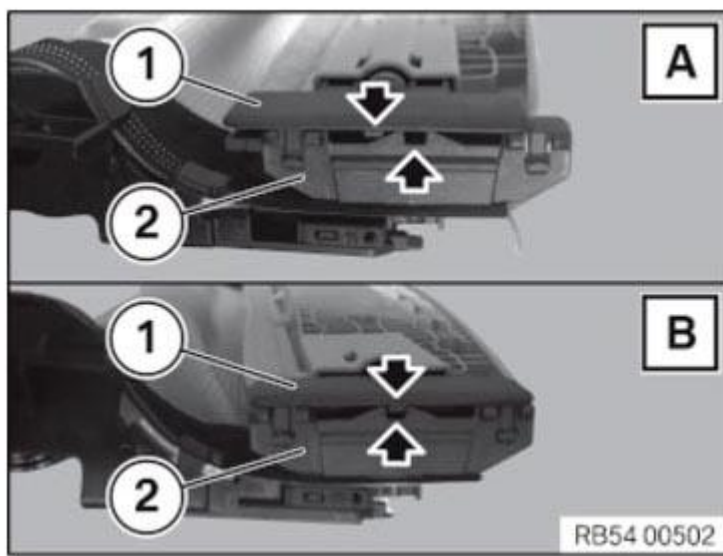
### Installation:

### Replacement:

- A. Delivery status
- B. Installation position

Prior to installation, the slider must be moved to the installation position (B) by pressing together.

Latch mechanism on upper section (1) must be located in corresponding fixture in lower section (2).

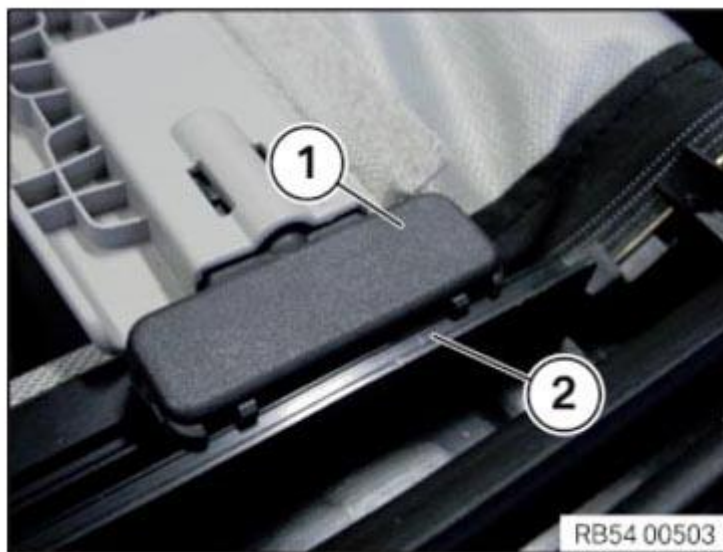


**Fig. 14: Locating Slider Latch Mechanism In Delivery Status And Installation Position**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** In case of an incorrect distance between the roller rails and control unit, malfunctions of the roller sunblind may occur.

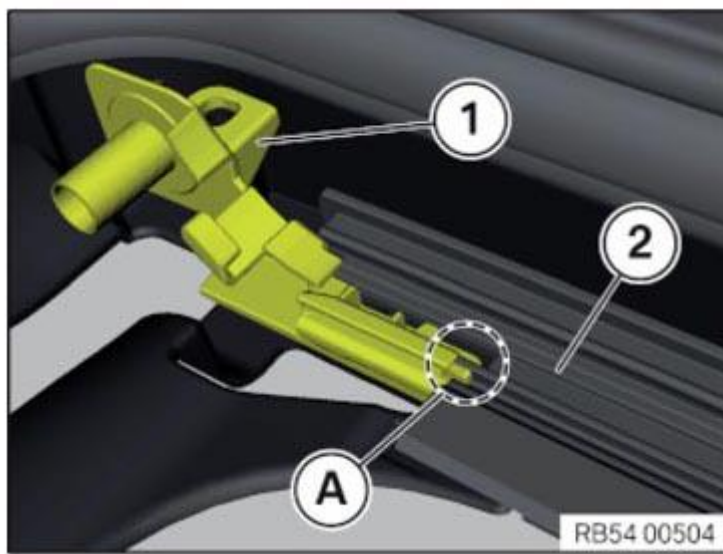
**CHECK** distance between roller rails and control unit and adjust if necessary.

Feed slider (1) in rail (2) on left and right.



**Fig. 15: Identifying Slider And Rail**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Figure does not show roller cover in order to illustrate correct position of holder (1).  
 Lateral holders (1) must be correctly inserted in rail (2) in area (A).  
 If holder (1) is not installed correctly, roller sunblind will catch in area (A) on rail (2) and may be damaged.



**Fig. 16: Identifying Holder And Rail**

Courtesy of BMW OF NORTH AMERICA, INC.

Feed in one holder (1) and press into position with special tool [64 1 020](#) if necessary.

Check correct installation position of holder (1):

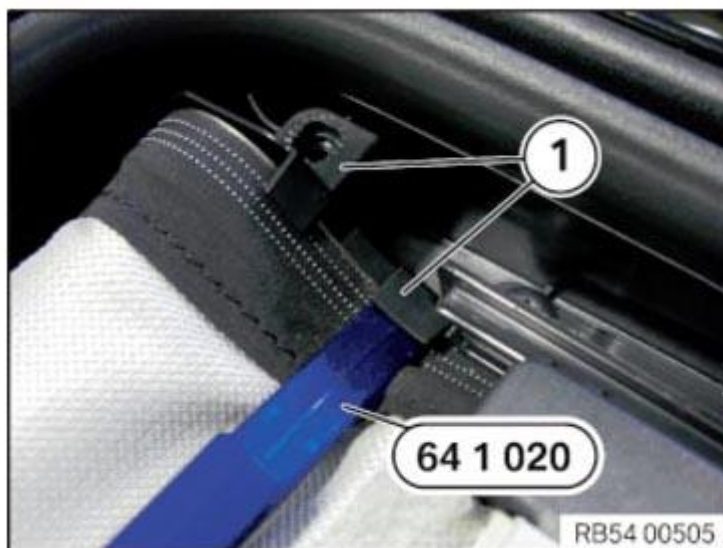
- Carefully close roller sunblind approx. 3 cm and check if roller sunblind catch on rail.

If roller sunblind catches on rail, holder (1) is **not** in correct position.

If roller sunblind is in correct position:

- Counterhold holder (1) and attach with appropriate screw.

Perform the same steps on the other holder.



**Fig. 17: Pressing Holder Into Position With Special Tool (64 1 020)**

Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

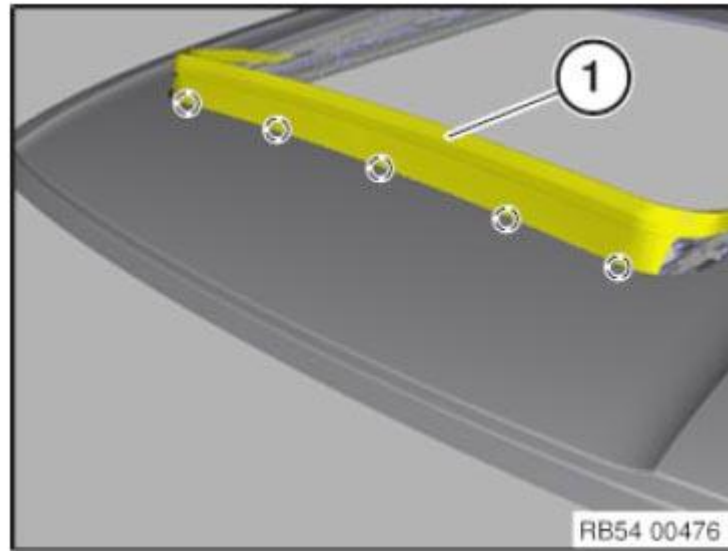
- Install [GLASS SLIDE/TILT SUNROOF PANEL](#)

**54 12 497 REMOVING AND INSTALLING/REPLACING WIND DEFLECTOR FOR GLASS SLIDE/TILT SUNROOF**

Open slide/tilt sunroof.



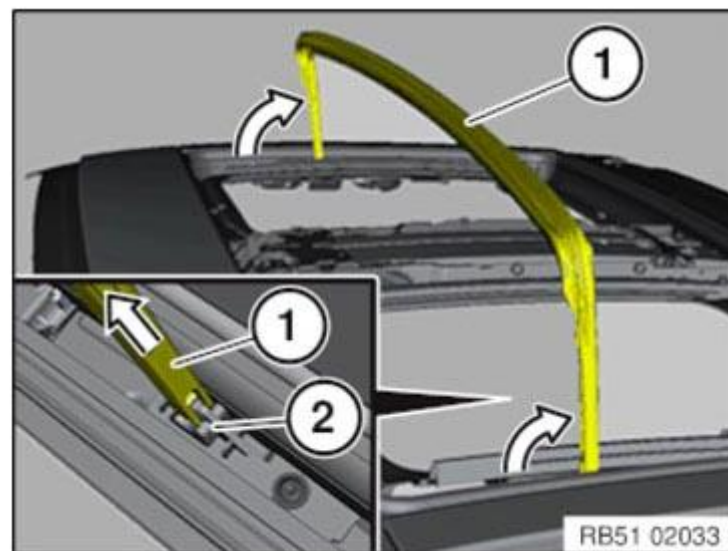
Carefully pull plastic strip on storage net of wind deflector (1) out of guide starting from the outside.



**Fig. 18: Identifying Wind Deflector And Guide**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lift wind deflector (1) in vertical position.

Lift wind deflector (1) upwards out of slide/tilt sunroof unit (2).



**Fig. 19: Lifting Wind Deflector Out Of Slide/Tilt Sunroof Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **54 13 160 REMOVING AND INSTALLING/REPLACING CONTROL UNIT FOR SLIDE/TILT SUNROOF**

**Special tools required:**

- [2 298 505](#)

**Necessary preliminary tasks:**

- Remove **ROLLER SUNBLIND** on left and right
- Close slide/tilt sunroof again without glass slide/tilt sunroof panel

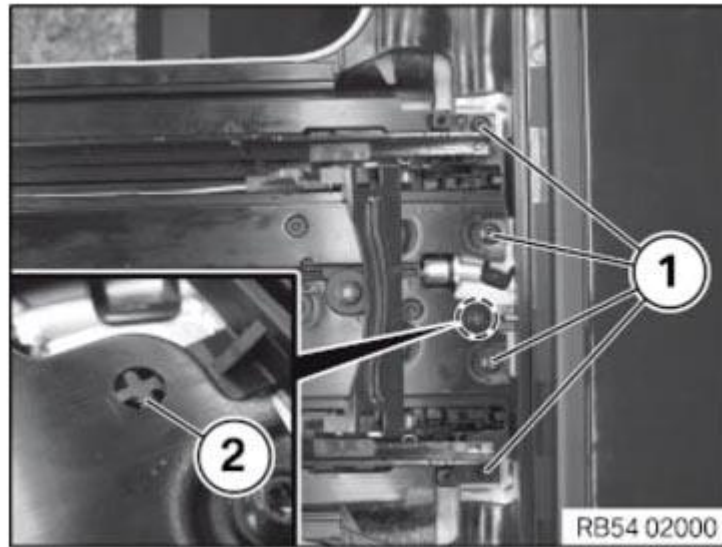
Release screws (1).

Tightening torque [54 12 2AZ](#) .

*Installation note:*



Make sure guide lug (2) is correctly seated in corresponding bore hole.



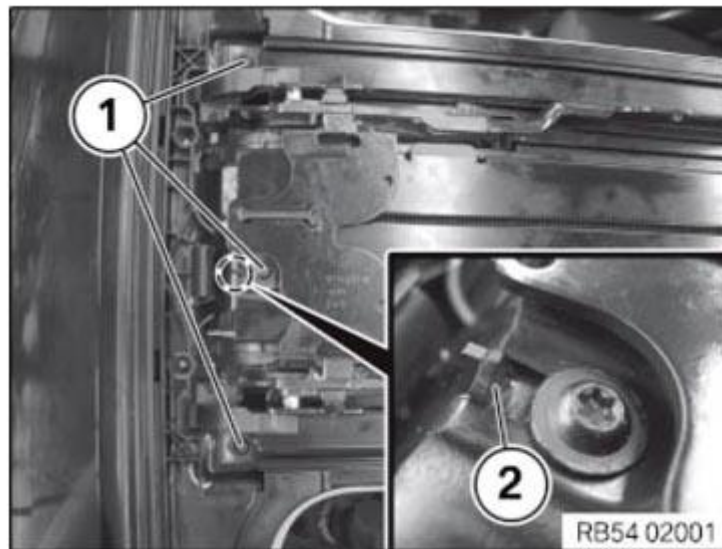
**Fig. 20: Identifying Guide Lug And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [54 12 2AZ](#) .

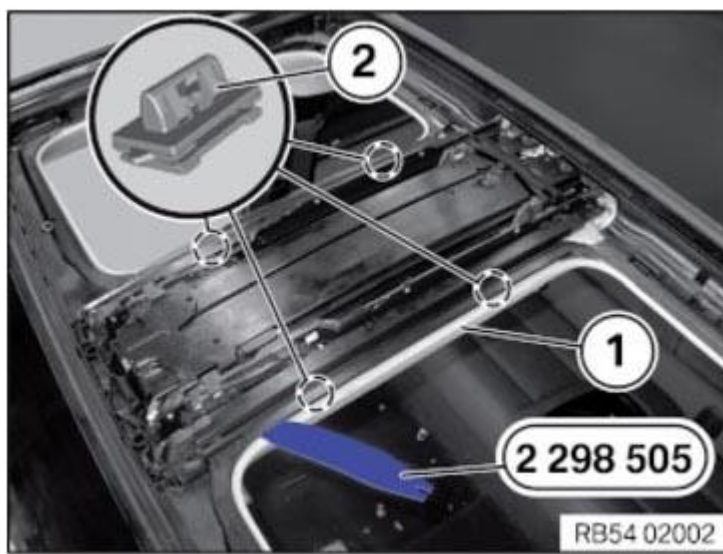
*Installation note:*

Make sure guide lug (2) is correctly seated in corresponding recess.



**Fig. 21: Identifying Guide Lug And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lever roofliner (1) out of specified clips (2) using special tool [2 298 505](#) .



**Fig. 22: Levering Roofliner Out Of Clips Using Special Tool (2 298 505)**

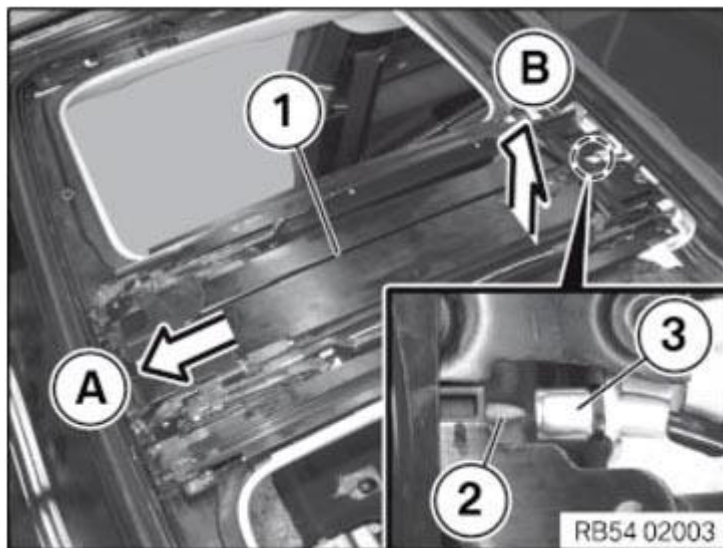
**Courtesy of BMW OF NORTH AMERICA, INC.**

- A. Pull control unit (1) forward slightly and feed drive cable (2) out of guide (3).
- B. Raise control unit (1) at rear and disconnect cable clip and plug connection at bottom.

Lift out control unit (1).

*Installation note:*

Insert drive cable (2) into corresponding guide (3).



**Fig. 23: Lifting Out Control Unit**

**Courtesy of BMW OF NORTH AMERICA, INC.**

**Replacement:**

- Remount **ELECTRIC MOTOR**

## ACCESSORIES AND BODY, CAB

### Slide/Tilt Roof - Tightening Torques - All I3 Models - i3

## ELECTRICAL SLIDE/TILT SUNROOF COMPONENTS

### 54 13 ELECTRICAL SLIDE/TILT SUNROOF COMPONENTS

#### TIGHTENING TORQUE SPECIFICATION - ELECTRICAL SLIDE/TILT SUNROOF COMPONENTS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Drive to cassette	F01/F02/F07/F10/F11/F15/F16/F18/F85/F86	Â	Replace screws	3Â±0.5 Nm
	F25/F26	Â	Replace screws	4 Nm
	F06/F13/I01	Â	Replace screws	3.5 Nm

## MECHANICAL COMPONENTS, SLIDE/TILT SUNROOF

### 54 12 MECHANICAL COMPONENTS, SLIDE/TILT SUNROOF

#### TIGHTENING TORQUE SPECIFICATION - MECHANICAL COMPONENTS AND SLIDE/TILT SUNROOF

Â	Type	Thread	Tightening specifications	Dimension
1AZ Glass slide/tilt sunroof panel to control unit	I01	M5x9 w/Washer	Â	5 Nm
2AZ Control unit to body	I01	Â	Â	4 Nm

---

## ACCESSORIES & BODY, CAB

### Sunroof and Convertible Top Operating Fluids

#### 1.0 CONVERTIBLE TOP MATERIAL

Cleaning Kit consists of three fluids for periodic maintenance of the top's outer surface:

- Car Shampoo

For cleaning the entire convertible top. Add 2 to 3 capfuls of shampoo to 2.5 gallons of water. Rinse with clean water.

- Glass Cleaner

Cleans the plastic rear window as well as the vehicle's glass windows. Spray on, wipe off with dry cloth.

- Impregnating Spray

After cleaning the top, apply this spray over a large area about 12 inches from the surface to seal the top against possible leaks.

Convertible Top Cleaning Kit

BMW Part No. 83 12 9 407 806

Impregnating Spray

BMW Part No. 83 12 9 407 802

#### 2.0 CONVERTIBLE TOP REAR (PLASTIC) WINDOW

##### REAR WINDOW CLEANER

Meguiar's Mirror Glaze Professional Plastic Cleaner #17 removes hairline scratches on the surface.

BMW Part No. 82 14 1 467 128.

##### REAR WINDOW POLISH

Meguiar's Mirror Glaze Professional Plastic Polish #10 restores and maintains clarity, leaves surface static-free.

BMW Part No. 82 14 1 467 129

##### CONTACT CEMENT

Attaching soft top material to zip-out rear window trim plastic channel on E30 and E36 convertibles. (former BMW Part No. 81 22 9 407 524)

3M 1357 High Performance Contact Adhesive

#### 3.0 CONVERTIBLE TOP STORAGE LID ADHESIVE

E30 and E36 Convertible top storage lid covering adhesive

3M™ Super Trim Adhesive Yellow Part No. 08090

#### 4.0 CONVERTIBLE TOP SEALING FRAME ADHESIVE

E36 Z3 Sealing Frame Adhesive

One roll of Bostik 3/4" x 1/8" Butyl Tape, available in cases of 12 rolls from Springfield Paper Specialties, phone number 215-643 2800, fax number 215-643-0639 for ordering information.

## 5.0 CONVERTIBLE TOP HYDRAULIC FLUID

### CONVERTIBLE TOP HYDRAULIC FLUID REFERENCE CHART

Model	BMW Part Number
E36/7	54 34 8 410 306
E46	54 34 7 117 733
E52	54 34 8 234 324
E64	54 34 7 717 733
E85	54 34 7 117 733
E88	54 34 0 394 395
E93	54 34 0 394 395
E89	54 34 0 394 395

## 6.0 SUNROOF

### Cassette Lubricant

Wurth Glide Grease Part No. 0893898

### Loctite 380

5 Series Touring double panel sunroof repairs. (former BMW Part No. 81 22 9 407 394)

3M Part No. 8155

Wurth Part No. 893 4103

Loctite Part No. 38050

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## ATEQ TPMS RESET PROCEDURE

### BMW - Procedure 11

## ATEQ TPMS RESET PROCEDURE

**NOTE:**        **Reset the TPMS after each correction of tire inflation pressures and after every tire or wheel change.**

1. Set the tire pressure of all wheels to specified pressure.
2. Using the Control Display, select Vehicle Info -> Vehicle Status -> Perform Reset.
3. Start the engine - do not drive away.
4. Reset the TPMS using "Perform Reset".
5. Drive vehicle for a short period of time at more than 19 mph (30 km/h).
6. On the Control Display, the tires are shown in gray and the status is displayed.
7. When the wheels on the Control Display are shown in green and "Tire Pressure Monitor (TPM) active" is displayed, Reset has successfully completed.

**NOTE:**        **The trip can be interrupted at any time. The reset procedure resumes automatically when the vehicle is driven again.**

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## AUTOMATIC STOP/START DISABLE

### BMW

## AUTO STOP/START DISABLE

**NOTE:** BMW calls this function, MSA or Auto Start/Stop.

### DISABLE CONDITIONS

On BMW vehicles equipped with the auto stop/start feature, there may or may not be an auto stop/start off button. For vehicles without the button, any or some of the following conditions may prevent the engine from automatically stopping while parked:

- Transmission is in P position
- Engine compartment hood is open
- Driver's seat belt is unlatched
- Driver's door is open
- Windshield defroster is on
- A/C is set to Manual and is running at Max.

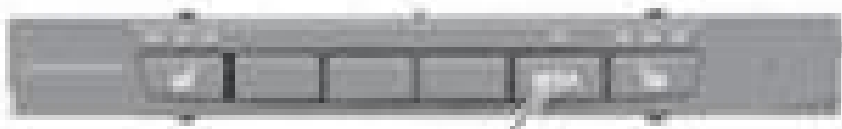
### DISABLE BUTTON

**NOTE:** BMW uses the designation MSA for the Automatic Engine Start/Stop function.

**NOTE:** On vehicles with an indicator light on the MSA button: Light ON means the auto stop function is deactivated.

Some vehicles may be equipped with an MSA (Automatic Engine Start/Stop) button. The MSA button will deactivate the Automatic Engine Start/Stop function, preventing the engine from automatically shutting-down while the vehicle is not moving. See [Fig.1](#)





MSA Button

Fig. 1: Typical Auto Stop/Start Off Buttons

## BRAKES

### BMW Operating Fluids

#### 1.0 GENERAL INFORMATION

Brake fluid, (glycol-based) as used in BMW brake systems, must conform with the following requirements:

- High boiling point
- Good low temperature resistance
- Low compressibility
- Corrosion inhibition for all metal parts inside of brake system
- Compatibility with all rubber parts used in brake system

These requirements are fulfilled by reputable brand name DOT 4 brake fluids.

Silicone-based brake fluid has better compressibility, but because it cannot absorb moisture, is subject to vapor lock at temperatures above 212°F/100°C. At lower temperatures, it may even ice-up. **Silicone-based brake fluid is not approved by BMW.**

Glycol-based brake fluid absorbs moisture from the atmosphere (hygroscopicity) through the brake fluid reservoir, brake hoses, etc. This absorption of water lowers the original boiling point of brake fluid and active safety of the entire system. If there is extended use of the brakes while driving downhill at high speeds, the thermal loads could cause vapor bubbles in the brake fluid. This situation could lead to reduced braking effectiveness.

The original boiling point of factory-approved brake fluids is approximately 500°F/260°C. Due to the hygroscopic behavior of brake fluid, 2% of water within one year is permissible. The boiling point of brake fluid will drop by 100°C with 3% water absorption. It is essential to conform with brake fluid changing intervals in order to guarantee the safety and maximum effectiveness of a brake system.

It would not be sufficient simply to replace the brake fluid in the reservoir. Experience has shown that vapor bubbles will occur first on areas of the brake caliper. This area is subjected to high thermal loads and also exposed to heat transmission.

When replacing the brake fluid, the brake fluid used as the working fluid in the hydraulic clutch should also be replaced. This is done by draining the clutch operation system or bleeding with the help of the clutch slave cylinder.

The brake fluid should be replaced by filling the brake fluid reservoir. Make sure that each bleeder valve of all wheel cylinders or brake calipers is kept open until the escaping brake fluid is clear and without air bubbles. Never use brake fluid that has been drained from the system.

Storage of brake fluids also deserves your special attention. The aging process begins with the initial contact between the brake fluid and the atmosphere. This means immediately after a new container is opened.

To keep the boiling point of stored brake fluids as high as possible, we recommend conforming with the following points:

- Close all containers tightly.
- Select small size containers, which can be used up quickly.
- Avoid pouring contents of one container into a different container.

#### 2.0 HANDLING BRAKE FLUIDS

Brake fluids could be mixed up accidentally with mineral oil products so it is important to leave them in their original containers and not pour them into a different container.

## **CAUTION**

If brake fluid accidentally comes into contact with your skin, wash it off with soap and water immediately. Eyes should be thoroughly flushed with cold water if contacted by brake fluid. Vomiting should be induced if brake fluid is internally consumed and a physician should be consulted.

If brake fluid is spilled or drips on a painted surface, wash it off with water immediately to prevent damage to the paint finish. Never rub it off. Brake fluids should not have contact with grease or oil. Wash hands to remove grease and oil before working with brake fluids. Also make sure that grease cannot enter the brake system.

Drained brake fluid must never be discarded in the garbage, oil disposal tanks or water drains.

Read instructions on container label prior to use.

## **3.0 BMW TESTED AND APPROVED BRAKE FLUIDS**

BMW Tested and Approved **DOT 4 ESL** Brake Fluid is available as follows:

12 fl. oz. bottle BMW Part No. 81 22 0 142 156

1 gallon container BMW Part No. 81 22 0 142 155

## **4.0 BRAKE FLUID CHANGE INTERVALS**

All Models Brake fluid change interval every 2 years.

## **5.0 AUXILIARY BRAKE MATERIALS**

### **BRAKE PAD PASTE**

For usage, refer to applicable service information for brakes.

<b>Trade name</b>	<b>BMW part number</b>
Brake block paste	81 22 9 407 103
Plastilube	83 23 0 305 690

<b>Trade name</b>	<b>BMW part number</b>
Never Seez Compound	83 23 9 407 830

**IMPORTANT:** Lubrication instructions in the brakes service information must be observed, in addition to any lubrication instructions provided with the new set of brake pads.

### **ATE BRAKE CYLINDER PASTE**

To install and preserve wheel brake cylinders, cylinder barrels, pistons and cup seals, the parts are clean prior to assembly and then treated with a thin coating of ATE brake cylinder paste.

<b>Trade name</b>	<b>BMW part number</b>
ATE brake cylinder paste	83 19 9 407 854

### **CORROSION INHIBITOR FOR ABS WHEEL SPEED SENSORS**

To avoid the possibility of corrosion between the ABS wheel speed sensor and bore hole in the wheel suspension parts, the ABS wheel speed sensors and the bore hole are cleaned and treated prior to assembly with a thin coating of corrosion inhibitor.

<b>Trade name</b>	<b>BMW part number</b>
-------------------	------------------------

<b>Trade name</b>	<b>BMW part number</b>
Staburags NBU 12/K	83 23 9 407 810

## **BRAKE CLEANER**

<b>Trade name</b>	<b>BMW part number</b>
BMW brake cleaner	83 19 2 154 780

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## BRAKES

### Brakes - Repair - All I3 Models - i3

## BRAKE TESTING AND BLEEDING

### 34 00 050 BLEEDING BRAKE SYSTEM WITH DSC

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

#### Necessary preliminary tasks:

- Remove [COVER IN LUGGAGE COMPARTMENT](#) on left.
- Read and comply with [GENERAL INFORMATION](#).

When replacing or repairing, observe the filling and bleeding instructions for the following parts:

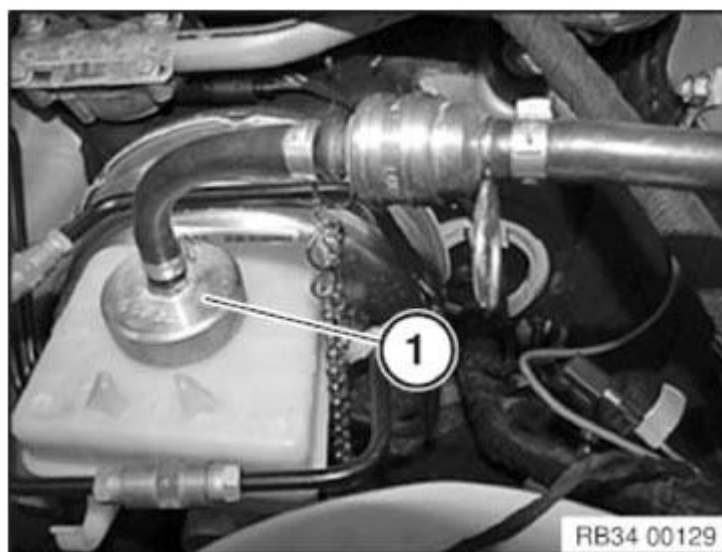
- Tandem brake master cylinder
- Hydraulic unit

IMPORTANT: • Components and lines which are fitted between these assemblies.

Connect bleeder unit with max. 2 bar filling pressure.  
A second person is needed for this repair work.  
Use only approved [BRAKE FLUIDS](#) .

IMPORTANT: Check relevant equipment manufacturer's operating instructions for each device.  
Charging pressure should not exceed 2 bar.

Connect bleeder unit (1) on expansion tank and switch on.



**[Fig. 1: Identifying Bleeder Unit On Expansion Tank](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect ISID to vehicle and select brake bleeding procedure.

**Completely bleed the brake system.**

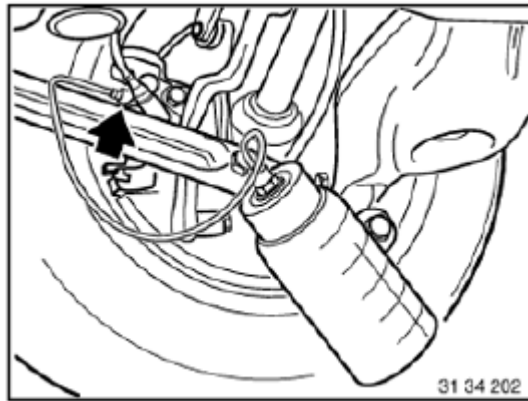


Connect vent hose with collecting vessel to vent valve on rear right brake caliper.

Open vent valve and purge until clear, bubble-free brake fluid emerges.

Close vent valve.

Follow same procedure on rear left, front right and front left wheel brake.



**Fig. 2: Locating Vent Valve**

Courtesy of BMW OF NORTH AMERICA, INC.

**Bleed the rear axle brake circuit.**

Connect vent hose with collecting vessel to vent valve on rear right brake caliper.

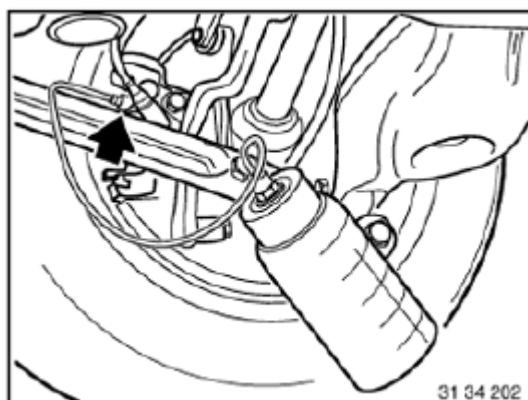
Open vent valve.

Run brake bleeding procedure with ISID with vent valve open.

After completing routine, press brake pedal 5 times to floor; clear and bubble-free brake fluid must flow out.

Close vent valve.

Repeat procedure at rear left.



**Fig. 3: Locating Vent Valve**

Courtesy of BMW OF NORTH AMERICA, INC.

**Bleed front-axle brake circuit.**

Connect vent hose with collecting vessel to vent valve on front right brake caliper.

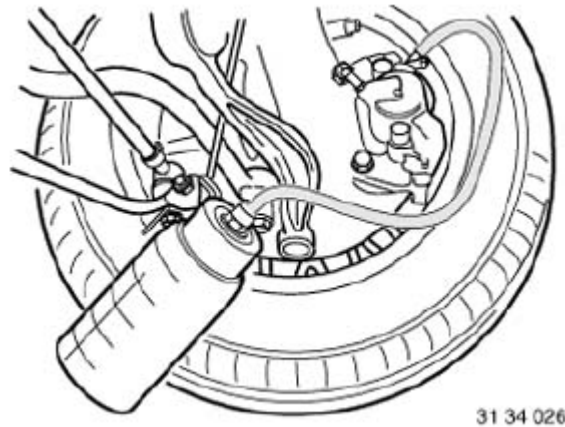
Open vent valve.

Run brake bleeding procedure with ISID with vent valve open.

After completing routine, press brake pedal 5 times to floor, clear and bubble-free brake fluid must flow out.

Close vent valve.

Repeat procedure at front left.



**Fig. 4: Identifying Vent Hose**

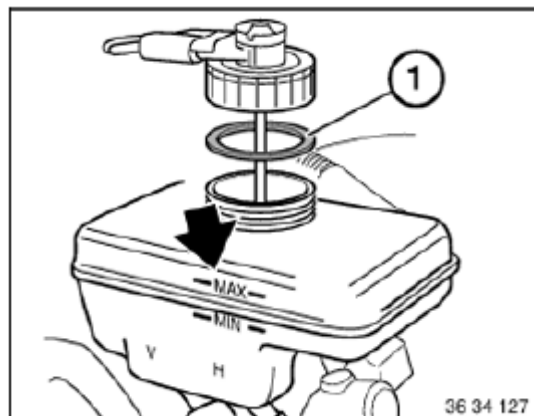
Courtesy of BMW OF NORTH AMERICA, INC.

Switch off bleeder unit and remove from expansion tank.

Check brake fluid level. If necessary, top up/draw off to "MAX" level.

Close expansion tank.

**NOTE:** Pay attention to seal (1) in sealing cap.



**Fig. 5: Locating MAX Level Mark On Expansion Tank**

Courtesy of BMW OF NORTH AMERICA, INC.

### **34 00 009 CHECKING BRAKES ON TEST STAND**

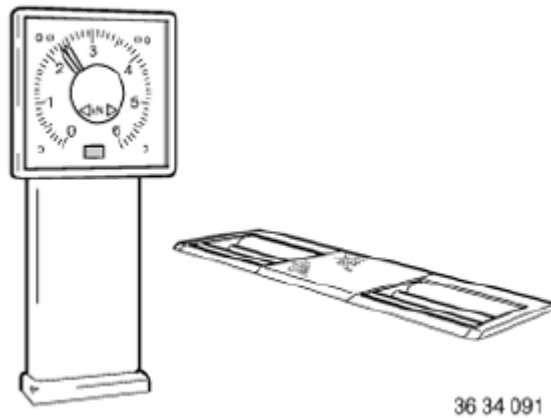
**Necessary preliminary tasks:**

- Check tires for damage
- Check tire treads
- Checking tire pressure
- The brakes must be at normal operating temperature. To that end, warm up and dry off the brake discs by braking the vehicle a few times.

**IMPORTANT:** • Only brake test stands with test speeds of 2.5-6 km/h may be used.

## Front brakes:

- Drive the front wheels of the vehicle onto the brake test stand
- Place the selector lever in selector lever position "N"
- Start the brake test stand
- Press service brake pedal
- Read off maximum brake power on left/right



**Fig. 6: Identifying Brake Test Stands**

Courtesy of BMW OF NORTH AMERICA, INC.

- IMPORTANT:
- Before using the brake test stand with the rear axle, roller operation must be activated at the instrument cluster.
  - It is not permissible to use the brake test stand with the rear axle if roller operation has not been activated!
  - When roller operation is activated, hold steering wheel in straight-ahead position, steering wheel movements deactivate roller operation!

Roller operation is activated using the kilometer reset button (1).

Press reset button (1) until the main menu appears in the middle of the instrument cluster.



**Fig. 7: Screen Display - Reset Button**

Courtesy of BMW OF NORTH AMERICA, INC.

In main menu (1), select the "03 Start roller" menu item using the reset button.



**Fig. 8: Screen Display - Select Start Roller From Main Menu**  
Courtesy of BMW OF NORTH AMERICA, INC.

Confirm the "03 Roller Operation" (1) menu item by pressing the reset button.



**Fig. 9: Screen Display - 03 Roller Operation Menu Item**  
Courtesy of BMW OF NORTH AMERICA, INC.

Roller operation is shown in the display with the message "Start ESC OFF".

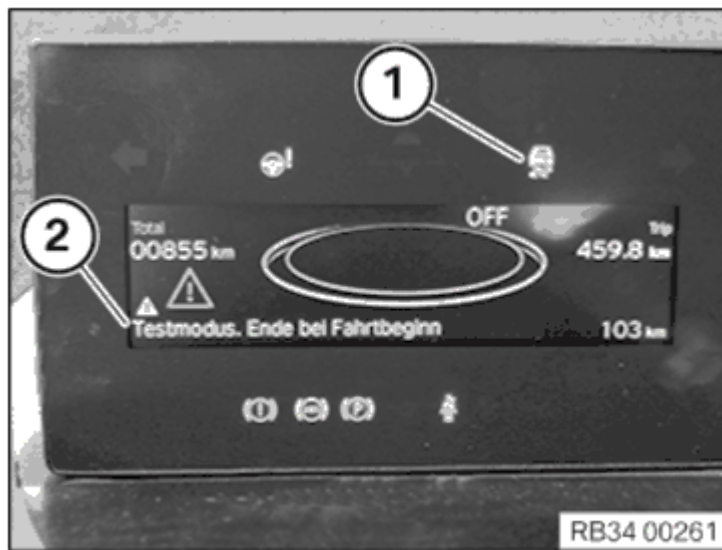
Press the reset button to start roller operation.



**Fig. 10: Screen Display - Start ESC OFF Message**  
Courtesy of BMW OF NORTH AMERICA, INC.

Warning light (1) and "Test mode ends when driving starts" light up on the display.

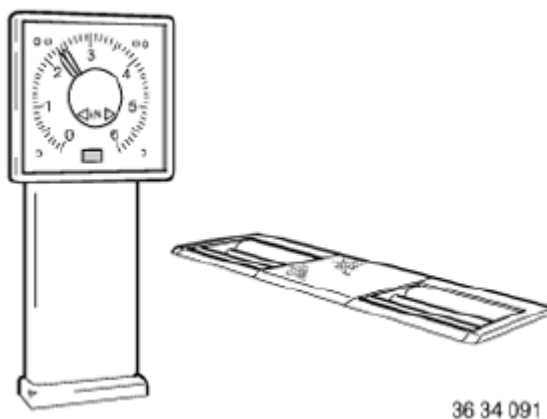
The brake test can now be performed.



**Fig. 11: Screen Display - Warning Light And Test Mode Ends**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### Rear brakes:

- Drive the rear wheels of the vehicle onto the brake tester
- Place the selector lever in selector lever position "N"
- Start the brake test stand
- Press service brake pedal
- Read off maximum brake power on left/right

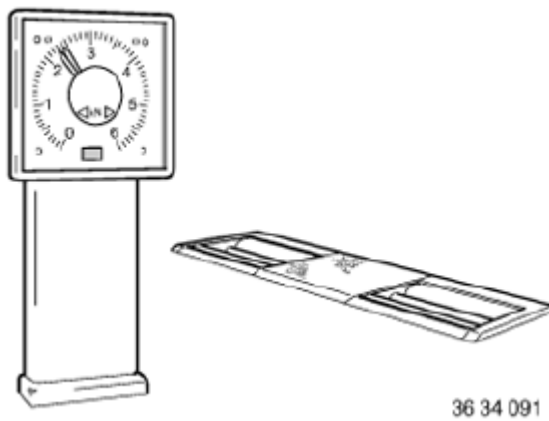


**Fig. 12: Identifying Brake Test Stands**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### Parking brake:

**NOTE:** The electromechanical parking brake can not be tested on a plate test stand!

- Drive the rear wheels of the vehicle onto the brake tester
- Place the selector lever in selector lever position "N"
- Start the brake test stand
- Wait for the parking brake light to flash slowly



**Fig. 13: Identifying Brake Test Stands**

Courtesy of BMW OF NORTH AMERICA, INC.

Actuate parking brake switch = application of brake pads.

The parking brake indicator light flashes quickly when brake test stand mode is activated and EMF actuators are partially locked.

Actuate parking brake switch = test force 1

Actuate parking brake switch again = test force 2

Actuate parking brake switch again = test force 3

The parking brake is released again when the button is actuated in the Release direction.



**Fig. 14: Releasing Parking Brake**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Roller operation is automatically deactivated after a terminal change!

**34 00 010 CHECKING THICKNESS OF BRAKE PAD**

Special tools required:

- 34 1 260

**NOTE:** The thickness of the outer brake pads can be determined without removing the wheels.



If necessary, move vehicle until opening for brake pad wear indicator (brake pad) can be seen through rim styling.

Insert special tool 34 1 260 wheel rim into opening for brake pad wear indicator.

Press special tool onto brake pad. Slide ring (1) in direction of arrow up to stop and read off measured value.

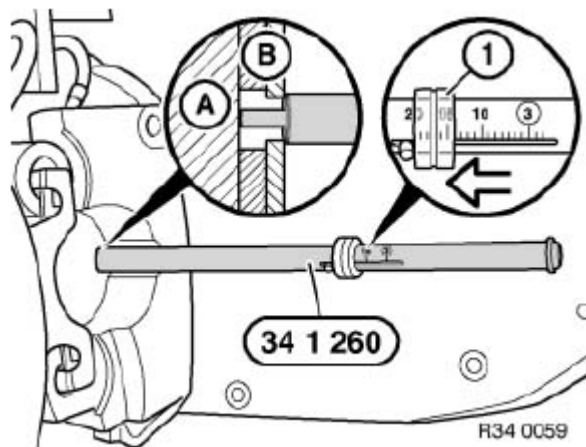
**NOTE:**

**A. Brake disc**

**B. Brake pad with backplate**

Remaining brake pad thickness of front brake.

Remaining brake pad thickness of rear brake.



**Fig. 15: Sliding Ring Up to Stop**

Courtesy of BMW OF NORTH AMERICA, INC.

**34 00... GENERAL INFORMATION ON BREAKING IN NEW BRAKE DISCS/BRAKE PADS**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

After completing work:

- Carry out function check on brake test stand to ensure that the brakes complies with legal requirements.
- Carry out test braking while driving at low speed; the effectiveness of the brakes may be reduced during the initial braking operations.
- Exaggerated drastic and continuous braking operations for faster breaking in are not permitted.
- Advise the customer not to perform any wilful drastic breaking in the first 200 km after brake replacement.
- Attach mirror tag to inside mirror.

**IMPORTANT:**

**34 00... GENERAL NOTES**

The brake system is one of the most important safety systems on any motor vehicle. It is therefore essential to act with utmost care when working on the brake system and to follow the instructions below.

- Ensure cleanliness and only use fluff-free cleaning cloths.

- Wash away or vacuum up brake dust, do not clear it away using compressed air. This dust is a health hazard.
- Do not under any circumstances allow any oil or grease to get into the brake system. This would result in a complete malfunction of the brake system.
- When cleaning brake components with brake cleaner, do not allow brake cleaner to get into in the brake system.
- Even the most minute traces of brake cleaner must be avoided.
- Replace brake fluid at least every two years.
- Never reuse drained brake fluid.
- Always use BMW-approved brake fluid.
- Dispose of brake fluid in approved appliances only.
- Do not allow brake fluid to drain into drain pipes, into the outside environment or into unsuitable facilities. This would create the risk of groundwater contamination since brake fluid is classed as a fluid that is hazardous to water.
- Do not allow brake fluid to come into contact with paintwork as this will destroy the paint.
- Brake fluid must not be allowed to remain on bare skin too long in order to avoid skin problems. Wash skin coated with brake fluid with water and soap.
- If brake fluid makes contact with eyes, immediately flush with large quantity of clean water and visit eye doctor.
- Brake pads:

Brake pads must be replaced when the warning threshold of the brake pad wear indicator is reached.

Brake pads must always be replaced on both sides of any axle.

The friction surfaces of the brake pads must not come into contact with oil or grease. The brake pads must be replaced if they are fouled by such substances.

In the case of rotation-dependent brake pads, make sure the arrow marking points in the direction of rotation of the brake disc for when the vehicle is moving forward. Brake pads with left/right markings must be fitted on the relevant side of the vehicle.

One-sided angled areas on the brake pads must be located on the disc contact side of the brake caliper for when the vehicle is moving forward.

- Brake discs:

Brake discs must not be scored or cracked. Furthermore, minimum brake disc thickness, disc runout, parallelism and surface roughness of the friction surfaces must not exceed or drop below the permitted values.

Always strip preservative off new parts before installation. With the rear brake discs, also strip preservative off brake drum on parking brake.

- Always strip preservative off new parts before installation.
- Brake calipers:

Only approved glycol-based pastes may be used for repairs on brake calipers.

All moving parts on the brake caliper must move freely: note grease specifications.

Use only BMW-approved lubricants to grease caliper guides.

- Brake lines and brake hoses must be correctly routed and must not abut with body or components in a way which would cause chafing.
- To prevent damage, release and tighten brake line couplings with a special brake line wrench only.
- The system must be bled each time any brake lines have been detached.
- All connection points must be checked for leaks.

- Only tighten down brake hoses on the front axle when wheels are in straight-ahead driving position.
- Close off open connections of brake lines and individual components to prevent dirt from getting into the brake system.
- When tightening down brake line couplings, observe tightening torque [34 32 1AZ](#) .

The traction control system is essentially maintenance-free; however the following must be observed:

- When carrying out welding work with electric welding equipment, be sure to disconnect the plug from the electronic control unit (ignition turned off).
- During painting work, the control unit may be subjected for brief periods to loads of max. 95 Å°C and for long periods (approx. 2 hours) to loads of max. 85 Å°C.
- Terminals must be completely tight on end poles of battery.
- Brake lines on hydraulic unit must not be swapped over: if applicable, mark them prior to disassembly.

On completion of repair work, carry out swap-over test with the DIS diagnosis system.

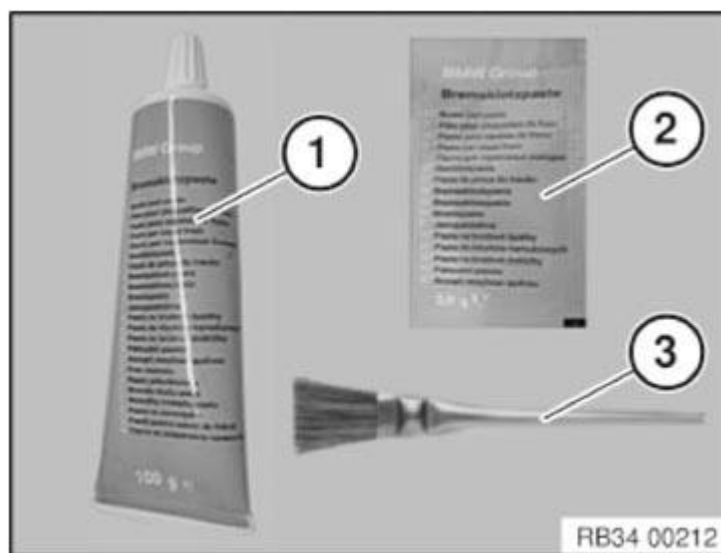
### **34 00 X01 GUIDELINE FOR APPLYING BRAKE PAD PASTE ON BRAKE PADS AND CALIPER CARRIER**

#### **Attention!**

**So as not to damage the surface coating, if possible do not mechanically clean the guide surfaces for the brake pads on the brake caliper mounting bracket, but rather clean with brake cleaner BMW TI. Clean number 83 19 2 154 780 and apply a thin coating of BMW TI break pad paste. Coat number 83 19 2 158 851 (3 gr.) or 83 19 2 158 852 (100 gr.).**

**Spread brake pad paste onto the marked surfaces using a brush!**

- (1) Brake pad paste 100 gr. BMW TI. Number 83 19 2 158 852
- (2) Brake pad paste 3 gr. BMW TI. Number 83 19 2 158 851
- (3) Brush for spreading brake pad paste over the marked areas.



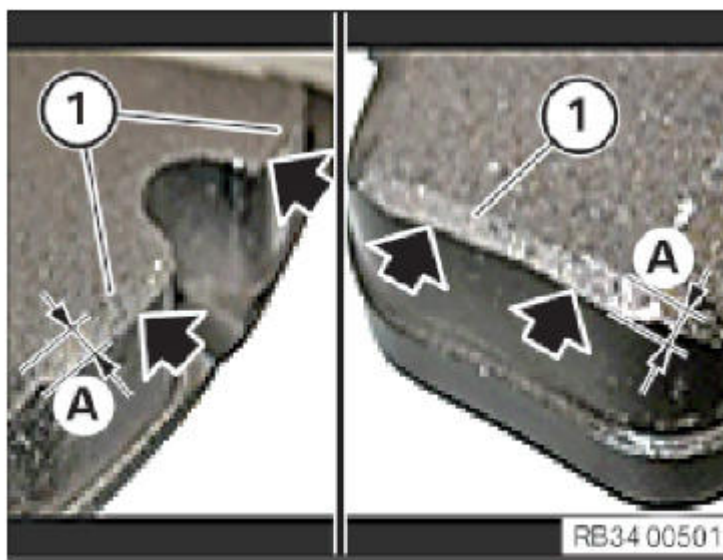
**Fig. 16: Identifying Brush For Spreading Brake Pad Paste**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### **Attention!**

**If new brake pads are mounted on a brake disc, the following must be observed:**

- Bevel edges in the area (1) slightly (dimension A must not exceed maximum 1 mm).

These procedures applies for all the following described brake systems.

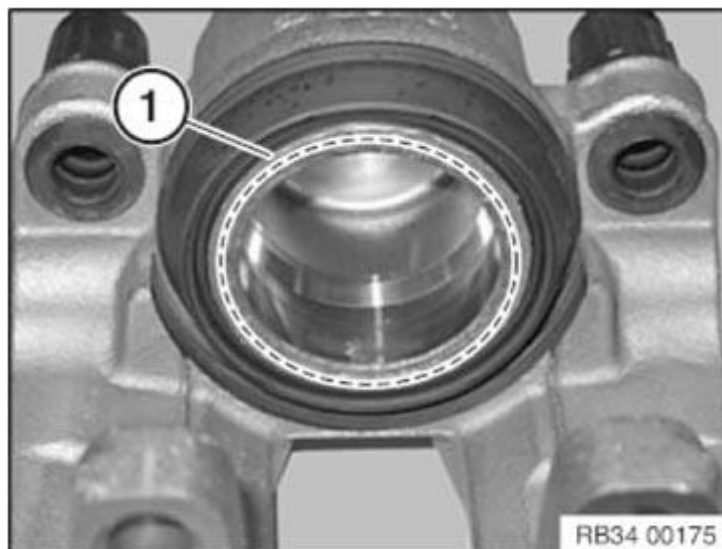


**Fig. 17: Locating Bevel Edges**

Courtesy of BMW OF NORTH AMERICA, INC.

IPS brake (made by CBI), 1-piston floating caliper brake (model ranges: 1-Series, 3-Series, 4-Series, X3)

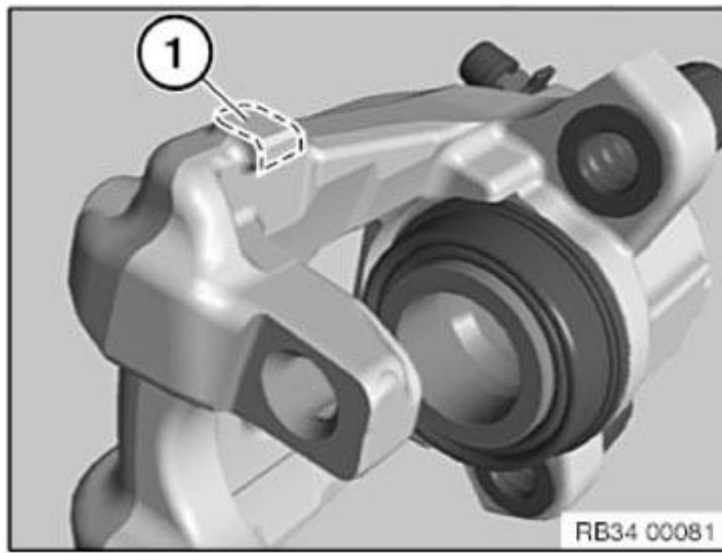
Clean contact surface (1) of brake piston with brake cleaner and apply a thin coating of brake pad paste.



**Fig. 18: Identifying Brake Piston Contact Surface**

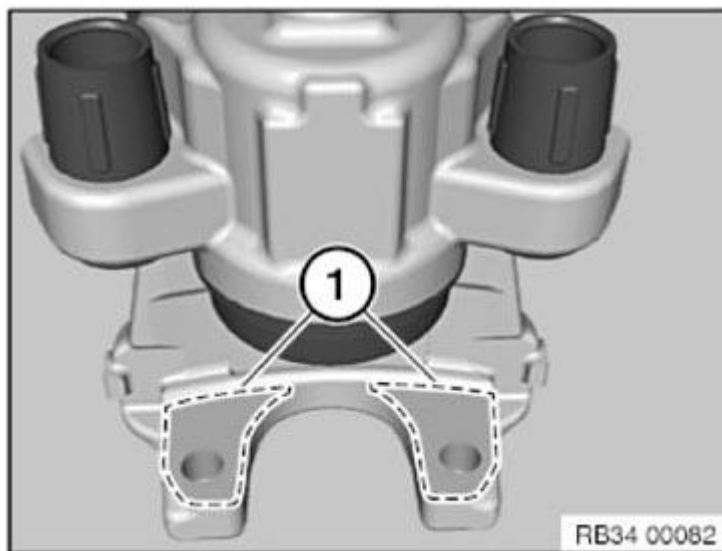
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surfaces (1) of T-heads/brake caliper housing with brake cleaner and apply a thin coating of brake pad paste.



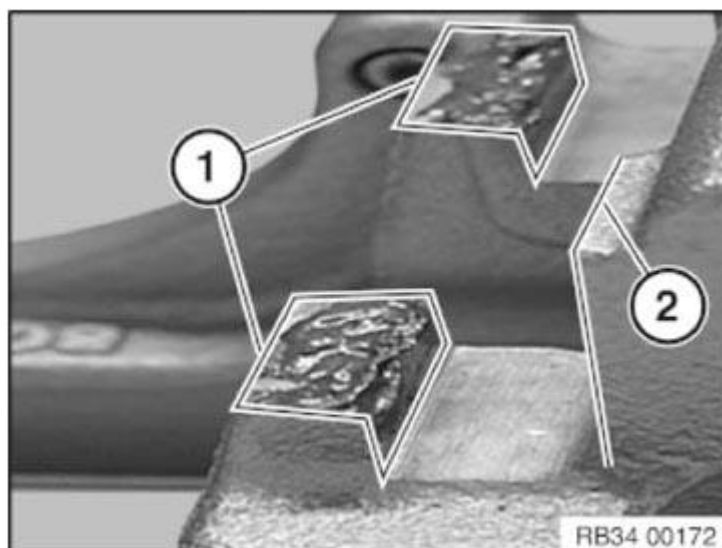
**Fig. 19: Identifying T-Heads/Brake Caliper Housing Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surface (1) of brake caliper with brake cleaner and apply a thin coating of brake pad paste.



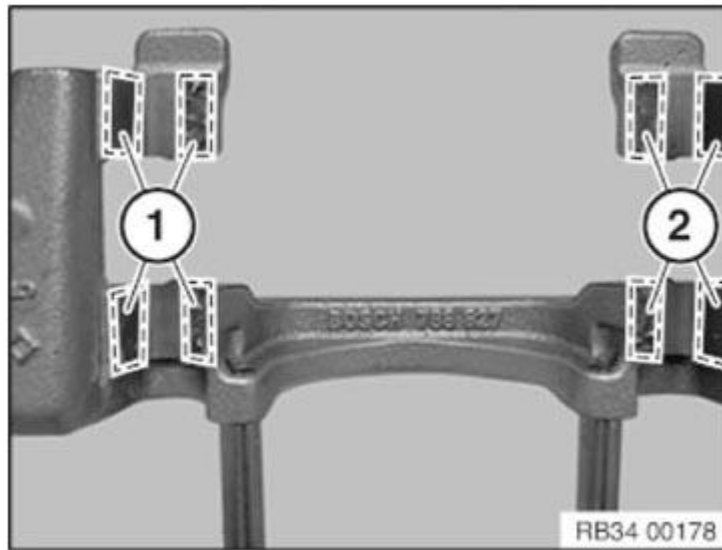
**Fig. 20: Identifying Brake Caliper Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (1) for the brake pads on the brake caliper mounting bracket. Clean guide surfaces (1 and 2) with brake cleaner and apply a thin coating of brake pad paste.



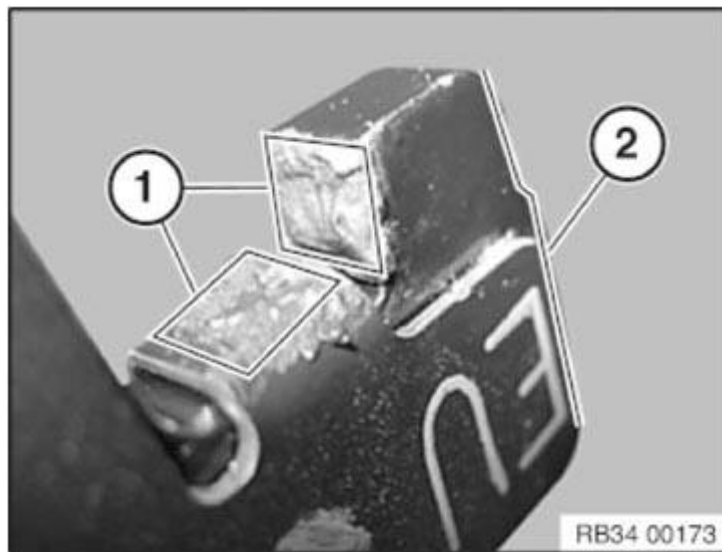
**Fig. 21: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (1 and 2) for the brake pads on the brake caliper mounting bracket. Clean guide surfaces (1 and 2) with brake cleaner and apply a thin coating of brake pad paste.



**Fig. 22: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

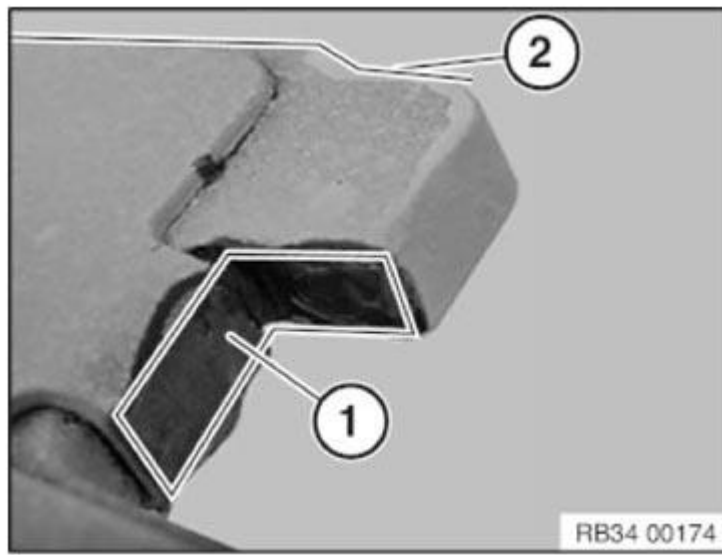
Apply a thin coating of brake pad paste to T-head of inner brake pad in area (1) and (2).



**Fig. 23: Identifying Inner Brake Pad T-Head Paste Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply a thin coating of brake pad paste to T-head of outer brake pad in area (1) and (2).

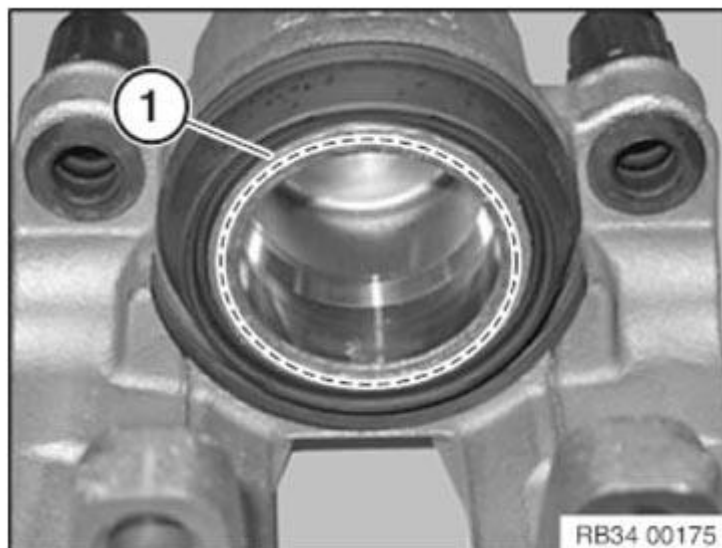




**Fig. 24: Identifying Outer Brake Pad T-Head Paste Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

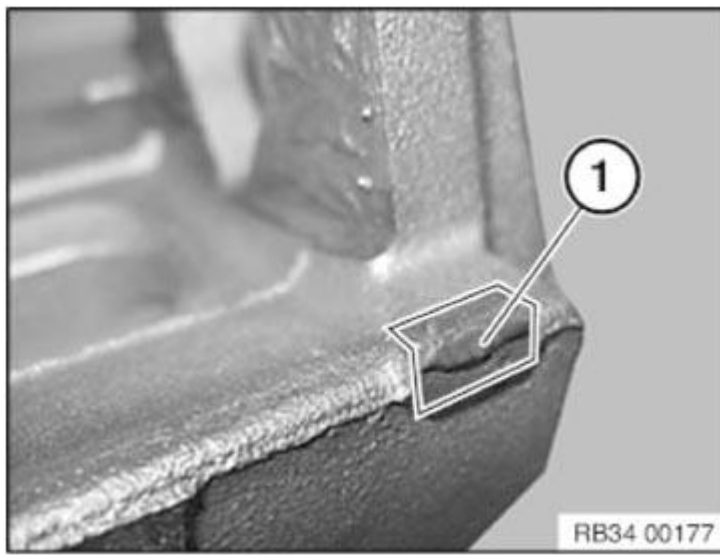
FN brake (made by Continental Teves), 1-piston floating caliper brake (model ranges: 5-Series, 6-Series, 7-Series, 8-Series, X1, X3, X5, Z4, Rolls-Royce)

Clean contact surface (1) of brake piston with brake cleaner and apply a thin coating of brake pad paste.



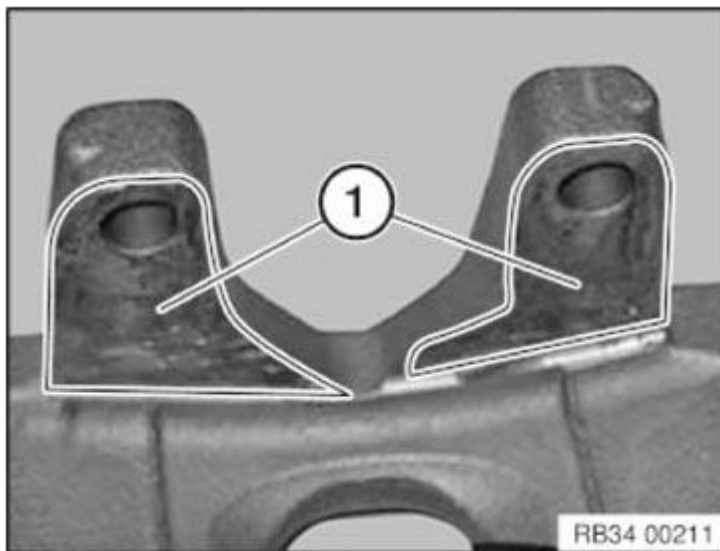
**Fig. 25: Identifying Brake Piston Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surfaces (1) of T-heads/brake caliper housing with brake cleaner and apply a thin coating of brake pad paste.



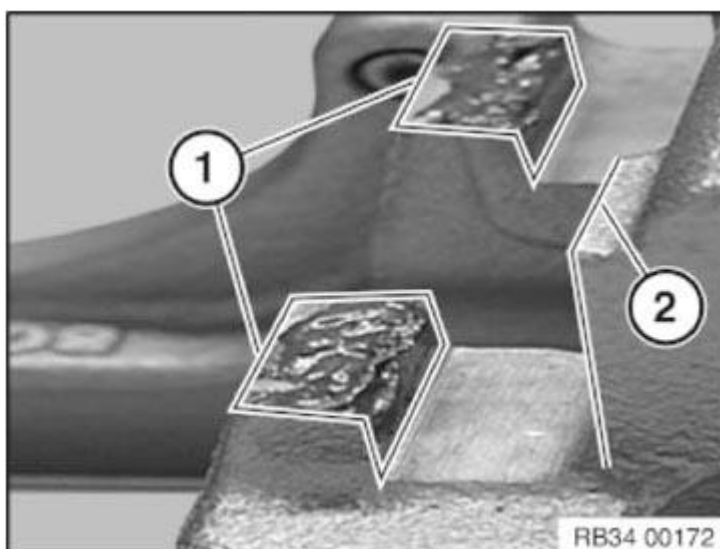
**Fig. 26: Identifying T-Heads/Brake Caliper Housing Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surface (1) of brake caliper with brake cleaner and apply a thin coating of brake pad paste.



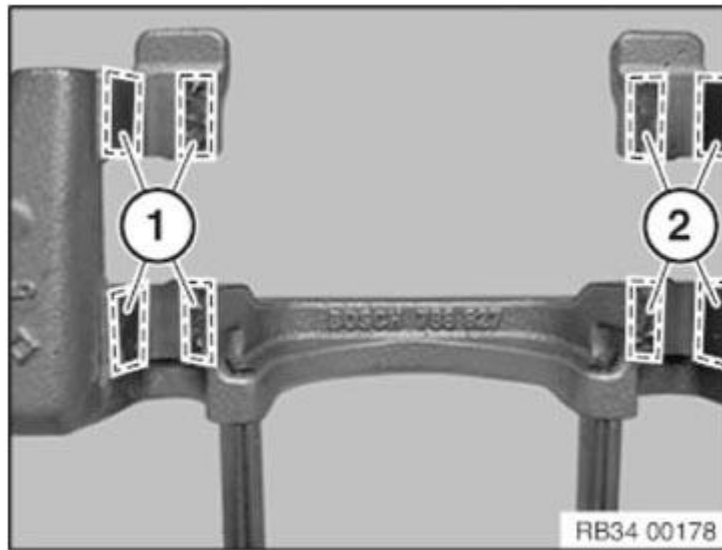
**Fig. 27: Identifying Brake Caliper Contact Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (1) for the brake pads on the brake caliper mounting bracket. Clean guide surfaces (1) with brake cleaner and apply a thin coating of brake pad paste.



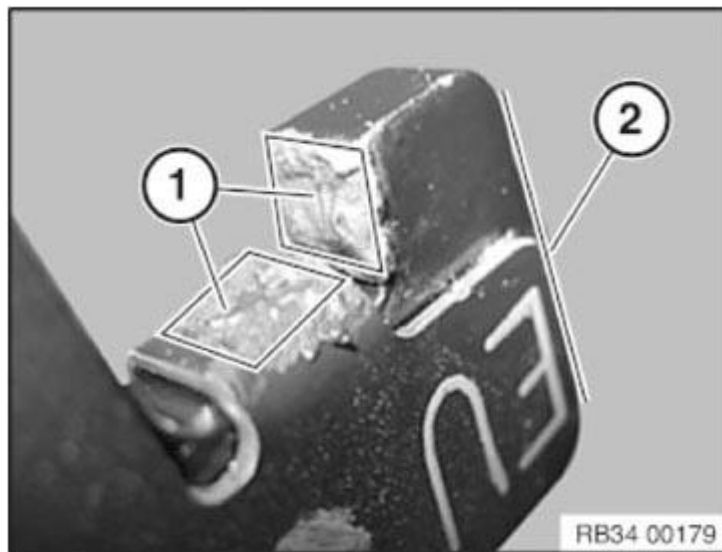
**Fig. 28: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (1 and 2) for the brake pads on the brake caliper mounting bracket. Clean guide surfaces (1 and 2) with brake cleaner and apply a thin coating of brake pad paste.



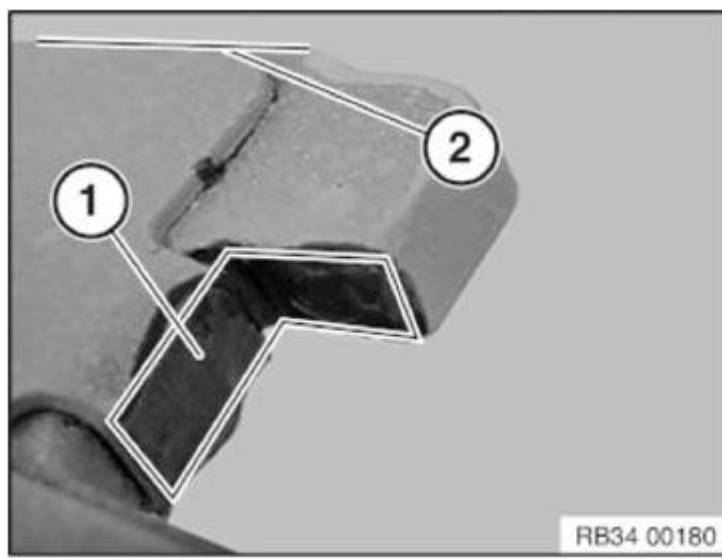
**Fig. 29: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat the T-head of the inner brake pad with brake pad paste in area (1 and 2).



**Fig. 30: Identifying Inner Brake Pad T-Head Paste Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

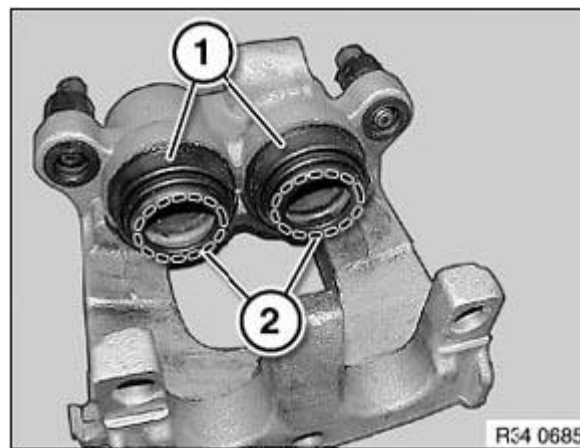
Lightly coat the T-head of the outer brake pad with brake pad paste in area (1 and 2).



**Fig. 31: Identifying Outer Brake Pad T-Head Paste Applying Area**  
 Courtesy of BMW OF NORTH AMERICA, INC.

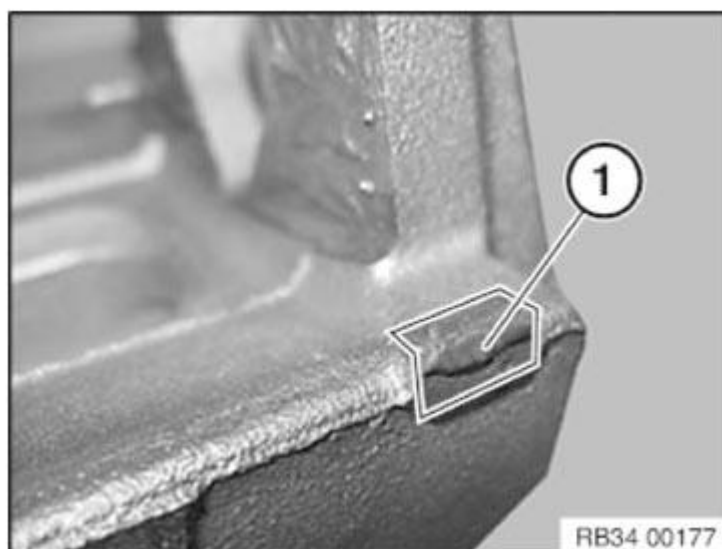
FN brake (made by Continental Teves), 2-piston floating caliper brake (model ranges: 5-Series, 6-Series, 7-Series, 8-Series, X5, Rolls-Royce)

Clean contact surface (2) of brake piston with brake cleaner and apply a thin coating of brake pad paste.



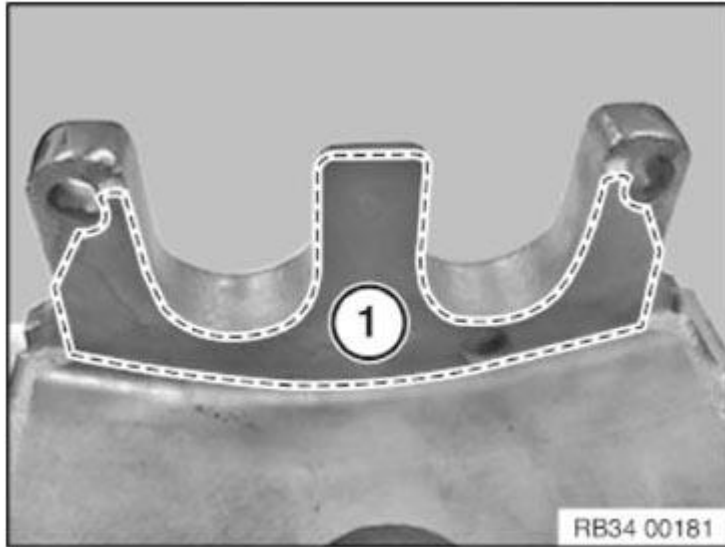
**Fig. 32: Identifying Brake Piston Contact Surface**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surfaces (1) of T-heads/brake caliper housing with brake cleaner and apply a thin coating of brake pad paste.



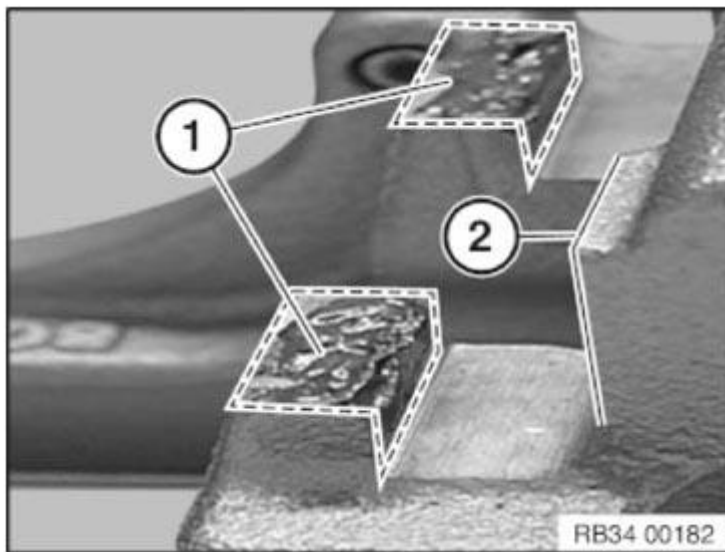
**Fig. 33: Identifying T-Heads/Brake Caliper Housing Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surface (1) and brake caliper with brake cleaner and apply a thin coating of brake pad paste.



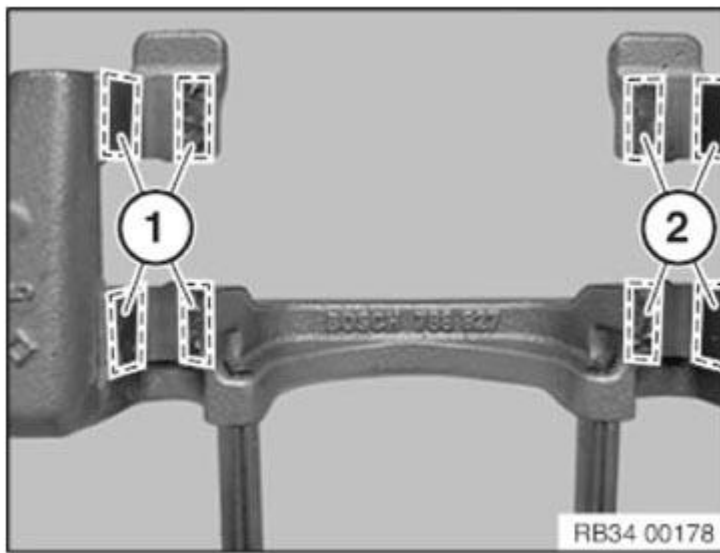
**Fig. 34: Identifying Brake Caliper Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (1 and 2) for the brake pads on the brake caliper mounting bracket. Clean guide surfaces (1 and 2) with brake cleaner and apply a thin coating of brake pad paste.



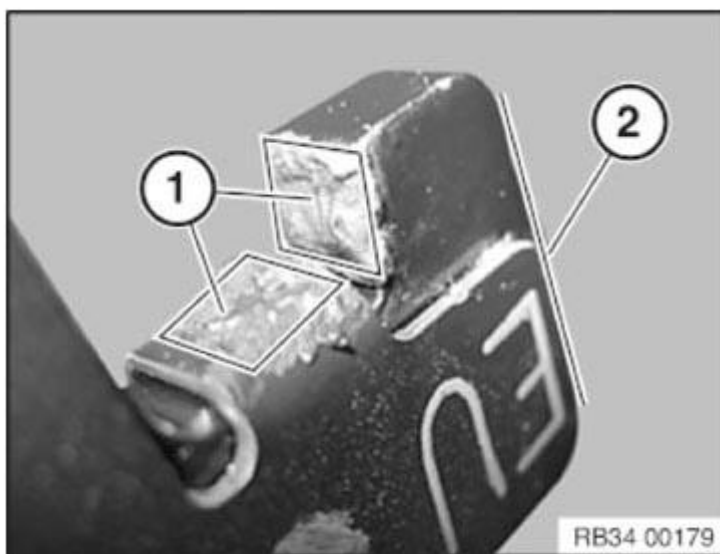
**Fig. 35: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (1 and 2) for the brake pads on the brake caliper mounting bracket. Clean guide surfaces (1 and 2) with brake cleaner and apply a thin coating of brake pad paste.



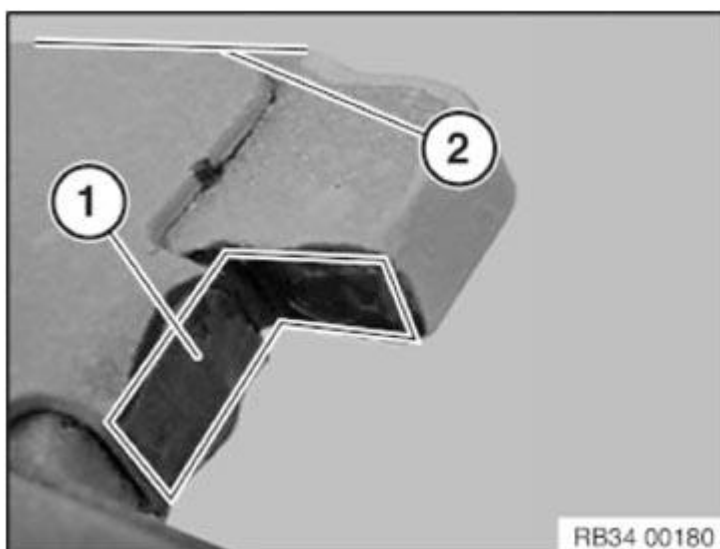
**Fig. 36: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat the T-head of the inner brake pad with brake pad paste in area (1 and 2).



**Fig. 37: Identifying Inner Brake Pad T-Head Paste Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat the T-head of the outer brake pad with brake pad paste in area (1 and 2).

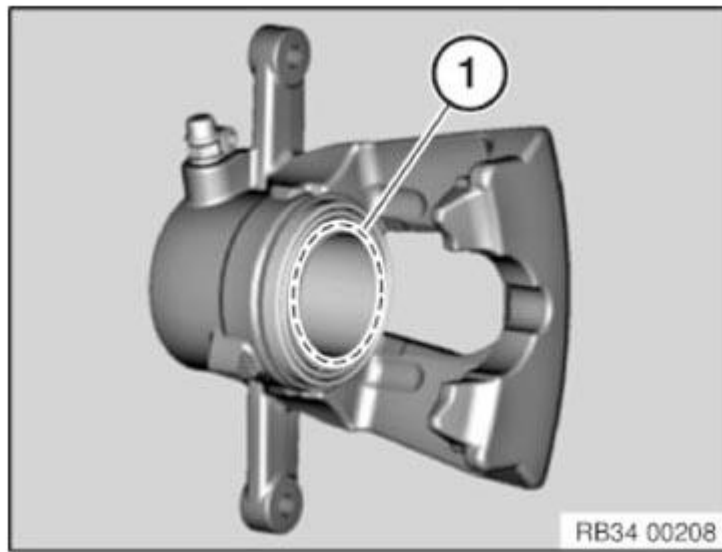




**Fig. 38: Identifying Outer Brake Pad T-Head Paste Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

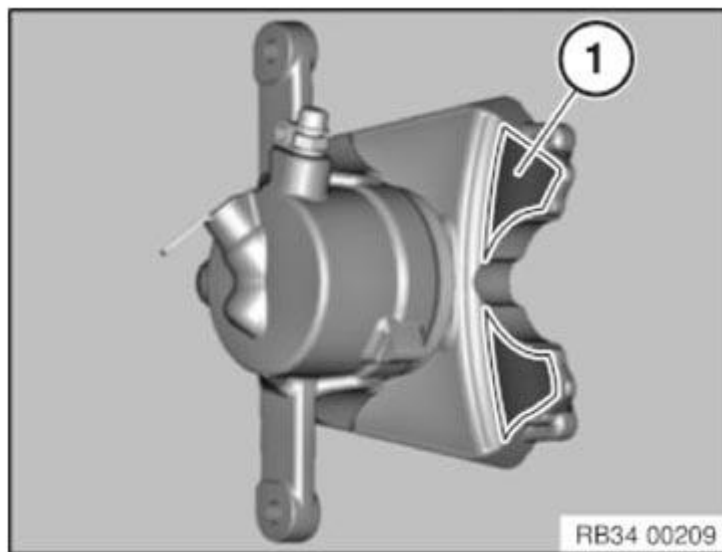
Collette brake (made by TRW), 1-piston brake caliper (model ranges: MINI, 1-Series, 5-Series, 6-Series, Z4)

Clean contact surface (1) of brake piston with brake cleaner and apply a thin coating of brake pad paste.



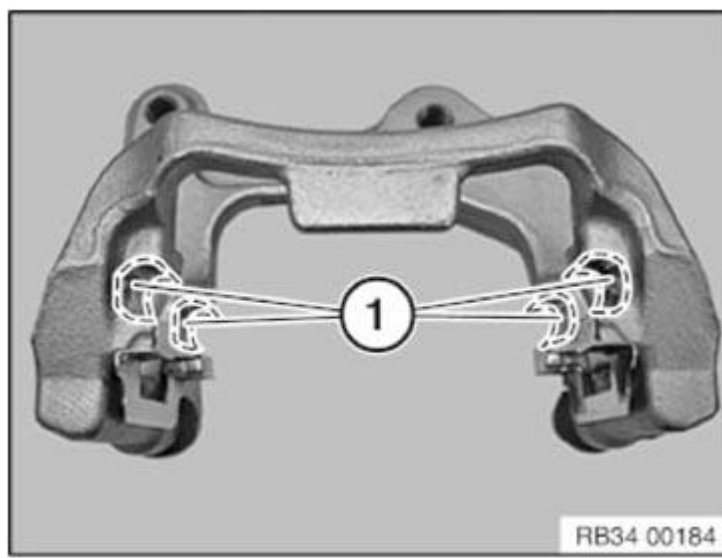
**Fig. 39: Identifying Brake Piston Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surface (1) of brake caliper with brake cleaner and apply a thin coating of brake pad paste.



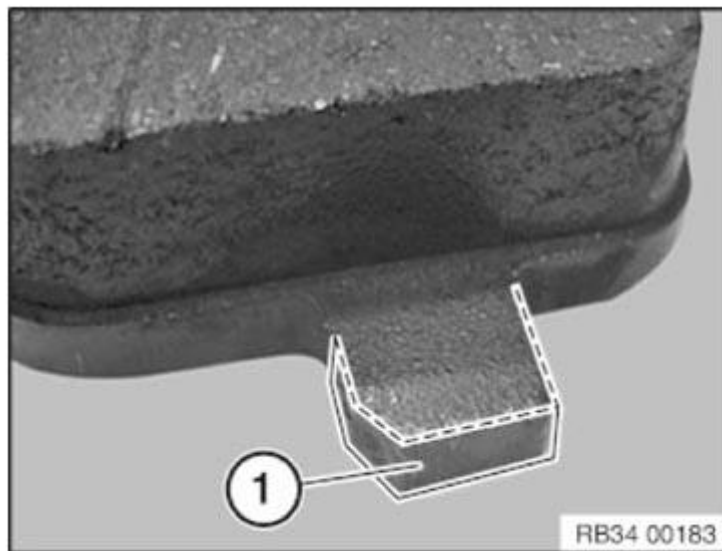
**Fig. 40: Identifying Brake Caliper Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surface (1) for the brake pads on the brake caliper mounting bracket. Clean guide surface (1) with brake cleaner and apply a thin coating of brake pad paste.



**Fig. 41: Identifying Brake Pad Guide Surfaces**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Apply a thin coating of brake pad paste to both sides of T-head of brake pad in area (1).



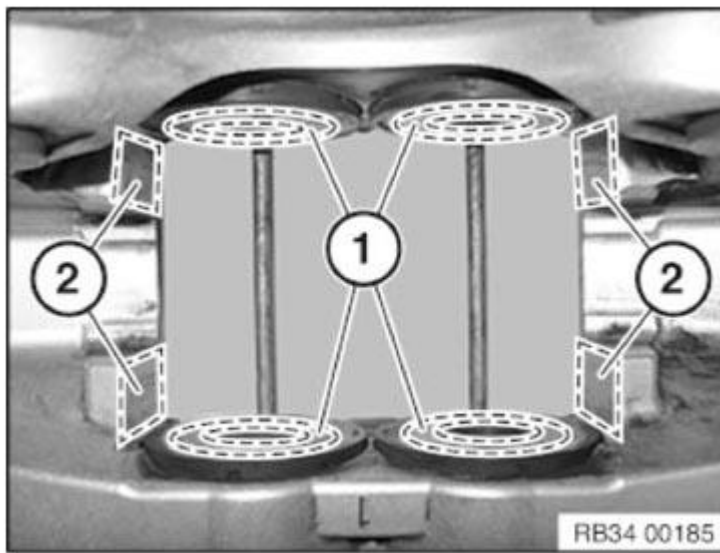
**Fig. 42: Identifying Brake Pad T-Head Paste Applying Area**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**P 4.40 brake (made by Brembo), 4-piston fixed caliper brake (model ranges: MINI, 1-Series, 3-Series, 4-Series, 5-Series, 6-Series, 7-Series, 8-Series, X5, Rolls-Royce)**

Clean contact surface (1) of brake piston with brake cleaner and apply a thin coating of brake pad paste.

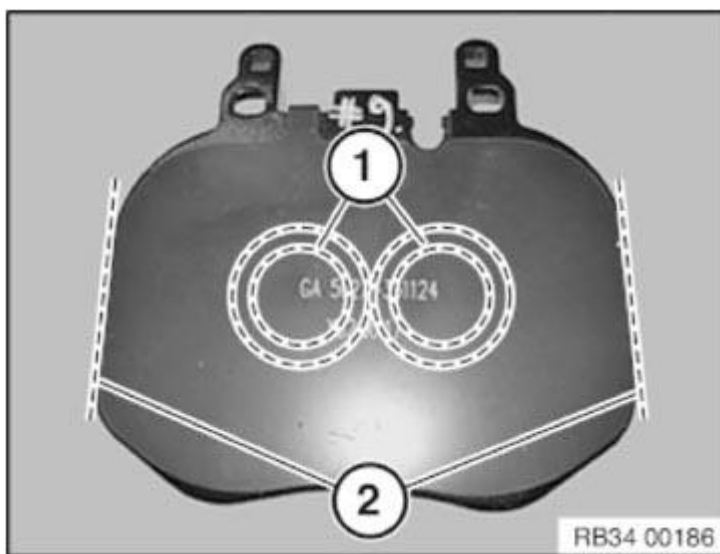
So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (2) for the brake pads on the brake caliper mounting bracket. Clean guide surface (2) with brake cleaner and apply a thin coating of brake pad paste.

Clean both inner and outer guide surfaces (2) and apply a thin coating of brake pad paste.



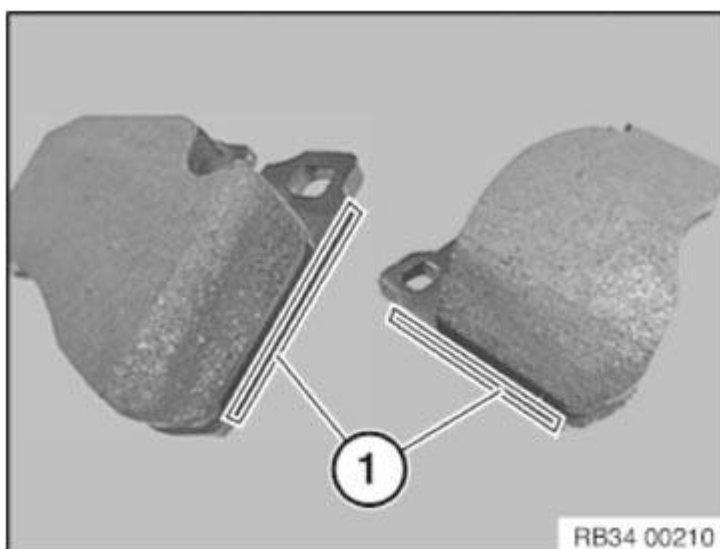
**Fig. 43: Identifying Brake Piston Contact And Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat both sides of the contact surface in area (1 and 2) with brake pad paste.



**Fig. 44: Identifying Brake Pad Contact Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat the brake pad contact surface on both sides in area (1) with brake pad paste.



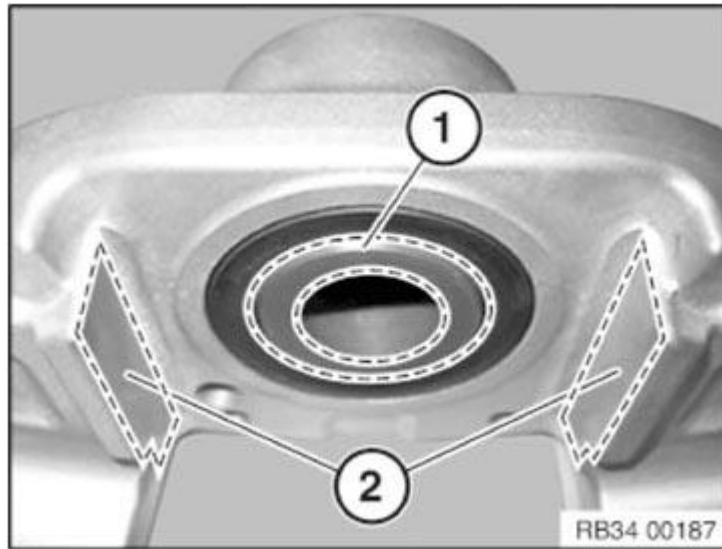
**Fig. 45: Identifying Brake Pad Contact Surface Coating Areas**  
Courtesy of BMW OF NORTH AMERICA, INC.

**P 4.40 brake (made by Brembo), 2-piston fixed caliper brake (model ranges: 1-Series, 3-Series)**

Clean contact surface (1) of brake piston with brake cleaner and apply a thin coating of brake pad paste.

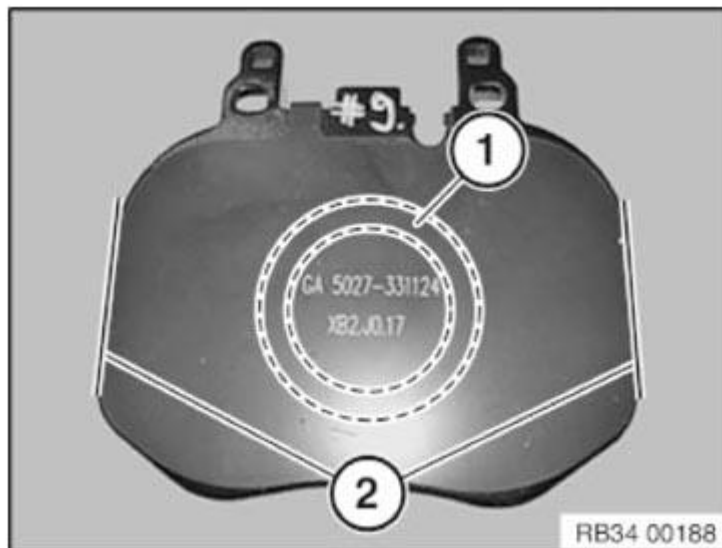
So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (2) for the brake pads on the brake caliper mounting bracket. Clean guide surface (2) with brake cleaner and apply a thin coating of brake pad paste.

Clean both inner and outer guide surfaces (2) and apply a thin coating of brake pad paste.



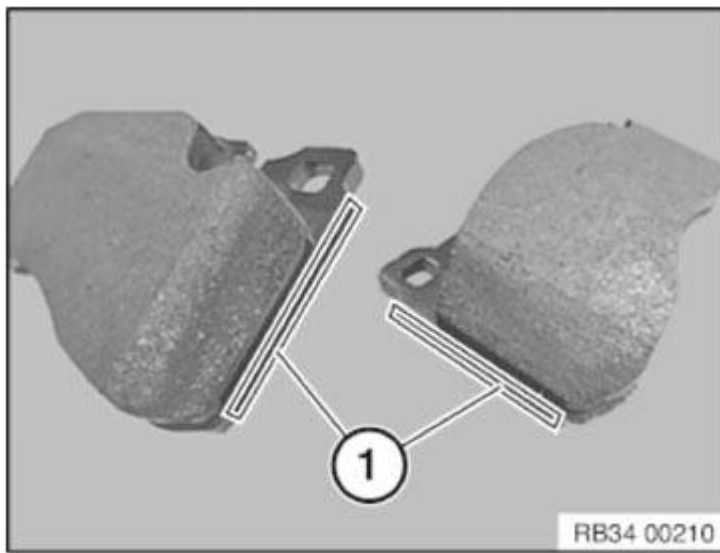
**Fig. 46: Identifying Brake Piston Contact And Brake Pad Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat both sides of the contact surface in area (1 and 2) with brake pad paste.



**Fig. 47: Identifying Brake Pad Coating Areas**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat the brake pad contact surface on both sides in area (1) with brake pad paste.



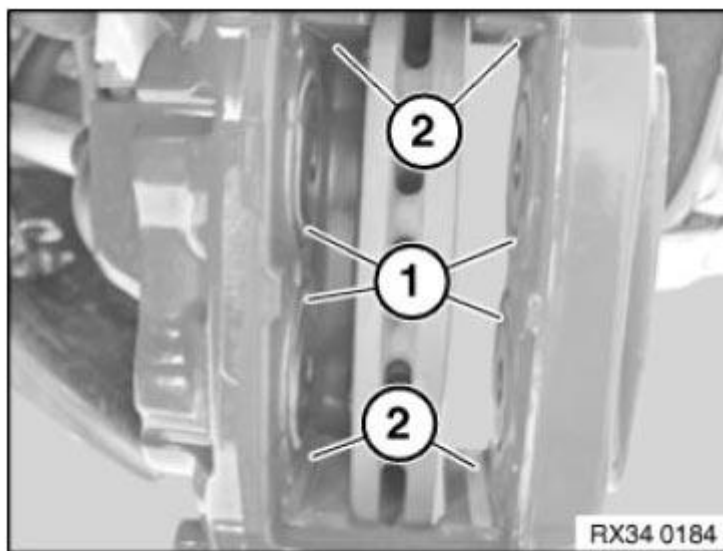
**Fig. 48: Identifying Brake Pad Contact Surface Coating Areas**

Courtesy of BMW OF NORTH AMERICA, INC.

**Brake (made by Brembo), 4-piston fixed caliper brake (model ranges: MINI F5x sport brake)**

Check dust boot (1) for damage and replace if necessary.

Clean brake caliper compartments (2) and apply a thin coating of brake pad paste.

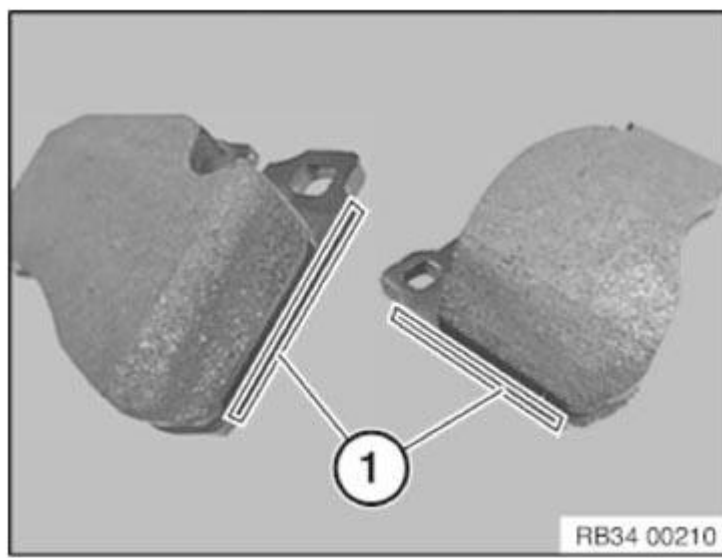


**Fig. 49: Identifying Dust Boot And Brake Caliper Compartments**

Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat the brake pad contact surface on both sides in area (1) with brake pad paste.

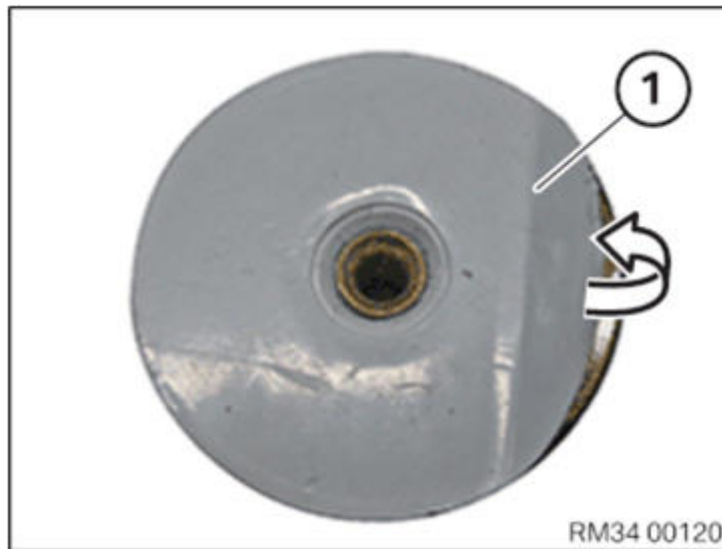
**Do not grease the brake lining backplate and thoroughly clean it with brake cleaner!**



**Fig. 50: Identifying Brake Pad Contact Surface Coating Areas**  
Courtesy of BMW OF NORTH AMERICA, INC.

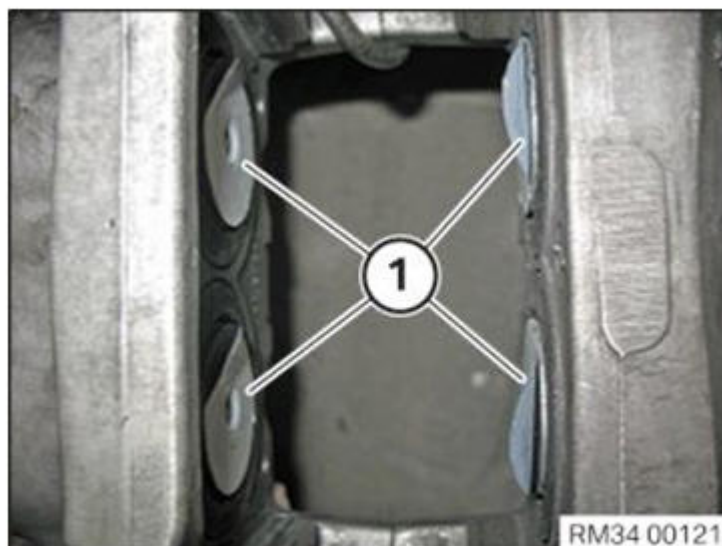
**Only use new claw plates!**

Slightly raise the protective film (1) at a place.



**Fig. 51: Raising Protective Film**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert the claw plates (1) into the brake pistons.



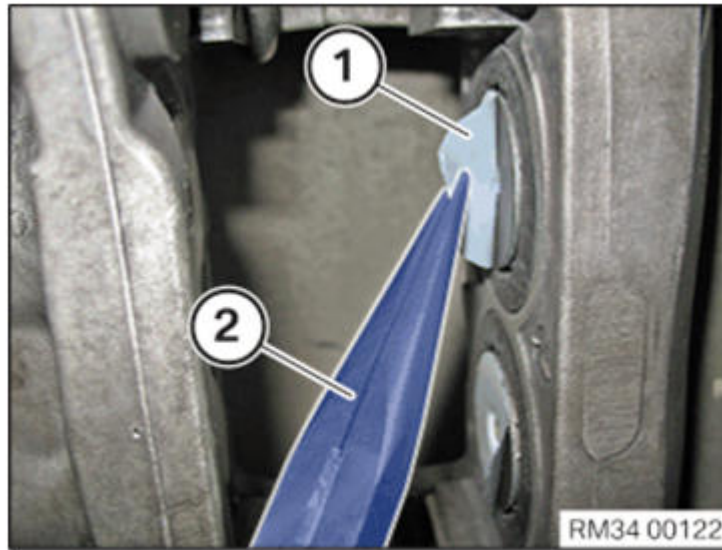


**Fig. 52: Identifying Brake Pistons Claw Plates**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull off the protective film (1) with long-nose pliers (2).

**Attention!**

The bonding surface of the claw plates must not be touched!



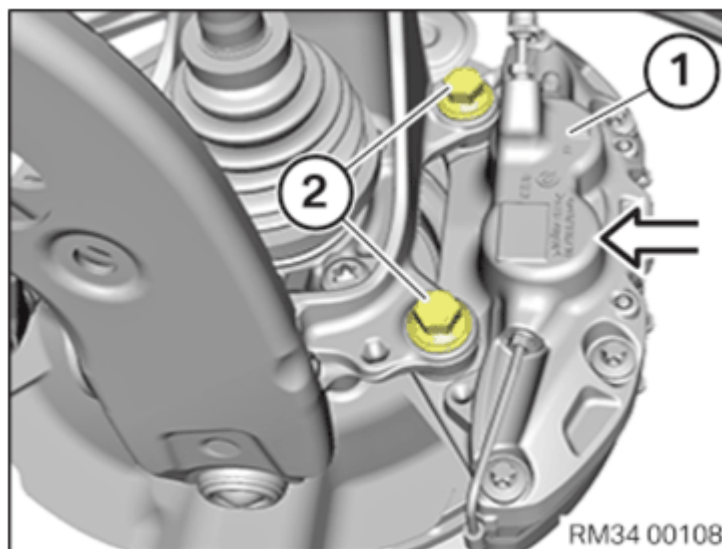
**Fig. 53: Pulling Off Protective Film With Long-Nose Pliers**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install the brake caliper (1) in direction of arrow.

**Parts:** Replace screws (2).

Insert screws (2) and tighten.

Tightening torque: [34 11 2AZ](#) .



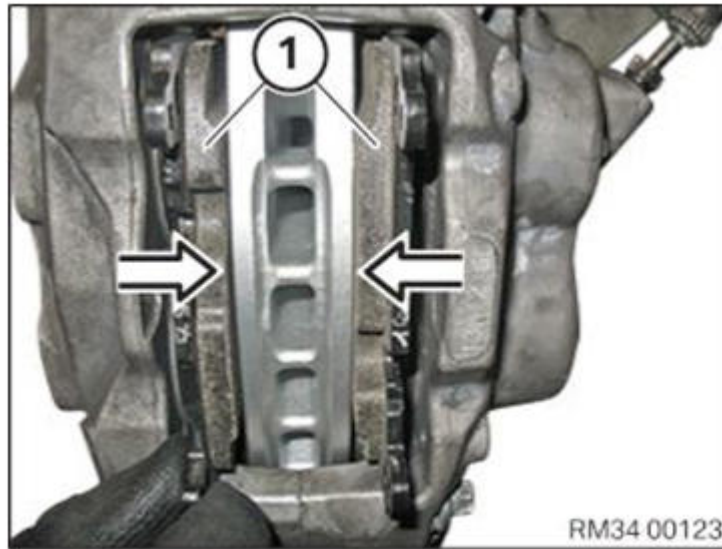
**Fig. 54: Installing Brake Caliper**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install the brake pad (1).

**Attention!**

The brake pads must not touch the bonding surface of the claw plates when inserting!

Apply the brake pads to the brake disc and insert.



**Fig. 55: Installing Brake Pad**

Courtesy of BMW OF NORTH AMERICA, INC.

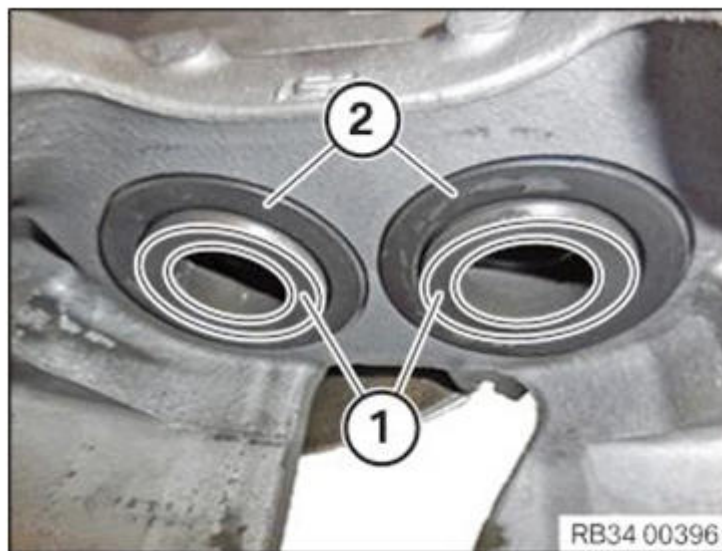
**In order to ensure a complete bonding of the claw plates with the brake pads, the following instruction must be strictly adhered to:**

Strongly press the brake pedal and hold it for at least 1 min!

**Brake (made by Continental), 4-piston fixed caliper brake (model ranges: 7-Series (G11, G12))**

Clean the contact surface (1) of the brake piston (4 pieces) with brake cleaner.

Check the dust boots (2) and renew as necessary.



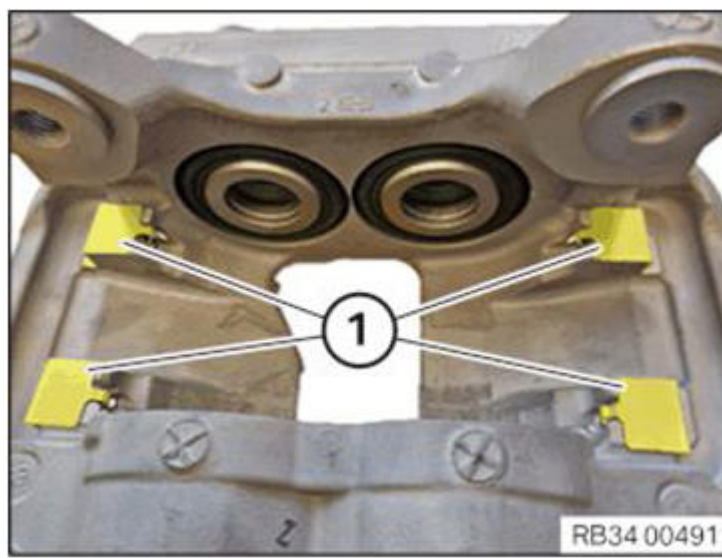
**Fig. 56: Identifying Brake Piston Contact Surface And Dust Boots**

Courtesy of BMW OF NORTH AMERICA, INC.

Always renew retaining plates 1!

Mount retaining plate 1.

It is paramount that the slide panels are correctly positioned in the guides!

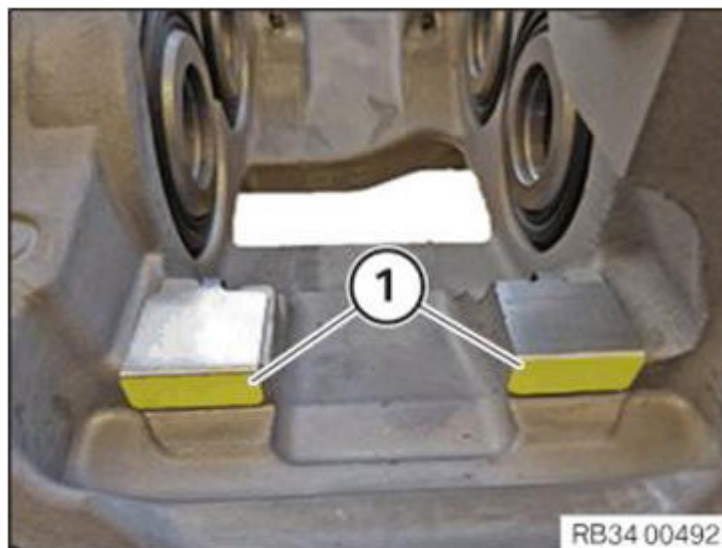


**Fig. 57: Identifying Retaining Plates**

Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, if possible do not mechanically clean the guide surfaces for the brake pads on the brake caliper mounting bracket.

Apply a thin layer of brake pad paste to the surfaces of the sliding plates (1).



**Fig. 58: Identifying Sliding Parts Paste Applying Areas**

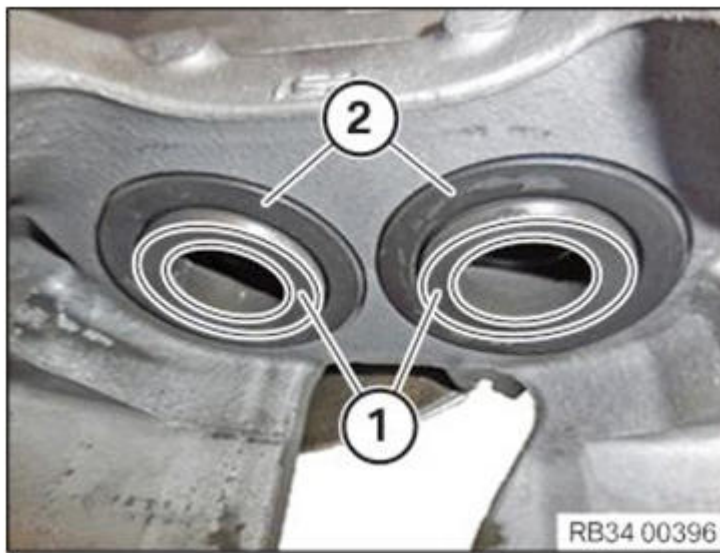
Courtesy of BMW OF NORTH AMERICA, INC.

**Brake (made by Brembo), 4-piston fixed caliper brake (model ranges: 7-Series (G11, G12))**

Clean the contact surface (1) of the brake piston (4 pieces) with brake cleaner.

Adhesive residues must be completely removed.

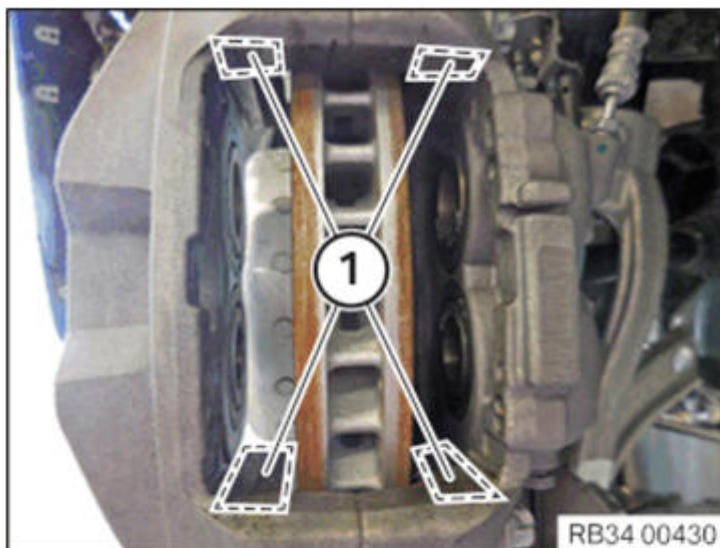
Check the dust boots (2) and renew as necessary.



**Fig. 59: Identifying Brake Piston Contact Surface And Dust Boots**  
Courtesy of BMW OF NORTH AMERICA, INC.

To prevent damage to the surface coating, do not clean the guide surfaces (1) for the brake pads on the brake caliper mechanically, if possible.

Clean guide surfaces (1) with brake cleaner and apply a thin coating of brake pad paste.



**Fig. 60: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove the protective film of the adhesive layer (1) from the brake pads.

Do not touch the adhesive layer!





**Fig. 61: Identifying Brake Pads Adhesive Layer**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Insert brake pads in the brake caliper, making sure the adhesive layer does not touch the brake pistons.

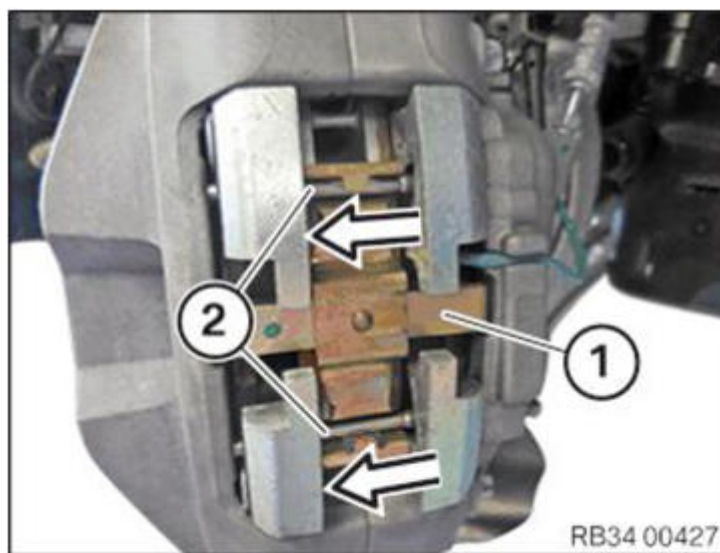
Fit retaining clip (1).

Drive in the locking pins (2) in the direction of the arrow.

**Attention!**

After the brake pads have been installed they must immediately be bonded to the brake pistons:

- Step on the brake pedal to the floor and hold the pressure for one minute. This causes the brake pads to adhere to the brake pistons.



**Fig. 62: Driving In Locking Pins**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**34 00 027 REPLACING FLUID IN BRAKE SYSTEM**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**NOTE:** Read and comply with **GENERAL INFORMATION**.  
 The capacities are oil change quantities.

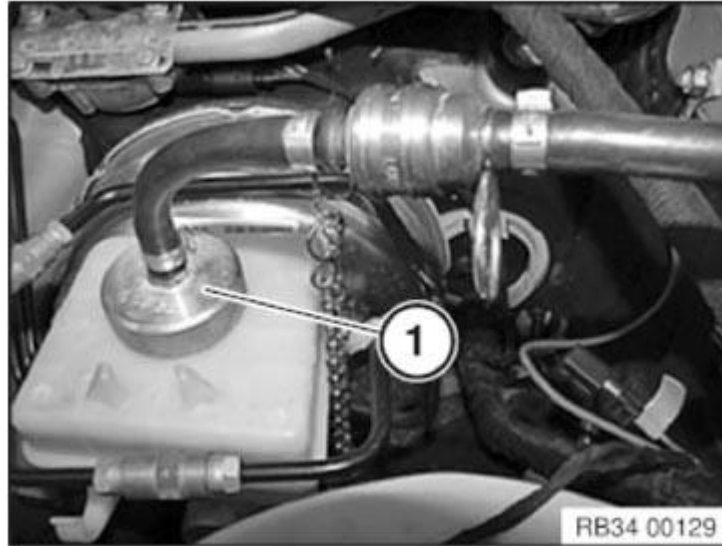
**Necessary preliminary tasks:**

- Remove **COVER IN FRONT LEFT LUGGAGE COMPARTMENT**

When carrying out repairs to the brake system, follow the procedure set out in  
IMPORTANT: **BLEEDING BRAKE SYSTEM WITH DSC.**  
Use only approved **BRAKE FLUIDS** .

Connect bleeder unit to expansion tank (1) and switch on.

**NOTE:** Follow the applicable equipment manufacturer's Owner's Handbook.  
Charging pressure should not exceed 2 bar.



**Fig. 63: Identifying Bleeder Unit On Expansion Tank**  
Courtesy of BMW OF NORTH AMERICA, INC.

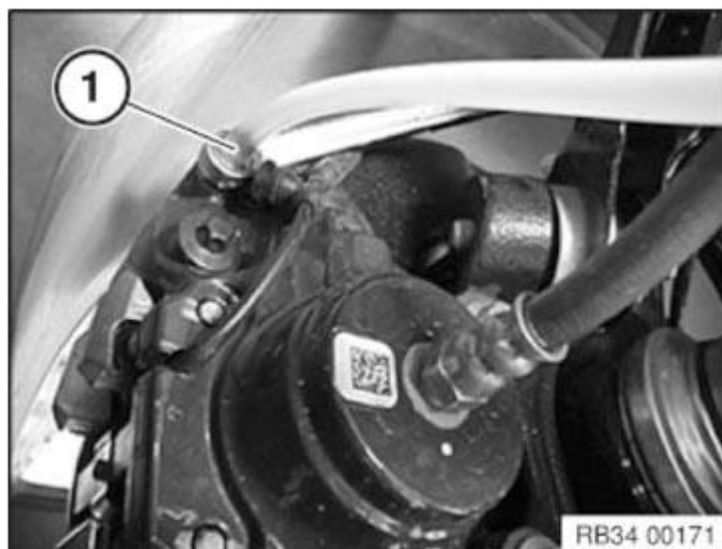
**Completely bleed the brake system.**

Connect vent hose (1) with collecting vessel to vent valve on rear right brake caliper.

Open vent valve and purge until clear, bubble-free brake fluid emerges.

Close vent valve.

**Follow same procedure on rear left, front right and front left wheel brake.**



**Fig. 64: Identifying Rear Right Brake Caliper Vent Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

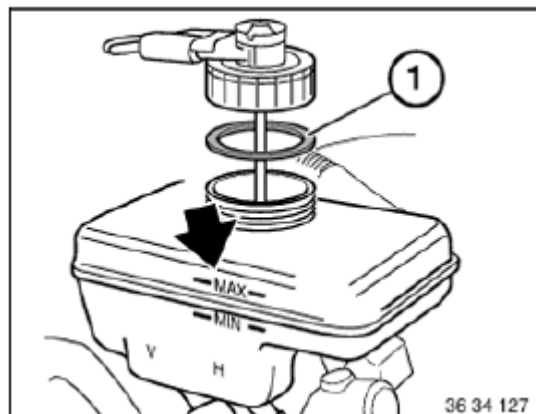


Switch off bleeder unit and remove from expansion tank.

Check brake fluid level. If necessary, top up/draw off to "MAX" level.

Close expansion tank.

**NOTE:** Pay attention to seal (1) in sealing cap.



**Fig. 65: Locating MAX Level Mark On Expansion Tank**

Courtesy of BMW OF NORTH AMERICA, INC.

## **FRONT BRAKES**

### **34 11 667 PRECISION-TURNING BOTH FRONT BRAKE DISCS ON BOTH SIDES**

#### **Attention!**

Always precision-turn both sides of both brake discs on one axle.

Maximum machining dimension per friction ring side is 0.8 mm!

Minimum brake disc thickness (MIN TH)

Brake discs of M models (Compound brake discs) must **not** be machined!

Only one brake pad set may be used up on brake discs which have been lathe-turned to minimum thickness (MIN TH).

#### **Mobile brake disc lathe:**

#### **Attention!**

Only BMW-approved brake disc lathes may be used!

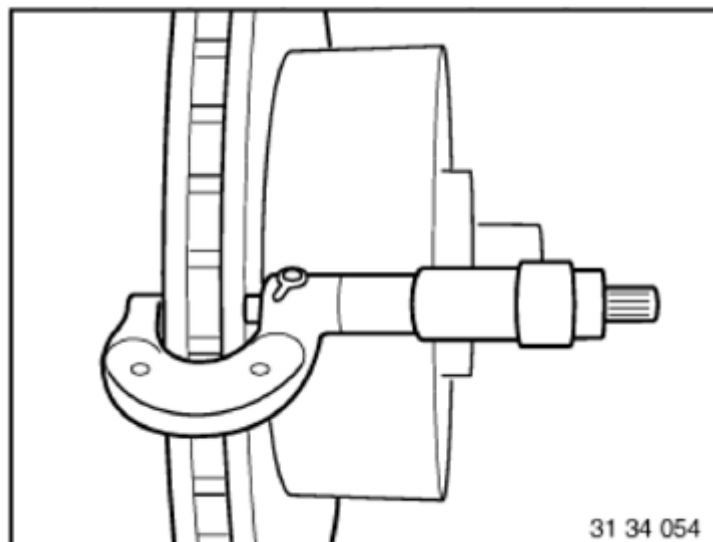
In the case of mobile brake disc lathes, the brake caliper and the brake anchor plate must be removed.

The brake discs remain on the vehicle.



**Fig. 66: Identifying Mobile Brake Disc Lathe**  
Courtesy of BMW OF NORTH AMERICA, INC.

After fine-grinding the brake discs, measure the thickness difference inside the braking surfaces at 8 points with an caliper gauge.



**Fig. 67: Measuring Thickness Difference Inside Braking Surfaces With Caliper Gauge**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **34 11 220 REMOVING AND INSTALLING/REPLACING BOTH FRONT BRAKE DISCS**

Special tools required:

- 34 1 280

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

Necessary preliminary tasks:

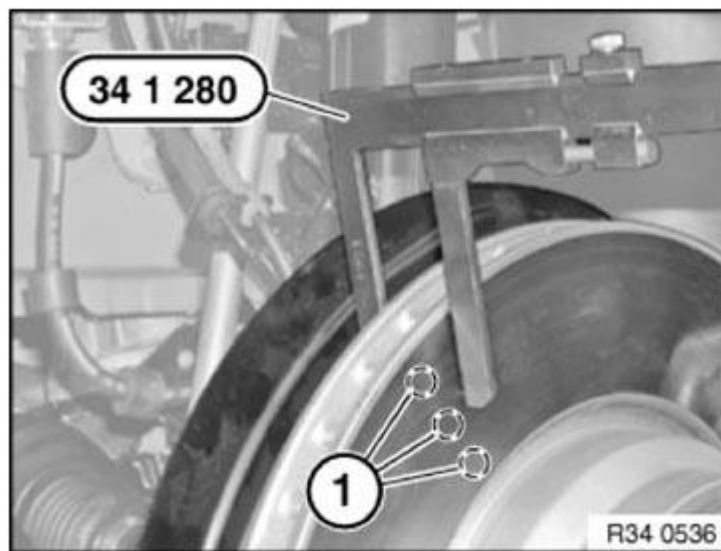
- Remove and clean **BRAKE PADS**.

Check minimum brake disc thickness:

- Position special tool 34 1 280 at three measuring points in area (1) and measure.
- Compare measuring result and lowest value with **SETPOINT VALUE** .

If the brake discs are replaced, you must also fit new brake pads.

Brake discs may only be replaced in pairs (on each axle).



**Fig. 68: Checking Minimum Brake Disc Thickness Using Special Tool (34 1 280)**  
Courtesy of BMW OF NORTH AMERICA, INC.

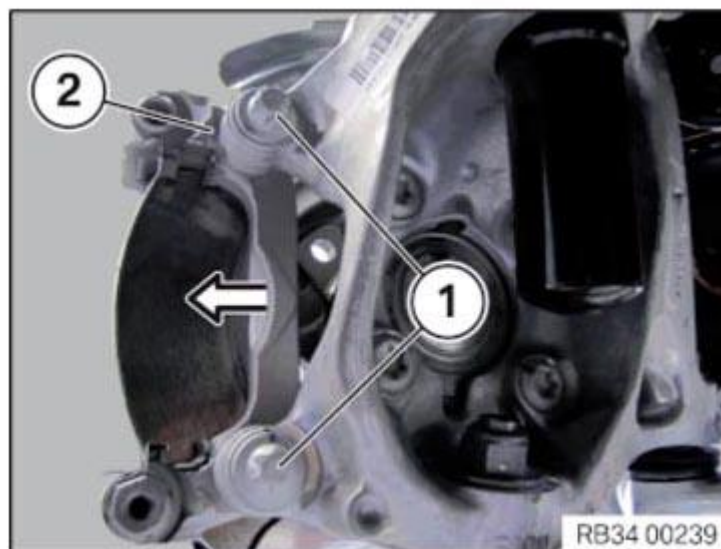
IMPORTANT: New brake pads may only be fitted if the brake disc thickness is greater than the **MINIMUM BRAKE DISC THICKNESS** (MIN TH).

Release screws (1) and remove brake anchor plate (2) to the rear.

*Installation note:*

Replace screws.

Tightening torque **34 11 2AZ** .

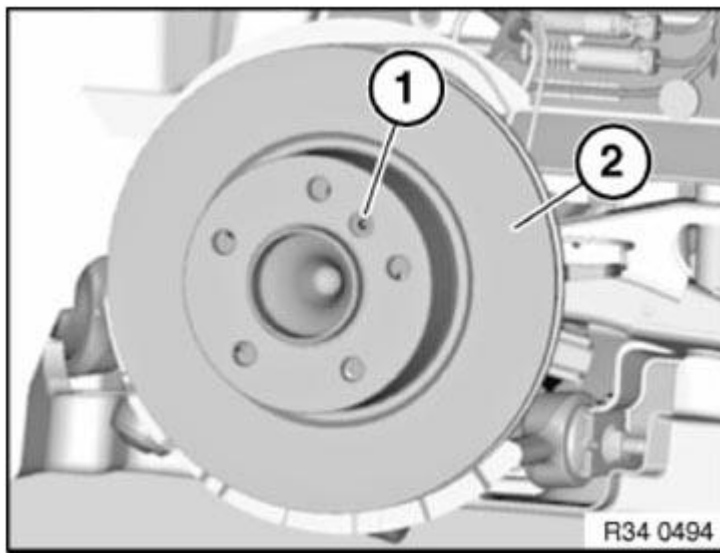


**Fig. 69: Removing Brake Anchor Plate To Rear**  
Courtesy of BMW OF NORTH AMERICA, INC.

To release brake disc: Do not under any circumstances strike friction ring with a hammer or similar!

IMPORTANT: If necessary, carefully tap on base of brake disc chamber with a rubber mallet.  
Clean contact surface of brake disc at wheel hub thoroughly and remove traces of corrosion.

Unevenness on contact surface may result in distortion of brake disc!



**Fig. 70: Identifying Brake Disc Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) and remove brake disc (2).

*Installation note:*

Replace screw.

Tightening torque **34 11 1AZ** .

**After installation:**

- Read and comply with notes on **BREAKING IN NEW BRAKE DISCS/BRAKE PADS**.

### **34 11 000 REMOVING AND INSTALLING/REPLACING BRAKE PADS ON BOTH FRONT DISC BRAKES**

**Special tools required:**

- 34 1 050
- 34 1 280

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**Attention!**

- **Do not mechanically clean the guide surfaces for brake pads to prevent damage to the surface coating. Clean the guide surfaces using brake cleaner, BMW part number 83 19 2 154 780. Carefully clean severely soiled guide surfaces with a suitable tool (e.g. brass wire brush, nylon brush). Then thinly coat with brake pad paste BMW part number 83 19 2 158 851 (3 gr.) or 83 19 2 158 852 (100 gr.).**

**Spread brake pad paste onto the marked surfaces using a brush!**

**Observe REGULATION ON APPLYING BRAKE PAD PASTE TO BRAKE PADS AND BRAKE ANCHOR PLATES!**

- **Retaining pins and expanding spring: for vehicles older than 48 months it is recommended to replace the retaining spring!**
- **Brake pad wear sensor: After removal it must be replaced (brake pad wear sensor loses its retention capability in the break pad).**
- **A CBS reset is mandatory upon every brake pad exchange!**

- If the brake pad wear sensor is partially ground (display in CBS menu): CBS reset possible within the vehicle.
- If the brake pad wear sensor is **not** partially ground: CBS reset possible via diagnosis system only.

### Necessary preliminary tasks:

- Remove **WHEELS** .
- Remove **BRAKE PAD WEAR SENSOR**.

Pull brake pad wear sensor rearward out of brake pad (left side only).

Unscrew guide bolts (1).

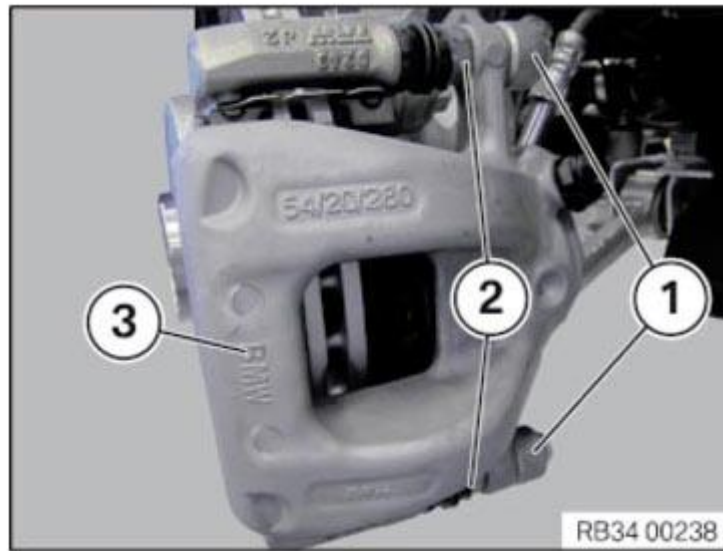
If necessary, grip at hexagon head (2).

Remove brake caliper (3).

*Installation note:*

Replace guide bolts.

Tightening torque **34 11 5AZ** .



**Fig. 71: Identifying Brake Caliper, Hexagon Head And Guide Bolts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove brake pads (1) in direction of arrow from caliper carrier.

### **Attention!**

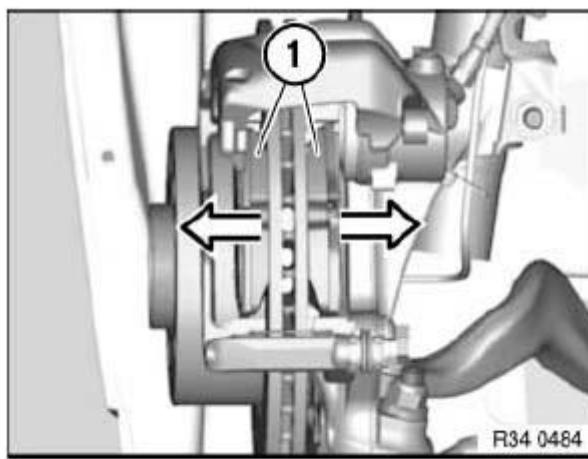
Mark any worn brake pads.

In the event of one-sided brake pad wear, do not change brake pads round.

Observe **MINIMUM THICKNESS OF BRAKE PADS** .

Clean brake pads.

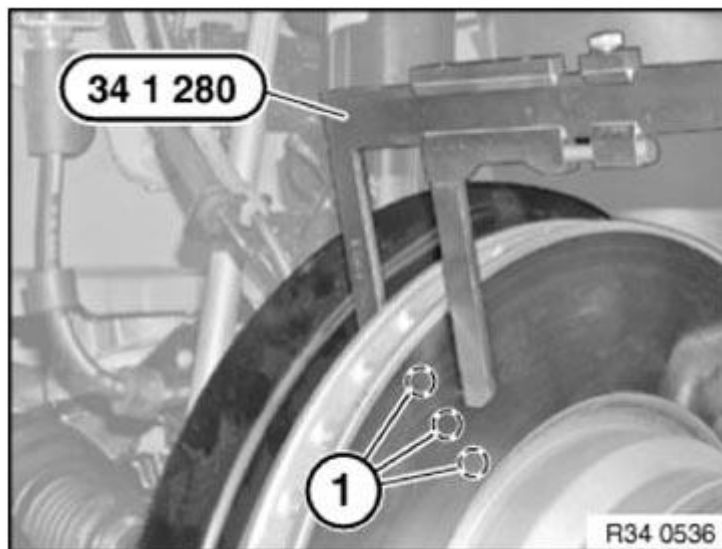
Do not apply grease to brake lining backplate.



**Fig. 72: Removing Brake Pads From Caliper Carrier**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Check minimum brake disc thickness:

- Position special tool 34 1 280 at three measuring points in area (1) and measure.
- Compare measuring result and lowest value with **SETPOINT VALUE** .



**Fig. 73: Checking Minimum Brake Disc Thickness Using Special Tool (34 1 280)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

New brake pads may only be installed if the brake disc thickness is greater than the **MINIMUM BRAKE DISC THICKNESS** .

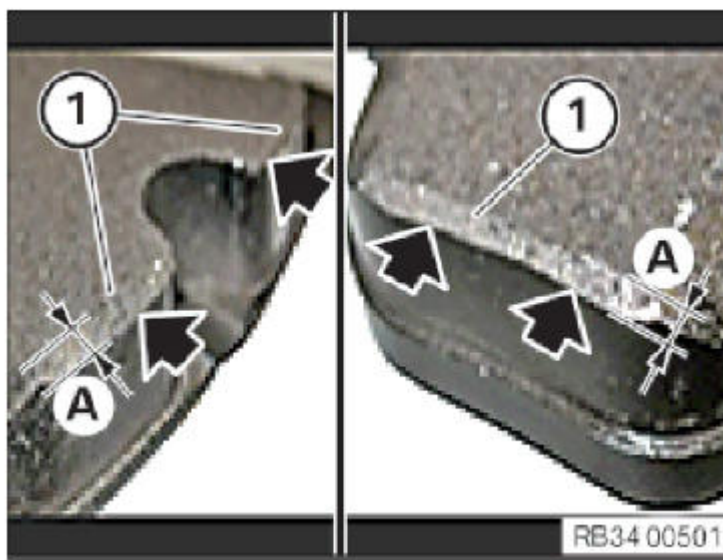
**Attention!**

**If new brake pads are mounted on a brake disc, the following must be observed:**

- Bevel edges in the area (1) slightly (dimension A must not exceed maximum 1 mm).

These procedures applies for all the following described brake systems.





**Fig. 74: Locating Bevel Edges**

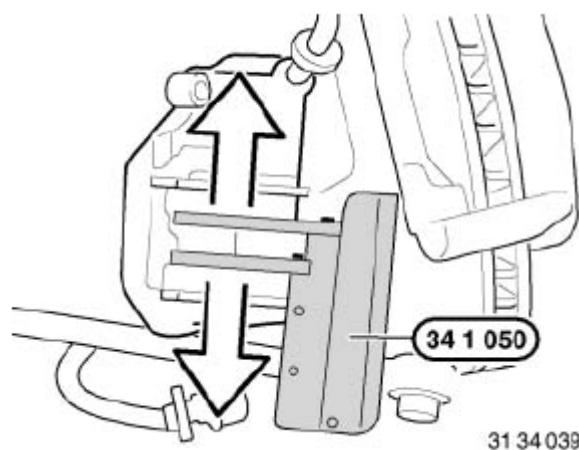
Courtesy of BMW OF NORTH AMERICA, INC.

Press brake piston fully back with special tool 34 1 050.

**Attention!**

When pressing piston back, note brake fluid level in expansion tank.

Overflowing brake fluid will damage the paintwork.



**Fig. 75: Pressing Brake Piston Fully Back With Special Tool (34 1 05075)**

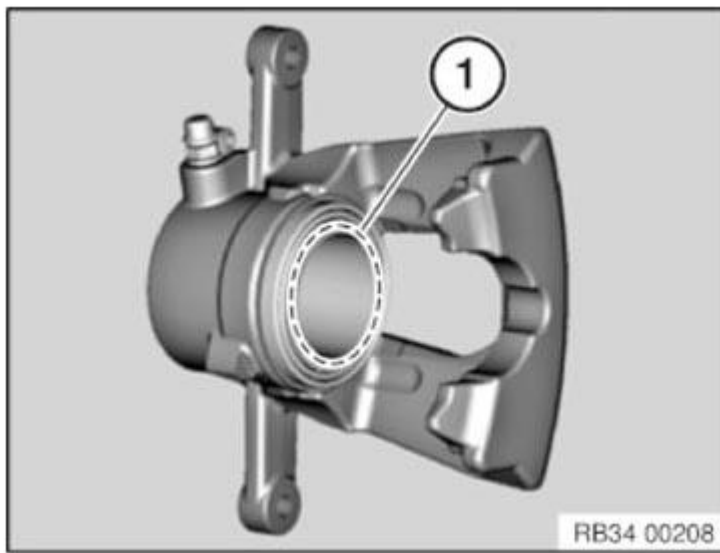
Courtesy of BMW OF NORTH AMERICA, INC.

Check dust boot (1) for damage and replace if necessary.

Clean contact surface (1) of brake piston with brake cleaner and apply a thin coating of brake pad paste.

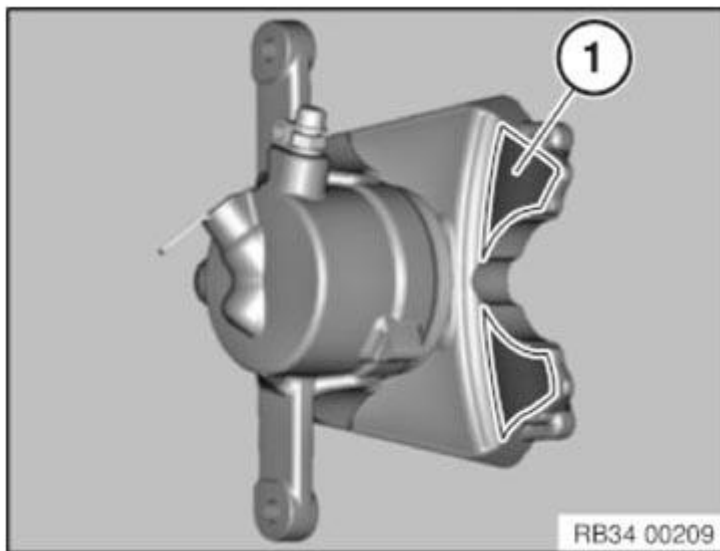
**Attention!**

Dust boot must not come into contact with brake pad paste as this may cause the dust boot to swell.



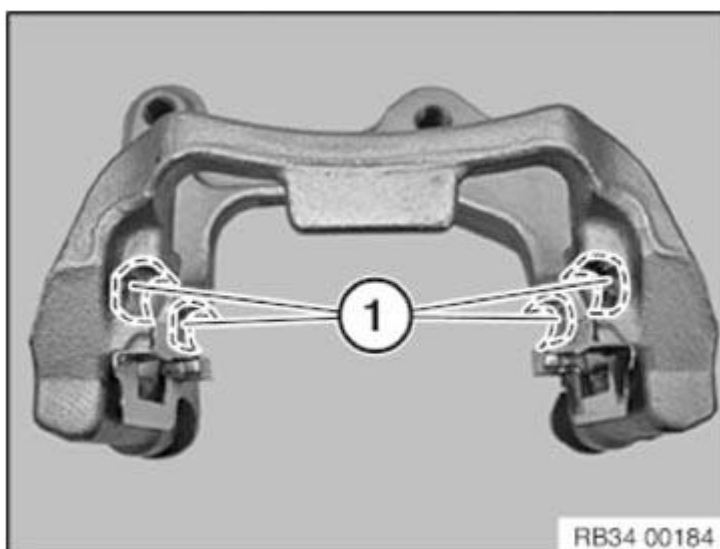
**Fig. 76: Identifying Brake Piston Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surface (1) of brake caliper with brake cleaner and apply a thin coating of brake pad paste.



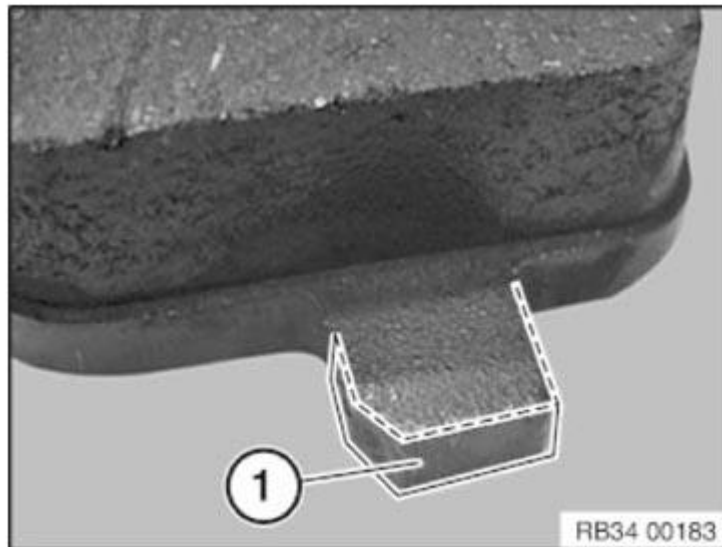
**Fig. 77: Identifying Brake Caliper Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surface (1) for the brake pads on the brake caliper mounting bracket. Clean guide surface (1) with brake cleaner and apply a thin coating of brake pad paste.



**Fig. 78: Identifying Brake Pad Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply a thin coating of brake pad paste to both sides of T-head of brake pad in area (1).

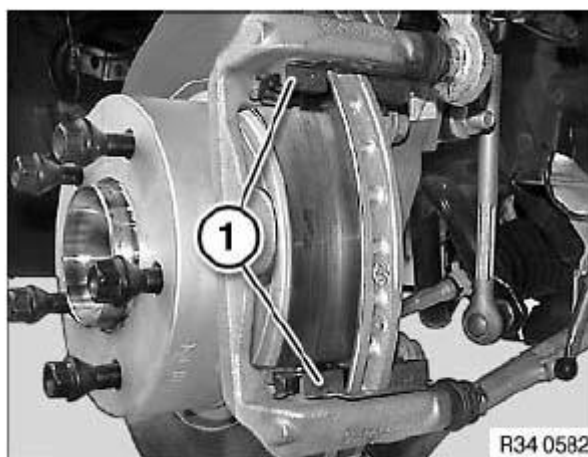


**Fig. 79: Identifying Brake Pad T-Head Paste Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Renew lining spring (1).

So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces for the brake pads on the brake caliper mounting bracket. Instead, clean with brake cleaner and apply a thin coating of brake pad paste.



**Fig. 80: Identifying Lining Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** After completing repair work:

- Fully depress brake pedal several times so that brake pads contact brake discs.
- When installing new brake pads at front and rear axles, brake fluid level must be brought up to "MAX" mark.
- Read and comply with notes on **BREAKING IN NEW BRAKE DISCS/BRAKE PADS.**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

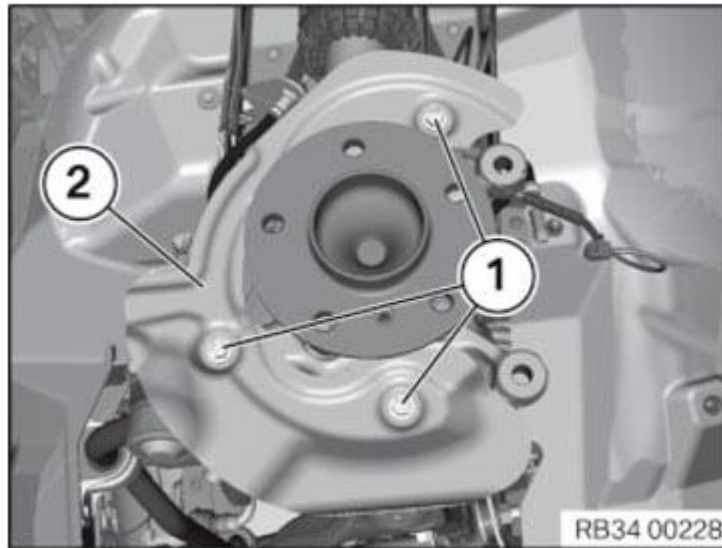
Necessary preliminary tasks:

- Remove front **BRAKE DISCS**.

Release screws (1) and remove brake guard plate (2).

*Installation note:*

Tightening torque **34 11 3AZ** .



**Fig. 81: Identifying Brake Guard Plate Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

## REAR BRAKES

### 34 21 320 REMOVING AND INSTALLING/RENEWING BOTH BRAKE DISCS

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**WARNING:** During repair work on the rear brake it must be ensured that the push button for the electrical parking brake cannot be activated.

Necessary preliminary tasks:

- Remove and clean **BRAKE PADS**.

When the repair work is complete, please pay attention to the following:

- Switch on ignition and, using electrical parking brake operating element, open parking brake once, close once and open again.

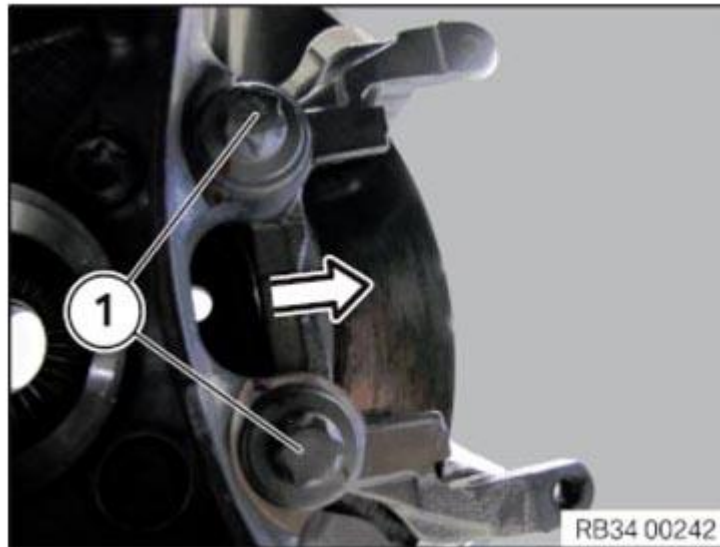
IMPORTANT: The brake discs need to be replaced every time the pads are changed.

Release screws (1) and pull off brake anchor plate (2).

*Installation note:*

Replace screws.

Tightening torque [34 21 2AZ](#) .

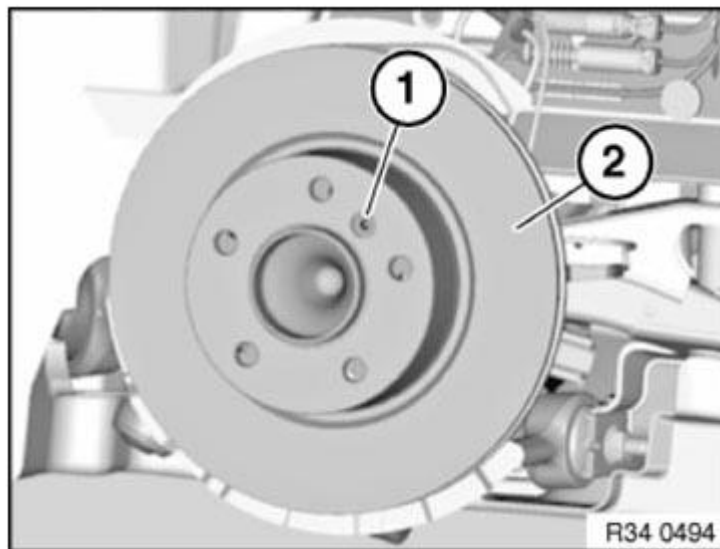


**Fig. 82: Pulling Off Brake Anchor Plate**

Courtesy of BMW OF NORTH AMERICA, INC.

To release brake disc: Do not under any circumstances strike friction ring with a hammer or similar!

**IMPORTANT:** If necessary, carefully tap on base of brake disc chamber with a rubber mallet.  
Clean contact surface of brake disc at wheel hub thoroughly and remove traces of corrosion.  
Unevenness on contact surface may result in distortion of brake disc!



**Fig. 83: Identifying Brake Disc Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) and remove brake disc (2).

*Installation note:*

Replace screw.

Tightening torque [34 21 1AZ](#) .

**After installation:**

- Read and comply with notes on [BREAKING IN NEW BRAKE DISCS/BRAKE PADS](#).

**34 21 200 REMOVING AND INSTALLING/REPLACING BOTH REAR BRAKE PADS OF DISC BRAKE**

## Special tools required:

- 34 1 050
- 34 1 280
- [2 285 574](#)
- [2 285 573](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

## Attention!

- Do not mechanically clean the guide surfaces for brake pads to prevent damage to the surface coating. Clean the guide surfaces using brake cleaner, BMW part number 83 19 2 154 780. Carefully clean severely soiled guide surfaces with a suitable tool (e.g. brass wire brush, nylon brush). Then thinly coat with brake pad paste BMW part number 83 19 2 158 851 (3 gr.) or 83 19 2 158 852 (100 gr.).

Spread brake pad paste onto the marked surfaces using a brush!

Observe [REGULATION ON APPLYING BRAKE PAD PASTE TO BRAKE PADS AND CALIPER CARRIERS!](#)

- Retaining pins and expanding spring: for vehicles older than 48 months it is recommended to replace the retaining spring!
- Brake pad wear sensor: After removal it must be replaced (brake pad wear sensor loses its retention capability in the brake pad).
- A CBS reset is mandatory upon every brake pad exchange!
  - If the brake pad wear sensor is partially ground (display in CBS menu): CBS reset possible within the vehicle.
  - If the brake pad wear sensor is **not** partially ground: CBS reset possible via diagnosis system only.

**WARNING:** During repair work on the rear brake, it must be ensured that the button for the electromechanical parking brake cannot be pressed!

## Necessary preliminary tasks:

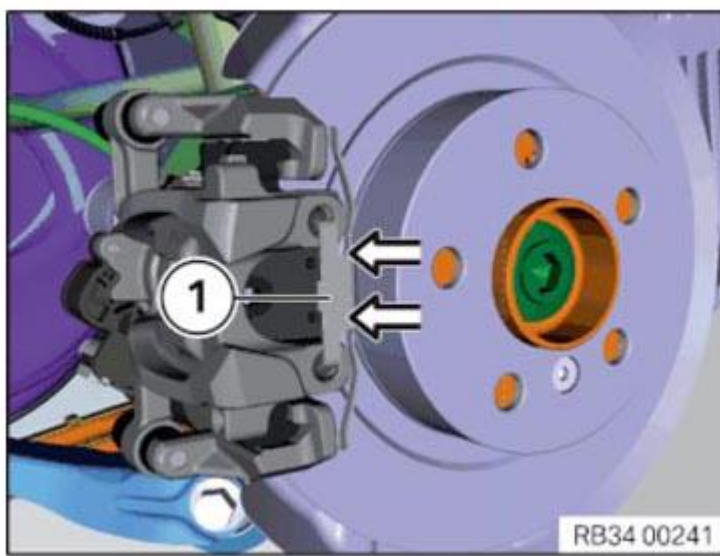
- Remove [WHEELS](#) .
- Remove [BRAKE PAD WEAR SENSOR](#).

When the repair work is complete, please pay attention to the following:

- Switch on ignition and, using electrical parking brake operating element, open parking brake once, close once and open again.

Lift out retaining spring (1).





**Fig. 84: Lifting Out Retaining Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove cover plug (1).

Release guide screws.

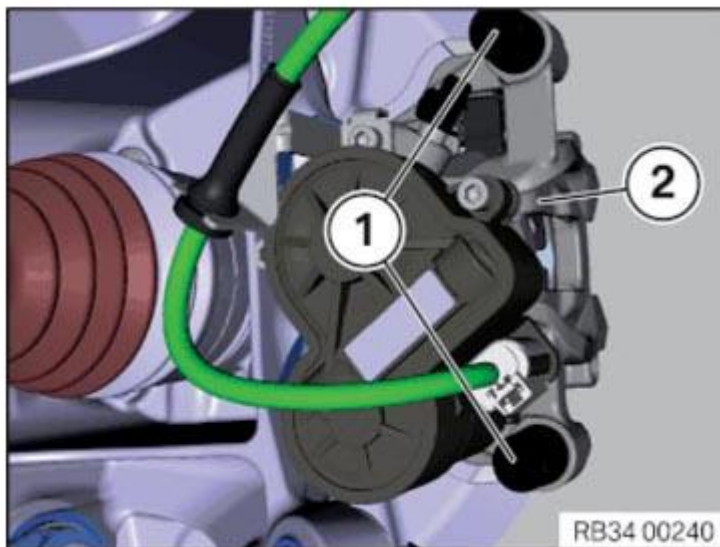
Remove brake caliper (2) by pulling forward.

**Attention!**

Tie brake caliper back and do not allow to hang from brake hose.

*Installation note:*

Tightening torque [34 21 4AZ](#) .



**Fig. 85: Identifying Cover Plug And Brake Caliper**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean guide screws only; do not grease.

Check thread.

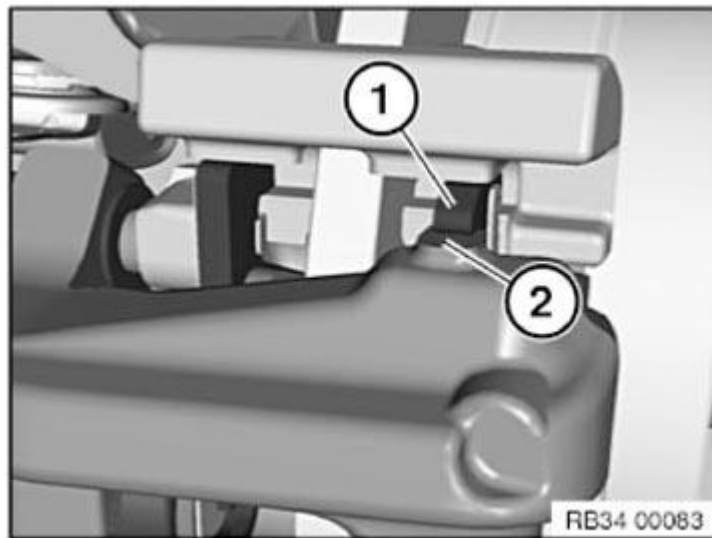
Replace all guide screws which are not in perfect condition.

*Installation note:*

When putting on the brake caliper, it is absolutely necessary to make sure that the T-head (1) of the outer brake pad is seated correctly on the contact surface (2).

**Attention!**

With brake pads that are already partially worn, pay particular attention that the position of the outer brake pad in relation to the contact surface (2) is ensured!



**Fig. 86: Identifying Outer Brake Pad T-Head And Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove brake pads (1).

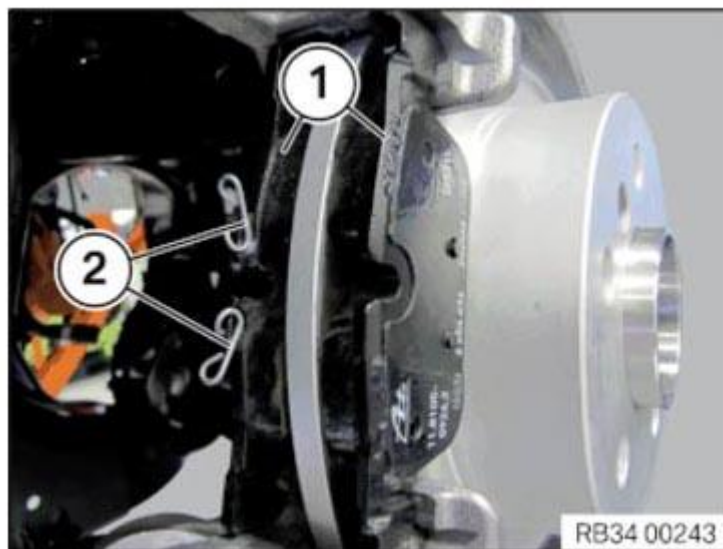
*Installation note:*

Brake pad with retaining springs (2) must be installed on the piston side.

**Attention!**

Mark any worn brake pads.

In the event of one-sided brake pad wear, do not change brake pads round.



**Fig. 87: Identifying Brake Pads And Retaining Springs**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean brake pads.

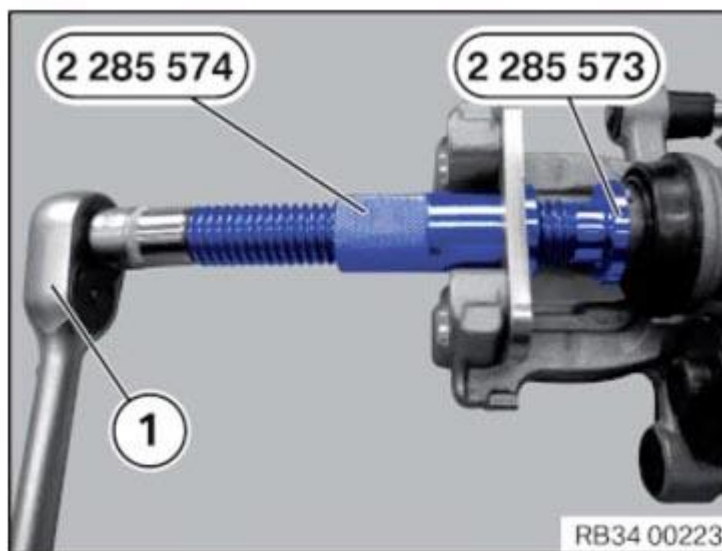
Place special tool [2 285 574](#) , [2 285 573](#) on brake piston.

Use reversible ratchet (1) to turn back brake piston up to limit position.

**Attention!**

When pressing piston back, note brake fluid level in expansion tank.

Overflowing brake fluid will damage the paintwork.



**Fig. 88: Positioning Special Tools (2 285 574) And (2 285 573) On Brake Piston**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

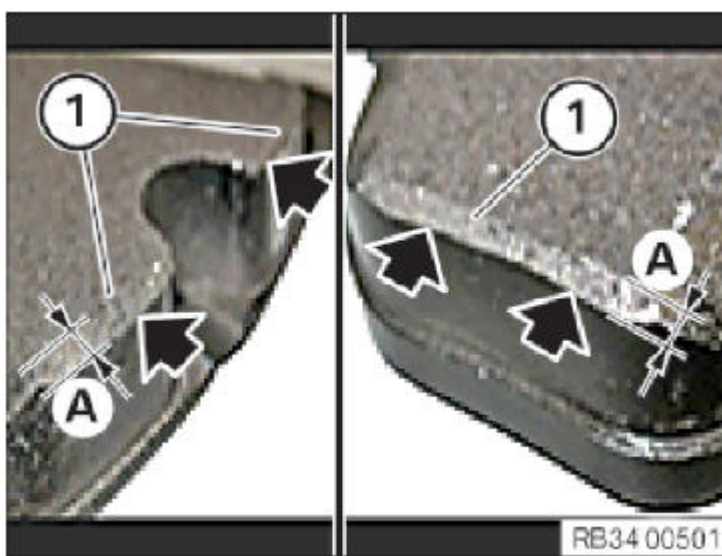
The **BRAKE DISCS** must also be renewed upon each brake pad exchange!

**Attention!**

If new brake pads are mounted on a brake disc, the following must be observed:

- Bevel edges in the area (1) slightly (dimension A must not exceed maximum 1 mm).

These procedures applies for all the following described brake systems.



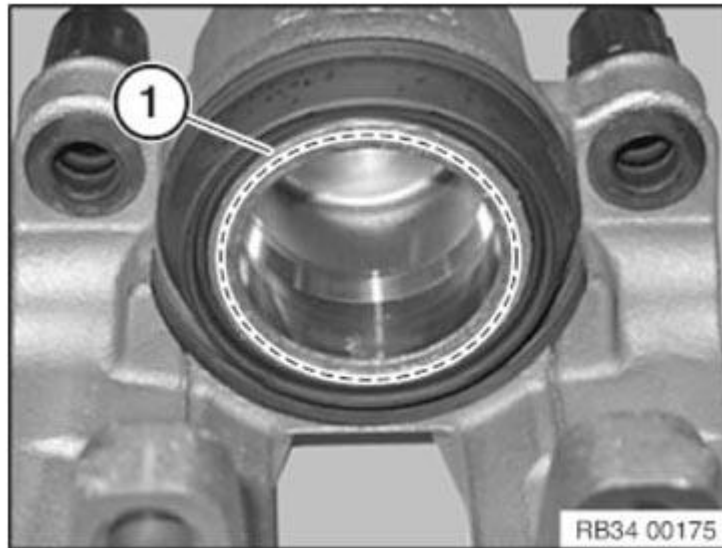
**Fig. 89: Locating Bevel Edges**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check dust boot for damage and renew if necessary.

Clean contact surface (1) of brake piston with brake cleaner and apply a thin coating of brake pad paste.

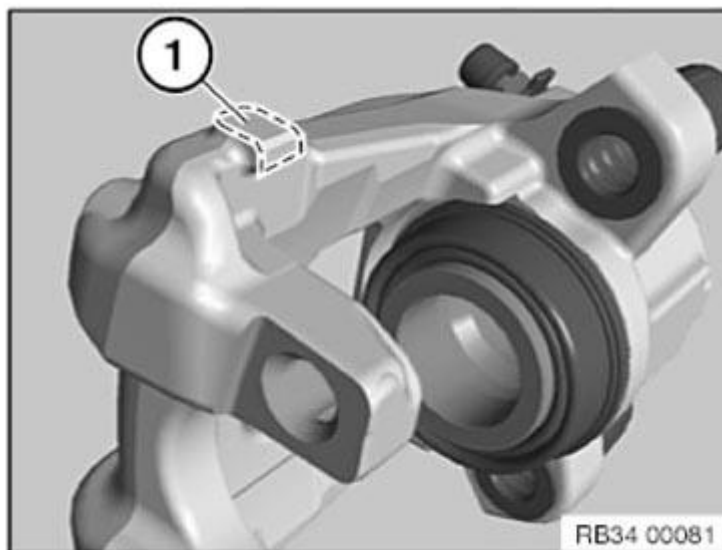
**Attention!**

Dust boot must not come into contact with brake pad paste as this may cause the dust boot to swell.



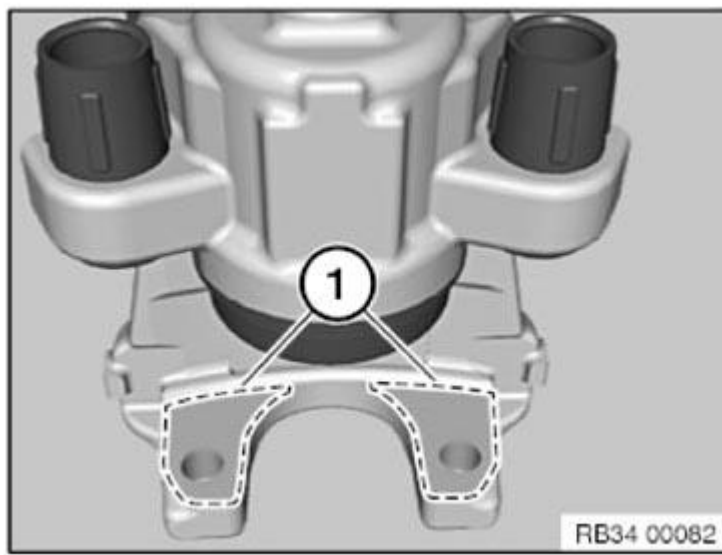
**Fig. 90: Identifying Brake Piston Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surfaces (1) of T-head/brake caliper housing with brake cleaner and apply a thin coating of brake pad paste.



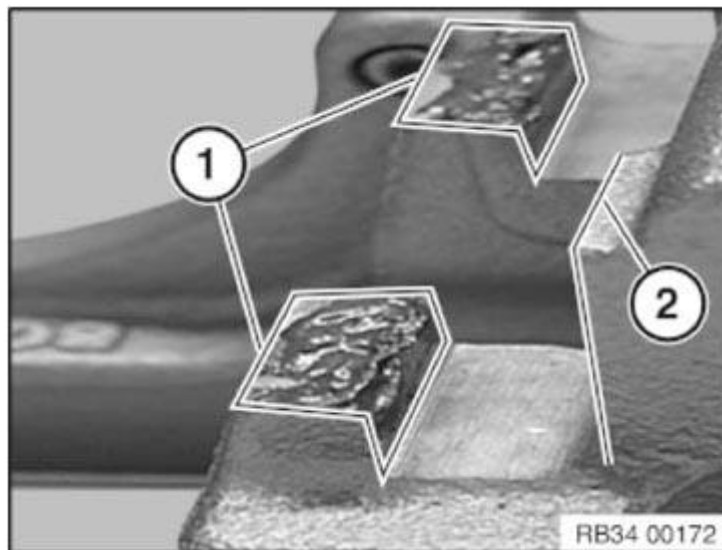
**Fig. 91: Identifying T-Heads/Brake Caliper Housing Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean contact surface (1) of brake caliper with brake cleaner and apply a thin coating of brake pad paste.



**Fig. 92: Identifying Brake Caliper Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

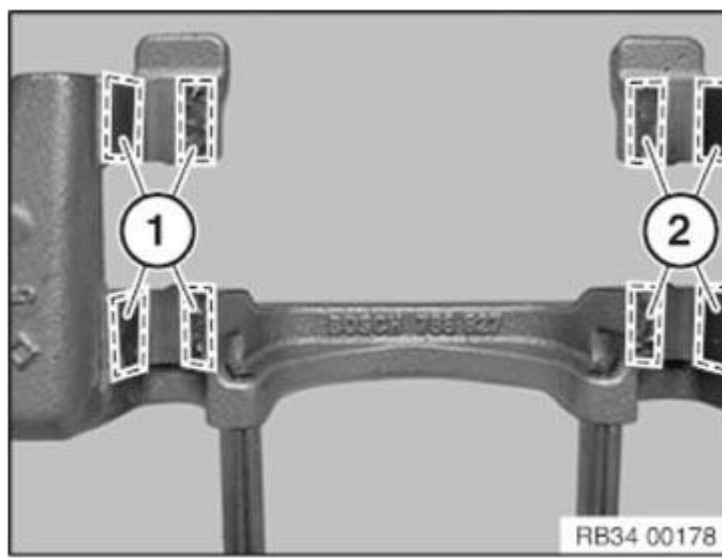
So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (1) for the brake pads on the brake caliper mounting bracket. Clean guide surfaces (1 and 2) with brake cleaner and apply a thin coating of brake pad paste.



**Fig. 93: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

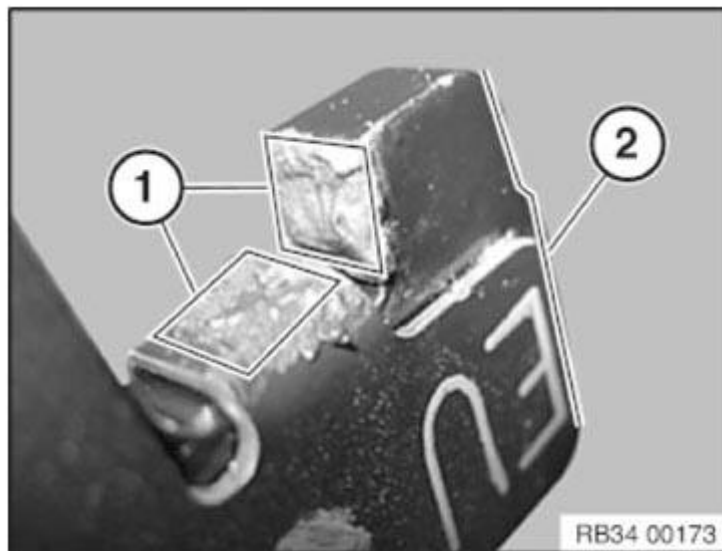
So as not to damage the surface coating, **if possible do not mechanically clean** the guide surfaces (1 and 2) for the brake pads on the brake caliper mounting bracket. Clean guide surfaces (1 and 2) with brake cleaner and apply a thin coating of brake pad paste.





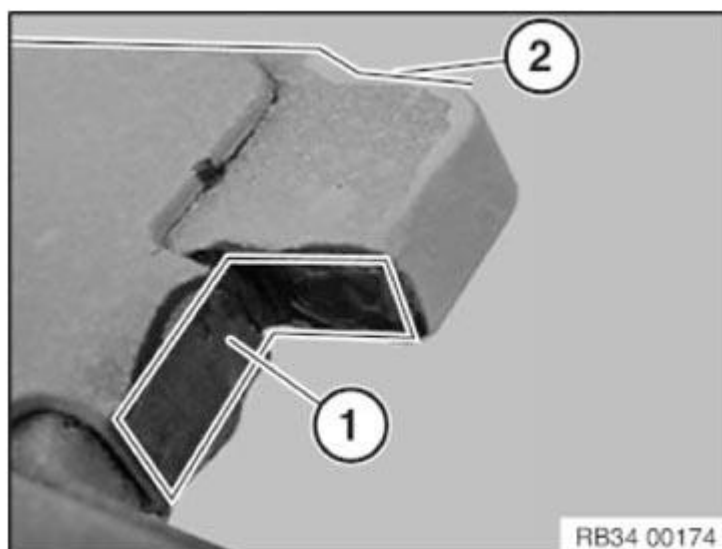
**Fig. 94: Identifying Brake Pads Guide Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply a thin coating of brake pad paste to T-head of inner brake pad in area (1) and (2).



**Fig. 95: Identifying Inner Brake Pad T-Head Paste Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply a thin coating of brake pad paste to T-head of outer brake pad in area (1) and (2).





**NOTE:** After completing repair work:

- Fully depress brake pedal several times so that brake pads contact brake discs.
- When installing new brake pads at front and rear axles, the brake fluid level must be brought up to "Max." marking.
- Read and comply with notes on [BREAKING IN NEW BRAKE DISCS/BRAKE PADS](#).

### 34 21 280 REMOVING AND INSTALLING/REPLACING REAR LEFT (OR RIGHT) PROTECTIVE PLATE

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

Necessary preliminary tasks:

- Remove rear [BRAKE DISCS](#).

Release screws (1) and remove protective plate (2).

*Installation note:*

Tightening torque [34 21 3AZ](#) .

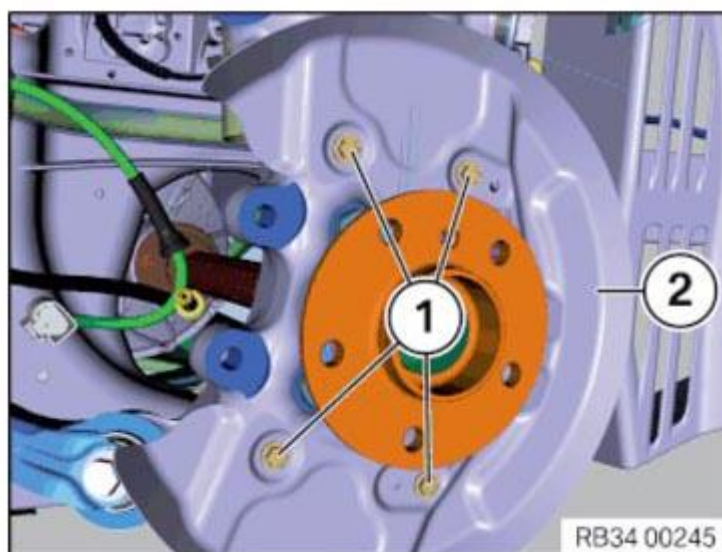


Fig. 97: Identifying Protective Plate Screws  
Courtesy of BMW OF NORTH AMERICA, INC.

## MASTER BRAKE CYLINDER

### 34 31 181 REMOVING AND INSTALLING/REPLACING EXPANSION TANK FOR HYDRAULIC BRAKE CONTROL

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

Necessary preliminary tasks:

- Read and comply with **GENERAL INFORMATION**.
- Remove **COVER** in engine compartment, left.

**After completing repair work:**

- Top up brake fluid.

**NOTE:** Extract brake fluid out of expansion tank. Use a suction bottle used exclusively for drawing off brake fluid.

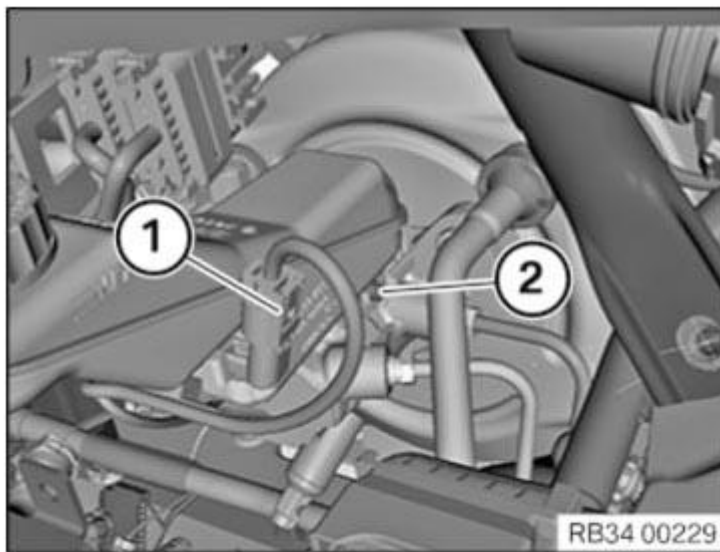
Do not reuse drawn out brake fluid.

Unfasten plug connection (1) and disconnect.

Release retaining screw (2).

*Installation note:*

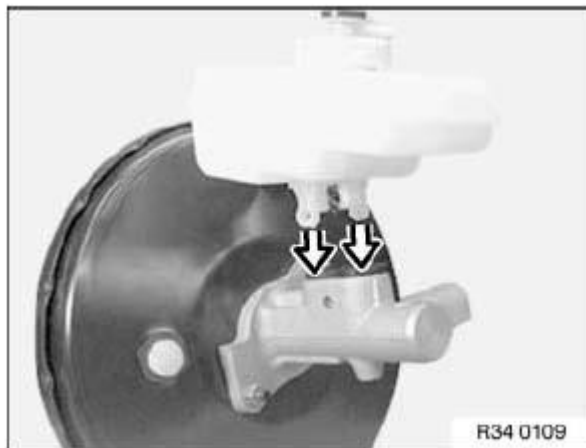
Tightening torque: **34 31 2AZ** .



**Fig. 98: Identifying Retaining Screw And Plug Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull expansion tank in direction of arrow vertically out of tandem brake master cylinder.

**IMPORTANT:** Check rubber plug in tandem brake master cylinder for damage and replace if necessary.  
 Push the expansion tank vertically onto the tandem brake master cylinder.



**Fig. 99: Pulling Expansion Tank Vertically Out Of Tandem Brake Master Cylinder**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## 34 31 505 REMOVING AND INSTALLING/REPLACING MASTER BRAKE CYLINDER FOR DSC

### Special tools required:

- [32 1 270](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

### Necessary preliminary tasks:

- Read and comply with [GENERAL NOTES](#).
- Remove [EXPANSION TANK](#).

### After completing repair work:

- Bleeding [BRAKE SYSTEM WITH DSC](#).

**IMPORTANT:** Before beginning repair work, fully press the brake pedal several times to reduce the vacuum pressure in the brake servo.

**IMPORTANT:** Do not bend brake lines.

Unfasten brake lines (1).

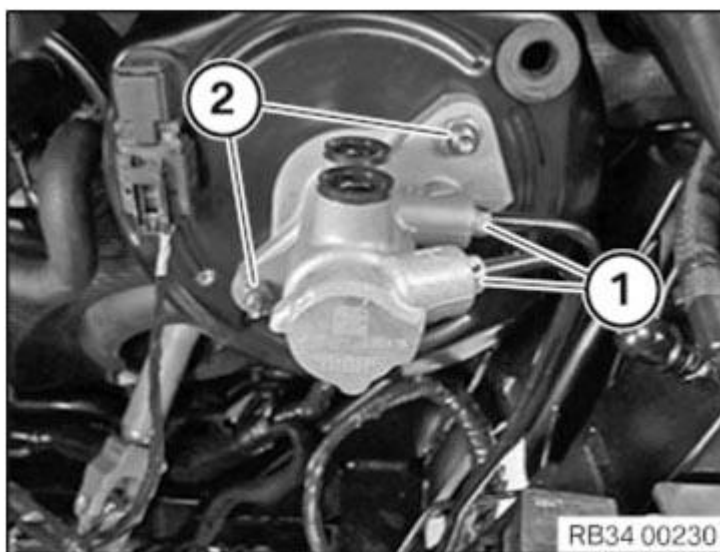
*Installation note:*

Tightening torque [34 32 1AZ](#) .

Close off brake lines and tandem brake master cylinder with seal plugs [32 1 270](#) .

Release nuts (2) and feed tandem brake master cylinder out of brake servo.

*Installation note:*



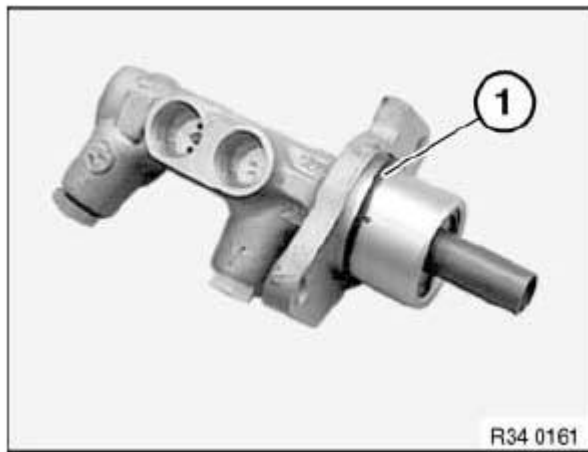
**Fig. 100: Identifying Brake Lines And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Replace self-locking nuts.

Tightening torque [34 31 1AZ](#) .

**Installation note:**

Replace sealing ring.

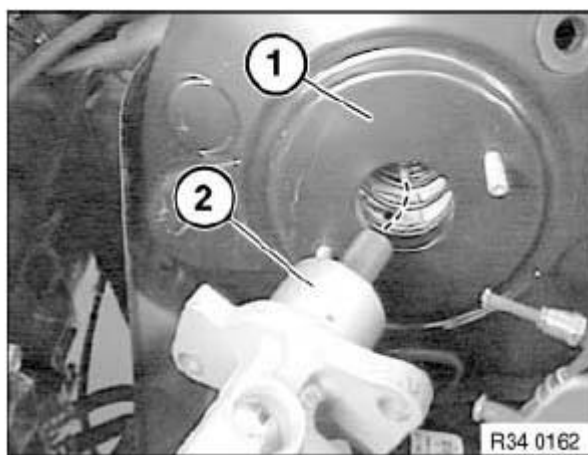


**Fig. 101: Identifying Sealing Ring**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

When inserting the tandem brake master cylinder (2) into the brake servo (1), make sure the pressure rod of the brake servo and that of the tandem brake master cylinder meet each other on one level.



**Fig. 102: Inserting Tandem Brake Master Cylinder Into Brake Servo**

Courtesy of BMW OF NORTH AMERICA, INC.

## **BRAKE LINES**

### **34 32 881 REPLACING FRONT LEFT OR RIGHT BRAKE HOSE**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**NOTE:**

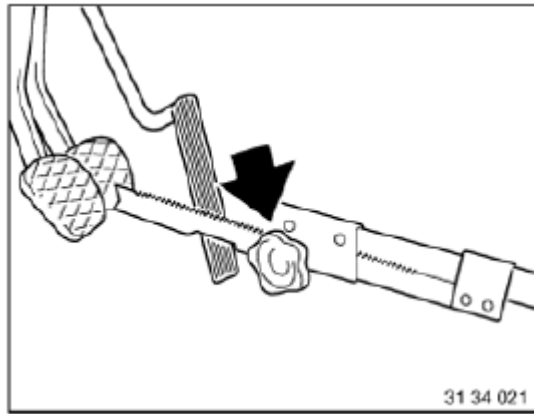
- Read and comply with **GENERAL INFORMATION**.

After completing repair work: **BLEED BRAKE SYSTEM**.

Press brake pedal down to floor and secure with pedal support.

**NOTE:** The pedal support may only be released when the brake lines are reconnected.

This prevents brake fluid from emerging from the expansion tank and air from entering the system when the brake lines are opened.



**Fig. 103: Locating Brake Pedal Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

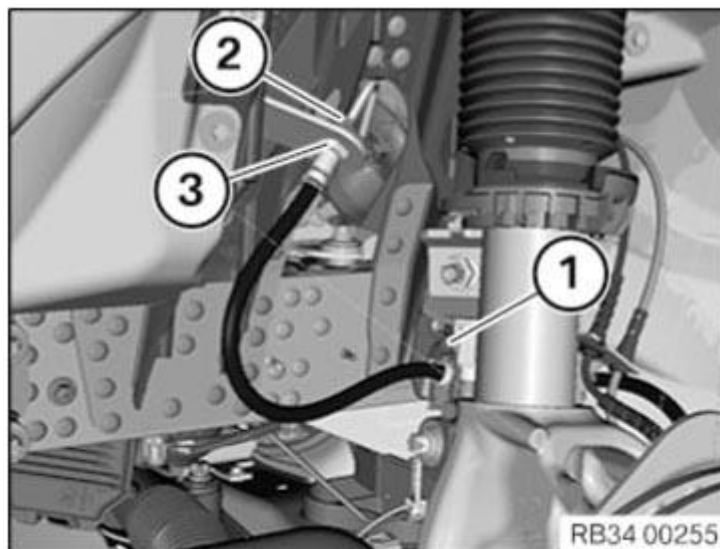
Pull out retaining clip (1) upwards.

Detach brake hose from brake line (2).

**IMPORTANT:** Grip brake hose at square head (3) to prevent connector from turning in retaining bracket.

*Installation note:*

Tightening torque [34 32 1AZ](#) .



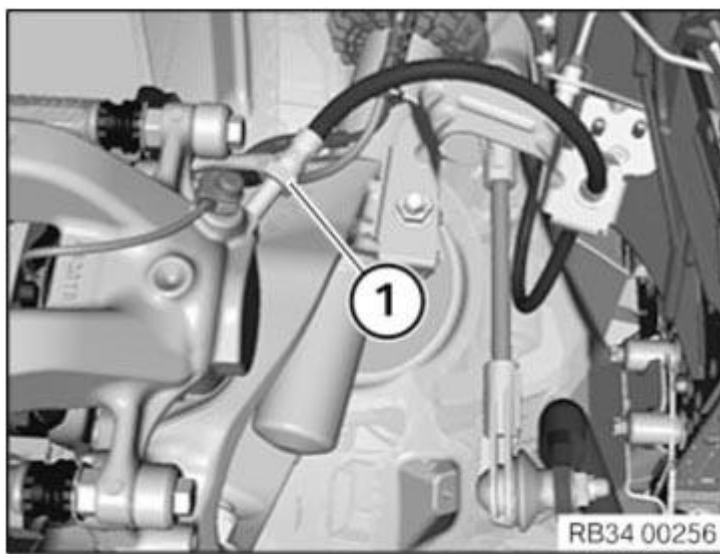
**Fig. 104: Identifying Retaining Clip, Brake Line And Square Head**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach brake hose (1) from brake caliper.

*Installation note:*

Tightening torque [34 32 2AZ](#) .

**IMPORTANT:** Make sure that the brake hose is routed correctly!



**Fig. 105: Identifying Brake Hose**

Courtesy of BMW OF NORTH AMERICA, INC.

- First tighten brake hose on brake caliper.  
 Move wheels into straight-ahead position.
- IMPORTANT:** Insert brake hose into holder on spring strut side and attach with retaining clip.  
 Insert brake hose into holder on body side and screw onto brake line.  
 Never twist brake hose when installing it and avoid all contact with parts attached rigidly to the body.

### 34 32 980 REPLACING REAR LEFT OR RIGHT BRAKE HOSE

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**NOTE:**

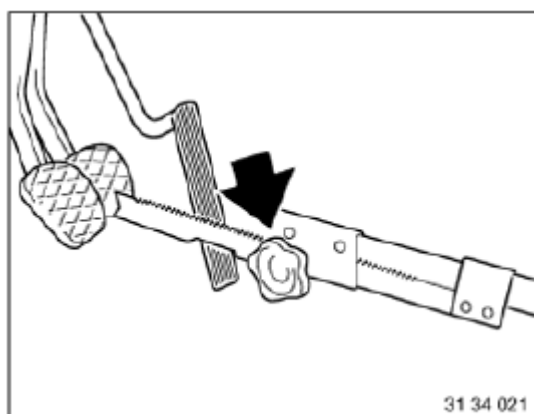
- Read and comply with **GENERAL INFORMATION**.
- Remove **WHEEL**.

After completing repair work: **BLEED BRAKE SYSTEM**.

Press brake pedal down to floor and secure with pedal support.

**NOTE:** The pedal support may only be released when the brake lines are reconnected.

This prevents brake fluid from emerging from the expansion tank and air from entering the system when the brake lines are opened.





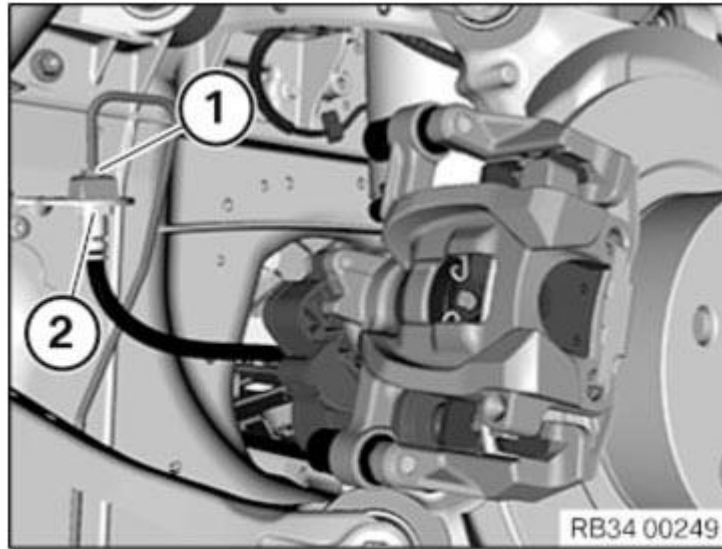
**Fig. 106: Locating Brake Pedal Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect brake hose from brake line (1).

Grip brake hose at square head (2) so that connecting piece cannot rotate in retaining bracket.  
**IMPORTANT:** Never twist brake hose when installing it and avoid all contact with parts attached rigidly to the body.

*Installation note:*

Tightening torque [34 32 1AZ](#) .

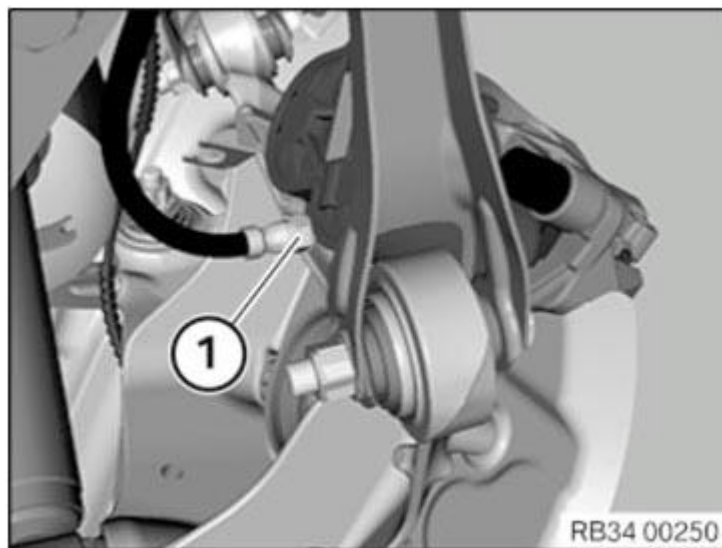


**Fig. 107: Identifying Brake Line And Square Head**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach brake hose from brake caliper (1).

*Installation note:*

Tightening torque [34 32 3AZ](#) .



**Fig. 108: Identifying Brake Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

First tighten brake hose on brake caliper.

Insert brake hose in holder and screw onto brake line.

## BRAKE BOOSTER

### 34 33 280 REMOVING AND INSTALLING BRAKE SERVO LOW-PRESSURE SENSOR

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

#### Necessary preliminary tasks:

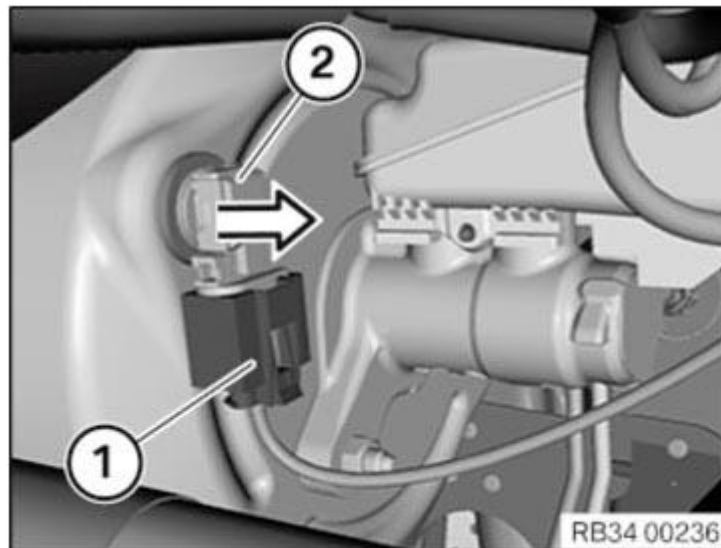
- Read and comply with [GENERAL INFORMATION](#).
- Remove [COVER IN LUGGAGE COMPARTMENT](#) front left.

Disconnect plug connection (1) on the brake vacuum sensor.

Carefully pull out brake vacuum sensor (2) from brake booster in direction of arrow.

*Installation note:*

Check seal in brake booster and replace if necessary.



**Fig. 109: Pulling Out Brake Vacuum Sensor From Brake Booster**

Courtesy of BMW OF NORTH AMERICA, INC.

### 34 33 200 REMOVING AND INSTALLING ELECTRIC VACUUM PUMP

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

#### Necessary preliminary tasks:

- Read and comply with [GENERAL NOTES](#).
- Remove front left headlight. See [REPLACING LEFT HEADLIGHT](#) or [REPLACING LEFT HEADLIGHT - LED TECHNOLOGY](#).

Disconnect plug connection (1).

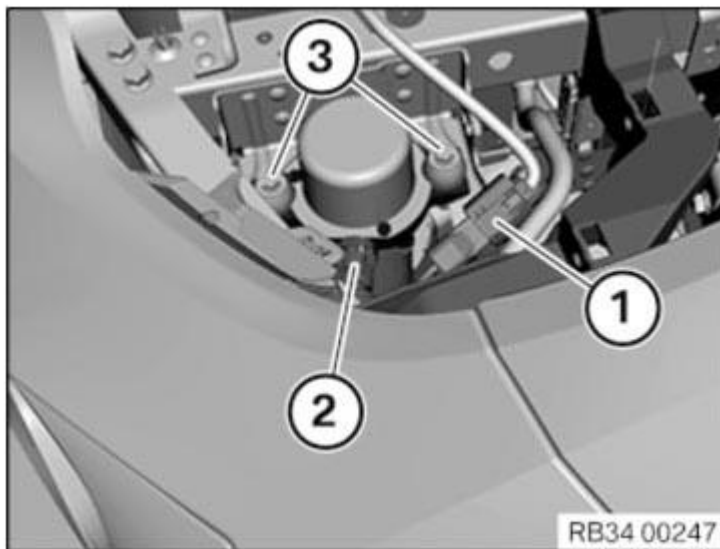
Unlock quick-release coupling (2) and detach vacuum line.

Release screws (3) and remove electrical vacuum pump.

*Installation note:*

Replace screws.

Tightening torque [34 33 2AZ](#) .



**Fig. 110: Identifying Vacuum Line Quick-Release Coupling And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **34 33 505 REMOVING AND INSTALLING OR REPLACING BRAKE BOOSTER**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

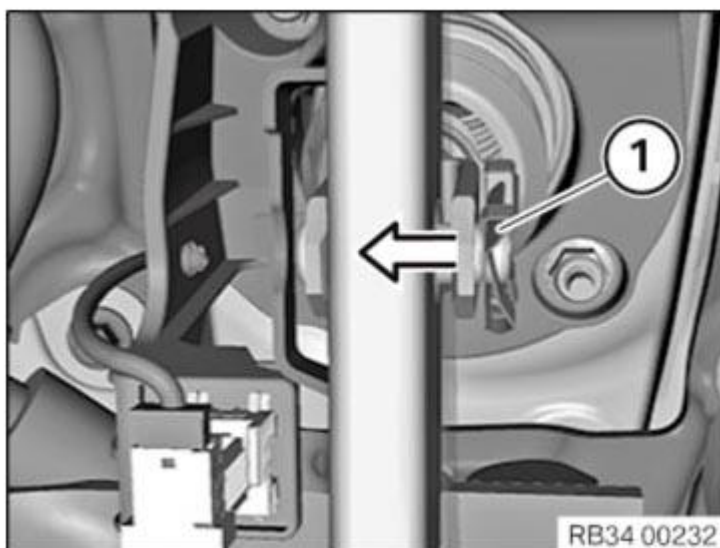
**Necessary preliminary tasks:**

- Read and comply with [GENERAL INFORMATION](#).
- Remove the [TANDEM BRAKE MASTER CYLINDER](#).
- Remove left [FOOTWELL TRIM](#)
- Remove [LUGGAGE COMPARTMENT WELL](#) at front.

Pull retaining clip (1) off of brake pedal and pull out retaining bolt.

*Installation note:*

Replace retaining clip (1) and check that it is correctly seated in the groove of the retaining bolt.



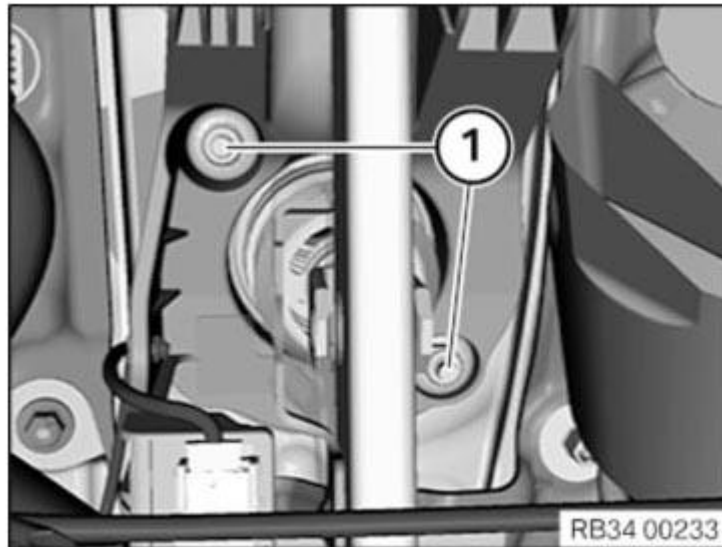
**Fig. 111: Pulling Retaining Clip Off Of Brake Pedal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unscrew nuts (1).

*Installation note:*

Replace self-locking nuts.

Tightening torque **35 11 1AZ** .

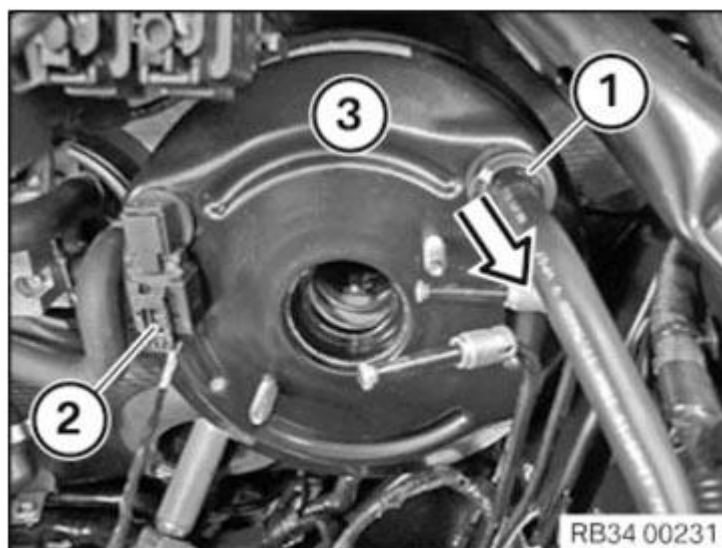


**Fig. 112: Identifying Self-Locking Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Do not use any force when removing and installing the brake booster; the brake booster  
IMPORTANT: can be damaged under certain circumstances.  
Brake lines must not be bent.

Remove non-return valve (1) from brake booster.

Disconnect plug connection (2).

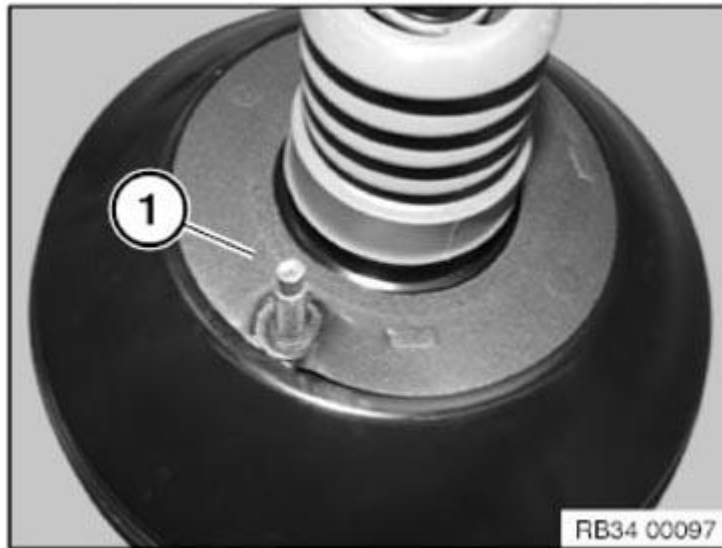


**Fig. 113: Pulling Brake Servo Out Of Bulkhead**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully pull brake servo (3) out of bulkhead and tilt out.

*Installation note:*

Seal (1) must always be replaced.



**Fig. 114: Identifying Brake Servo Seal**

Courtesy of BMW OF NORTH AMERICA, INC.

### 34 33 072 REPLACE VACUUM LINE WITH NON-RETURN VALVE

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

#### Necessary preliminary tasks:

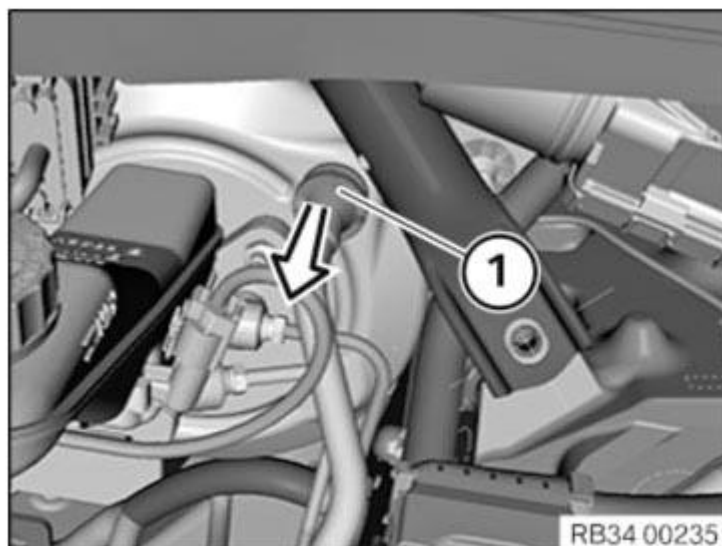
- Read and comply with [GENERAL INFORMATION](#).
- Remove front left [WHEEL ARCH TRIM](#)
- Remove [FRONT LEFT COVER IN LUGGAGE COMPARTMENT](#).

**IMPORTANT:** Before beginning repair work, fully press the brake pedal several times to reduce the vacuum pressure in the brake servo. This makes it easier to pull off the vacuum hose.

Pull non-return valve (1) in direction of arrow out of brake booster.

*Installation note:*

Check seal in brake booster and replace if necessary.



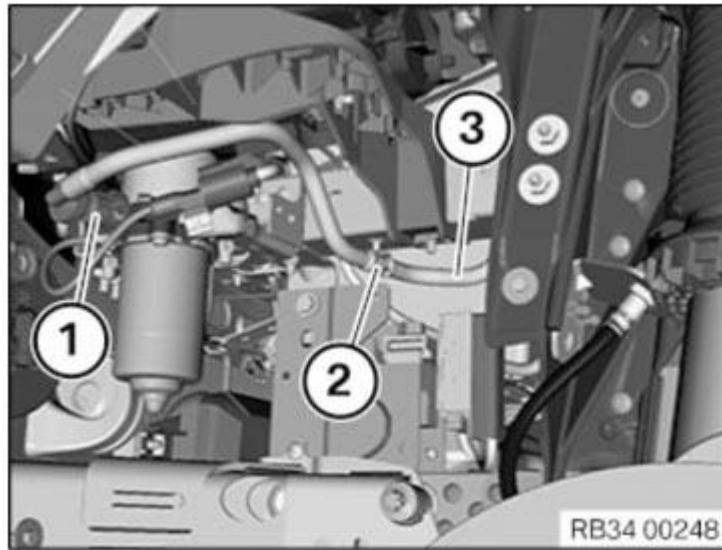


**Fig. 115: Pulling Non-Return Valve Out Of Brake Booster**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock quick-release coupling (1) and detach vacuum line.

Detach vacuum line from bracket (2).

Feed out vacuum line (3).



**Fig. 116: Identifying Vacuum Line Quick-Release Coupling And Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **ELECTRICAL COMPONENTS/WEAR INDICATOR**

### **34 35 001 REPLACING A BRAKE PAD SENSOR (FRONT)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric cars.

#### **Attention!**

**The brake pad wear sensor must be replaced once it has been removed (brake pad wear sensor loses its retention capability in the brake pad).**

If a brake pad wear sensor that has already been ground has to be replaced even though the minimum brake pad thickness has not yet been reached, you must observe the following: The new sliding contact must be filed down with a file to the same length as the sanded sliding contact.

When renewing the brake pad wear sensor, a CBS reset needs to be carried out.

If a brake pad wear sensor was renewed without renewing the brake pads, the following needs to be paid attention to:

- Carry out service function "CBS correction reset" via BMW diagnosis and information system.

#### **Necessary preliminary tasks:**

- Remove **WHEEL**

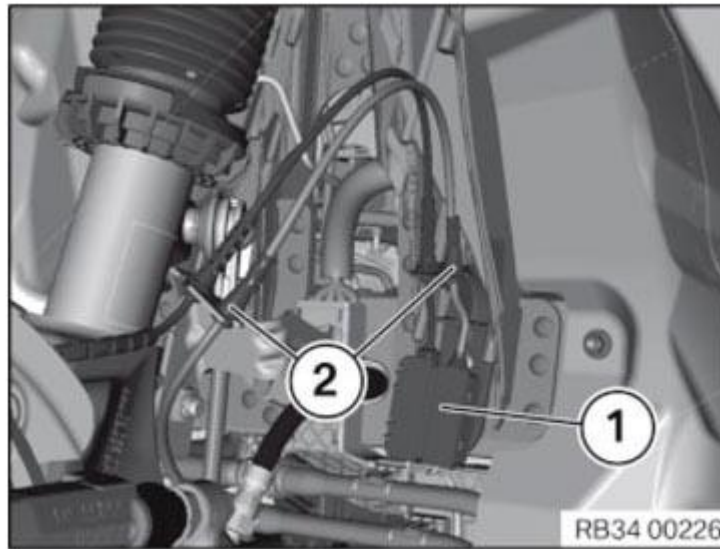
Fold the connector housing (1) up and disconnect the plug connection.

Detach the brake pad wear sensor from the brackets (2).

*Installation note:*



Do not route/fix the brake pad wear sensor cable via the dust cap of the brake ventilation valve!



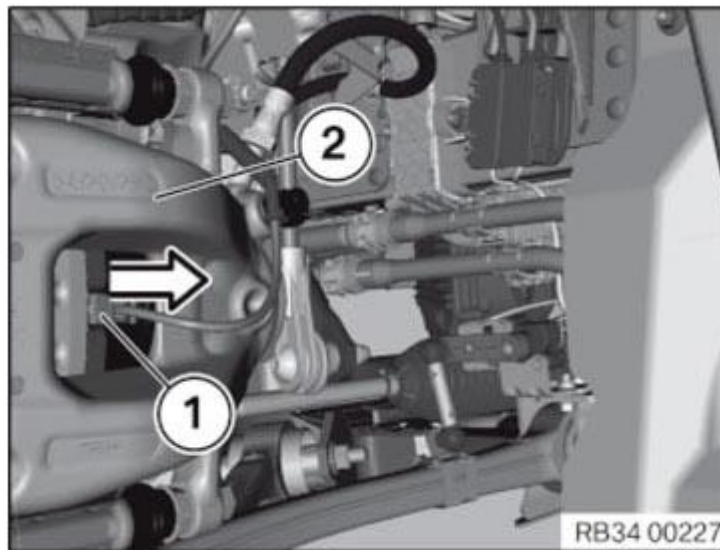
**Fig. 117: Identifying Brake Pad Wear Sensor Brackets And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push together clamp (1) and pull off brake pad wear sensor from brake pad in direction of arrow.

Detach cable on brake caliper (2).

*Installation note:*

Make sure clamp (1) and brake pad wear sensor are properly seated in brake pad.



**Fig. 118: Pulling Off Brake Pad Wear Sensor From Brake Pad**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **34 35 003 REPLACING A BRAKE PAD SENSOR (REAR)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric cars.

**Attention!**

The brake pad wear sensor must be replaced once it has been removed (brake pad wear sensor loses its retention capability in the brake pad).

If a brake pad wear sensor that has already been ground has to be replaced even though the minimum brake pad thickness has not yet been reached, you must observe the following: The new sliding contact must be filed down with a file to the same length as the sanded sliding contact.

When renewing the brake pad wear sensor, a CBS reset needs to be carried out.

If a brake pad wear sensor was renewed without renewing the brake pads, the following needs to be paid attention to:

- Carry out service function "CBS correction reset" via BMW diagnosis and information system.

**Necessary preliminary tasks:**

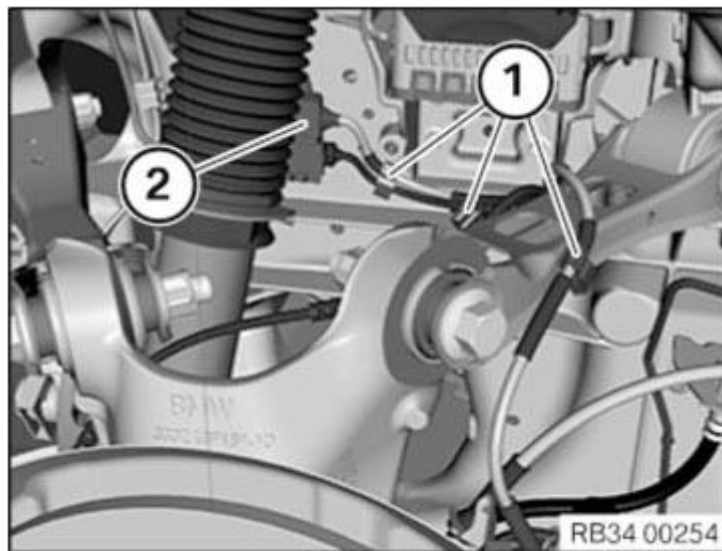
- Remove rear right **WHEEL**

Disengage cable from holders (1).

Open housing (2) and disconnect the plug connection.

*Installation note:*

Ensure proper locking of the plug connector and proper seating of the cable in the brackets.



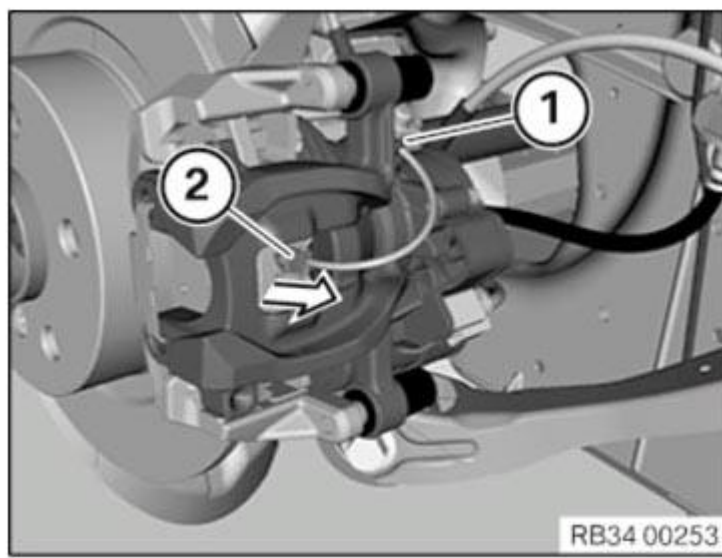
**Fig. 119: Identifying Holders And Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach cable from bracket (1).

Detach brake pad wear sensor (2) in direction of arrow from brake pad.

*Installation note:*

Make sure holders (1) and brake pad wear sensor (2) are correctly seated in brake caliper.



**Fig. 120: Detaching Brake Pad Wear Sensor From Brake Pad**  
Courtesy of BMW OF NORTH AMERICA, INC.

## DSC HYDRAULIC UNIT

### 34 51 527 REMOVING AND INSTALLING/REPLACING DSC HYDRAULIC UNIT

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

Necessary preliminary tasks:

- Read and comply with **GENERAL INFORMATION**.
- Draw off brake fluid.
- Removing front **LUGGAGE COMPARTMENT WELL**.

**NOTE:** Extract brake fluid out of expansion tank. Use a suction bottle used exclusively for drawing off brake fluid.  
Do not reuse drawn out brake fluid.

After completing repair work:

- **BLEED BRAKE SYSTEM**.
- Mix-up test, brake lines.

Do not mix up brake lines.

**IMPORTANT:** If necessary, mark before removal.  
Close off connecting bores with seal plugs.

Disconnect plug connection (1).

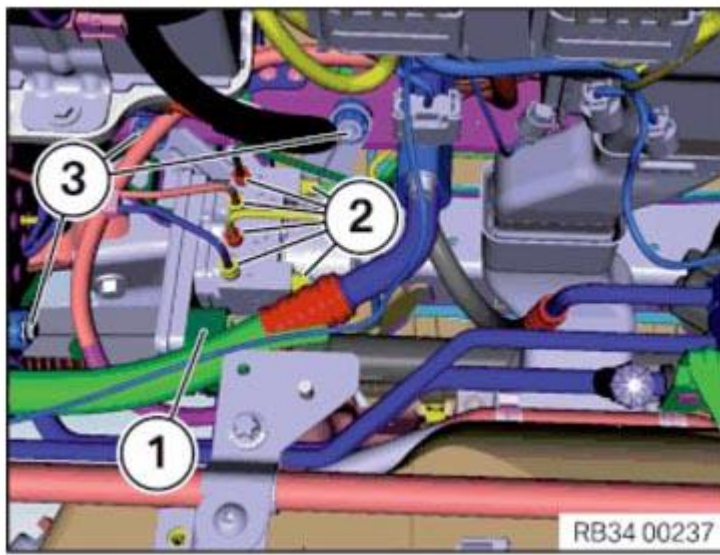
Unfasten brake lines (2).

*Installation note:*

Tightening torque **34 32 1AZ**.

Release screw (3) and feed out hydro aggregate in upward direction.

**IMPORTANT:** Brake lines must not be bent!



**Fig. 121: Identifying Brake Lines, Plug Connection And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Tightening torque [34 51 5AZ](#) .

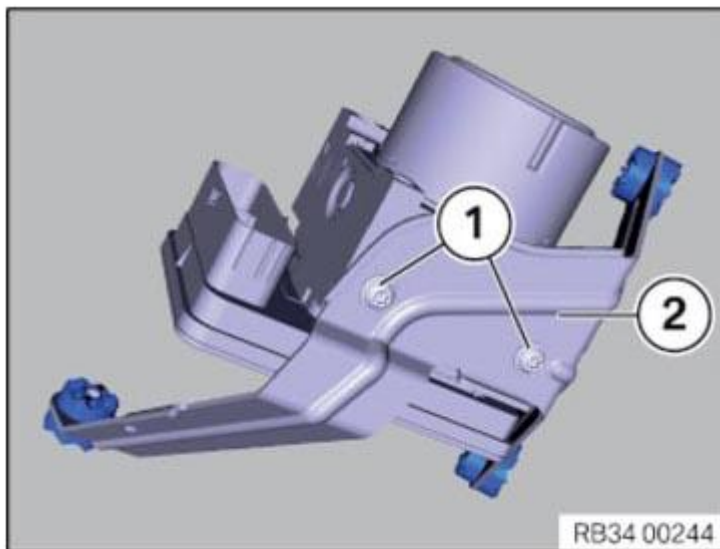
**When replacing hydraulic unit:**

Release screws (1) and convert holder (2).

*Installation note:*

Tightening torque [34 51 4AZ](#) .

Modify [DSC CONTROL UNIT](#).



**Fig. 122: Identifying Holder Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**When replacing control unit:**

- Carry out programming/encoding
- Adjustment of steering angle sensor

## **ELECTRONIC COMPONENTS**

### **34 52 516 REMOVING AND INSTALLING/REPLACING DSC CONTROL UNIT**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST DAMAGE FROM ELECTROSTATIC DISCHARGE (ESD PROTECTION)**.

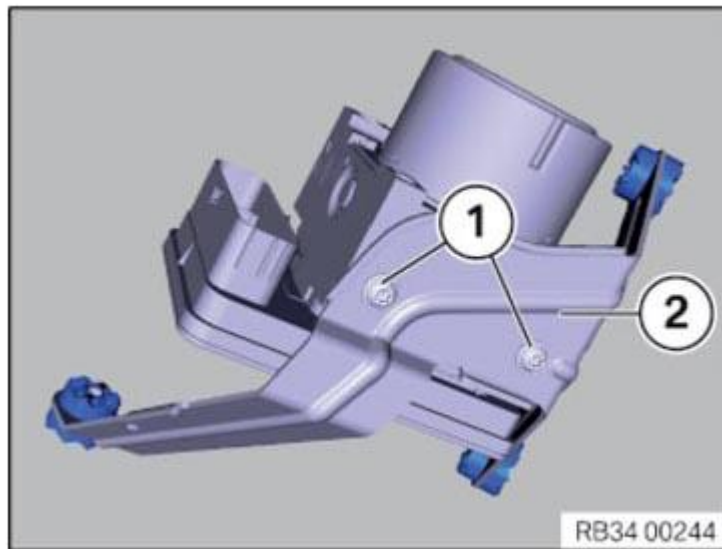
Necessary preliminary tasks:

- Remove **HYDRAULIC UNIT**.

Release screws (1) and convert holder (2).

*Installation note:*

Tightening torque **34 51 4AZ**.

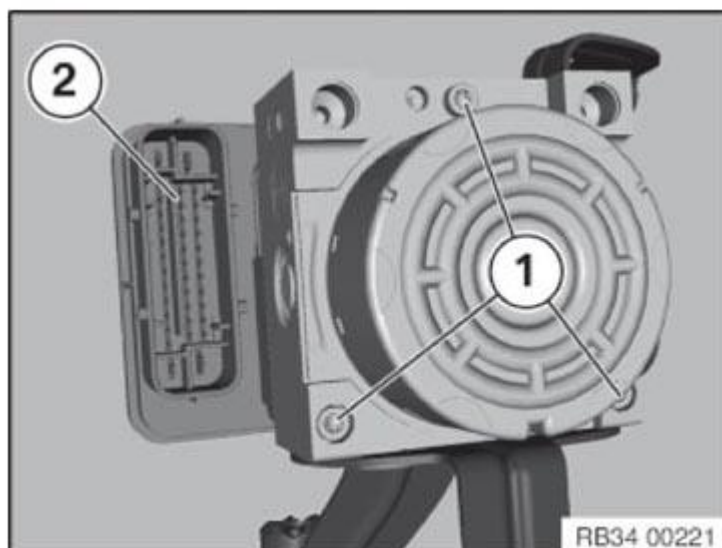


**Fig. 123: Identifying Holder Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage to the contacts when removing and installing the hydraulic unit.

Release screws (1) and carefully detach control unit (2) towards front.



**Fig. 124: Identifying Control Unit Screws**

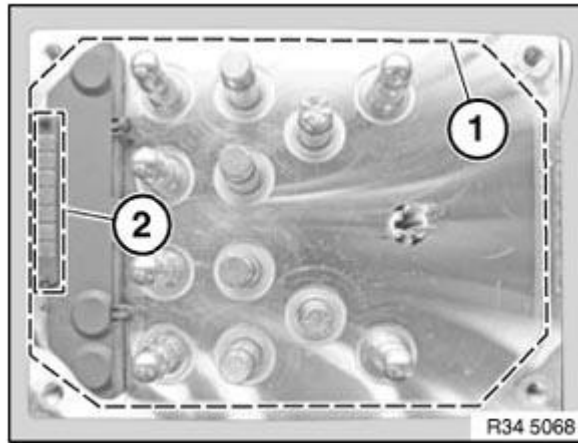
Courtesy of BMW OF NORTH AMERICA, INC.



**IMPORTANT:** Cleaning with compressed air, chemical solvents and sharp-edged objects is not permitted.

Do not touch pressure sensor contacts (2) with your fingers or clean the contacts.

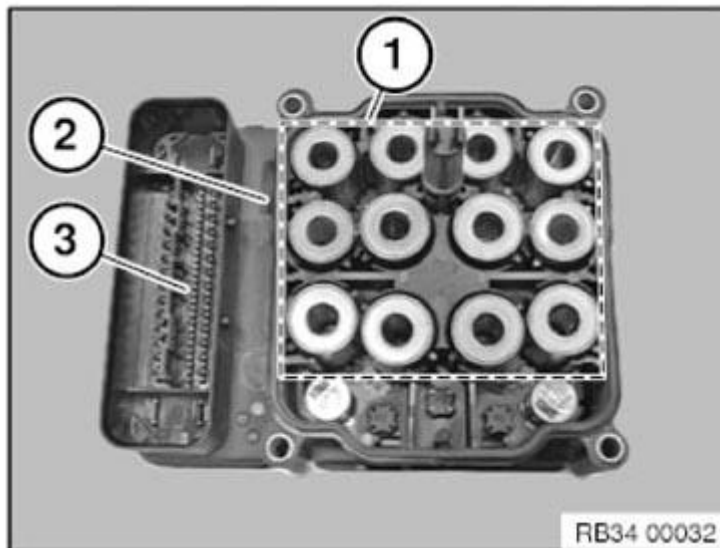
If necessary, clean sealing surface (1) with a plastic scraper or a fluff-free cloth.



**Fig. 125: Identifying Pressure Sensor Contacts And Sealing Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Do not touch, clean or readjust valve coils (1) and pressure sensor contact springs with your fingers.

Check gasket (2) for damage. If damaged, replace DSC control unit (3).



**Fig. 126: Identifying DSC Control Unit, Gasket And Valve Coils**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

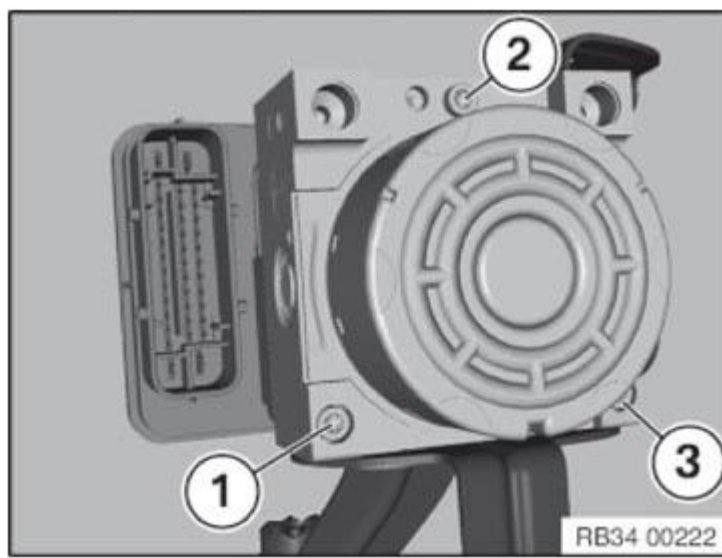
Make sure screws are inserted evenly and DSC control unit rests on hydraulic unit.

Replace screws.

Observe tightening sequence (1-3).

Tightening torque [34 51 1AZ](#) .





**Fig. 127: DSC Control Unit Bolts Tightening/Loosening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

- Carry out programming/encoding
- Steering angle sensor adjustment
- Brake line mix-up test:
- Function check of hydraulic unit

**34 52 162 REMOVING AND INSTALLING/REPLACING EMF ACTUATOR**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric cars.

**Necessary preliminary tasks:**

- Release parking brake.
- Switch off ignition.

**IMPORTANT:** Switch off ignition at least 30 s before disconnecting the plug connection!

After installation, observe the following: switch on ignition and, using parking brake operating element, open parking brake once, close once and open again.

Disconnect plug connection (1).

Detach cable from cable clip (2).

Release screws (3).

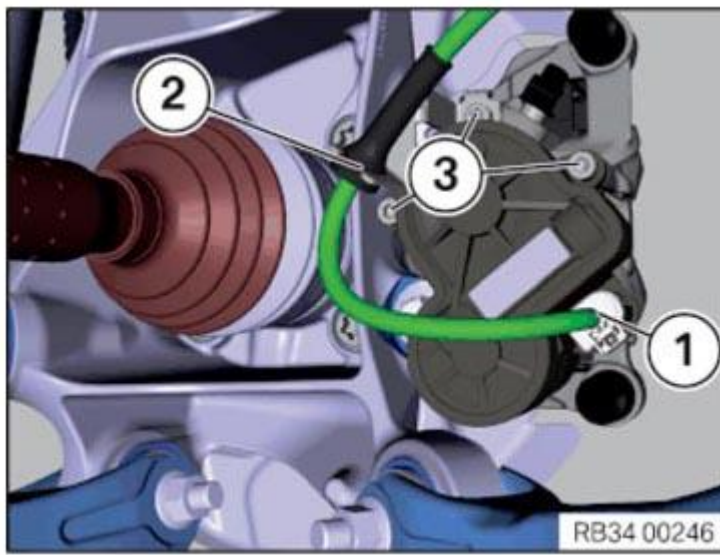
*Installation note:*

Replace screws.

Tightening torque **34 41 1AZ** .

Take off holder.

Pull off actuator drive from brake caliper.

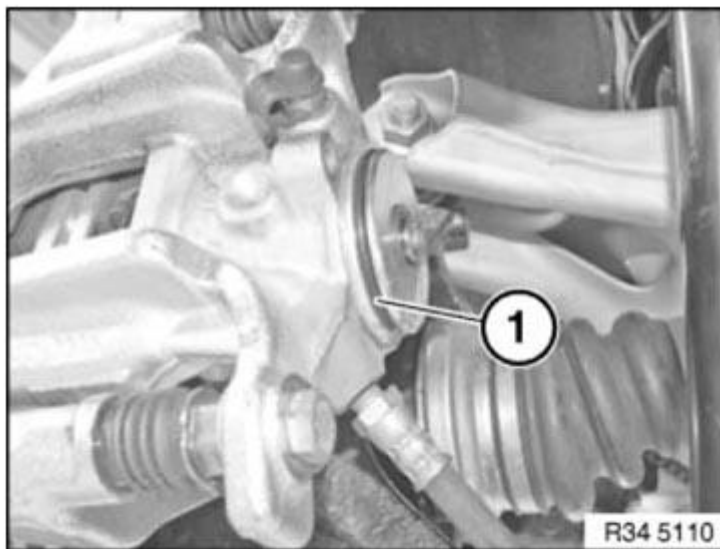


**Fig. 128: Identifying Cable Clip, Screws And Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Check sealing ring (1), replace if necessary.

Apply a light coating of brake fluid to sealing ring (1) before fitting.

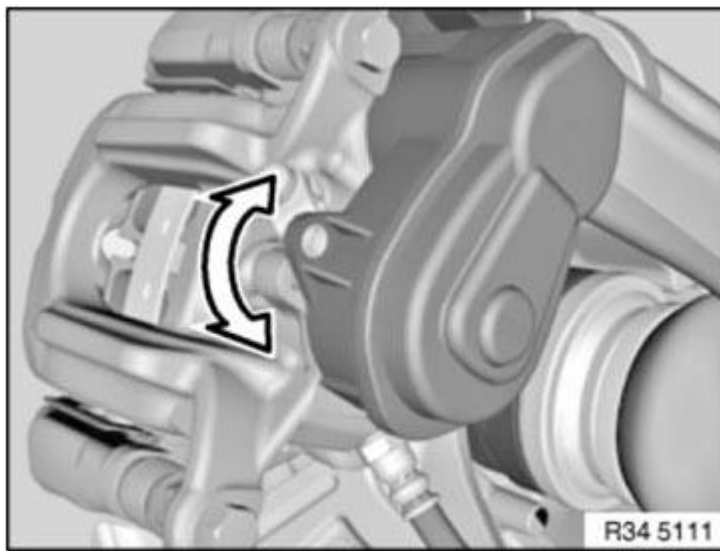


**Fig. 129: Identifying Sealing Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Carefully fit actuator drive until teeth engage and actuator drive rests flush on brake caliper.

If necessary, turn actuator drive slightly until bore hole and thread are flush.



**Fig. 130: Turning Actuator Drive**

Courtesy of BMW OF NORTH AMERICA, INC.

### 34 52 535 REPLACING A REAR PULSE SENSOR

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST DAMAGE FROM ELECTROSTATIC DISCHARGE (ESD PROTECTION)**.

**Necessary preliminary tasks:**

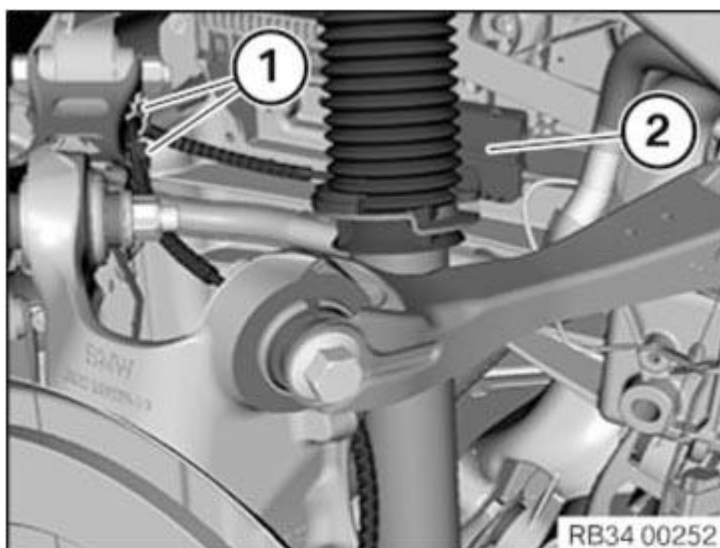
- Remove rear **WHEEL**
- Read and comply with **GENERAL INFORMATION**.

Detach line (1) from brackets.

Open housing cover (2) and disconnect plug connection.

*Installation note:*

Ensure proper locking of plug connection and proper seating of rubber grommets.



**Fig. 131: Identifying Housing Cover And Bracket Lines**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

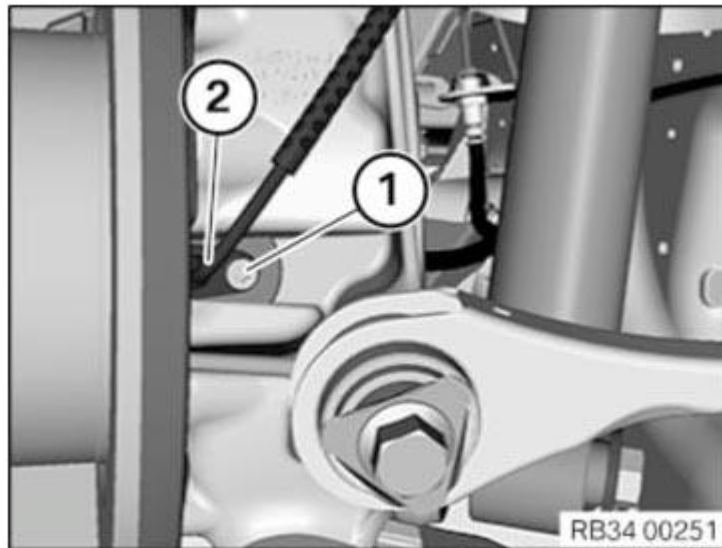
Withdraw wheel speed sensor (2) from bore hole.

*Installation note:*

Tightening torque [34 51 3AZ](#) .

Clean bore hole for pulse sensor and grease with Stabuags NBU 12/K lubricating grease.

IMPORTANT: Prior to installation, check sensor head for damage and replace if necessary.



**Fig. 132: Identifying Wheel Speed Sensor Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **34 52 525 REPLACING ONE FRONT PULSE SENSOR**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

**Necessary preliminary tasks:**

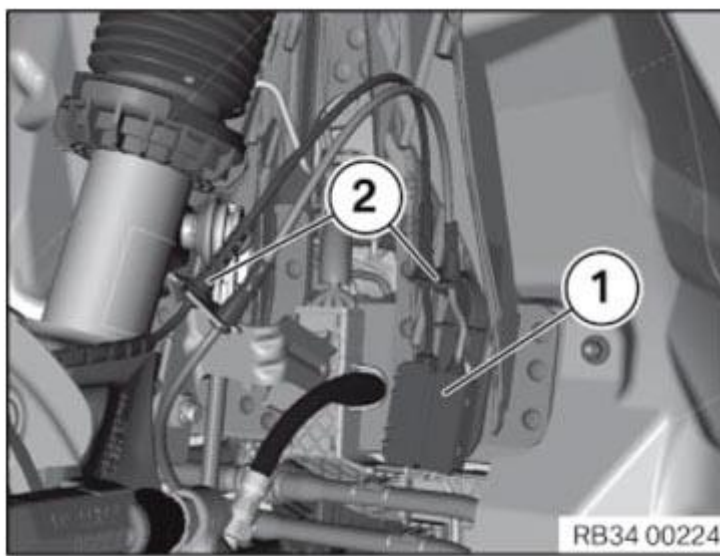
- Remove front [WHEEL](#) .
- Read and comply with [GENERAL INFORMATION](#).

Open connector housing (1), pull plug connection out of holder and disconnect.

Disengage cable with rubber grommets from holders (2).

*Installation note:*

Ensure proper locking of plug connection and proper seating of rubber grommets.



**Fig. 133: Identifying Connector Housing And Holders**  
Courtesy of BMW OF NORTH AMERICA, INC.

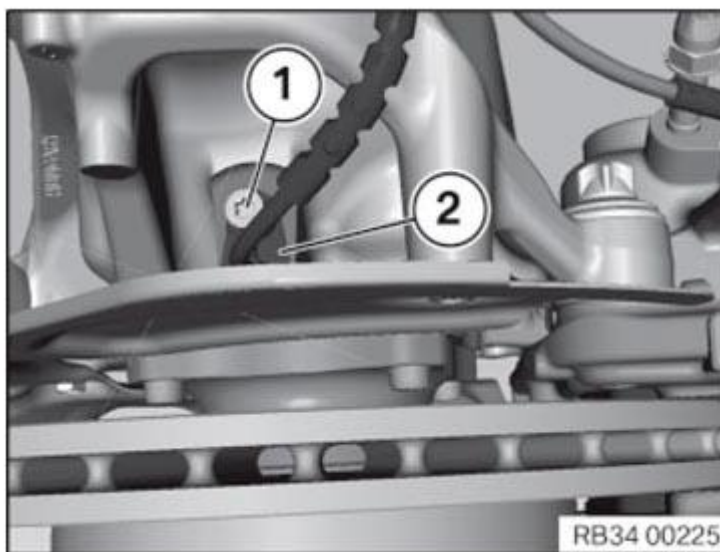
Release hexagon socket screw (1) and pull wheel speed sensor (2) out of bore hole.

*Installation note:*

Tightening torque [34 51 3AZ](#) .

Clean bore for pulse sensor and lubricate with Staburags NBU 12/K lubricating grease.

IMPORTANT: Check sensor head prior to installation for external damage, replacing if necessary.



**Fig. 134: Identifying Hexagon Socket Screw And Wheel Speed Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

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## BRAKES

Brakes - Special Tools - All I3 Models - i3

### BRAKES

#### 2285573 PIN WRENCH MINIMUM SET: MECHANICAL TOOLS AM

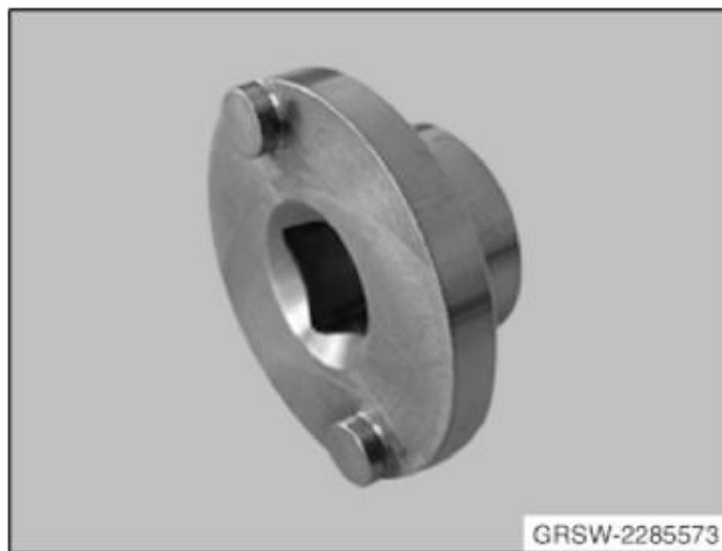
**NOTE:** Applies to: BMW i Aftersales Basic contour-graphic silhouette foil is included in the delivery specification.

#### Storage Location

B36

#### SI number

01 36 13 (025)



**Fig. 1: Identifying Pin Wrench (2285573)**

Courtesy of BMW OF NORTH AMERICA, INC.

#### 2365377 PIN WRENCH MINIMUM SET: MECHANICAL TOOLS AM

**NOTE:** Pin wrench for rear axle brake calipers. Pin wrench for resetting the brake pistons of the electrical parking brake (I01, F45, F46, F48 - rear disc brakes) in combination with resetting tool [83 30 2 285 574](#).

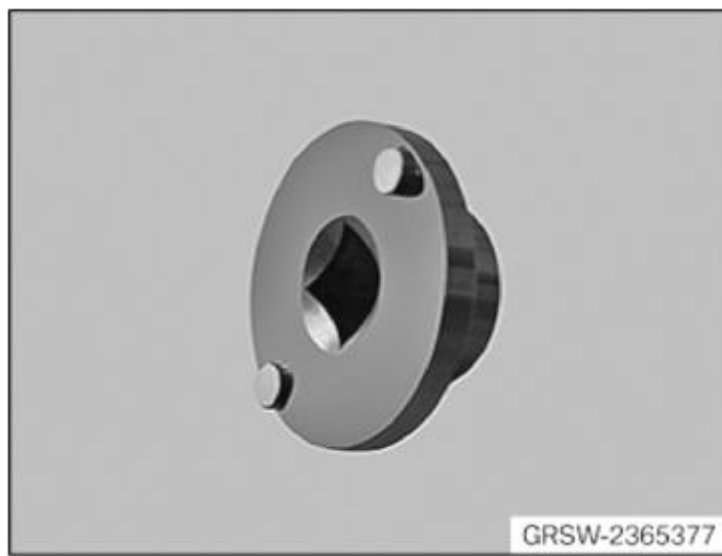
#### Storage Location

B74

#### SI number

01 44 14 (184)





**Fig. 2: Identifying Pin Wrench (2365377).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2285574 RESET MINIMUM SET: MECHANICAL TOOLS AM**

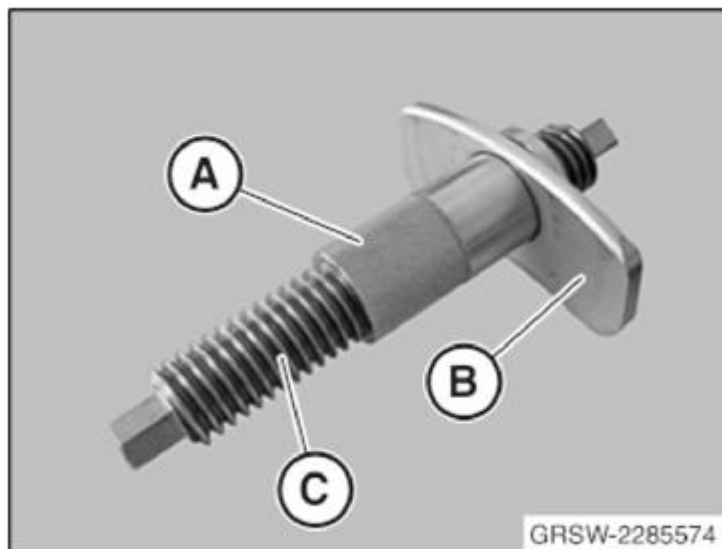
**NOTE:** Applies to: BMW i Aftersales Basic for turning back the brake pistons.  
Tool set, consisting of: Nut - 83302285574/A Pressure plate - 83302285574/B Spindle - 83302285574/C.

**Storage Location**

B36

**SI number**

01 36 13 (025)



**Fig. 3: Identifying Reset (2285574).**  
Courtesy of BMW OF NORTH AMERICA, INC.

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## BRAKES

### Brakes - Technical Data - All I3 Models - i3

## FRONT BRAKE

### 34 11 FRONT BRAKE I01

#### FRONT BRAKE I01 SPECIFICATION

<p><b>IMPORTANT:</b>                  Installation of new brake pads is approved only provided that the brake disc thickness exceeds the specified dimension for "MIN TH" (see below).</p> <p>Brake discs must be replaced when they reach the nominal thickness (see below) minus 2.4 mm!(Not applicable to perforated brake discs and M vehicles).Depending on:</p> <ul style="list-style-type: none"> <li>• Engine type</li> <li>• Transmission version</li> <li>• Equipment specification (e.g. maximum load increase, chassis official-use, national version, etc.)</li> </ul> <p>different brake discs can be fittedThe brake discs must always be assigned by way of the relevant vehicle identification number via the BMW parts catalogue!</p>	Å	Å
Different thicknesses on brake linings	Max. mm	0.01
Nominal size (diameter x thickness)	mm	280x20
(MIN TH) is stamped in brake disc chamber	mm	18.4
Pad wear warning from remaining brake pad thickness	mm	397

## REAR BRAKE

### 34 21 REAR BRAKE DISCS I01

#### REAR BRAKE DISCS I01 SPECIFICATION

<p><b>IMPORTANT:</b>                  Each time the rear brake pads are replaced, the brake discs must also be replaced!</p> <p>Depending on:</p> <ul style="list-style-type: none"> <li>• Engine type</li> <li>• -Transmission version</li> </ul>	Å	Å
--	---	---

- Equipment specification (e.g. maximum load increase, chassis official-use, national version, etc.)

different brake discs can be fitted  
The brake discs must always be assigned by way of the relevant vehicle identification number via the BMW parts catalogue.

Different thicknesses on brake linings	Max. mm	0.01
Nominal size (diameter x thickness)	mm	280x8.6
(MIN TH) is stamped in brake disc chamber	mm	-
Pad wear warning from remaining brake pad thickness	mm	3.7

## BRAKES

### Brakes - Tightening Torques - All I3 Models - i3

#### BRAKE LINES

##### 34 32 BRAKE LINES

###### TIGHTENING TORQUE SPECIFICATION - BRAKE LINES

Â	Type	Thread	Tightening specifications	Value
1AZ Brake line screw connection/union screws	I01/I12	M12x1/M10x1	Â	14 Nm
AZ Brake hose to brake caliper, front	I01/I12	Â	Â	24 Nm
3AZ Brake hose to brake caliper, rear	I01/I12	Â	Â	24 Nm

#### BRAKE SERVO

##### 34 33 BRAKE SERVO

###### TIGHTENING TORQUE SPECIFICATION - BRAKE SERVO

Â	Type	Thread	Tightening specifications	Dimension
1AZ Brake booster to pedal assembly console	I01/I12	M8	Replace nuts	22 Nm
2AZ Electric vacuum pump to bracket	I01/I12	M6	Â	9 Nm

#### FRONT BRAKE

##### 34 11 FRONT BRAKE

###### TIGHTENING TORQUE SPECIFICATION - FRONT BRAKE

Â	Type	Thread	Tightening specifications	Value
1AZ Brake disc to wheel hub	I01/I12	Â	Replace screws	16 Nm
2AZ Brake anchor plate to swivel bearing	I01/I12	M12x1.5	Replace screws Jointing torque Angle of rotation	30 Nm 90 Â°
3AZ Guard plate to swivel bearing	I01/I12	M6	Replace screws	12 Nm
4AZ Guide screw (hexagon screw)	I01	WAF 13	Â	35 Nm

#### MASTER BRAKE CYLINDER

##### 34 31 MASTER BRAKE CYLINDER

###### TIGHTENING TORQUE SPECIFICATION - MASTER BRAKE CYLINDER

Â	Type	Thread	Tightening specifications	Dimension
1AZ Brake master cylinder to brake booster (vacuum)	I01/I12	M8	Replace self-locking nuts.	21 Nm
2AZ Retaining screw for expansion tank	I01/I12	Â	Â	4 Nm

#### PARKING BRAKE

## 34 41 PARKING BRAKE

### TIGHTENING TORQUE SPECIFICATION - PARKING BRAKE

Â	Type	Thread	Tightening specifications	Value
1AZ EMF actuator to brake caliper Cable clip to brake caliper	I01	wrench size 5 mm	Replace screws	8 Nm
Â	I01	wrench size 5 mm	Replace screws	14 Nm
2AZ EMF actuator to brake caliper	I12	Â	Replace screws	12 Nm
3AZ Electromechanical parking brake control unit to rear axle module	I12	Â	Replace plastic nut	3 Nm

## PEDAL ASSEMBLY CONSOLE

### 35 11 PEDAL ASSEMBLY CONSOLE

### TIGHTENING TORQUE SPECIFICATION - PEDAL ASSEMBLY CONSOLE

Â	Type	Thread	Tightening specifications	Value
1AZ Bearing pedestal to brake assembly and body	I01/I12	nut M8	Replace self-locking nuts	21 Nm
Â	I12	nut M6	Replace self-locking nuts	8 Nm
Â	I01	M8 screw	Â	19 Nm

## REAR BRAKE

### 34 21 REAR BRAKE

### TIGHTENING TORQUE SPECIFICATION - REAR BRAKE

Â	Type	Thread	Tightening specifications	Dimension
1AZ Brake disc to wheel hub	I01/I12	Â	Replace screws	16 Nm
2AZ Brake anchor plate to wheel carrier	I01/I12	M12x1.5	Replace screws	110 Nm
3AZ Protective plate to wheel carrier	I01/I12	M6	Replace screws	12 Nm
4AZ Guide screw (socket head cap screw)	I01	WAF 7	Â	28 Nm
5AZ Guide screw (hexagon screw)	I12	WAF 13	Replace screws	35 Nm

## SLIP CONTROL SYSTEM (DSC)

### 34 51 SLIP CONTROL SYSTEM (DSC)

### TIGHTENING TORQUE SPECIFICATION - SLIP CONTROL SYSTEM (DSC)

Â	Type	Thread	Tightening specifications	Value
1AZ Control unit on hydraulic unit DSC MK 100	I01/I12	Â	Replace screws	5.5 Nm
2AZ SAS control unit to holder	I01/I12	Â	Â	8 Nm
3AZ Pulse sensor to swivel bearing/wheel carrier	I01/I12	Â	Â	8 Nm
4AZ Bracket to hydraulic unit	I01/I12	Â	Â	8 Nm
5AZ Bracket, hydraulic unit to body	I01/I12	Â	Â	8 Nm

## TESTING AND BLEEDING BRAKES

**TIGHTENING TORQUE SPECIFICATION - TESTING AND BLEEDING BRAKES**

<b>Â</b>	<b>Type</b>	<b>Thread</b>	<b>Tightening specifications</b>	<b>Dimension</b>
1AZ Vent valve	I01	WAF 11	Front Brake	10 Nm
Â	I01	WAF 11	Rear Brake	15 Nm
Â	I12	WAF 11	Front Brake	18 Nm
Â	I12	WAF 11	Rear Brake	10 Nm

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## BRAKES

### Pedals - Repair - All I3 Models - i3

## BEARING SUPPORT FOR FOOT PEDAL

### 35 11 000 REMOVING AND INSTALLING COMPLETE BEARING SUPPORT FOR FOOT PEDAL

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

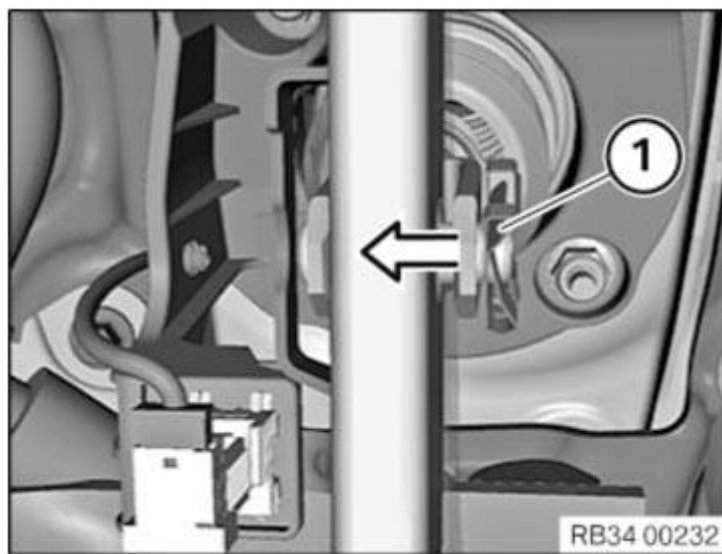
#### Necessary preliminary tasks:

- Remove [TRIM PANEL FOR PEDAL MECHANISM](#) .

Pull retaining clip (1) off of brake pedal and pull out retaining bolt.

*Installation note:*

Replace retaining clip (1) and check that it is correctly seated in the groove of the retaining bolt.



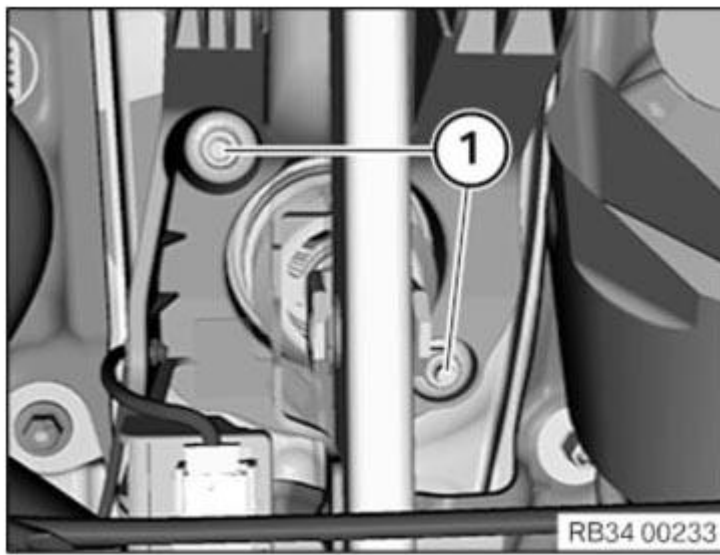
**Fig. 1: Pulling Retaining Clip Off Of Brake Pedal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unscrew nuts (1).

*Installation note:*

Replace self-locking nuts.

Tightening torque [35 11 1AZ](#) .



**Fig. 2: Identifying Self-Locking Nuts**

Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1).

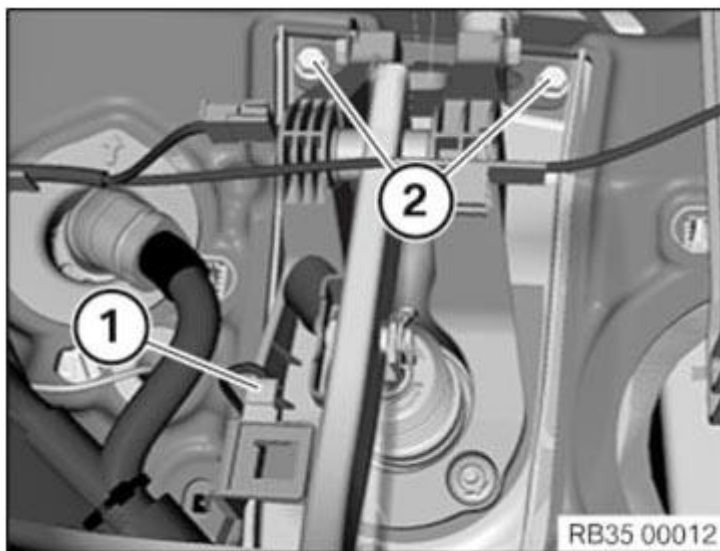
Release screws (2) and swing out bearing support.

*Installation note:*

First, tighten nuts on screw connection to brake booster and then tighten screws (2).

Replace self-locking nuts and screws.

Tightening torque **35 11 1AZ** .



**Fig. 3: Identifying Bearing Support Screws And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

## **ACCELERATOR PEDAL MODULE**

### **35 40 001 REMOVING AND INSTALLING OR REPLACING ACCELERATOR PEDAL MODULE**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric cars.

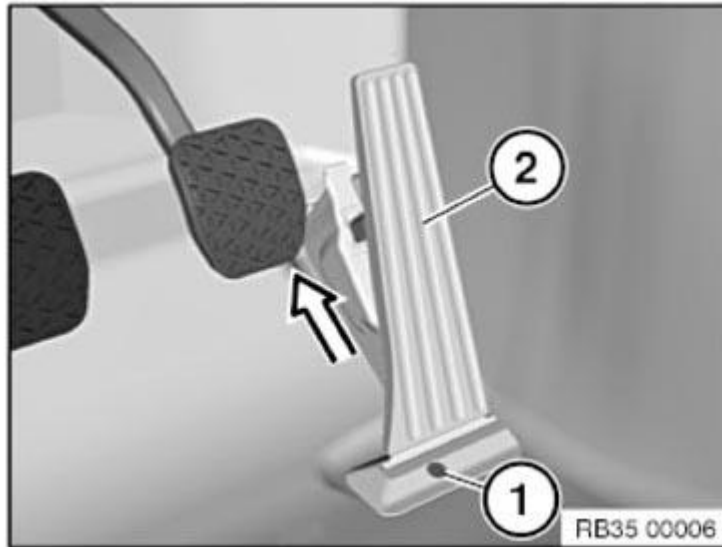
Take off cap.

Release screw (1).

Pull the accelerator pedal module (2) upwards out of bracket.

*Installation note:*

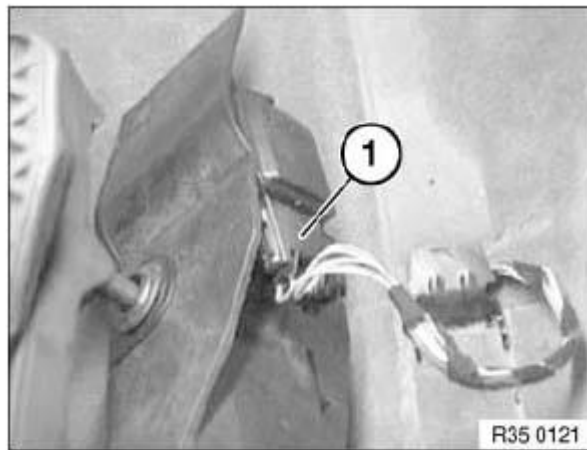
Tightening torque [35 40 1AZ](#) .



**Fig. 4: Pulling Accelerator Pedal Module From Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull off connector (1).

Remove accelerator pedal module.



**Fig. 5: Identifying Accelerator Pedal Module Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

---

**BRAKES****Pedals - Tightening Torques - All I3 Models - i3****PARKING BRAKE****34 41 PARKING BRAKE****TIGHTENING TORQUE SPECIFICATION - PARKING BRAKE**

Â	Type	Thread	Tightening specifications	Value
1AZ EMF actuator to brake caliper Cable clip to brake caliper	I01	wrench size 5 mm	Replace screws	8 Nm
	I01	wrench size 5 mm	Replace screws	14 Nm
2AZ EMF actuator to brake caliper	I12	Â	Replace screws	12 Nm
3AZ Electromechanical parking brake control unit to rear axle module	I12	Â	Replace plastic nut	3 Nm

**PEDAL ASSEMBLY CONSOLE****35 11 PEDAL ASSEMBLY CONSOLE****TIGHTENING TORQUE SPECIFICATION - PEDAL ASSEMBLY CONSOLE**

Â	Type	Thread	Tightening specifications	Value
1AZ Bearing pedestal to brake assembly and body	I01/I12	nut M8	Replace self-locking nuts	21 Nm
	I12	nut M6	Replace self-locking nuts	8 Nm
	I01	M8 screw	Â	19 Nm

**PEDALS****35 40 PEDALS****TIGHTENING TORQUE SPECIFICATION - PEDALS**

Â	Type	Thread	Tightening specifications	Value
1AZ Accelerator pedal module to body	I01/I12	M6	Â	8 Nm

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## **BRAKES**

### **Pedals Operating Fluids**

#### **1.0 GENERAL INFORMATION**

For lubricating friction points on the pedal assemblies, use Syntheso Glep 1 (BMW Part No. 83 23 9 407 778).

---

## CANADIAN MODEL REFERENCE

### Canadian-To-U.S. Model Reference Tables

#### \* PLEASE READ THIS FIRST \*

**NOTE:** This GENERAL INFORMATION article is displayed for all vehicles. Data contained in this article may not apply to the specific vehicle selected.

#### ACURA

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

#### ACURA MODEL CROSS-REFERENCE

Canadian Model	US Model
1996-2000 1.6EL	Canadian Only (Based on 1996-2000 Japanese Market Honda Domani)
2001-2005 1.7EL	2001-2005 Honda Civic
2004-2005 EL	2004-2005 Honda Civic
2006-2011 CSX	2006-2011 Honda Civic

#### ASUNA

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#### ASUNA MODEL CROSS-REFERENCE

Canadian Model	US Model
1992-93 Sunfire	1990-92 Isuzu Impulse & 1990-93 Geo Storm ("R" Body)
1993 GT/ SE	1988-93 Pontiac LeMans ("T Body)
1992-93 Sunrunner	1989-99 Geo Tracker ("J" Body)

#### AUDI

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#### AUDI MODEL CROSS-REFERENCE

Canadian Model	US Model
1985-86 Quattro	Nearest Match: 1984 Quattro Similar To: 1985-86 Coupe



Canadian Model	US Model
1996-97 S6	Nearest Match: 1996-97 A6

## CHRYSLER CORP.

### CHRYSLER

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#### CHRYSLER MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-93 Daytona	1984-93 Dodge Daytona
1988-93 Dynasty	1988-93 Dodge Dynasty
1993-04 Intrepid	1993-04 Dodge Intrepid
2000-02 Neon	2000-02 Dodge Neon

### DODGE

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#### DODGE MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-90 2000	1989-90 Mitsubishi Galant
1992-93 Colt Wagon	1992-93 Plymouth Colt Vista
1994 Colt Wagon	1994 Mitsubishi Expo (LRV)
1987-88 Expo	1987-88 Colt Vista
1995-96 Colt	1995-96 Eagle Summit 1995-96 Mitsubishi Mirage
2003-05 SX	2003-05 Neon

### EAGLE

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#### EAGLE MODEL CROSS-REFERENCE

Canadian Model	US Model
1991-93 2000 GTX	1989-93 Mitsubishi Galant
1989-91 Vista (Sedan/Notchback)	1989-91 Dodge Colt
1992 Vista	1992 Plymouth Colt
1989-91 Vista Wagon	1989-91 Dodge Colt Vista

### PLYMOUTH

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**PLYMOUTH MODEL CROSS-REFERENCE**

Canadian Model	US Model
1978-81 Caravelle	1978-87 Dodge Diplomat
1982-84 Caravelle	1982-84 Gran Fury Also: Dodge 600
1990-92 Colt 100/200	1990-92 Colt
1995-96 Colt	1995-96 Eagle Summit 1995-96 Mitsubishi Mirage
1992-94 Colt Wagon	1992-94 Mitsubishi Expo (LRV)
1987-89 Expo	1987-89 Colt Vista

**GENERAL MOTORS****BUICK****NOTE:**

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**BUICK MODEL CROSS-REFERENCE**

Canadian Model	US Model
2005-09 Allure	2005-09 Buick LaCrosse
1986-87 Somerset Regal	1986-87 Regal (Somerset is a Regal trim level)

**CHEVROLET****NOTE:**

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**CHEVROLET MODEL CROSS-REFERENCE**

Canadian Model	US Model
1989-92 Sprint	1989-92 Geo Metro 1989-92 Suzuki Swift
1989-92 Tracker	1989-92 Geo Tracker 1989-92 Suzuki Sidekick
2004-08 Optra (Sedan/Wagon)	2004-08 Suzuki Forenza
2004-08 Optra5	2004-08 Suzuki Reno
2004-06 Epica	2004-06 Suzuki Verona
2012 Orlando	Canadian Only
2009 Uplander	Canadian Only Best Match: 2008 Uplander
2013-4 Chevrolet Trax	2015 Chevrolet Trax

## GMC

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### GMC MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-92 Tracker	1989-94 Geo Tracker
2002-05 Jimmy	2002-05 Chevrolet Blazer (Not TrailBlazer)

## OLDSMOBILE

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### OPTIMA/PASSPORT MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-90 Delta 88	1989-90 Eighty-Eight

## OPTIMA

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### OPTIMA/PASSPORT MODEL CROSS-REFERENCE

Canadian Model	US Model
1988-91 Optima (Passport)	1988-91 Pontiac LeMans ("T" Body)

## PONTIAC

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### PONTIAC MODEL CROSS-REFERENCE

Canadian Model	US Model
1982 Parisienne	Best Match: 1983 Parisienne
1985-89 Firefly	1985-89 Chevrolet Sprint
1990-00 Firefly	1990-00 Suzuki Swift 1998-00 Chevrolet Metro
1987-91 Tempest	1987-91 Chevrolet Corsica

Canadian Model	US Model
2007 Montana SV6	2007 Buick Terraza 2007 Saturn Relay 2007 Chevrolet Uplander
2008-09 Montana SV6	2008 Chevrolet Uplander
1982-83 Grand LeMans	1982-82 Bonneville 1981 Oldsmobile Cutlass
1985-87 Sunburst	1985-87 Chevrolet Spectrum
1994-97 Sunrunner	1994-97 Geo Tracker
2005-09 Wave & G3 Wave	2005-09 Chevrolet Aveo
2010 G3	2010 Chevrolet Aveo
2005-08 G5 Pursuit, G5, & Pursuit	2005-08 Chevrolet Cobalt
1982-87 Acadian	1982-87 Chevrolet Chevette

## HYUNDAI

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### HYUNDAI MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-87 Pony	Canadian Only
1985-88 Stellar	Canadian Only

## JAGUAR

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### JAGUAR MODEL CROSS-REFERENCE

Canadian Model	US Model
1983-92 XJ12	Canadian Only

## KIA

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### KIA MODEL CROSS-REFERENCE

Canadian Model	US Model
2010-11 Borrego	Canadian Only Best Match: 2009 Borrego
2001-10 Magentis	2001-10 Optima
2011-12 Rondo	Canadian Only Best Match: 2010 Rondo

## MAZDA

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### MAZDA MODEL CROSS-REFERENCE

Canadian Model	US Model
1992-96 MX3 Precidia	1992-95 MX3
1995 323	1995 Protege
1997 B3000	1997 B4000 1997 Ford Ranger
2010 B-Series Trucks	Canadian Only Best Match: 2009 B-Series Trucks
1993-97 MX6 Mystere	1993-97 MX6 193-97 Ford Probe
1992-95 929 Serenia	1988-95 929
1993-97 626 Cronos	1988-97 626

## MERCEDES-BENZ

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### MERCEDES-BENZ MODEL CROSS-REFERENCE

Canadian Model	US Model
1992 350SD / 350SDL	1992 300SD
2006-11 B200	Canadian Only
2008-09 C230	2008-09 C300
2010-11 C250	2010-11 C300
2009 CLK63	Canadian Only Best Match: 2008 CLK63
2007 E280	2007 E320
2008-09 E300	2008-09 E350
2009-11 S450	2010-11 S400

## MERCURY

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### MERCURY MODEL CROSS-REFERENCE

Canadian Model	US Model
1987 Tracer	1987 Mazda 323

## MERKUR

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#### MERKUR MODEL CROSS-REFERENCE

Canadian Model	US Model
1987 Scorpio	Canadian Only Best Match: 1988 Scorpio

## MITSUBISHI

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

#### MITSUBISHI MODEL CROSS-REFERENCE

Canadian Model	US Model
2009 Endeavor	Canadian Only Best Match: 2008 Endeavor
2011-13 RVR	2011-13 Outlander Sport

## NISSAN

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#### NISSAN MODEL CROSS-REFERENCE

Canadian Model	US Model
1991-95 Axxess Wagon	Canadian Only Best Match: 1990 Axxess Wagon
1986-88 Multi Wagon	1986-88 Stanza Wagon
1984 Micra	Canadian Only
2005-06 X-Trail	Canadian Only

## RENAULT

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

#### RENAULT MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-86 LeCar	Canadian Only Best Match: 1983 LeCar



## SATURN

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

### SATURN MODEL CROSS-REFERENCE

Canadian Model	US Model
2009 Astra	Canadian Only Same As: 2008 Astra

## SMART

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

### SMART MODEL CROSS-REFERENCE

Canadian Model	US Model
2005-07 Fortwo	Canadian Only Best Match: 2008 Fortwo

## SUBARU

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

### SUBARU MODEL CROSS-REFERENCE

Canadian Model	US Model
1988-89 Chaser	1988-89 GL (Chaser is a hatchback version of the GL)

## SUZUKI

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

### SUZUKI MODEL CROSS-REFERENCE

Canadian Model	US Model
1986-88 Forsa	1986-88 Chevrolet Sprint
1982-85 Samurai (SJ410)	Canadian Only
2004-08 Swift+	2004-08 Chevrolet Aveo
2009 Swift+	2009 Chevrolet Aveo

## TOYOTA

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### TOYOTA MODEL CROSS-REFERENCE

Canadian Model	US Model
1998-99 Paseo	Canadian Only Best Match: 1997 Paseo
1999 Tercel	Canadian Only Best Match: 1998 Tercel
2006 Yaris	Canadian Only Best Match: 2007 Yaris

## VOLKSWAGEN

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

### VOLKSWAGEN MODEL CROSS-REFERENCE

Canadian Model	US Model
1995 Corrado	Canadian Only
1992 & 1994 EuroVan (Gas)	Canadian Only Best Match: 1993 Eurovan
1993-97 EuroVan (Diesel)	Canadian Only (No Diesel Eurovans Sold in U.S.)
2007-08 Golf (A5)	Canadian Only Best Match: 2006 Golf
2008-09 Golf (A6)	Canadian Only Best Match: 2010 Golf
1993 GTI	Canadian Only Best Match: 1993 Cabriolet
1994 GTI	Canadian Only Best Match: 1994 Jetta III
1989 Scirocco	Same As: 1988 Scirocco
1985-92 Transporter Van/Pickup	Canadian Only
1993-03 Transporter Van	1993-03 EuroVan

## VOLVO

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

### VOLVO MODEL CROSS-REFERENCE

Canadian Model	US Model

Canadian Model	US Model
1987-88 244 & 245	Canadian Only Best Match: 1987-88 240
2007 C30	Canadian Only Best Match: 2007 S40, V50, C70 Are Similar

## ALL OTHERS

**NOTE:** This GENERAL INFORMATION article is displayed for all vehicles. Data contained in this article may not apply to the specific vehicle selected.

**NOTE:** All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

Information for other vehicles is not available or known.

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## COLLISION

### Paintwork - Repair - All I3 Models - i3

## GENERAL PAINTWORK INFORMATION

### 64 00... INFORMATION ON USING CLEANING AGENT/PAINTS (PERSONAL PROTECTION EQUIPMENT)

**WARNING:** Use of cleaning agents/paints not compliant with instructions can cause serious injuries or burns!  
Handling cleaning agents/paints can trigger allergic skin and respiratory reactions!

#### Observe following instructions:

- IMPORTANT:
- Store cleaning agents/paints only in a secure cabinet.
  - Keep cleaning agents/paints away from naked flames and other sources of ignition.
  - Protect cleaning agents/paints from high temperatures and direct sunlight.
  - Always keep an eye douche on hand, change the water regularly (once a month).

#### Observe following instructions before use:

- IMPORTANT:
- Manufacturer's instructions (on container/packaging)
  - Hazard warnings (on container/packaging)
  - Manufacturer's instructions on package insert
  - Material safety data sheet of manufacturer
  - National market regulations

#### Observe following instructions during use:

- IMPORTANT:
- Do not eat, drink or smoke while working with these products.
  - Avoid direct contact with skin and eyes.
  - Wear personal protective clothing/equipment.
  - Ensure that all enclosed areas are well ventilated or extract fumes directly.
  - Immediately change working clothes soiled with cleaning agent/paint.
  - After finishing work, wash your hands and apply protective skin cream.

IMPORTANT: Follow hazard warnings and wear personal protection equipment!

#### First Aid:

- If product comes in contact with eyes, immediately flush with running water for about 10 - 15 minutes. Seek the advice of eye specialist.
- In the event of skin contact and where applicable an allergic skin reaction, clean the affected areas immediately with soap and water and then apply silicone-free skin cream. Seek advice of physician.
- If an adhesive product is swallowed, rinse mouth/parts of mouth thoroughly with running water. Drink 1-2 glasses of water. Do not induce vomiting. Consult a doctor.

- After inhaling vapors ensure ample supply of fresh air. Keep calm, keep respiratory tracks clear and call doctor.

## Recycling:

Dispose of cleaning agents/paints in a professional manner!

Observe national/country-specific disposal regulations.

## 41 00... INFORMATION/WARNING LABELS

Missing or damaged labels (e. g. tire pressure) must be replaced.

--> overview via the installation location

## 61 00... NOTES ON HANDLING THE HIGH PRESSURE CLEANER

**WARNING:** Only used a high pressure cleaner approved by BMW!  
 Only instructed persons aged over 16 years may work using a high pressure cleaner.  
 Check the high pressure cleaner and electrical wiring for visible damage.  
 Only use at a suitable location.

Pay attention to following hazard warnings:

- IMPORTANT:
- Danger of injury due to water jet
  - Contact with hazardous substances in spray
  - Risk of skidding on wet floor
  - Risk of stumbling due to hoses and cables
  - Comply with notes and instructions on HANDLING CLEANING AGENTS
  - Risk of scalding when cleaning with hot water.
  - On electric or hybrid cars, the safety instructions for handling with hybrid cars are to be complied with.

**WARNING:** The following personal protective equipment is to be used:

- Safety goggles/face guard
- Suitable gloves
- Apron
- Rubber boots
- Ear protectors
- Safety shoes

Notes on washing a vehicle with a high pressure cleaner:

- IMPORTANT:
- Do not wash directly on gaskets and control units during engine washes.
  - A minimum distance of 30 cm must be adhered to for tires and tire valves.
  - A minimum distance of 30 cm must be adhered to for the soft top and painted parts.
  - Do not use if engine is still hot.
  - Do not exceed maximum water temperature of 60 degrees.
  - Do not spray directly onto cameras/sensors.
  - On electric or hybrid cars do not wash on high-voltage components.

## 99 00... NOTES ON PAINTWORK OF HYBRID/ELECTRIC (HEV/PHEV) CARS

Procedure when drying after painting:

**IMPORTANT:** Danger of damage to battery!  
Vehicle may not be kept in dryer for more than 2 hours at 60°C.

## **99 NOTES ON USING TEMPERATURE-CONTROLLED INFRA-RED RADIATORS**

When using temperature-controlled infrared radiators, damage to adhesive bonds, paint and vehicle components can occur when drying spatula and filler.

The temperature sensors in the infrared radiator only operate reliably on large, even surfaces.

On small surfaces such as C-pillars or sills, often only a colder, adjacent area is measured.

This leads to actual surface temperatures of up to 130°C, even if only 70°C is set on the infrared radiator.

When the rear side walls are partially replaced by bonding and riveting, these high temperatures can lead to a visible pattern in the area of the joint.

Remedy:

Check the surface temperatures on small component surfaces during the drying process with an external temperature sensor.

The general rule is: The surface temperatures must not exceed 85°C.

**IMPORTANT:** Do not use infrared radiators on carbon parts!  
Risk of component destruction.

## **99 00... NOTE REGARDING MATTE PAINTWORK**

Special procedure for matte paintwork:

Matte paintwork cannot be touched up since the painted surface cannot be polished.

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**DRIVELINE/AXLES**  
**BMW Operating Fluids**

**SPECIFIED GREASE**

**GREASE FOR PROPELLER SHAFT (FLEXIBLE COUPLING (RUBBER DOUGHNUT) CENTER BEARING AND SPLINE END)**

Use one of the following greases for greasing the propeller shaft center bearing or locating pin of the transmission output flange and the splines of the propeller shaft spline end.

**GREASE FOR PROPELLER SHAFT CHART**

<b>Trade name</b>	<b>Manufacturer/Supplier</b>
Molykote Longterm 2 PLUS	DOW CORNING
Optimol Olistamoly 2	Optimol-Iwerke

**GREASE FOR FITTED PROPELLER SHAFT**

The following grease should be used for greasing the hub spline of the propeller shaft at the final drive unit/output flange:

**GREASE FOR PROPELLER SHAFT HUB SPLINE CHART**

<b>Trade name</b>	<b>BMW part number</b>	<b>Container size</b>
Castrol Optitemp HT LF1	83 23 0 417 754	50 g tube

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## ELECTRICAL

### General Electrical System - Repair - i3\_I01

## SAFETY AND GENERAL INFORMATION

### 61 00... SAFETY INFORMATION FOR HANDLING ELECTRIC/HYBRID VEHICLES

#### 1. *Qualification:*

All repair work on high-voltage components **must be performed by qualified technicians** (qualification: training for work on high-voltage vehicles).

#### 2. *Identification:*

Observe **warning notices** on high-voltage components. When replacing individual high-voltage components, check if warning stickers are present. Independently attaching warnings is only allowed on the locations provided for them. Use only approved and appropriately identified original new parts.

#### 3. *Rules of conduct/protective measures:*

- Note operating instructions for handling high-voltage battery units.
- Do not under any circumstances touch open high-voltage cables and high-voltage components on damaged vehicle before shutting down the high-voltage electrical system.
- In the event of damage (mechanical, thermal) transition metal oxides, carbon, electrolyte solvents and their products of decomposition may be released.

Damaged high-voltage battery units must be stored in an acid-resistant pan in a location in the open that is protected against the weather (sun, rain) and secured against unauthorized access. Do not inhale escaping gasses.

- Prevent escaping substances from entering drains, pits and the sewer system.
- Collect any material that is discharged and have it disposed of according to the work instruction, wear acid-resistant protective clothing when doing so.
- Notify the fire brigade if fire breaks out, clear the area immediately and make accident scene safe.

Attempt to extinguish the fire without putting persons in danger (suitable extinguishant: water and water foam).

- A cut 2nd emergency separation point must be repaired with a butt connector.

#### 4. *Measures before starting work:*

- Each job on the vehicle must be assigned by appropriately trained personnel. Before work is started, this electrician must place the vehicle in the operating condition required to perform the relevant activity. The qualified personnel's instructions and directions absolutely must be followed. **No work may be carried out without this qualified personnel being consulted first.**
- The readiness to drive must be ended before shutting off the voltage of the high-voltage system. The readiness to drive is ended when the driver is absent only under the following conditions:
  1. seat belt buckle unlocked **and**
  2. the driver's door is open **and**
  3. no brake activated **and**
  4. no accelerator pressing **and**
  5. speed < 3 km/h (2 mph)
- Work on live high-voltage components is expressly prohibited. Before each operation on the high-voltage system, the system must be isolated from the power supply by qualified personnel (high-voltage safety connector Off) and secured against unauthorized return to service (padlock).

- Before beginning work, it is mandatory to check that the equipment is de-energized and is protected against being energized again.

Work is only permitted to begin if:

1. Corresponding display in instrument cluster: **High-voltage system switched off**

When a high-voltage warning is active (indicator light, Check Control, etc.), it is essential to determine and eliminate the cause of this warning via the diagnosis system before continuing with any other work.

**If it cannot be definitively established that the equipment is de-energized**, work is not permitted to begin. **risk of serious injury or death.** Before work begins, a qualified electrician (1000 V DC) must verify that the system is de-energized using appropriate measuring devices and procedures.

**=> In this case, a qualified electrician or Technical Support must be contacted.**

- Do not carry out any work whatsoever on high-voltage components while the batteries are charging. Before starting work, disconnect the charging cable from the vehicle.
- The vehicle must not be charged and refuelled at the same time.
- No repair work may be carried out at the high-voltage system when a combustion engine is currently running.
- The coolant pump and electric fan can be switched on automatically when terminal 15 is switched on or the high-voltage battery unit is charging. The following preliminary work must be performed prior to working on the electric fan to prevent injuries caused by an automatically activated electric fan.
  1. Disconnect any connected charging cables.
  2. Switch off terminal 15.
  3. Disconnect high-voltage system from power.
  4. Disconnect plug connections from the electric fan.

#### 5. Measures during/after activities:

- Identifiable mechanical damage to or tampering with high-voltage components must be reported immediately to the qualified personnel in charge.
- When carrying out any work on the high-voltage system, it is prohibited to drive externally all the drive train components (wheels, gearbox, drive shafts, etc.).
- Check all connectors and plug connections of the high-voltage components for damages after disconnecting them and/or before connecting them.
- High-voltage cables (orange coating) and their connectors and ferrules **may not** be repaired. If damaged, a cable must always be replaced completely.
- High-voltage cables must not be twisted or kinked. Crushed high-voltage cables must be replaced.
- After a bending operation, the resulting bend may only be returned to its original shape. To repeat bending at the same place is not permitted.
- When working in the vicinity of high-voltage components (identified accordingly with warning stickers and orange-colored coating), protect these components against damage.
- The specified work steps in the repair instructions must be adhered to exactly.
- High-voltage components and their holders must be screwed/bolted to the defined tightening torque. Tightening torques and tightening specifications must be observed.
- Connecting high-voltage components to body ground is crucial to safety for reasons of equipotential bonding. For this reason, it is prohibited to operate any high-voltage components without them being correctly connected to body ground. The measurement (insulation measurement) is performed by the vehicle automatically and therefore manual measurement is not required.

For a correct ground connection, the retaining elements of high-voltage components must not be painted. Follow further PAINTING NOTES .

- Removed high-voltage battery units must be stored in a manner that protects them from misuse and damage.

#### 6. *Potential compensation:*

Potential compensation wires, high-voltage cable, and the battery earth lead of the electrical machine electronics have a safety screw connection.

- Clean contact faces and have then checked by a second person.
- Tighten down screws/bolts to specified torque.
- Have tightening torque checked by a second person.
- Both persons must document that the work has been carried out correctly in the vehicle records.

### **61 00... DIAGNOSIS FOR CONDITION BASED SERVICE**

#### **NOTE: Red symbol for pre-delivery check**

The vehicle is coded at the end of line so that the red symbol for the pre-delivery check is shown in the Next Service indicator (same symbol as vehicle check).

The symbol is a reminder to the Service staff that the pre-delivery check has not yet been carried out on this vehicle.

#### **NOTE: Do not carry out a reset.**

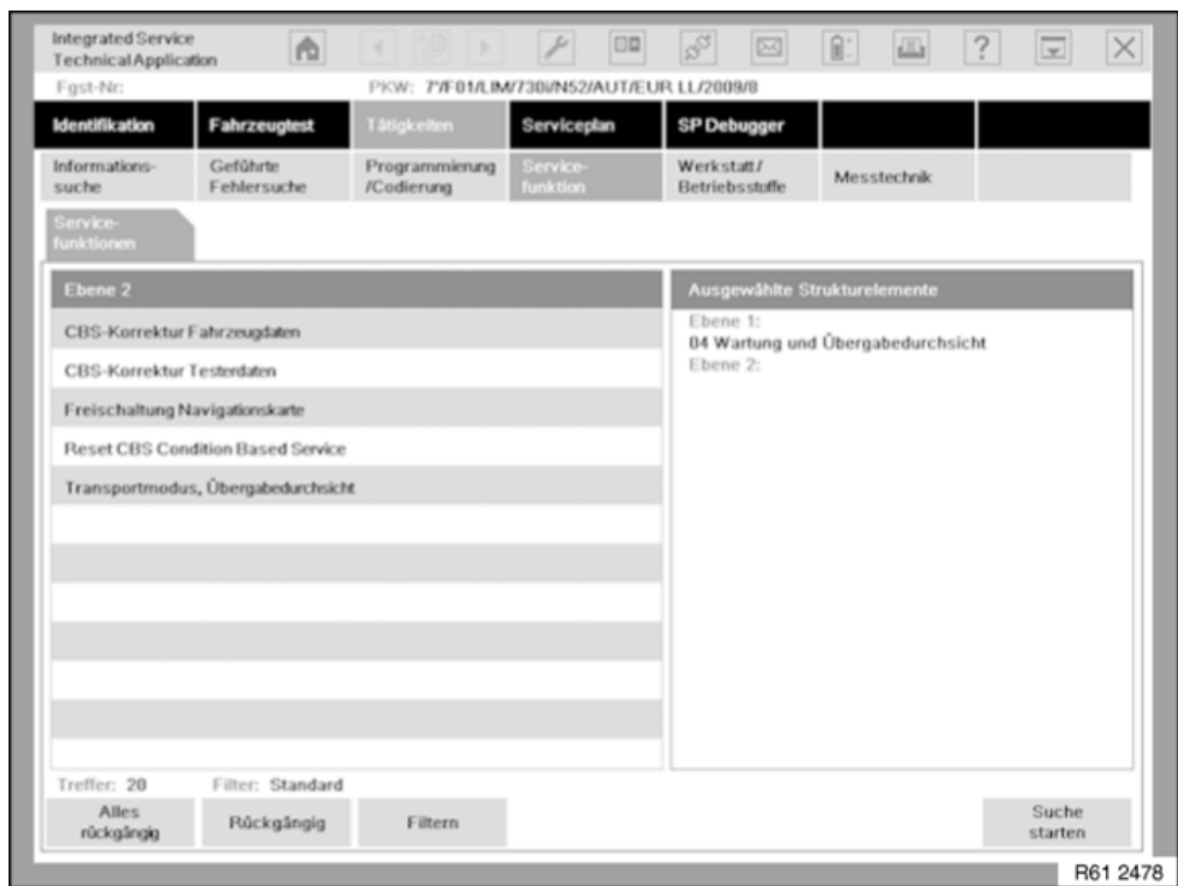


T0004655

**Fig. 1: Display - Vehicle Diagnosis Screen**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Do **not** confuse this function with the "Vehicle check" scope of maintenance work. Do not run a reset with the KOMBI.

When executing the pre-delivery check with the "Transport mode/Pre-delivery check" service function: The symbol will be suppressed automatically after the service function has been executed.



**Fig. 2: Display - BMW Diagnosis System Screen**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

4 service functions are available in the BMW diagnosis system for maintenance:

- Transport mode/pre-delivery check
- CBS correction, tester data
- Reset CBS
- CBS vehicle data correction

### **Service Function: Transport Mode/Pre-delivery check**

In order to ensure that a vehicle can be handed over to the customer in proper condition, the "Transport mode/pre-delivery check" service function must be performed.

The following positions are checked during the pre-delivery check:

- Deactivation of the transport mode.
- To determine the vehicle-specific vehicle performance per week an adaptation process is activated. Transport and immobilization periods before vehicle delivery to the customer therefore do not have any effect on the customer-specific weekly distance travelled.

The weekly mileage is used to control escalation from "green" to "yellow" (approx. 4 weeks before "red") for maintenance scopes with remaining distances. It is the vehicle performance determined over the last 6 weeks which is taken into account.

- Encoding or deletion of the legally-specified intervals for the legally stipulated vehicle inspection and exhaust-gas test.
- Inputting the target dates for the legally stipulated vehicle inspection and exhaust-gas test (automatically or manually).

Automatically: by date entry of the first registration and the interval

Manually: by directly entering the target date

- Entry of local, service-related phone numbers, depending on vehicle equipment specification (e.g. BMW Group Mobile Service, BMW Hotline, customer's local dealer).

The country-specific phone numbers are displayed in the BMW diagnosis system as a note. When asked for input information the phone numbers can simply be read off.

- Information on initializing the TeleServices depending on the vehicle equipment.
- Checking and where necessary adjusting the on-board date for the vehicle.
- Entry of the date of the first registration of the vehicle.
- Clear diagnostic fault entries from fault memory.

**NOTE:           Reduction of input effort.**

In order to minimize the input effort for the workshop, standardized data is saved on the BMW diagnosis system (for repeat use). The standardized data can be changed with the "CBS correction, tester data" service function.

**Service Function: CBS correction, tester data**

With the "Pre-delivery check" service function, data will automatically be stored in the vehicle. The standardized data can be changed with the "CBS correction, tester data" service function.

The following standardized data can be modified:

- Phone numbers:
  - BMW Group Mobile Service
  - BMW Hotline
  - Local dealer

The country-specific phone numbers are contained in the BMW diagnosis system as a note (to be read off when required for input). The phone numbers must be input with the international dialling code.

- Legally stipulated vehicle inspection (country-specific):
  - Encoding or deletion
  - Interval for calculating the target date

The target date is calculated on the basis of the date of the first registration.

- Legally stipulated exhaust-gas test (country-specific):
  - Encoding or deletion
  - Interval for calculating the target date

The target date is calculated on the basis of the date of the first registration.

**NOTE:           Automation after installation of the BMW diagnosis system.**

If the pre-delivery check is being carried out for the first time, the standardized data will be defined automatically. It is therefore not necessary to enter the data separately.

**Service Function: Reset CBS Condition Based Service**

The scope of maintenance work can be reset with the "Reset CBS Condition Based Service" service function. Even when the availability is above 80 %. The reset via the BMW diagnosis system has the advantage that the on-board date is corrected automatically.

The individual maintenance scopes are displayed in the BMW diagnosis system with service counter and availability.

- The service counter is increased by one count on resetting. In new vehicles all service counters are set to "1".



The service counters are used in the Service Acceptance Module (SAM) to control the additional work for specific maintenance operations.

- On resetting the availability is set at 100%. The percentage availability is the wear value for the maintenance operation.

The greater the availability, the further away the next service.

0% means that the maintenance measure must be carried out.

### **Service Function: CBS vehicle data correction**

**IMPORTANT:** The data have been exceeded.

After carrying out this service function, it will no longer be possible to restore the previous status.

The service function "CBS vehicle data correction" is available if resetting has been carried out **unintentionally** . Thus the availability of a maintenance measure can be corrected to a value which corresponds more closely to the actual situation.

For this correction a date or kilometer reading is entered. This data is processed internally to give a percentage availability. Here, the BMW diagnosis system will only accept a value which is lower than the current status in the control unit. In addition, the service counter of the scope is automatically reduced by one counter during correction.

The entries in the service booklet are used to determine the actual availability. The most recent maintenance measure (kilometer reading and date) allows the reconstruction availability for the specific scope that corresponds more closely to the actual situation. This does not include the correction of the brake pad availability. The remaining brake pad thickness must be measured and entered (in millimeters).

#### **NOTE: Reference for distance- and time-dependent maintenance scopes**

On correction the availability depends on the distance-dependent and time-dependent calculation.

### **61 00... DIAGNOSIS FOR CONDITION BASED SERVICE**

#### **NOTE: Red symbol for pre-delivery check**

The vehicle is coded at the end of line so that the red symbol for the pre-delivery check is shown in the Next Service indicator (same symbol as vehicle check).

The symbol is a reminder to the Service staff that the pre-delivery check has not yet been carried out on this vehicle.

#### **NOTE: Do not carry out a reset.**

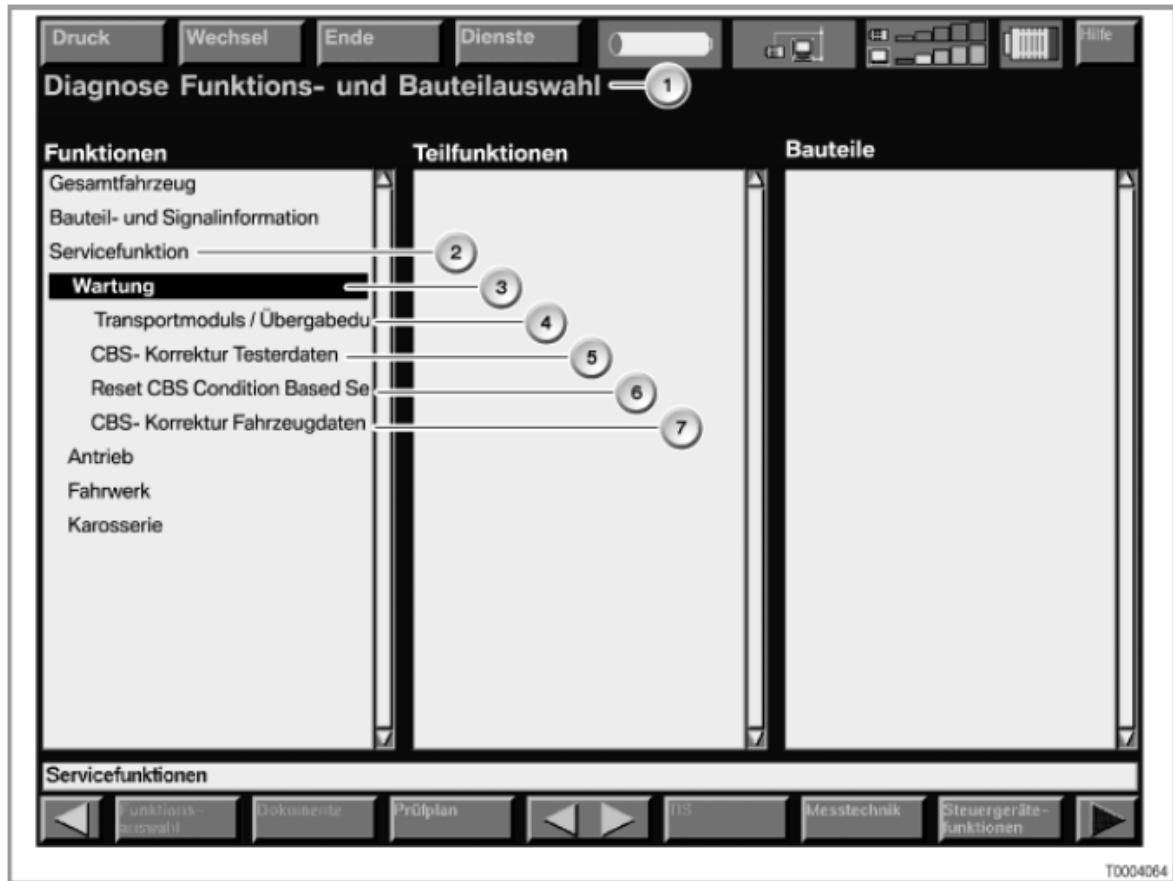
Do **not** confuse this function with the "Vehicle check" scope of maintenance work. Do not run a reset with the KOMBI.

When executing the pre-delivery check with the "Transport mode/Pre-delivery check" service function: The symbol will be suppressed automatically after the service function has been executed.



T0004055

**Fig. 3: Display - Vehicle Diagnosis Screen**  
 Courtesy of BMW OF NORTH AMERICA, INC.



T0004064

**Fig. 4: Display - Transport Mode/Pre-Delivery Check Screen**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Item	Explanation
1	Function and component selection
2	Service functions
3	Maintenance
4	Transport mode/pre-delivery check
5	CBS correction, tester data
6	Reset CBS Condition Based Service
7	CBS vehicle data correction
∧	∧

4 service functions are available in the BMW diagnosis system for maintenance:

- Transport mode/pre-delivery check
- CBS correction, tester data

- Reset CBS
- CBS vehicle data correction

### **Service Function: Transport Mode/Pre-delivery check**

In order to ensure that a vehicle can be handed over to the customer in proper condition, the "Transport mode/pre-delivery check" service function must be performed.

The following positions are checked during the pre-delivery check:

- Deactivation of the transport mode.
- To determine the vehicle-specific vehicle performance per week an adaptation process is activated. Transport and immobilization periods before vehicle delivery to the customer therefore do not have any effect on the customer-specific weekly distance travelled.

The weekly mileage is used to control escalation from "green" to "yellow" (approx. 4 weeks before "red") for maintenance scopes with remaining distances. It is the vehicle performance determined over the last 6 weeks which is taken into account.

- Encoding or deletion of the legally-specified intervals for the legally stipulated vehicle inspection and exhaust-gas test.
- Inputting the target dates for the legally stipulated vehicle inspection and exhaust-gas test (automatically or manually).

Automatically: by date entry of the first registration and the interval

Manually: by directly entering the target date

- Entry of local, service-related phone numbers, depending on vehicle equipment specification (e.g. BMW Group Mobile Service, BMW Hotline, customer's local dealer).

The country-specific phone numbers are displayed in the BMW diagnosis system as a note. When asked for input information the phone numbers can simply be read off.

- Information on initializing the TeleServices depending on the vehicle equipment.
- Checking and where necessary adjusting the on-board date for the vehicle.
- Entry of the date of the first registration of the vehicle.
- Clear diagnostic fault entries from fault memory.

### **NOTE: Reduction of input effort.**

In order to minimize the input effort for the workshop, standardized data is saved on the BMW diagnosis system (for repeat use). The standardized data can be changed with the "CBS correction, tester data" service function.

### **Service Function: CBS correction, tester data**

With the "Pre-delivery check" service function, data will automatically be stored in the vehicle. The standardized data can be changed with the "CBS correction, tester data" service function.

The following standardized data can be modified:

- Phone numbers:
  - BMW Group Mobile Service
  - BMW Hotline
  - Local dealer

The country-specific phone numbers are contained in the BMW diagnosis system as a note (to be read off when required for input). The phone numbers must be input with the international dialling code.

- Legally stipulated vehicle inspection (country-specific):

- Encoding or deletion
- Interval for calculating the target date

The target date is calculated on the basis of the date of the first registration.

- Legally stipulated exhaust-gas test (country-specific):
  - Encoding or deletion
  - Interval for calculating the target date

The target date is calculated on the basis of the date of the first registration.

**NOTE: Automation after installation of the BMW diagnosis system.**

If the pre-delivery check is being carried out for the first time, the standardized data will be defined automatically. It is therefore not necessary to enter the data separately.

**Service Function: Reset CBS Condition Based Service**

The scope of maintenance work can be reset with the "Reset CBS Condition Based Service" service function. Even when the availability is above 80 %. The reset via the BMW diagnosis system has the advantage that the on-board date is corrected automatically.

The individual maintenance scopes are displayed in the BMW diagnosis system with service counter and availability.

- The service counter is increased by one count on resetting. In new vehicles all service counters are set to "1".

The service counters are used in the Service Acceptance Module (SAM) to control the additional work for specific maintenance operations.

- On resetting the availability is set at 100%. The percentage availability is the wear value for the maintenance operation.

The greater the availability, the further away the next service.

0% means that the maintenance measure must be carried out.

**Service Function: CBS vehicle data correction**

**IMPORTANT:** The data have been exceeded.

After carrying out this service function, it will no longer be possible to restore the previous status.

The service function "CBS vehicle data correction" is available if resetting has been carried out **unintentionally** . Thus the availability of a maintenance measure can be corrected to a value which corresponds more closely to the actual situation.

For this correction a date or kilometer reading is entered. This data is processed internally to give a percentage availability. Here, the BMW diagnosis system will only accept a value which is lower than the current status in the control unit. In addition, the service counter of the scope is automatically reduced by one counter during correction.

The entries in the service booklet are used to determine the actual availability. The most recent maintenance measure (kilometer reading and date) allows the reconstruction availability for the specific scope that corresponds more closely to the actual situation. This does not include the correction of the brake pad availability. The remaining brake pad thickness must be measured and entered (in millimeters).

**NOTE: Reference for distance- and time-dependent maintenance scopes**

On correction the availability depends on the distance-dependent and time-dependent calculation.

## 61 25 900 DISCONNECTING HIGH-VOLTAGE SYSTEM FROM POWER

See [61 25 900 DISCONNECTING HIGH-VOLTAGE SYSTEM FROM POWER](#).

### 61 00... ENCODE/PROGRAM CONTROL UNIT(S)

**NOTE:** Depending on the vehicle and the equipment, the following flat rate unit items are available for programming/encoding:

- 61 00 710
- 61 00 720
- 61 00 730

**NOTE:**

- In order to avoid incorrect programming procedures and Check Control message, it is essential to always use the most recent version when working with the ISTA/P programming system.
- Battery voltage must not drop below 13.0 V during programming. Connect battery charger prior to programming.

Only use battery chargers recommended by BMW for low voltage vehicle electrical system.

No high-voltage switch off is required in electric vehicles or hybrid vehicles for programming/encoding.

**IMPORTANT:** The high-voltage system will be automatically switched off by the programming system.

**Exception:**

BMW I01

#### Programming routine via ISTA/P:

- Connect the battery charger to the vehicle.
- Connect the programming system with the vehicle.
- Determine the action plan.
- Accept action plan with the control units to be programmed/encoded and enabled, if necessary or work through.
- Observe the reworking list.
- If applicable, connect the workshop system to the vehicle, depending on the reworking list. Perform brief test and delete fault memory.

**NOTE:** A switch to the workshop system may not necessarily be required with the integration of the service functions and the "Delete fault memory" function in ISTA/P. Check the rework list accordingly.

- The information about programming the workshop system and the corresponding notes in the user documentation must be observed.

### 61 00... BATTERY AND HIGH-VOLTAGE STORAGE SYSTEM

See [6120 BATTERY](#) and [6125 HIGH-VOLTAGE STORAGE SYSTEM](#).

### 61 00... NOTES ON EARTH BONDING SCREW CONNECTIONS

Connecting high-voltage components to body ground is crucial to safety for reasons of equipotential bonding. For this reason, it is prohibited to operate any high-voltage components without them being correctly connected to body ground.

For a correct ground connection, the retaining elements of high-voltage components must not be painted. Follow further painting notes.

Potential compensation wires, high-voltage cables and the battery earth lead of the electrical machine electronics have a safety screw connection. The following procedure must be adopted **without fail** :

- Clean contact faces and have then checked by a second person.
- Tighten down screws/bolts to specified torque.
- Have tightening torque checked by a second person.
- Both persons must document that the work has been carried out correctly in the vehicle records.

## **61 00... NOTES ON ELECTRICAL PROPERTIES OF CARBON BODY**

**NOTE:**        **The body of BMW i vehicles consists of several carbon body components linked together by means of adhesive. (carbon: carbon fibre reinforced plastic)**

Carbon body components are electroconductive.

Nonetheless, the electrical conductivity of carbon is lower than the one of steel or aluminium.

**IMPORTANT:** Therefore, the carbon body cannot be used as the ground of the vehicle electrical system. The adhesive partially prevents the electrical current flow between the carbon body components.

In the case of a short circuit between vehicle electrical system and carbon body, the current may be below the triggering threshold of electrical fuses.

**IMPORTANT:** If the electrical fuse was not triggered in such case of a short circuit, the carbon body components may be damaged due to high heat load.

**To prevent damages on the carbon body, it is crucial to adhere to the following notes:**

- Carbon body may not be used as ground.
- Measurements may only be carried out to ground/ground support point, not to the carbon body.
- Ensure a correct ground contact according to the wiring diagram is set before carrying out checks relating to electrical components.

**In case of damages of electrical components, proceed as follows:**

1. Disconnect high-voltage system from power.
2. Disconnect battery ground cable.
3. Repair damaged electrical components.
4. Check carbon body for eventually visible surface damage caused by heat load in the area of damage of electrical components.
5. Contact Technical Support in cases of doubt.

## **61 00... NOTES ON HANDLING OPTICAL FIBRES**

To avoid damage when handling optical fibres, comply with the following points:

- The minimum permitted bending radius is 25 mm
  - Do not subject optical fibres to compressive and tensile load
- IMPORTANT:**
- Protect optical fibres against the effects of heat  $\geq 85 \text{ }^{\circ}\text{C}$  (e.g. during welding work, drying work with infrared beams or hot air blower)
  - Fibre-optic cables are permitted to show only one junction point (bridge), replace fibre-optic cables if necessary

**NOTE:**        **The optical fibres are colored differently as follows:**

- **Green = MOST (M edia O riented S ystems T ransport) optical fibre**



- Yellow = ISIS (Intelligent Safety and Integration System) optical fibre
- Orange=repair fibre-optic cables

Follow notes for processing cables and optical fibres. See [CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH](#) and [CRIMPING OPTICAL FIBRES](#).

## 61 00... NOTES ON HANDLING THE HIGH PRESSURE CLEANER

**WARNING:** Only used a high pressure cleaner approved by BMW. Only instructed persons aged over 16 years may work using a high pressure cleaner. Check the high pressure cleaner and electrical wiring for visible damage. Only use at a suitable location.

Pay attention to following hazard warnings:

- IMPORTANT:
- Danger of injury due to water jet
  - Contact with hazardous substances in spray
  - Risk of skidding on wet floor
  - Risk of stumbling due to hoses and cables
  - Comply with notes and instructions on [HANDLING CLEANING AGENTS](#).
  - Risk of scalding when cleaning with hot water.
  - On electric or hybrid cars, the safety instructions for handling with hybrid cars are to be complied with.

**WARNING:** The following personal protective equipment is to be used:

- Safety goggles/face guard
- Suitable gloves
- Apron
- Rubber boots
- Ear protectors
- Safety shoes

Notes on washing a vehicle with a high pressure cleaner:

- IMPORTANT:
- Do not wash directly on gaskets and control units during engine washes.
  - A minimum distance of 30 cm must be adhered to for tires and tire valves.
  - A minimum distance of 30 cm must be adhered to for the soft top and painted parts.
  - Do not use if engine is still hot.
  - Do not exceed maximum water temperature of 60 degrees.
  - Do not spray directly onto cameras/sensors.
  - On electric or hybrid cars do not wash on high-voltage components.

## 61 00... NOTES ON HANDLING WIRING HARNESES AND CABLES

The following applies in general:

To avoid damage, observe the following instructions:

- Avoid compressive and tensile loads

- To ensure professional repairs, perform repair work only with BMW-approved or recommended special tools and spare parts
- Make sure cables are laid without kinks or abrasions
- Ensure non-contacting routing at sharp-edged body parts; use edge protection if necessary
- Secure additionally laid cables/leads with cable ties

**The following additionally applies**

**Shielded cables**

Contact points in the shielding can cause problems with regard to noise radiation and interference immunity. Consequently, distinctions have to be drawn between the following types:

**Coaxial cable**

- Shielded coaxial cables RTK031 may only be repaired with a special crimping tool.
- For aerial lines only the bushing contact may be repaired.
- RG174 Lines and the bushing contact may not be repaired.

**CVBS cables**

- CVBS cables may not be repaired.
- CVBS cables must be replaced in their entirety.

**HSD cables**

- HSD cables may not be repaired.
- HSD cables must be replaced in their entirety.

**Fibre-optic cables:**

**NOTE:** Fibre-optic cables are colored differently as follows:

- **Green = MOST (Media Oriented Systems Transport) optical fibre**
- **Yellow = ISIS (Intelligent Safety Integration System) optical fibres**
- **Orange=repair fibre-optic cables**

- IMPORTANT:**
- Optical fibres are permitted to show only **one** junction point (bridge). Replace optical fibres if necessary
  - Smallest permissible bending radius is 25 mm
  - Avoid effects of heat  $\geq 85 \text{ }^{\circ}\text{C}$

Follow notes for processing cables and optical fibres. See **CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH** and **CRIMPING OPTICAL FIBRES**.

**FlexRay (twisted cables):**

It is possible to repair the FlexRay. In the event of damage, the cables can be joined with conventional **BUTT CONNECTORS AND HEAT-SHRINK TUBING**.

**NOTE:**

- **FlexRay lines may only reveal one separation point (bride); renew complete line if necessary.**
- **If possible, maintain twisted cable after repair.**
- **After repairs, twist cables as close as possible to the connector/separation point.**

- Twisting must be as symmetrical as possible.

**Airbag lines:**

## **REPAIRING AIRBAG CABLES**

**Replacement of wiring harnesses:**

If after replacing wiring harnesses connectors remain, they should be sealed outside the vehicle interior, for example, with butyl tape so that moisture ingress can be eliminated permanently.

## **61 00... REPAIRING AIRBAG CABLES**

**IMPORTANT:** Only repair those cables which show visible signs of damage. In the event of visible damage, make sure there is only one cable repair in effect after the repair work. If no visible damage can be identified, the entire cable must be replaced. When carrying out repairs to the airbag wiring harness, you must use the spare parts available via BMW.

Safety regulations for **HANDLING COMPONENTS OF AIRBAG SYSTEM** .

Instructions for **DISCONNECTING AND CONNECTING BATTERY** .

**In event of non-visible damage to wiring harness:**

Disconnect plug connection on airbag module or on adapter plug. It is absolutely vital to disconnect the contacts in succession as there is a risk of mixing up (similar parts). Cut through one cable after the other at an appropriate position, do not under any circumstances cut through both cables at the same time. Insulate cables remaining in wiring harness with insulating tape. Now disconnect plug connection on airbag control unit. Unpin contacts. Cut through one cable after the other at an appropriate position and insulate with insulating tape, do not under any circumstances cut through both cables at the same time. Pin contacts of repair cable for airbag control unit in control unit plug, assignment of repair cables is relevant. Lay repair cable in vehicle parallel to existing airbag lead. Now pin in contacts for airbag control unit or contacts of adapter plug, assignment of repair cables is relevant. Cut off excess length of repair cable in proximity (visible area) of airbag module or of adapter plug. Twist open cables. With the butt connectors and heat-shrink tubings obtained via BMW, reconnect the cables with the same cable colors. Twist cables again, open length (twist) must not exceed 40 mm. Secure interface (heat-shrink tubing) with insulating tape to prevent cables from twisting open.

Instructions for cutting off, insulating, crimping cables, installing and removing contacts:

### **CUTTING OFF AND INSULATING CABLES.**

### **BUTT CONNECTORS AND HEAT-SHRINK TUBING.**

### **INSTALLING AND REMOVING CONTACTS.**

**In event of visible damage:**

Expose cable at damaged areas. Cut through one cable after the other at an appropriate position and insulate cables no longer required in wiring harness with insulating tape, do not under any circumstances cut through both cables at the same time. Now, depending on the scope of work, unpin contacts either on airbag control unit/airbag module or on adapter plug. Cut off unpin cables. Insulate cables remaining in wiring harness with insulating tape. Now pin in contacts of repair cable, assignment of repair cables is relevant. Lay repair cable in vehicle parallel to existing airbag lead up to separation point. Cut off excess length of repair cable. Twist open cables. Connect cables with butt connectors and heat-shrink tubings obtained via BMW, assignment of repair cables is relevant. Twist cables again, open length (twist) must not exceed 40 mm. Secure interface (heat-shrink tubing) with insulating tape to prevent cables from twisting open.

Instructions for cutting off, insulating, crimping cables, installing and removing contacts:

### **CUTTING OFF AND INSULATING CABLES.**

### **BUTT CONNECTORS AND HEAT-SHRINK TUBING.**

## INSTALLING AND REMOVING CONTACTS.

### **61 13... NOTES FOR OPENING CONTACTS AND LOCKS OF DIFFERENT PLUG CONTACT SYSTEMS**

See **61 13... NOTES FOR OPENING CONTACTS AND LOCKS OF DIFFERENT PLUG CONTACT SYSTEMS.**

### **61 13... UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS IN ELECTRICAL AND HYBRID VEHICLES**

See **61 13... UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS IN ELECTRICAL AND HYBRID VEHICLES.**

## **WIRING HARNESS, REPAIR CABLE**

### **61 00... NOTES ON HANDLING WIRING HARNESSES AND CABLES**

**The following applies in general:**

To avoid damage, observe the following instructions:

- Avoid compressive and tensile loads
- To ensure professional repairs, perform repair work only with BMW-approved or recommended special tools and spare parts
- Make sure cables are laid without kinks or abrasions
- Ensure non-contacting routing at sharp-edged body parts; use edge protection if necessary
- Secure additionally laid cables/leads with cable ties

**The following additionally applies**

#### **Shielded cables**

Contact points in the shielding can cause problems with regard to noise radiation and interference immunity. Consequently, distinctions have to be drawn between the following types:

#### **Coaxial cable**

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- RG174 Lines and the bushing contact may not be repaired.

#### **CVBS cables**

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- CVBS cables must be replaced in their entirety.

#### **HSD cables**

- HSD cables may not be repaired.
- HSD cables must be replaced in their entirety.

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**NOTE:** Fibre-optic cables are colored differently as follows:

- **Green = MOST (Media Oriented Systems Transport) optical fibre**
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- **Orange=repair fibre-optic cables**

- IMPORTANT:
- Optical fibres are permitted to show only **one** junction point (bridge). Replace optical fibres if necessary
  - Smallest permissible bending radius is 25 mm
  - Avoid effects of heat  $\geq 85 \text{ }^{\circ}\text{C}$

Follow notes for processing cables and optical fibres. See [CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH](#) and [CRIMPING OPTICAL FIBRES](#).

#### FlexRay (twisted cables):

It is possible to repair the FlexRay. In the event of damage, the cables can be joined with conventional [BUTT CONNECTORS AND HEAT-SHRINK TUBING](#).

#### NOTE:

- FlexRay lines may only reveal one separation point (bride); renew complete line if necessary.
- If possible, maintain twisted cable after repair.
- After repairs, twist cables as close as possible to the connector/separation point.
- Twisting must be as symmetrical as possible.

#### Airbag lines:

#### [REPAIRING AIRBAG CABLES](#)

#### Replacement of wiring harnesses:

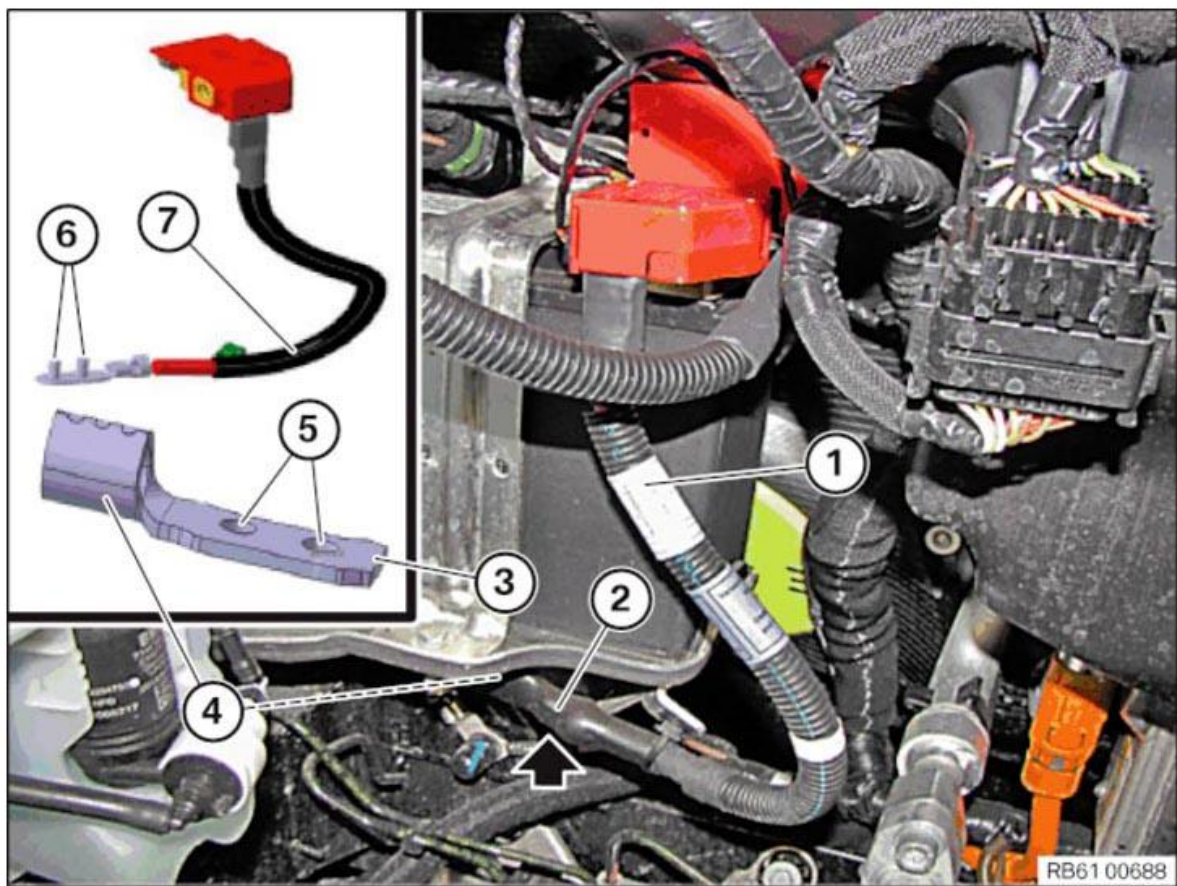
If after replacing wiring harnesses connectors remain, they should be sealed outside the vehicle interior, for example, with butyl tape so that moisture ingress can be eliminated permanently.

#### **61 12... REPLACING POSITIVE BATTERY CABLE WITH SAFETY BATTERY TERMINAL**

**NOTE:** After activation of the safety battery terminal as a result of an accident, the entire positive battery cable does not have to be replaced. A separation point is located under the battery.

#### Necessary preliminary tasks:

- Remove [BATTERY TRAY](#)



**Fig. 5: Identifying Positive Battery Cable With Threaded Bolts**

Courtesy of BMW OF NORTH AMERICA, INC.

**Introductory details:**

- (1): Positive battery cable to be replaced with safety battery terminal, arrow marks the separation point.
- (4): Vehicle positive battery cable is not replaced, arrow marks the separation point.
- (7): New replacement positive battery cable, which is connected to positive battery cable (4) with threaded bolts (5, 6).

Disconnect plug (1).

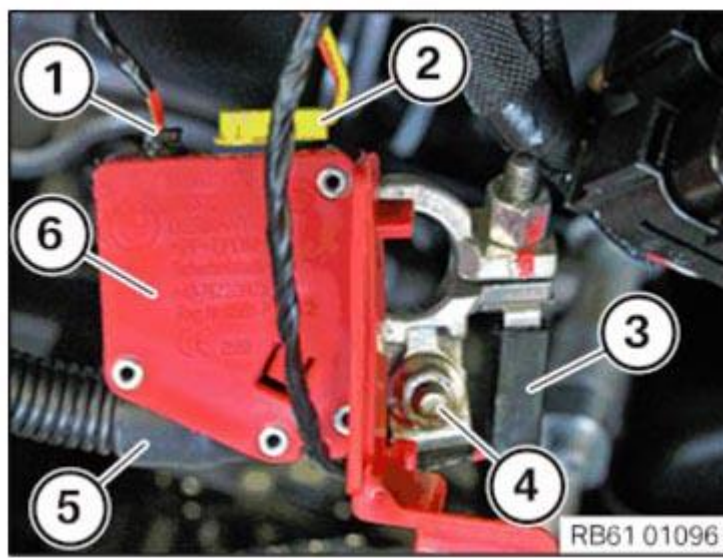
Disconnect plug (2).

Disconnect plug (3).

Slacken nut (4).

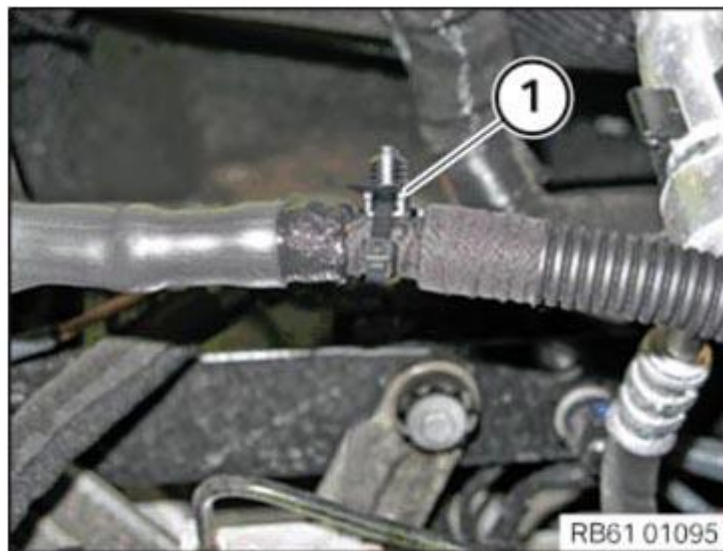
Remove the positive battery cable (5) to the power distribution box from the safety battery terminal (6).





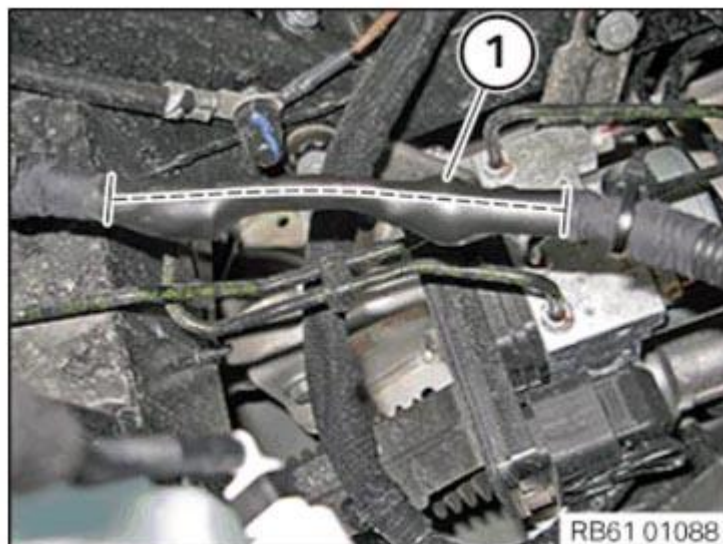
**Fig. 6: Identifying Positive Battery Cable And Safety Battery Terminal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip the safety battery terminal with positive battery cable (1) to below the battery holder.



**Fig. 7: Identifying Positive Battery Cable Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.

Cut open heat-shrink tubing (1) and remove.



**Fig. 8: Identifying Heat-Shrink Tubing Cutting Position**  
Courtesy of BMW OF NORTH AMERICA, INC.

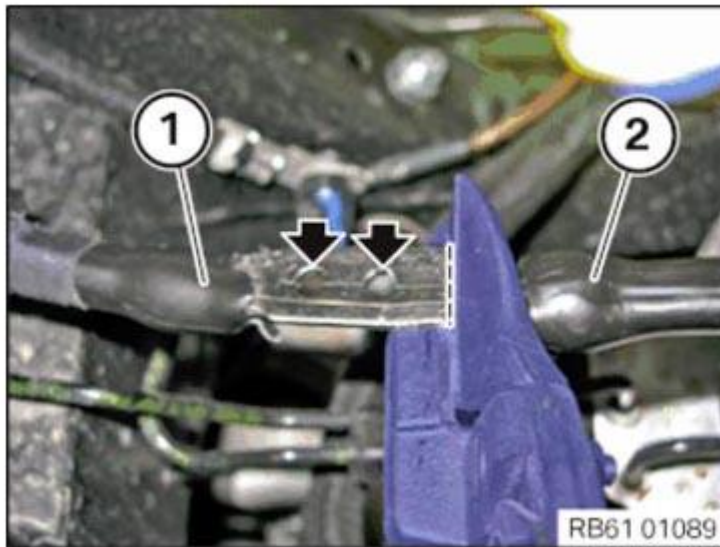
Disconnect positive battery cable as shown using plate shears.

Both bore holes must remain on the vehicle positive battery cable (1).

If necessary, deburr cutting edges.

Section (2) with the safety battery terminal is replaced.

If necessary, remove remnants of the heat-shrink tubing and sealing strips on the vehicle positive battery cable (1).

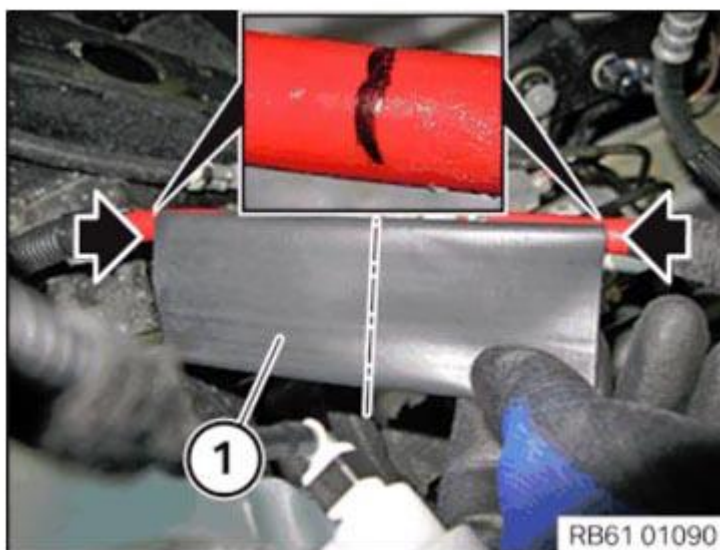


**Fig. 9: Locating Both Bore Holes On Vehicle Positive Battery Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Join both cable halves.

Hold heat-shrink tubing (1) against positive battery cable.

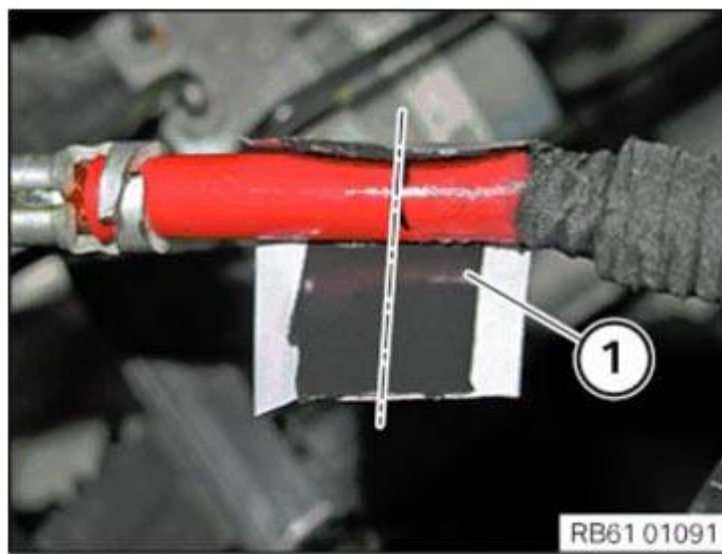
Mark the positive battery cable on both sides as shown.



**Fig. 10: Identifying Mark Positive Battery Cable On Both Sides**  
Courtesy of BMW OF NORTH AMERICA, INC.

Place one sealing strip (1) centrally on each of the marks to the left and right of the separation point.

Push heat-shrink tubing over the positive battery cable.

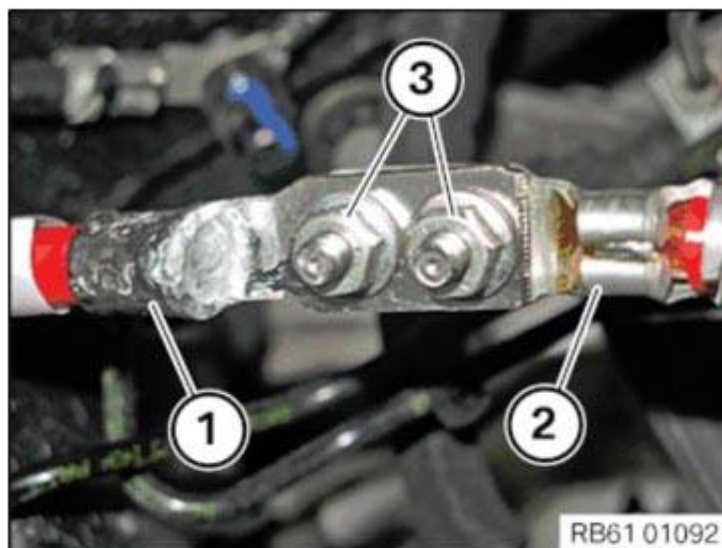


**Fig. 11: Placing Sealing Strip On Marks**  
Courtesy of BMW OF NORTH AMERICA, INC.

Join repair line (2) to existing positive battery cable (1).

Tighten down nuts (3).

Tightening torque: 8 Nm.

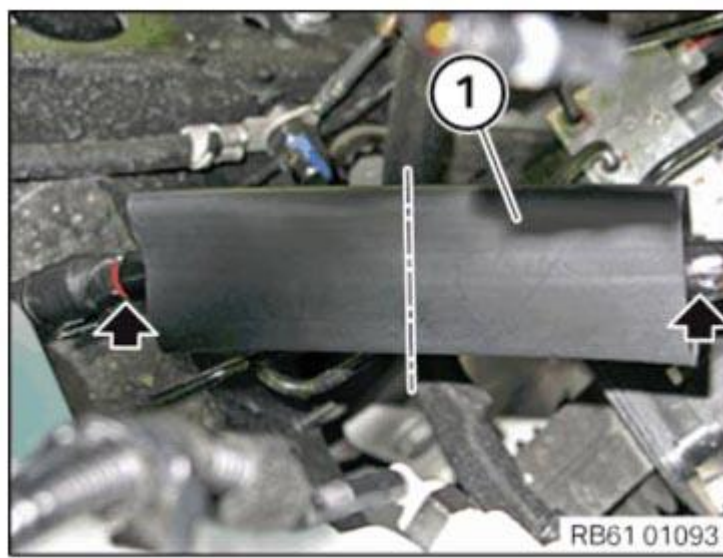


**Fig. 12: Identifying Positive Battery Cable And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove protective film on both sealing strips.

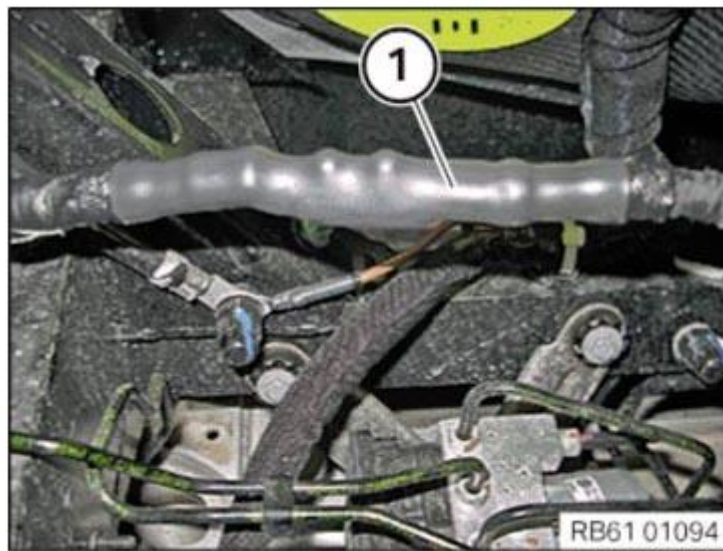
Position heat-shrink tubing (1) in such a way that 1 cm of sealing strip remains visible on both ends.





**Fig. 13: Identifying Heat-Shrink Tubing**  
Courtesy of BMW OF NORTH AMERICA, INC.

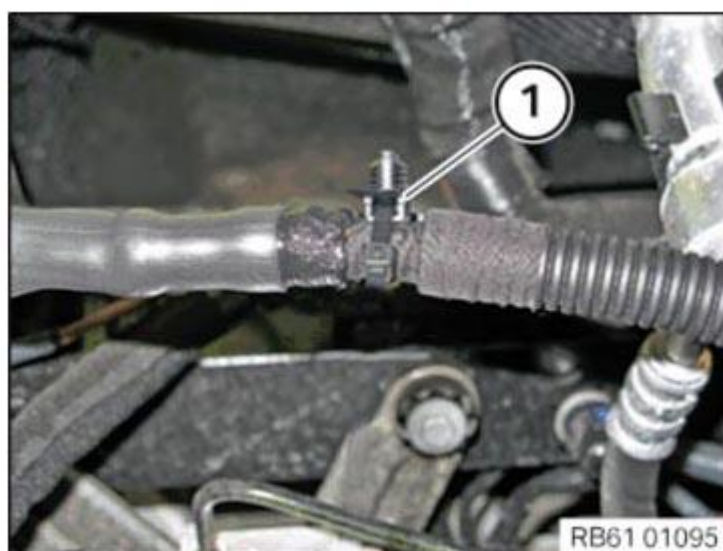
Shrink the heat-shrink tubing (1) with a hot air blower at 400 Å°C. Use a heat-shrink tubing reflector.



**Fig. 14: Identifying Heat-Shrink Tubing**  
Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, renew clip (1).

Clip in complete positive battery cable and secure.



**Fig. 15: Identifying Positive Battery Cable Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.

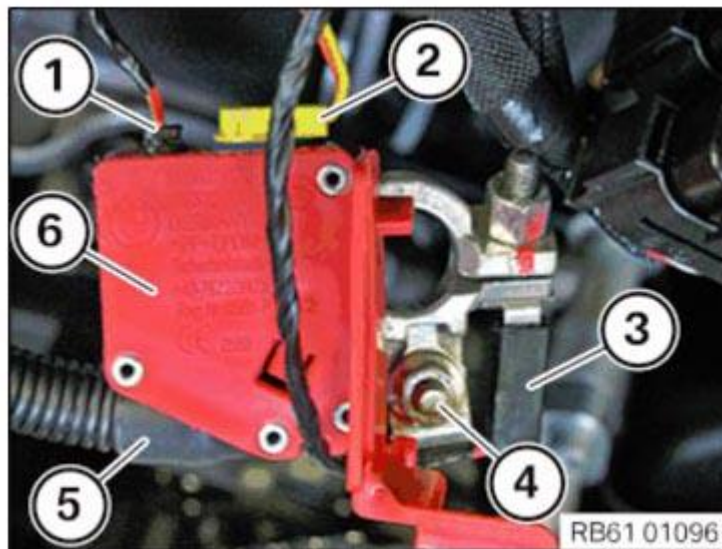
Connect the plug (1).

Connect connector (2).

Connect connector (3).

Join positive battery cable (5) to safety battery terminal (6) and tighten with nut (4).

Tightening torque: 8 Nm.



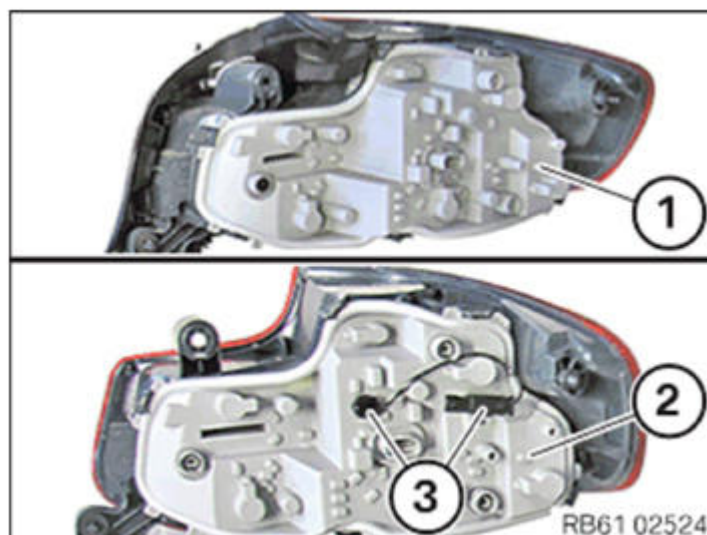
**Fig. 16: Identifying Positive Battery Cable And Safety Battery Terminal**  
Courtesy of BMW OF NORTH AMERICA, INC.

**61 11 090 RETROFIT GROUNDING CABLE FOR THE REAR LIGHT ON THE RIGHT AND LEFT (TO 10/2016)**

**NOTE:** If the socket housing is replaced for vehicles with production dates to 10/2016, the grounding cable must be retrofitted.

Socket housing (1): Version until 10/2016

Socket housing (2): Version from 10/2016 with additional ground (3)



**Fig. 17: Identifying Rear Light Socket Housing Versions And Additional Ground**  
Courtesy of BMW OF NORTH AMERICA, INC.

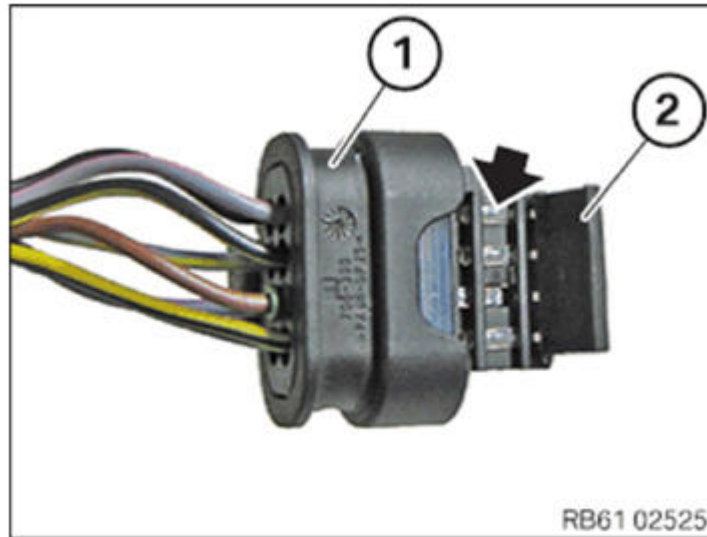
**Necessary preliminary work:**

- Remove the socket housing for the rear light on the left and right

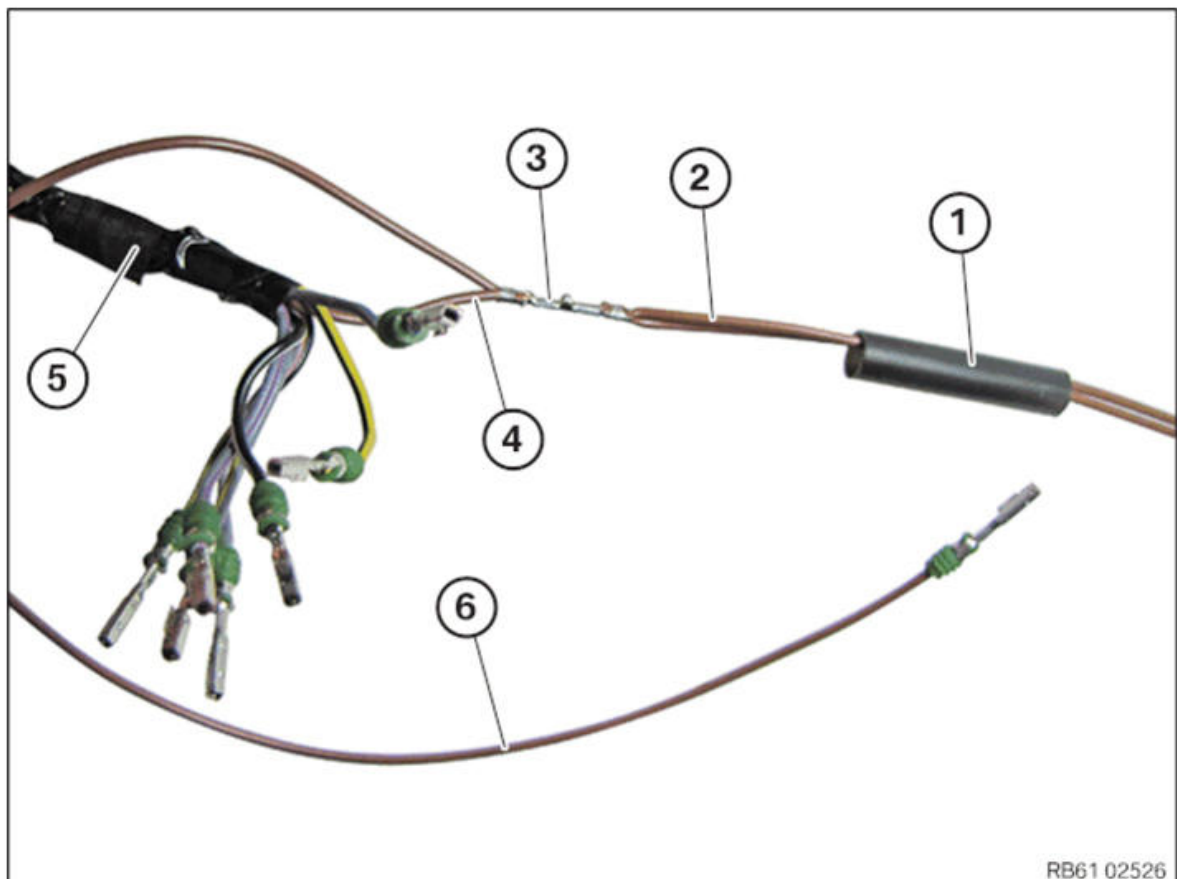
Comply with notes on **HANDLING WIRING HARNESSSES.**

Unpin the 8-pin connector (1) from the vehicle wiring harness:

- Open the secondary lock (2) with a suitable tool (e.g. small screwdriver) on the top and bottom.
- Use a suitable tool (such as a small screwdriver) to carefully push the primary locking device down as shown by the arrow.
- Pull all cables out.



**Fig. 18: Identifying Vehicle Wiring Harness 8-Pin Connector And Secondary Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 19: Identifying Rear Light Grounding Cable Related Components**  
Courtesy of BMW OF NORTH AMERICA, INC.



Disconnect the pin of the brown grounding cable (4) from the vehicle wiring harness (5).

Strip the insulation off the brown grounding cable (4) from the vehicle wiring harness (5).

Slide heat-shrink tubing (1) from the repair kit onto the double grounding cable (2).

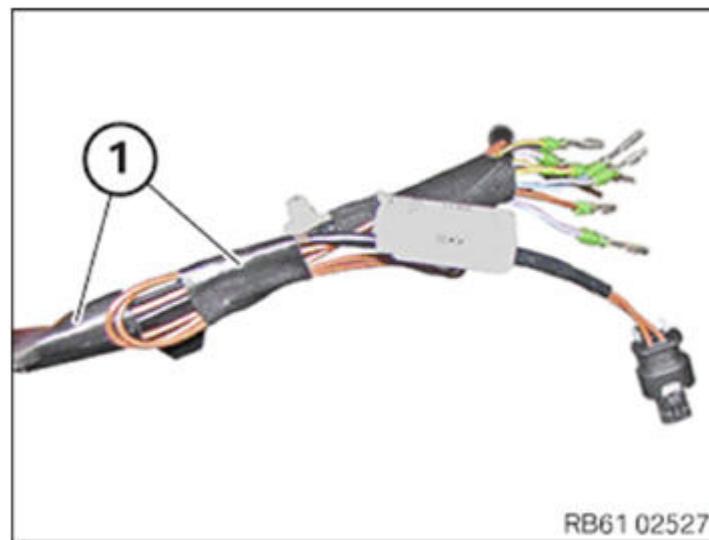
Crimp the vehicle grounding cable (4) and the single grounding cable (6) from the repair kit with a butt connector (3) with the double grounding cable (2) from the repair kit.

Position the heat-shrink tubing (1) in the center over the butt connector (3).

Shrink the heat-shrink tubing (1) with a hot air blower at 400°C. Use a heat-shrink tubing reflector.

Secure the grounding cables on the vehicle wiring harness with adhesive tape (1) as shown.

Pin the cable to the 8-pin **new connector** from the repair kit as follows:

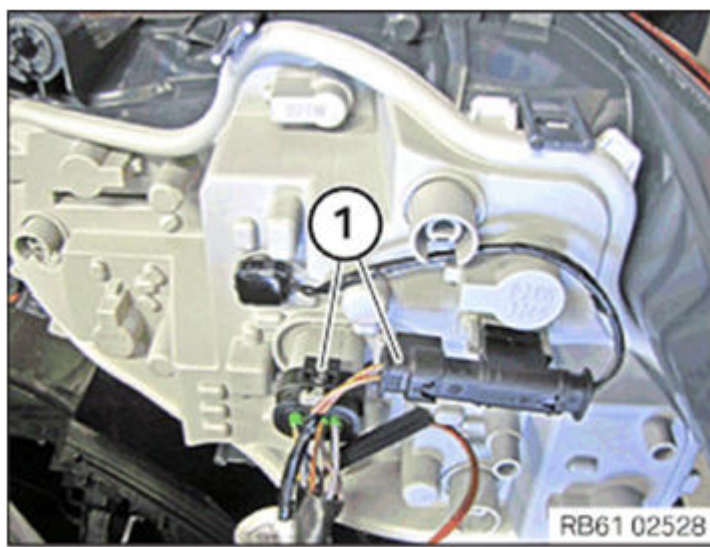


**Fig. 20: Securing Vehicle Wiring Harness Grounding Cable Using Adhesive Tape**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pin	Rear light, left	Rear light, right
1	grey/blue	black/grey
2	grey/violet	grey/yellow
3	grey/yellow	grey/black
4	black/white	grey/blue
5	yellow/black	grey/pink
6	Brown	black/blue
7	black/yellow	Brown
8	grey/pink	yellow/violet

Connect both plug connections.

Install the socket housing for the rear light on the left and right.

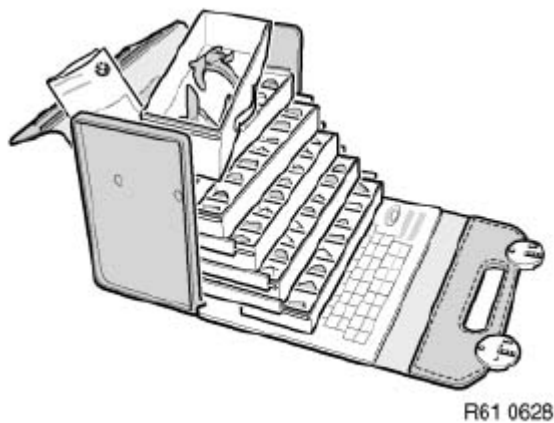


**Fig. 21: Identifying Rear Light Plug Connection Socket Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 13... SPECIAL TOOLS FOR WIRING HARNESS REPAIRS**

#### **Special tools required:**

- 61 0 300
- 61 0 400
- 61 1 100
- **61 4 320**
- 61 0 200
- 61 0 210
- **61 0 220**
- 61 0 230
- 61 0 240



**Fig. 22: Identifying Special Tools Kit**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### **Release and press-out tool:**

- Special tool 61 0 300
- Special tool 61 0 400 (MINI N12/N14)
- Special tool 61 1 100 (engine)

#### **Handling:**

- Notes for **OPENING CONTACTS AND LOCKS** of different connector contact systems



**Fig. 23: Identifying Special Tools Kit**

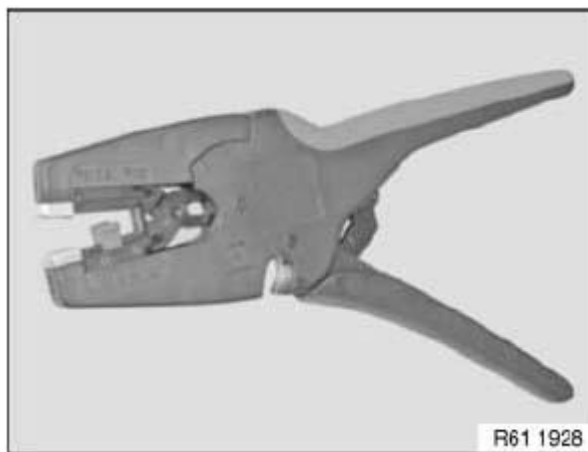
Courtesy of BMW OF NORTH AMERICA, INC.

**Cutting to length and stripping insulation from cables:**

Wire stripper MultiStrip10

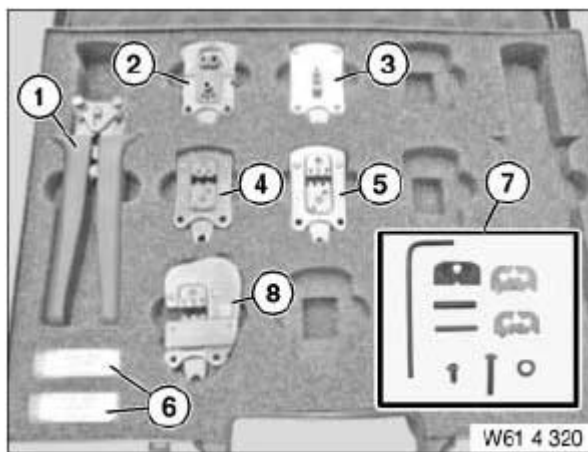
**Handling:**

- **CUTTING CABLES TO LENGTH AND STRIP INSULATION**



**Fig. 24: Identifying Wire Stripper**

Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 25: Identifying Crimping Stop Parts (Small Contacts) And Butt Connectors**

Courtesy of BMW OF NORTH AMERICA, INC.

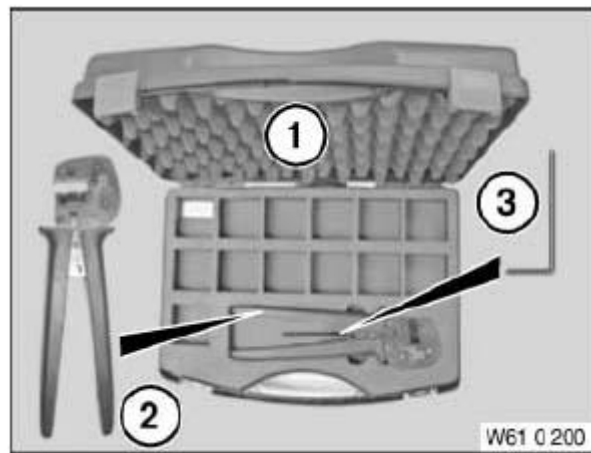
**Crimping stop parts (small contacts) and butt connectors:**

- Special tool **61 4 320**

1. Tool without crimping head
2. Crimping head (**STRIPPING INSULATION AND CUTTING FIBRE-OPTIC CABLES TO LENGTH**)
3. Crimping head (**CRIMPING FIBRE-OPTIC CABLE CONTACTS**)
4. Crimping head (**CRIMPING MQS CONTACTS**)
5. Crimping head (**CRIMPING MPQ CONTACTS**)
6. Replacement blade (face-cutting fibre-optic cables)
7. Replacement blade with tool (insulation stripping unit)
8. Universal crimping head

**Crimping stop parts (large contacts) and butt connectors:**

- Special tool 61 0 200 (crimping set)
- Special tool 61 0 210 (matrix set SLK 8)
- Special tool **61 0 220** (matrix set SLK 2.8)
- Special tool 61 0 230(matrix set MAK 8/DFK4)
- Special tool 61 0 240 (butt connector 4.0 - 6.0 mm<sup>2</sup> )



**Fig. 26: Identifying Crimping Tool (610200)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**AUXILIARY CABLE, REPAIR CABLE**

**61 12... COMPLETELY REPLACE POSITIVE BATTERY CABLE (RANGE EXTENDER)**

**Necessary preliminary tasks:**

- Disconnect **NEGATIVE BATTERY LEAD**
- Remove **FRONT RIGHT WHEEL ARCH COVER**
- Remove **RIGHT REAR WHEEL ARCH COVER**
- Remove **TRIM PANEL FOR COVER ON RIGHT SIDE MEMBER**
- Remove **UPPER SERVICE CAP**

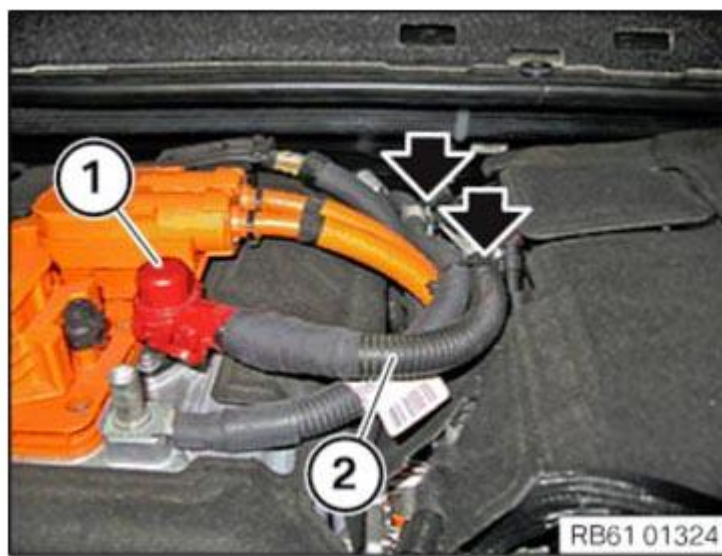
Take off cover and release nut (1) from positive battery cable on electrical machine electronics.

Tightening torque **12 36 3AZ** .

Release positive battery cable from brackets.

Unfasten cable strap.

**NOTE:**        **Replace cable straps.**



**Fig. 27: Locating Cable Straps**

Courtesy of BMW OF NORTH AMERICA, INC.

Fold back cover (1).

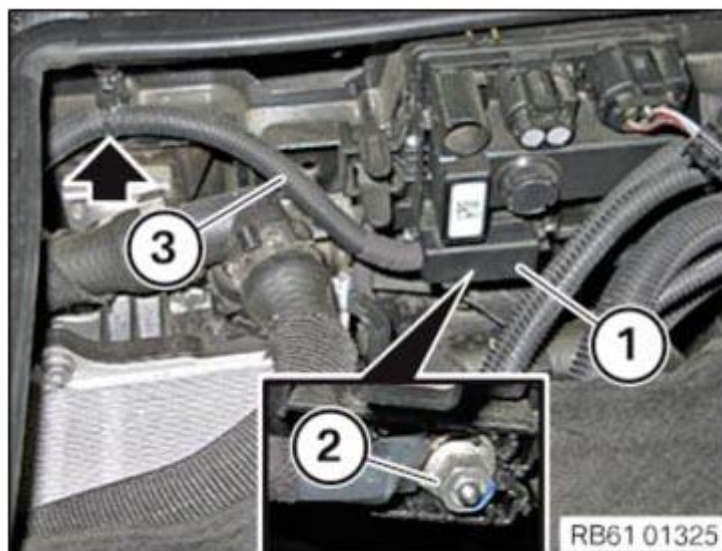
Slacken nut (2).

Tightening torque [61 12 1AZ](#) .

Release positive battery cable from brackets.

Unfasten cable strap.

**NOTE:** Replace cable straps.



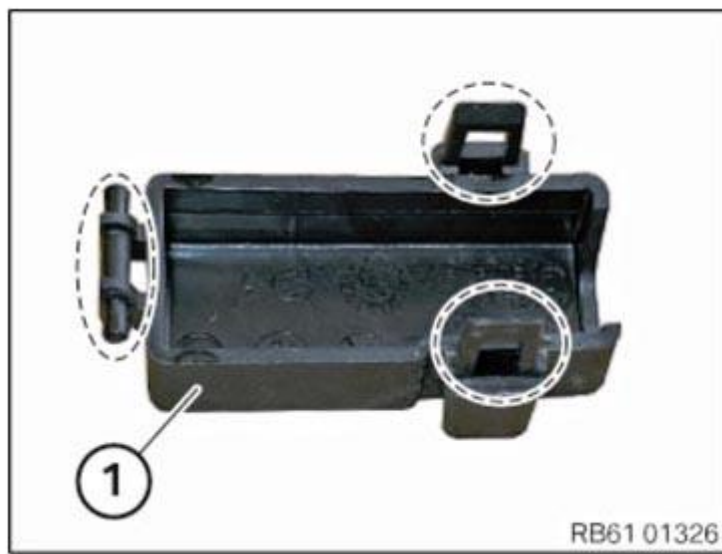
**Fig. 28: Locating Cable Strap**

Courtesy of BMW OF NORTH AMERICA, INC.

Installation note:

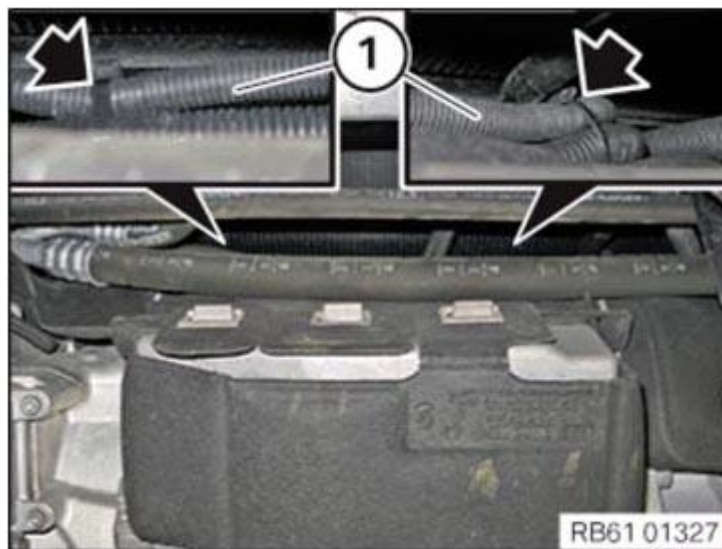
Latch mechanisms on the cover (1) must not be damaged or missing.





**Fig. 29: Identifying Latch Mechanisms On Cover**  
 Courtesy of BMW OF NORTH AMERICA, INC.

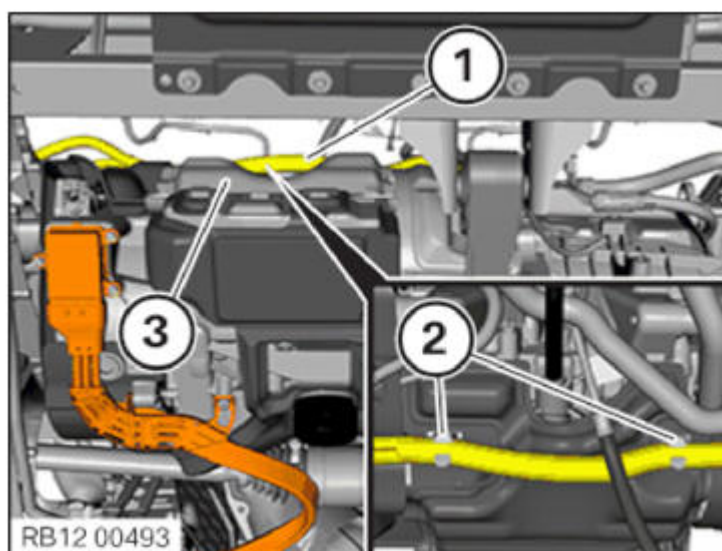
If necessary, release cable strap at positive battery cable (1).



**Fig. 30: Locating Positive Battery Cable Strap**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Detach positive battery cable (1) from clamps (2) on range extender (3).

Feed out positive battery cable (1).





**Fig. 31: Detaching Positive Battery Cable From Clamps On Range Extender**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

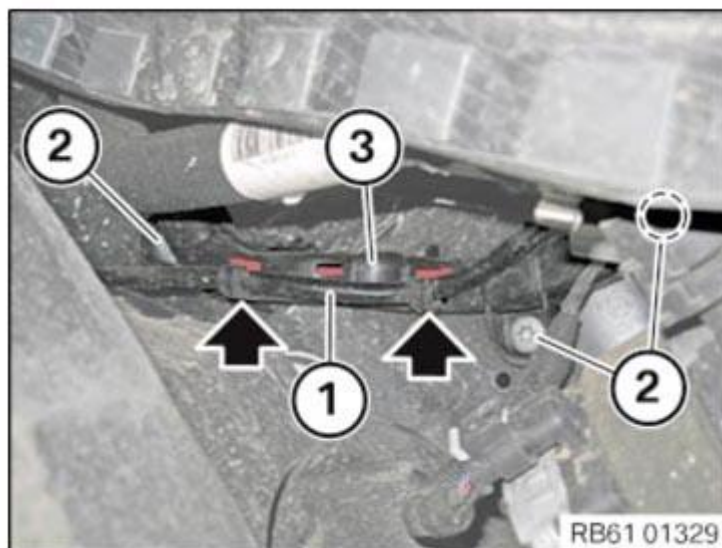


**Fig. 32: Identifying Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed out cable (1).

Unfasten screws (2).

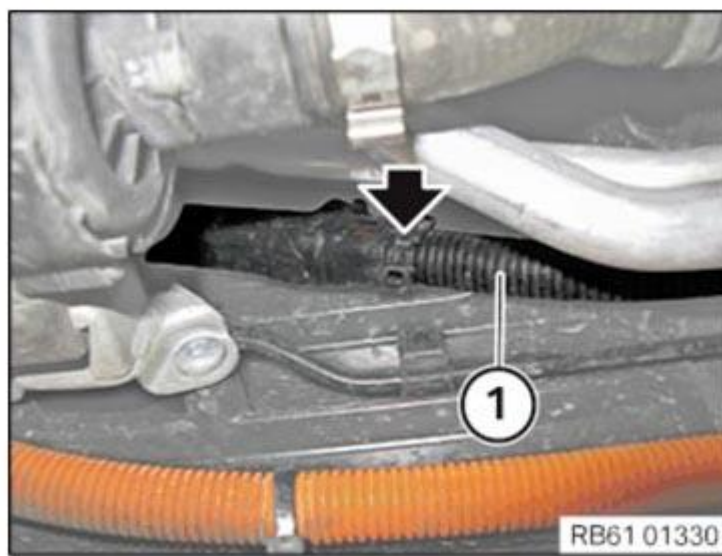
Feed out positive battery cable (3).



**Fig. 33: Locating Positive Battery Cable Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

If necessary detach cable strap.

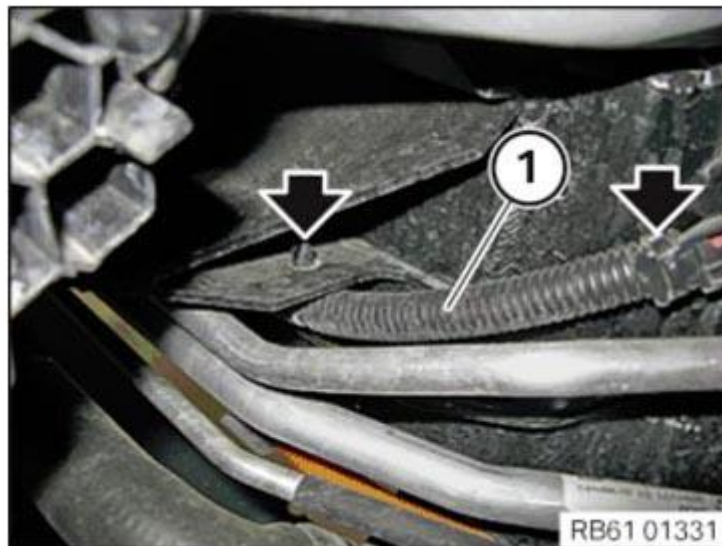
Release positive battery cable (1) from the brackets along the side sill and feed out towards the front.



**Fig. 34: Locating Positive Battery Cable Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release positive battery cable (1) from brackets.

Feed out positive battery cable (1).



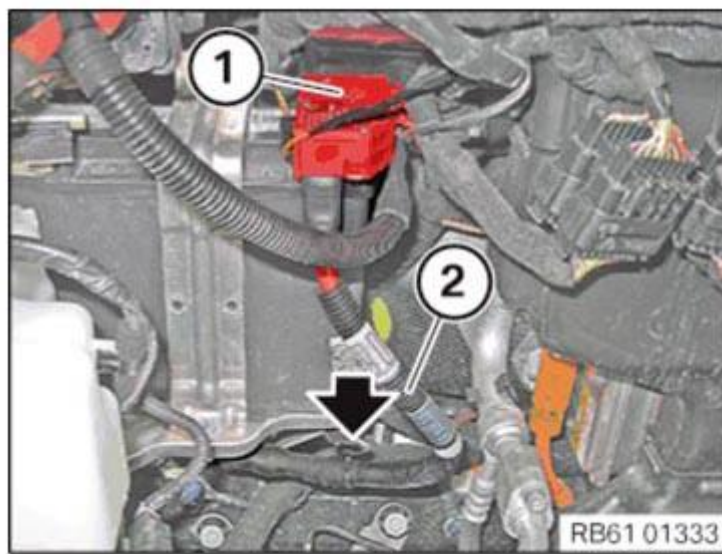
**Fig. 35: Locating Positive Battery Cable From Brackets**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open cover on positive battery terminal (1) and slacken nut underneath.

Tightening torque **61 21 2AZ** .

Remove positive battery terminal (1).

Unclip positive battery cable (2) from brackets.



**Fig. 36: Identifying Cover On Positive Battery Terminal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect connector (1) on safety battery terminal (4).

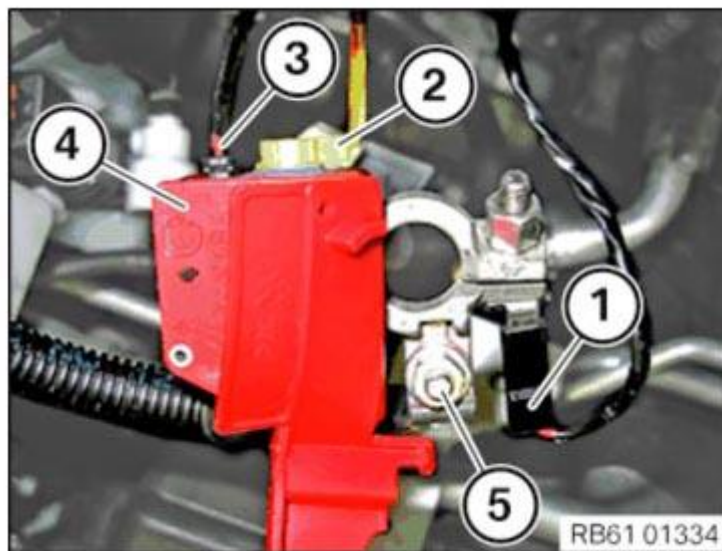
Disconnect connector (2) on safety battery terminal (4).

Disconnect connector (3) on safety battery terminal (4).

Slacken nut (5).

Tightening torque [61 21 2AZ](#) .

Feed out positive battery cable with safety battery terminal (4) towards the right wheel arch.



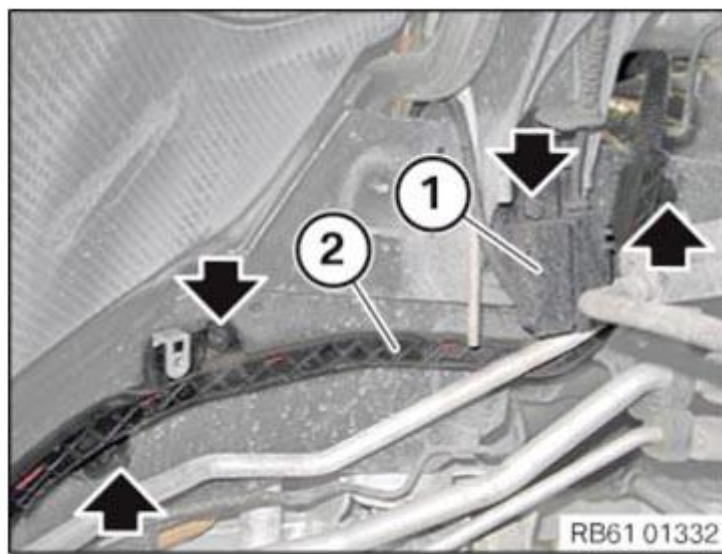
**Fig. 37: Identifying Connectors On Safety Battery Terminals**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut on cable clip (1).

Lay down cable clip (1) on the side.

Release plastic nuts.

Feed out positive battery cable (2).



**Fig. 38: Locating Plastic Nuts**

Courtesy of BMW OF NORTH AMERICA, INC.

## 61 12... INFORMATION ON INTELLIGENT BATTERY SENSOR (IBS)

**NOTE:** Do not connect the charger to the 12 V charging socket

The 12 V charging socket is supplied with voltage by the rear power distribution box via relay. This relay drops out after terminal 15 OFF. This means that a trickle charger connected at the 12 V charging socket will be disconnected from the battery. Only charge the battery via the jump start terminal point. Only then can the voltage supply be registered by the vehicle.

**WARNING:** Danger of destruction in event of mechanical strain

- Do not introduce any additional connections at the battery negative terminal.
- Do not modify the grounding cable. The ground cable also serves heat dissipation.
- Do not establish any connection between the IBS and the sensor screw.
- Do not use force when disconnecting the pole shoe from the battery terminal:
  - Do not pull on the ground cable.
  - Do not place any tools under the IBS to lever off the pole shoe.
- Do not use IBS connections as levers.
- Use a torque wrench and set tightening torque in accordance with repair instructions.
- Do not release or tighten down sensor screw (Torx screw).
- Avoid contact between IBS and ground.

**WARNING:** Danger of destruction to IBS and wiring upon battery replacement

- The IBS and wiring can be destroyed by mechanical strain upon battery replacement. Therefore avoid mechanical strain.
- The size (capacity) of the battery required for the car is coded in the Car Access System (CAS).
- Use the battery size (capacity) installed as standard upon battery replacement.
- Recode the Car Access System (CAS) when installing a battery with a different capacity.
- Register battery replacement via Service functions in diagnosis system.
- Delete fault code entries in the Digital Engine Electronics (DME) associated with battery replacement.
- Always proceed in accordance with the repair instructions.

**NOTE:** Battery draining possible in spite of the intelligent battery sensor IBS being fault-free.



- A battery can be drained (e.g. with lights or radio switched on) even when the IBS functions perfectly in conjunction with power management.
- For this reason, only exchange the IBS when there is a corresponding fault code entry.

## 61 12 460 REMOVING AND INSTALLING/REPLACING CHARGING POWER SOCKET

**WARNING:** High-voltage system - risk of serious injury or death.

**WARNING:** The following points must be strictly observed prior to starting work :

- Disconnect **HIGH-VOLTAGE SYSTEM** from power
- **SAFETY INFORMATION** for handling electric/hybrid vehicles.

### Necessary preliminary tasks:

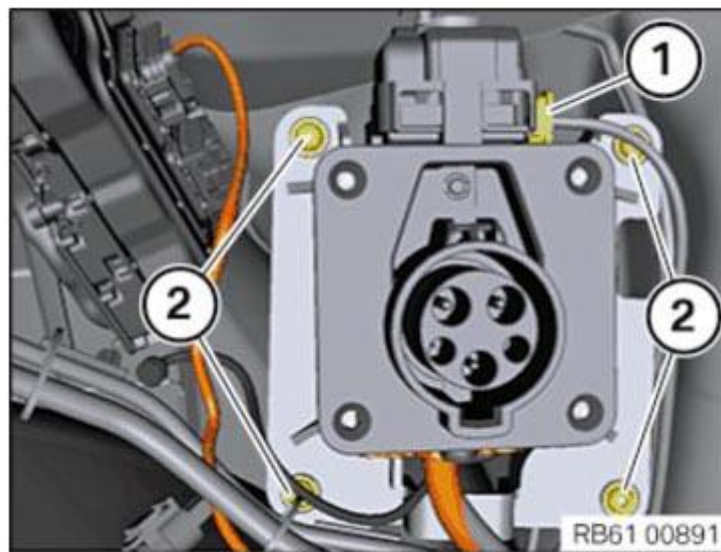
- Remove REAR RIGHT SIDE SECTION

Release screws (1) and remove charging socket.

Tightening torque **61 12 1AZ** .

### Installation note:

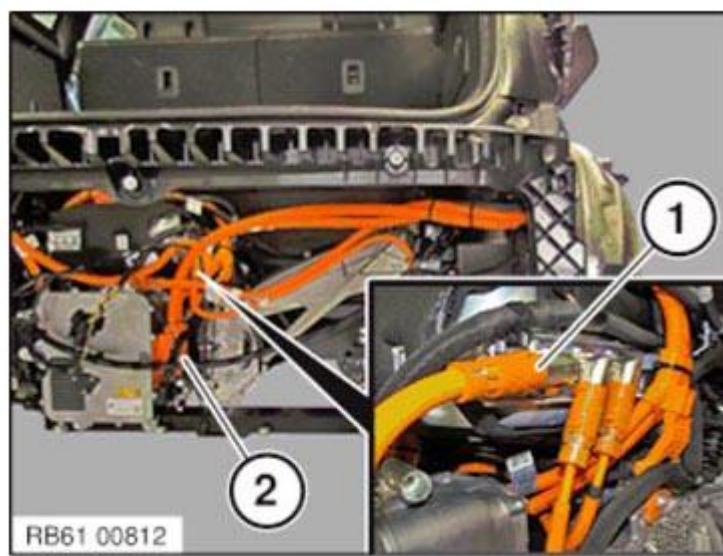
Tensioning strap on emergency release must be positioned with angle facing upwards and away from actuator.



**Fig. 39: Identifying Charging Power Socket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect the high-voltage connector (1) and high-voltage connector (2) from the charging electronics. Refer to **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS IN ELECTRICAL AND HYBRID VEHICLES**.

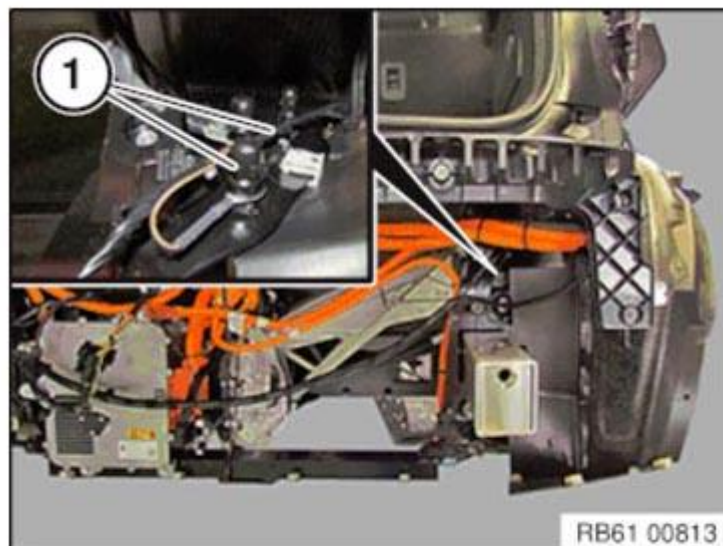
**NOTE:** According to version  
If no charging electronics are installed, then the high-voltage connector (1) on the power electronics must be disconnected.



**Fig. 40: Disconnecting High-Voltage Connector From Charging Electronics**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release ground screw connection (1).

Tightening torque [61 12 3AZ](#) .



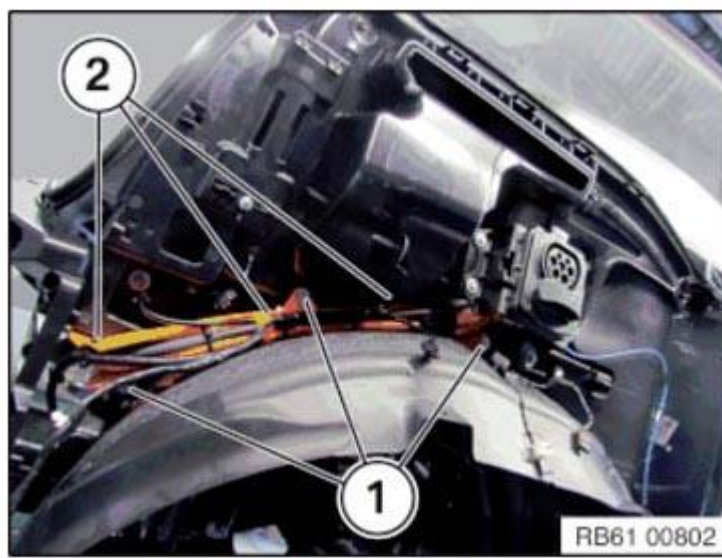
**Fig. 41: Identifying Ground Screw Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip high-voltage cable (1).

Release screws (2) and feed out high-voltage cable with cable clip.

Tightening torque [61 12 2AZ](#) .





**Fig. 42: Identifying High-Voltage Cable And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

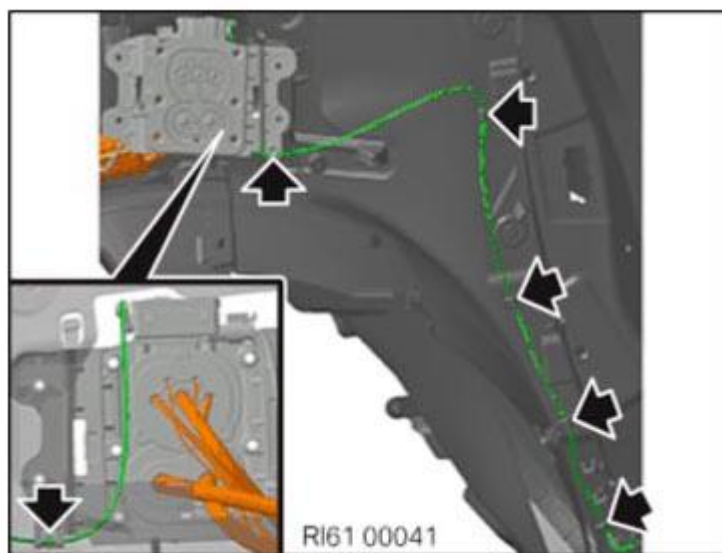
Note different variants for transferring the emergency release.

Incorrect routing of the tensioning strap can cause the emergency release to jam and therefore prevent charging.

**ECE version**

**with SA4U7**

**Fast charging with direct current**

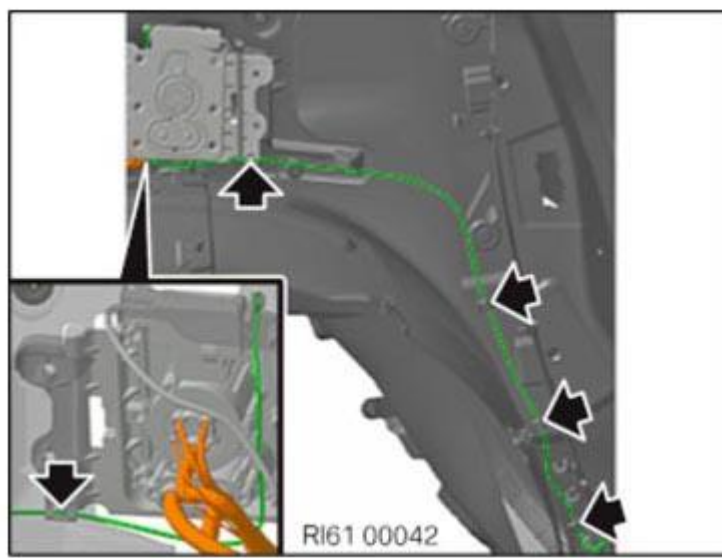


**Fig. 43: Locating Tensioning Strap (ECE Version With SA4U7)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**US version**

**with SA4U7**

**Fast charging with direct current**

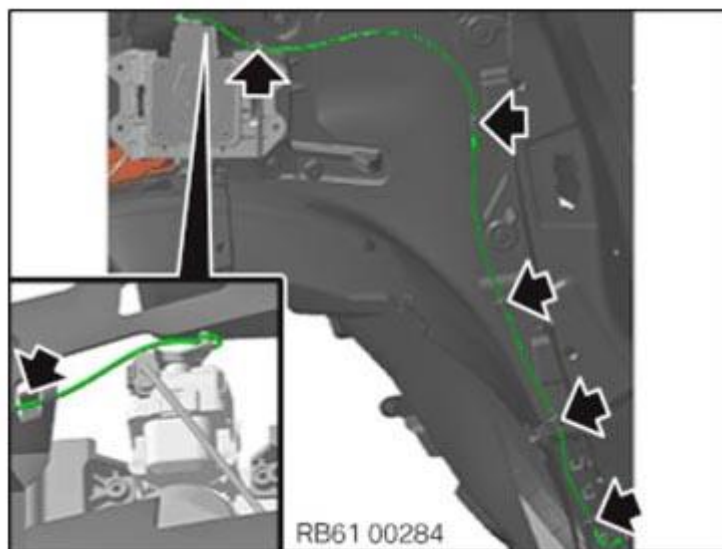


**Fig. 44: Locating Tensioning Strap (US Version With SA4U7)**  
Courtesy of BMW OF NORTH AMERICA, INC.

US version

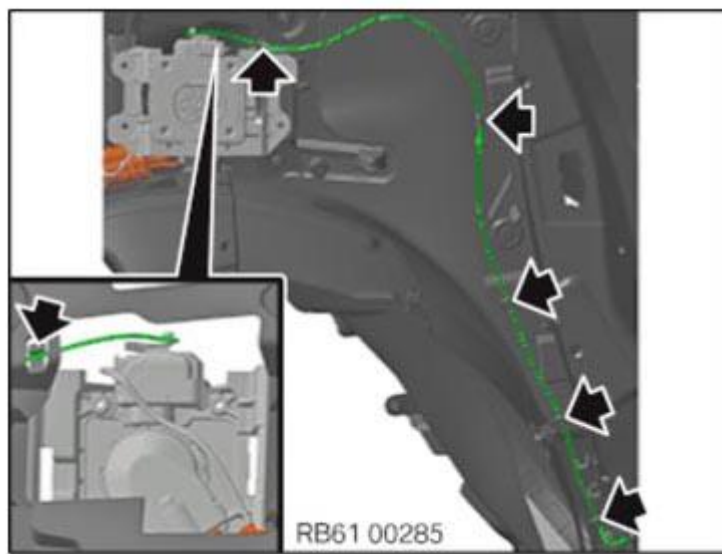
without SA4U7

Fast charging with direct current



**Fig. 45: Locating Tensioning Strap (US Version Without SA4U7)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Chinese version

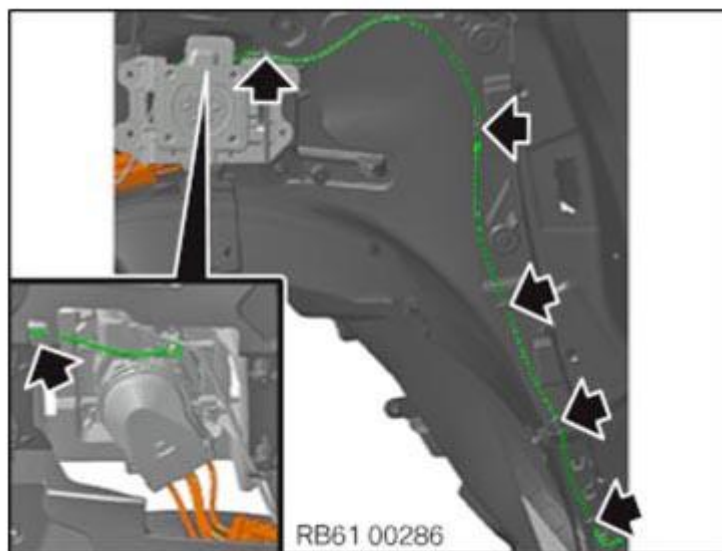


**Fig. 46: Locating Tensioning Strap (Chinese Version)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

ECE version

without SA4U7

Fast charging with direct current



**Fig. 47: Locating Tensioning Strap (ECE Version Without SA4U7)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**12 43 002 REMOVING AND INSTALLING/REPLACING HIGH-VOLTAGE CABLE (RANGE EXTENDER)**

See **12 43 002 REMOVING AND INSTALLING/REPLACING HIGH-VOLTAGE CABLE (RANGE EXTENDER)** .

**61 12 013 REPLACING NEGATIVE BATTERY LEAD**

**WARNING:** High-voltage system - risk of serious injury or death.  
 The following points must be strictly observed prior to starting work :  
 Disconnect **HIGH-VOLTAGE SYSTEM** from power  
**SAFETY INFORMATION** for handling electric/hybrid vehicles.

**WARNING:** Observe **SAFETY INFORMATION** for handling vehicle battery.  
 Follow instructions for **DISCONNECTING AND CONNECTING BATTERY** .  
 Follow instructions on **INTELLIGENT BATTERY SENSOR (IBS)** .

**Necessary preliminary work:**

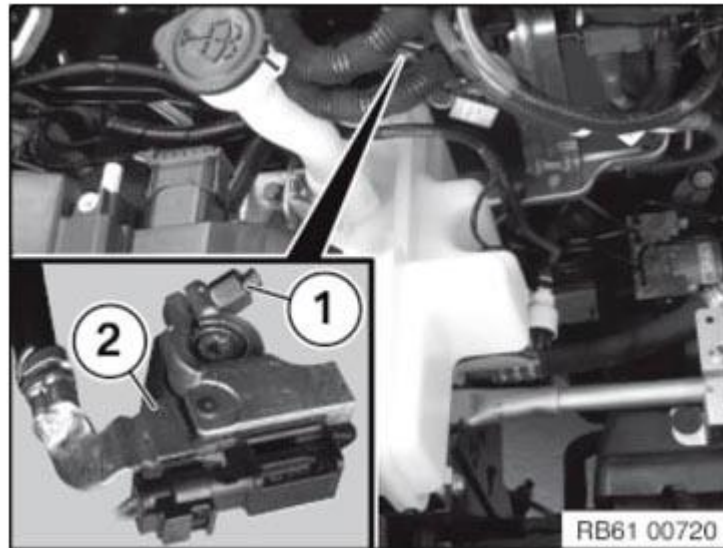
- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Remove **FRONT LUGGAGE COMPARTMENT WELL**

**IMPORTANT:** Do not under any circumstances detach or lever off intelligent battery sensor (2) from battery by force.

Loosen nut (1).

Tightening torque **61 21 1AZ** .

Remove intelligent battery sensor (2) from battery and place battery earth lead to one side.



**Fig. 48: Identifying Intelligent Battery Sensor And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque **61 21 5AZ** .

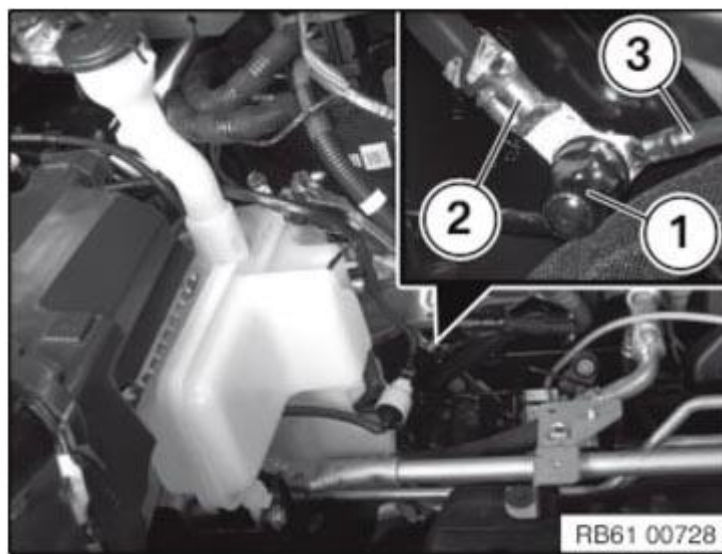
Remove battery earth lead (2) from threaded bolt and feed out.

*Installation note:*

Caution, risk of damage to ground pin. Do not exceed the prescribed tightening torque.

Ensure the correct mounting of the battery earth lead (2).

Ensure the correct mounting of the grounding cable (3).



**Fig. 49: Identifying Battery Earth Lead And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 12 001 REPLACING POSITIVE BATTERY CABLE (FROM BATTERY TO FRONT POWER DISTRIBUTION BOX)**

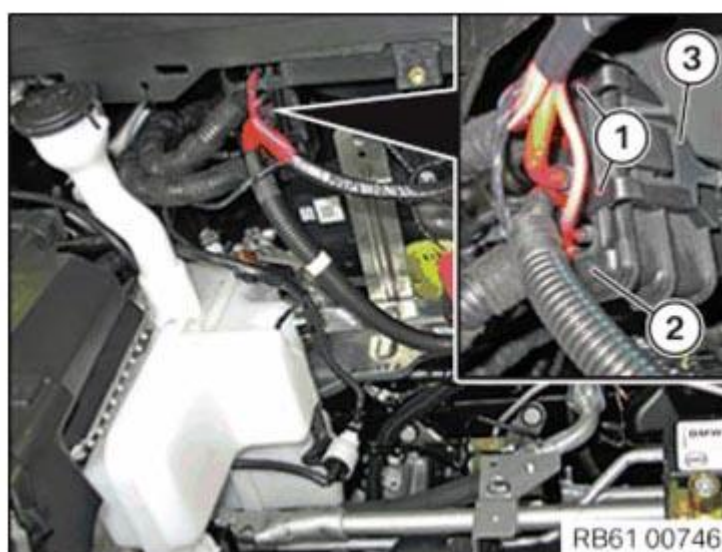
**WARNING:** High-voltage system - risk of serious injury or death.  
 The following points must be strictly observed prior to starting work :  
 Disconnect **HIGH-VOLTAGE SYSTEM** from power  
**SAFETY INFORMATION** for handling electric/hybrid vehicles.

**WARNING:** Observe **SAFETY INFORMATION** for handling vehicle battery.

Necessary preliminary work:

- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Remove **FRONT LUGGAGE COMPARTMENT WELL**

Unlock latch mechanisms (1) and release power distribution box for positive battery cable (2) from holder (3) in direction of arrow.



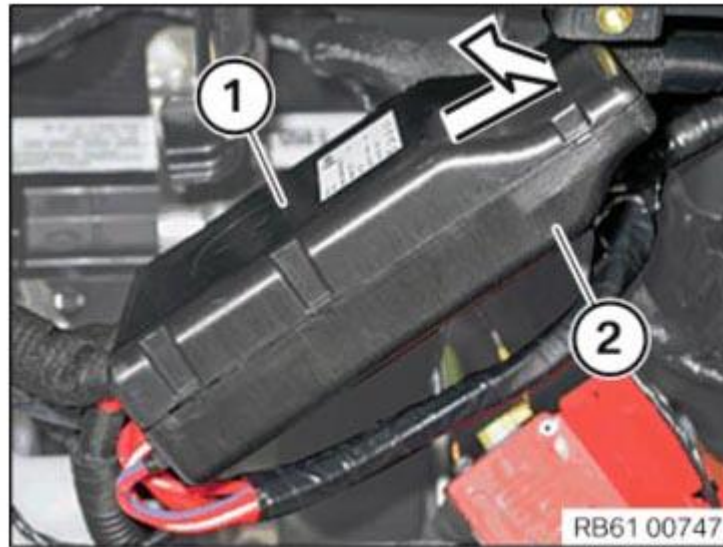
**Fig. 50: Releasing Power Distribution Box For Positive Battery Cable From Holder**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release upper housing section (1) from power distribution box for positive battery cable (2) in direction of arrow and remove.

*Installation note:*



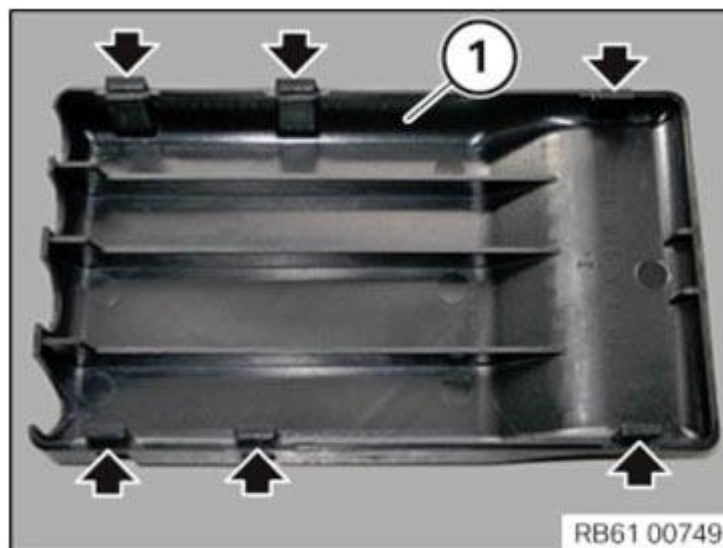
Ensure upper housing section (1) engages correctly.



**Fig. 51: Releasing Upper Housing Section From Power Distribution Box For Positive Battery Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Retaining lugs must not be missing or damaged.



**Fig. 52: Locating Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut on safety battery terminal (1).

Tightening torque [61 21 2AZ](#) .

Release nut (2) on power distribution box for positive battery cable.

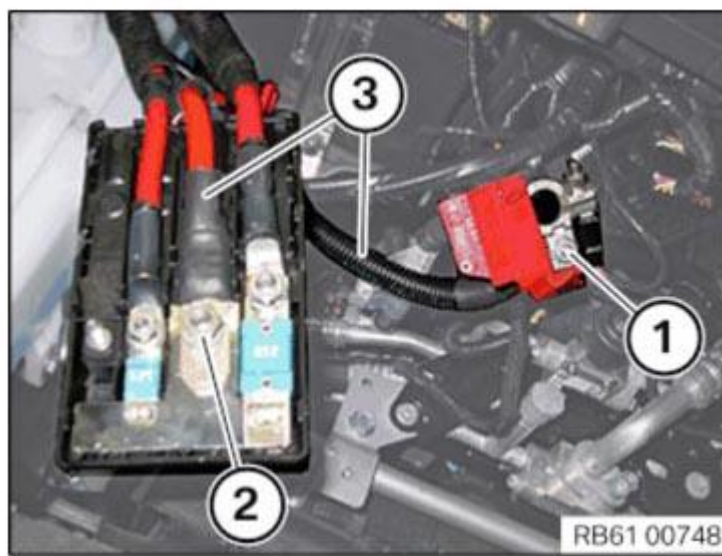
Remove positive battery cable(3).

*Installation note:*

**Risk of short circuits.**

Make sure positive battery cable (3) is correctly seated.





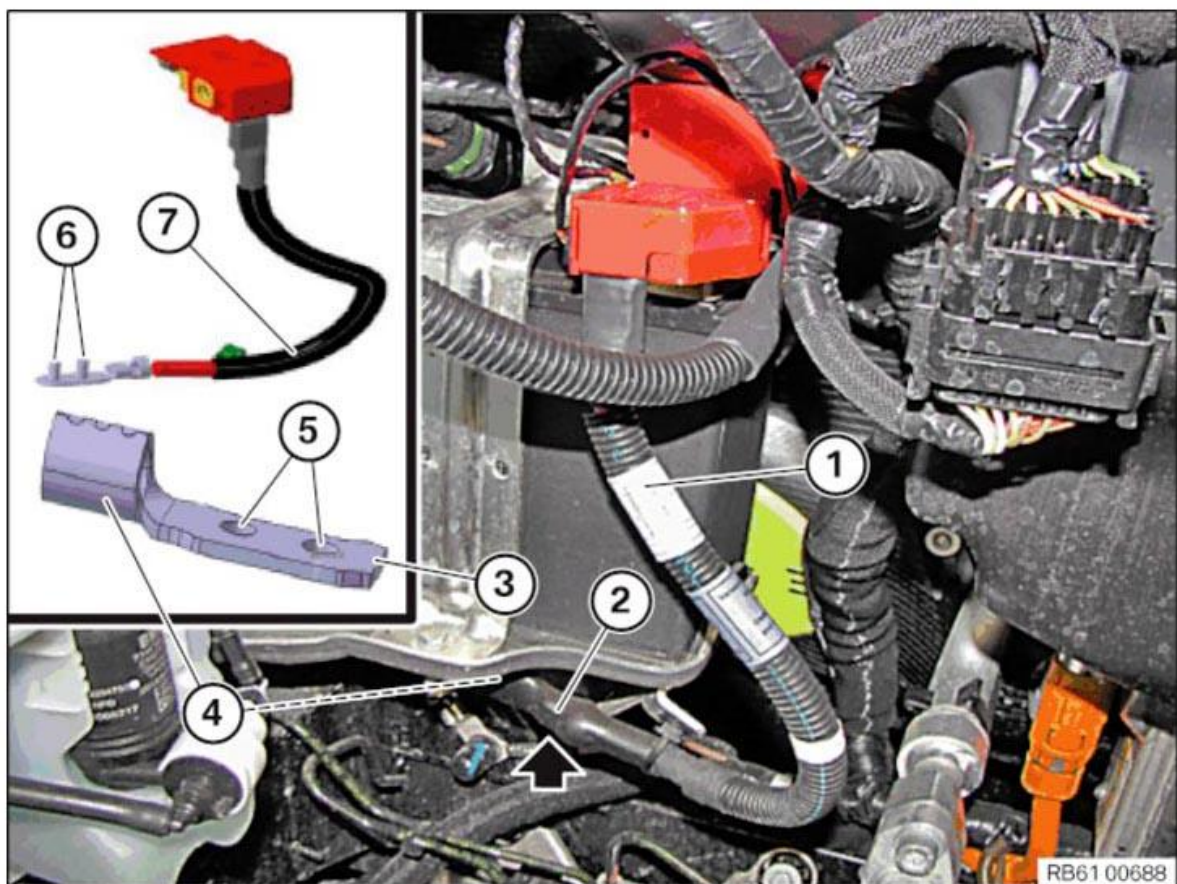
**Fig. 53: Identifying Nut On Safety Battery Terminal**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 12... REPLACING POSITIVE BATTERY CABLE WITH SAFETY BATTERY TERMINAL**

**NOTE:** After activation of the safety battery terminal as a result of an accident, the entire positive battery cable does not have to be replaced. A separation point is located under the battery.

Necessary preliminary tasks:

- Remove **BATTERY TRAY**



**Fig. 54: Identifying Positive Battery Cable With Threaded Bolts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Introductory details:

(1): Positive battery cable to be replaced with safety battery terminal, arrow marks the separation point.

(4): Vehicle positive battery cable is not replaced, arrow marks the separation point.

(7): New replacement positive battery cable, which is connected to positive battery cable (4) with threaded bolts (5, 6).

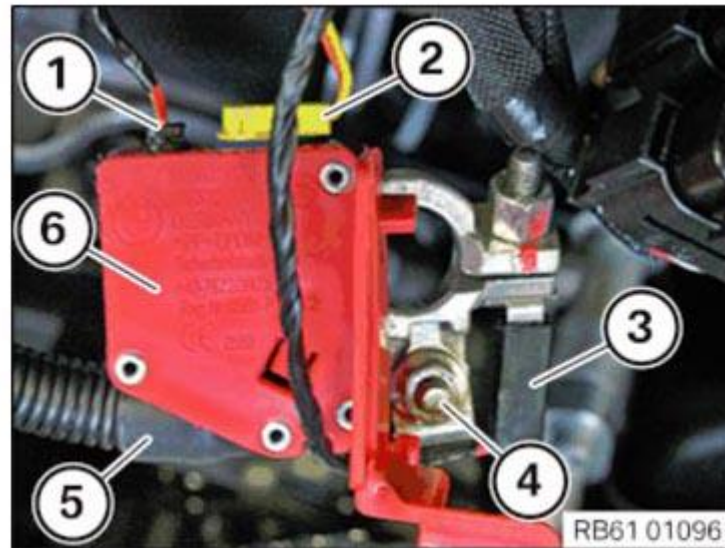
Disconnect plug (1).

Disconnect plug (2).

Disconnect plug (3).

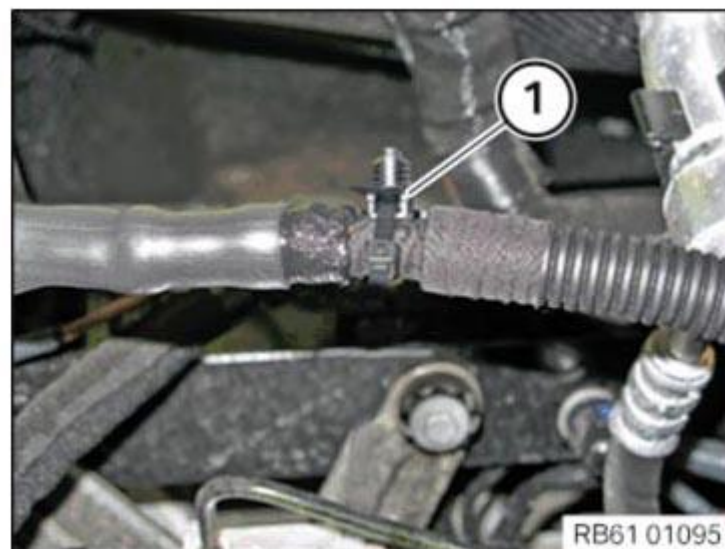
Slacken nut (4).

Remove the positive battery cable (5) to the power distribution box from the safety battery terminal (6).



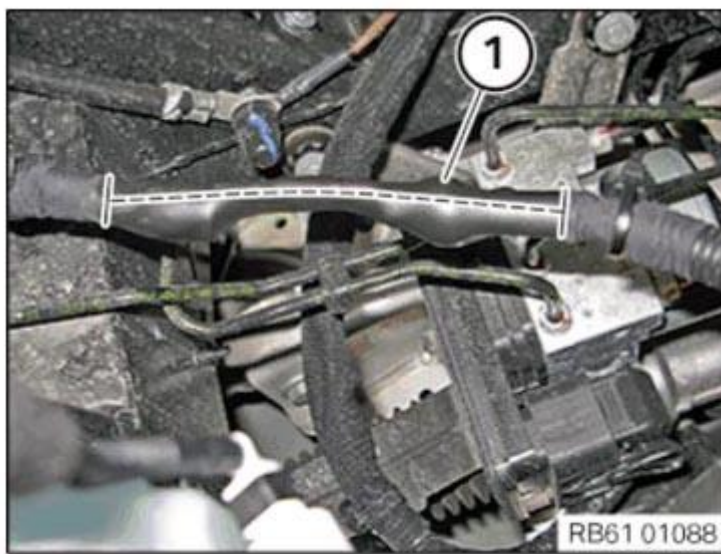
**Fig. 55: Identifying Positive Battery Cable And Safety Battery Terminal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip the safety battery terminal with positive battery cable (1) to below the battery holder.



**Fig. 56: Identifying Positive Battery Cable Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.

Cut open heat-shrink tubing (1) and remove.



**Fig. 57: Identifying Heat-Shrink Tubing Cutting Position**  
Courtesy of BMW OF NORTH AMERICA, INC.

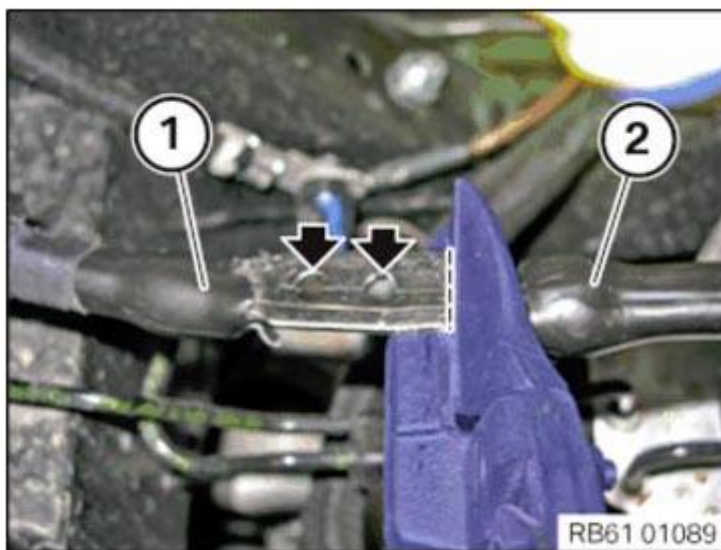
Disconnect positive battery cable as shown using plate shears.

Both bore holes must remain on the vehicle positive battery cable (1).

If necessary, deburr cutting edges.

Section (2) with the safety battery terminal is replaced.

If necessary, remove remnants of the heat-shrink tubing and sealing strips on the vehicle positive battery cable (1).



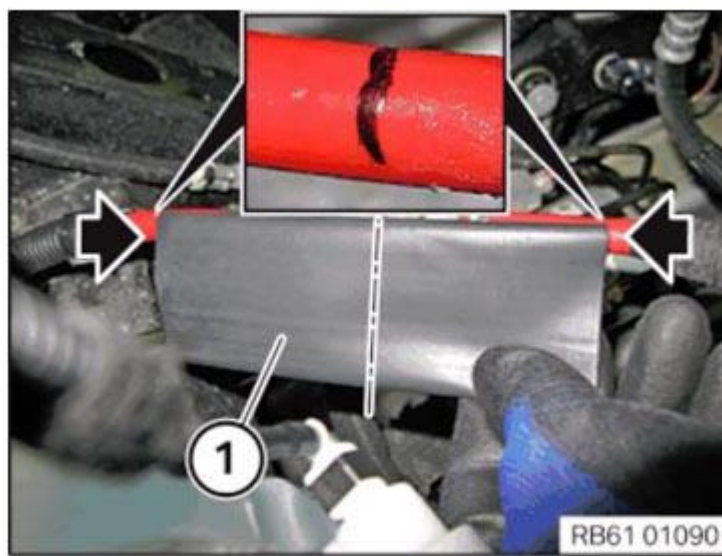
**Fig. 58: Locating Both Bore Holes On Vehicle Positive Battery Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Join both cable halves.

Hold heat-shrink tubing (1) against positive battery cable.

Mark the positive battery cable on both sides as shown.

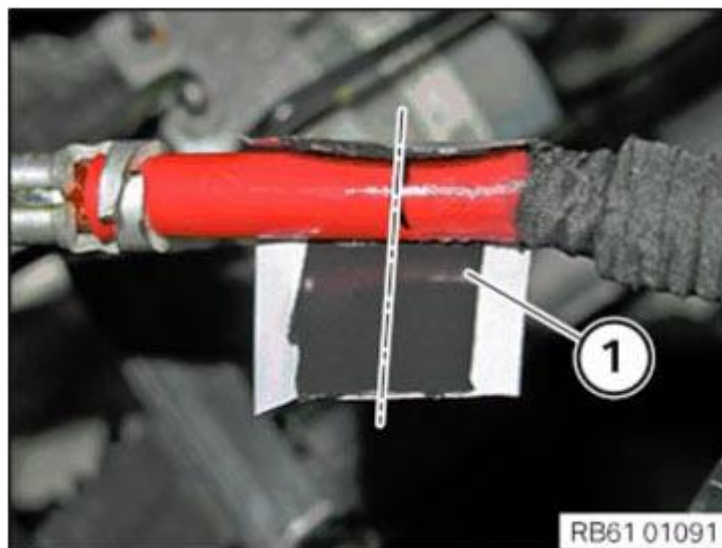




**Fig. 59: Identifying Mark Positive Battery Cable On Both Sides**  
Courtesy of BMW OF NORTH AMERICA, INC.

Place one sealing strip (1) centrally on each of the marks to the left and right of the separation point.

Push heat-shrink tubing over the positive battery cable.

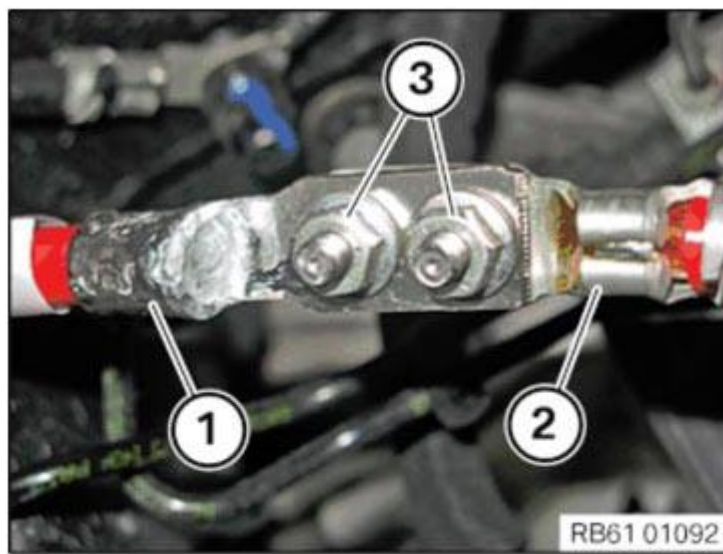


**Fig. 60: Placing Sealing Strip On Marks**  
Courtesy of BMW OF NORTH AMERICA, INC.

Join repair line (2) to existing positive battery cable (1).

Tighten down nuts (3).

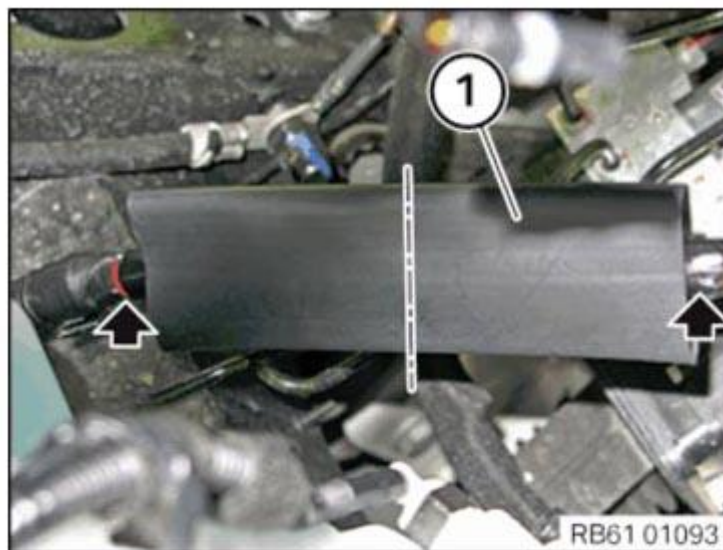
Tightening torque: 8 Nm.



**Fig. 61: Identifying Positive Battery Cable And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

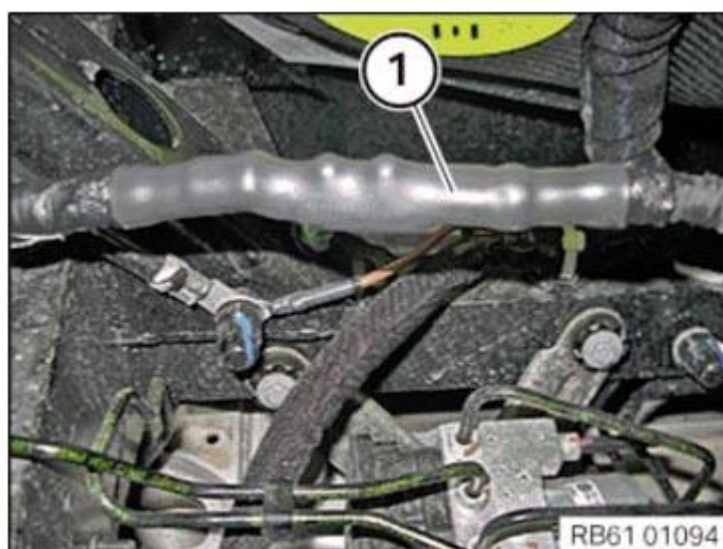
Remove protective film on both sealing strips.

Position heat-shrink tubing (1) in such a way that 1 cm of sealing strip remains visible on both ends.



**Fig. 62: Identifying Heat-Shrink Tubing**  
Courtesy of BMW OF NORTH AMERICA, INC.

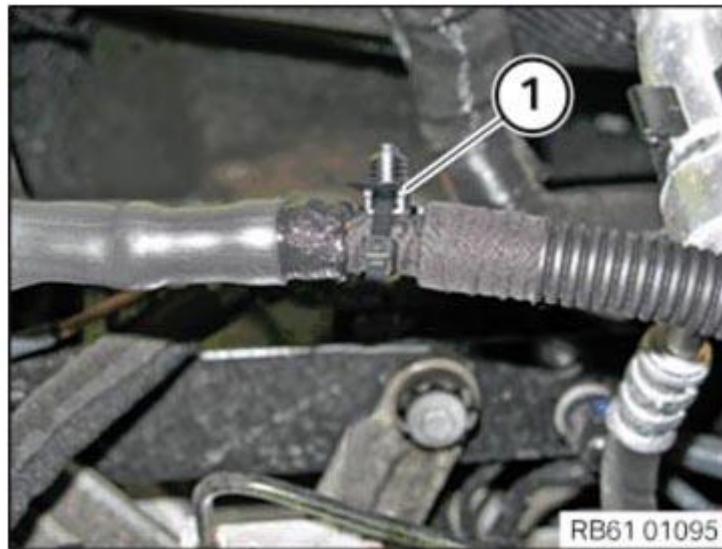
Shrink the heat-shrink tubing (1) with a hot air blower at 400 Å°C. Use a heat-shrink tubing reflector.



**Fig. 63: Identifying Heat-Shrink Tubing**  
Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, renew clip (1).

Clip in complete positive battery cable and secure.



**Fig. 64: Identifying Positive Battery Cable Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.

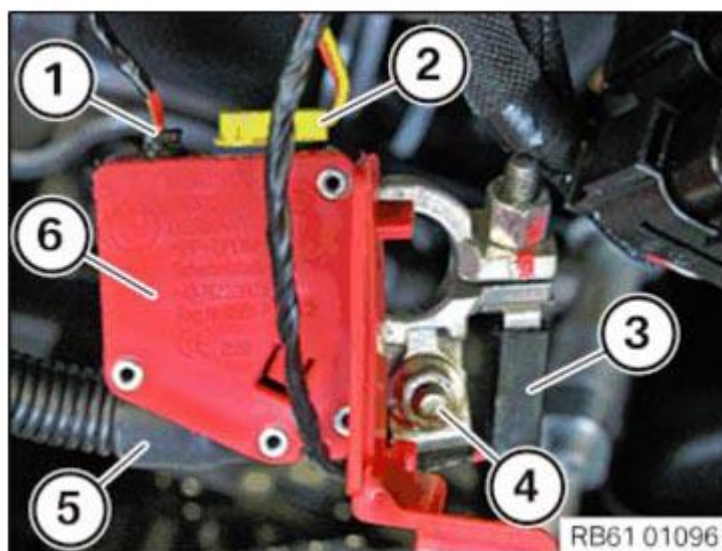
Connect the plug (1).

Connect connector (2).

Connect connector (3).

Join positive battery cable (5) to safety battery terminal (6) and tighten with nut (4).

Tightening torque: 8 Nm.



**Fig. 65: Identifying Positive Battery Cable And Safety Battery Terminal**  
Courtesy of BMW OF NORTH AMERICA, INC.

**61 12 451 REPLACING THE HIGH-VOLTAGE CABLE BETWEEN ELECTRICAL MACHINE ELECTRONICS AND HIGH-VOLTAGE BATTERY UNIT (PRODUCTION DATE FROM 12/2014)**

**WARNING:** High-voltage system - risk of serious injury or death.

**WARNING:** The following points must be strictly observed prior to starting work :



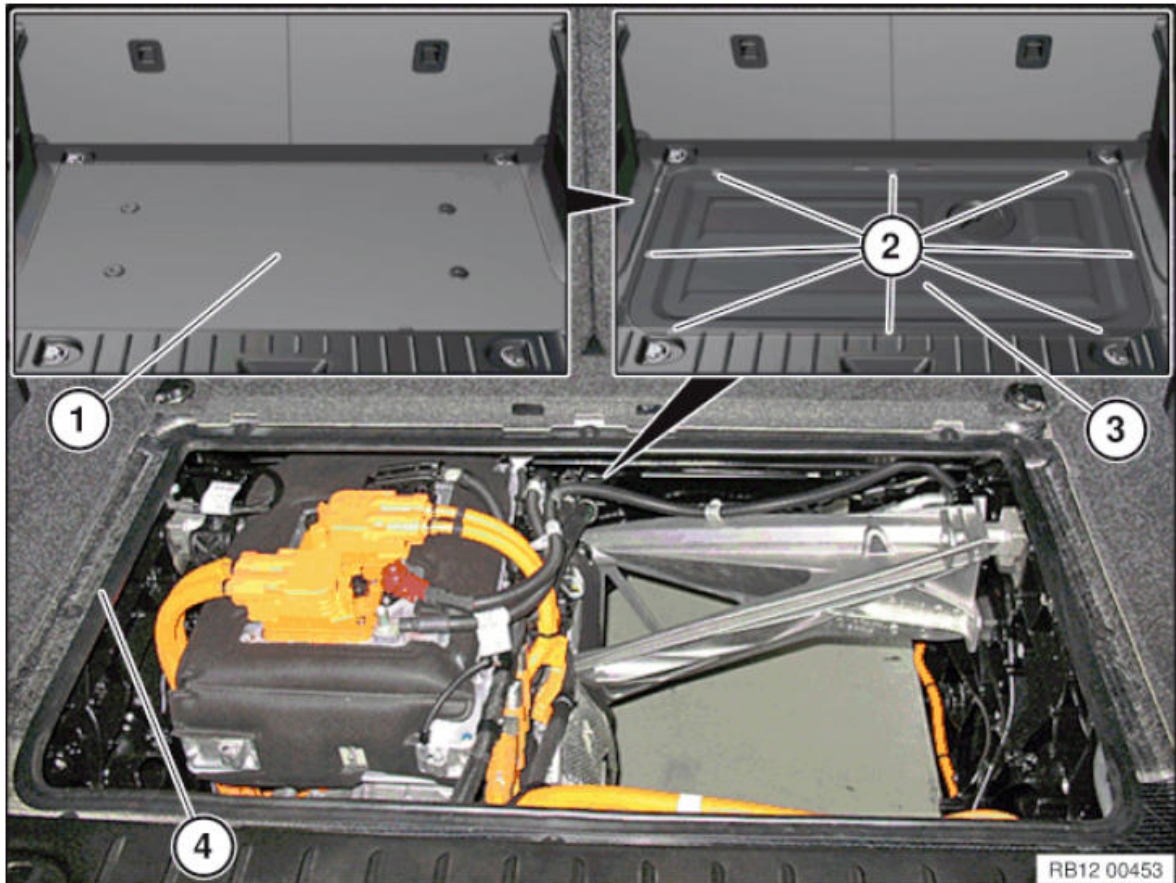
- Disconnect **HIGH-VOLTAGE SYSTEM** from power
- **SAFETY INFORMATION** for handling electric/hybrid vehicles.

**Necessary preliminary tasks:**

- Remove LEFT HORIZONTAL STRUT
- Remove vertical strut. See REMOVING VERTICAL STRUT or REMOVING VERTICAL STRUT (VEHICLES WITH RANGE EXTENDER) .
- In vehicles with convenience charging electronics:

Remove the **CONVENIENCE CHARGING ELECTRONICS**.

**Removal:**



**Fig. 66: Identifying Luggage Compartment Floor Trim Panel And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

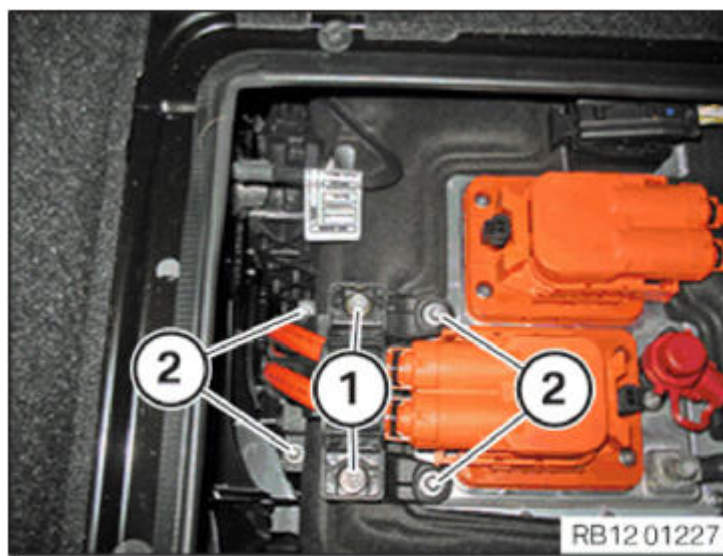
Release screws (2) and remove service cap (3) towards top.

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

Release the screws (1) and remove the tension relief.

Loosen the screws (2) from the bracket for tension relief.



**Fig. 67: Identifying Tension Relief Bracket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

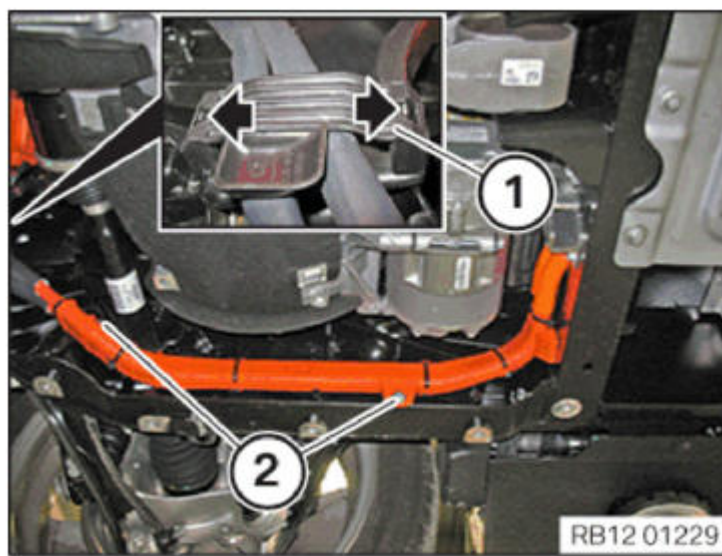
Unlock and disconnect the connector for the high-voltage cable (1).



**Fig. 68: Identifying High-Voltage Cable Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press the retaining lugs towards the outside and pull off the line clip (1).

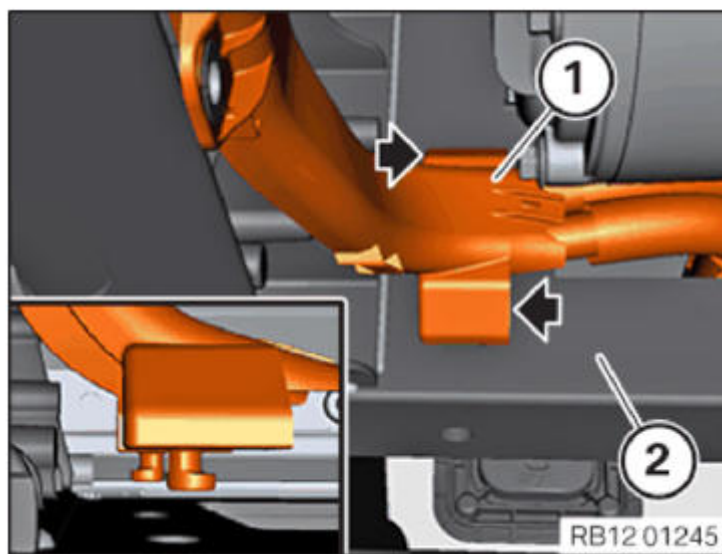
Unfasten screws (2).



**Fig. 69: Locating Line Clip**

Courtesy of BMW OF NORTH AMERICA, INC.

Detach the retaining lugs from the cable channel (1) of the Drive module (2) in the direction of the arrow.



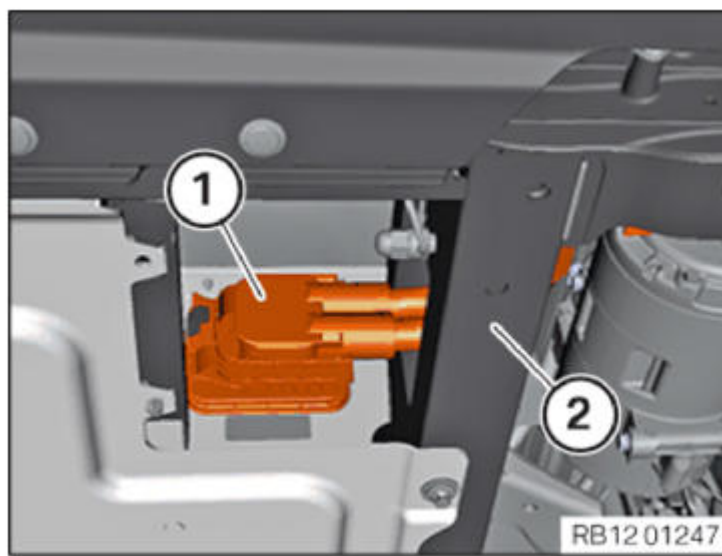
**Fig. 70: Detaching Retaining Lugs From Cable Channel Of Drive Module**

Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Unlock and disconnect the connector for the high-voltage cable (1).

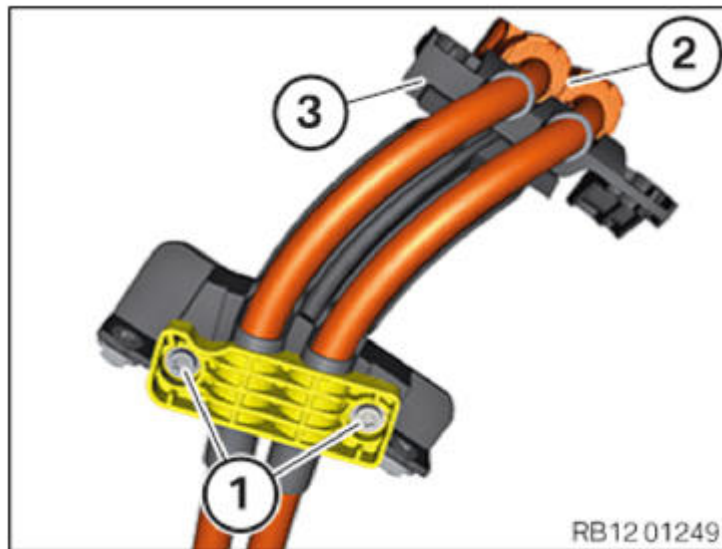
Remove the high-voltage cable (1) through the rear axle module (2).



**Fig. 71: Identifying High-Voltage Cable And Rear Axle Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release the screws (1) and remove the tension relief.

Remove the high-voltage cable (2) from the bracket for tension relief (3).



**Fig. 72: Identifying High-Voltage Cable And Tension Relief Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

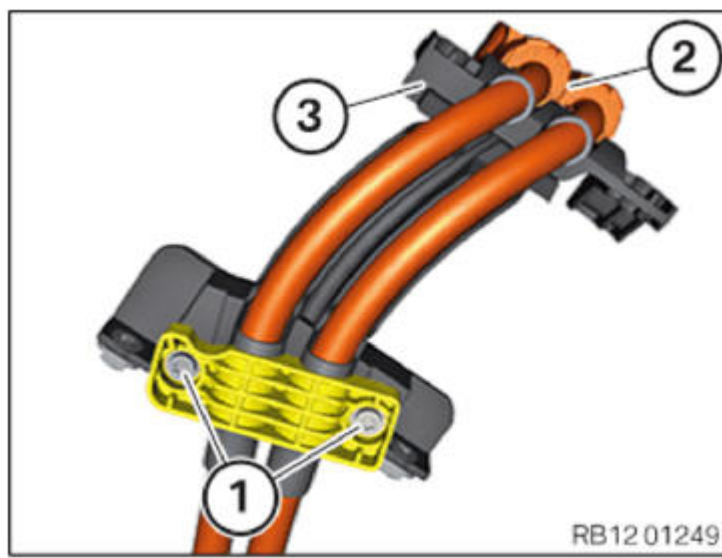
**Installation:**

Position the high-voltage cable (2) on the bracket for tension relief (3).

Position the tension relief and tighten the screws (1).

Tightening torque [61 12 8AZ](#) .



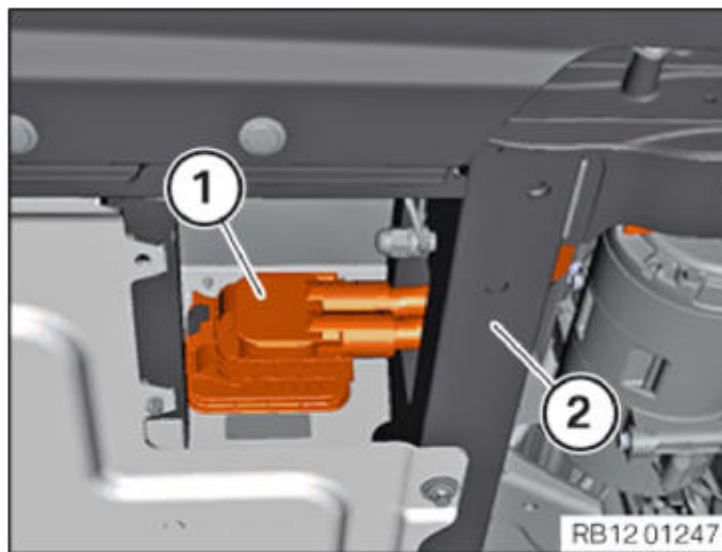


**Fig. 73: Identifying High-Voltage Cable And Tension Relief Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert the high-voltage cable (1) through the Drive module (2).

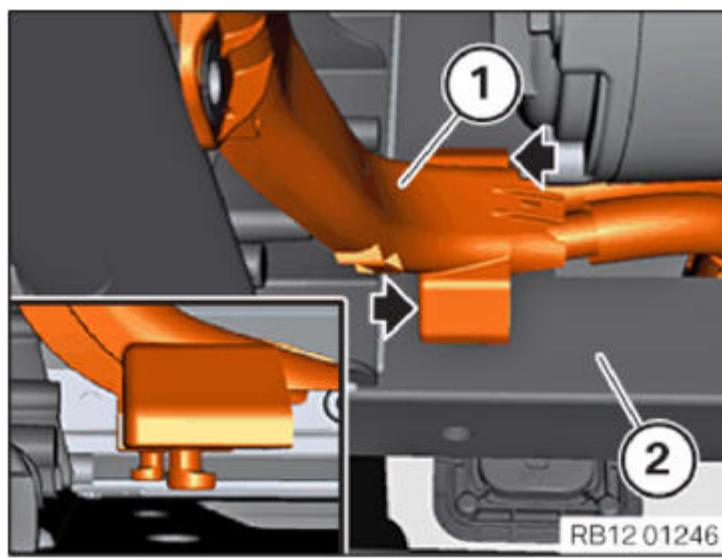
IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Connect and lock the connector for the high-voltage cable (1) on the high-voltage battery unit.



**Fig. 74: Identifying High-Voltage Cable And Rear Axle Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attach the retaining lugs of the cable channel (1) in the direction of the arrow at the Drive module (2).

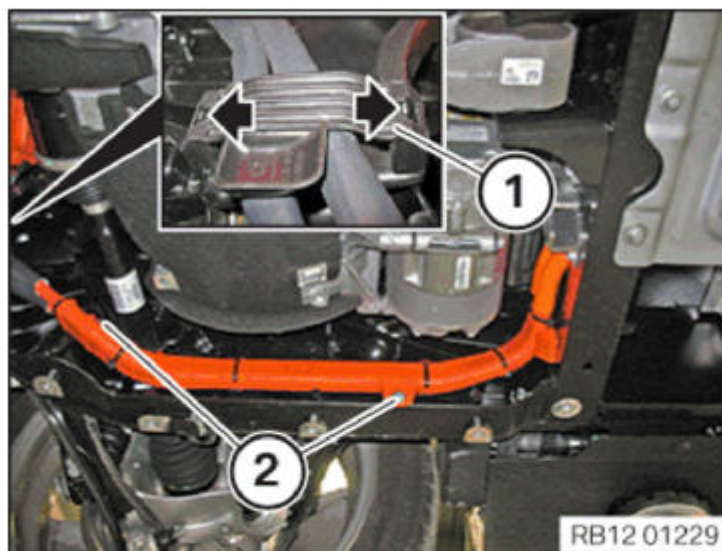


**Fig. 75: Attaching Retaining Lugs Of Cable Channel At Drive Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position the high-voltage cable and clip in the line clip (1).

Tighten down screws (2).

Tightening torque [61 12 4AZ](#) .



**Fig. 76: Locating Line Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe notes on [UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS](#) on electric vehicles.

Connect and lock the connector for the high-voltage cable (1).





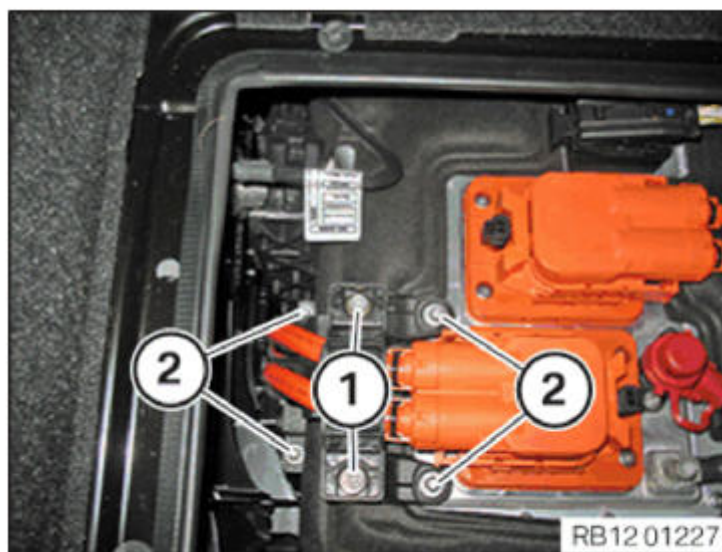
**Fig. 77: Identifying High-Voltage Cable Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten the screws (2) of the tension relief bracket.

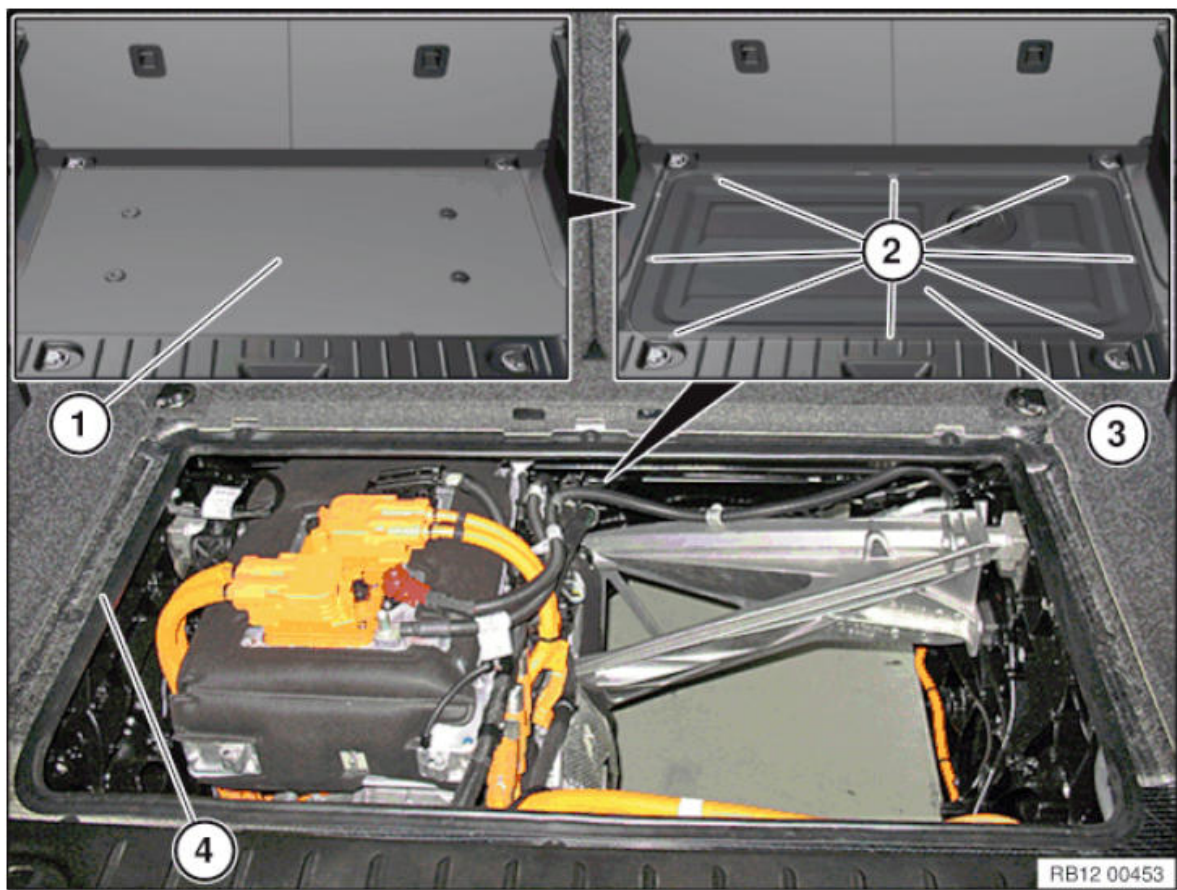
Tightening torque [61 12 7AZ](#) .

Position tension relief and tighten screws (1).

Tightening torque [61 12 8AZ](#) .



**Fig. 78: Identifying Tension Relief Bracket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 79: Identifying Luggage Compartment Floor Trim Panel And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

IMPORTANT: Position service cap and tighten screws (2).

Tightening torque **51 47 4AZ** .

Insert luggage compartment floor trim panel (1).

**61 12 451 REPLACING THE HIGH-VOLTAGE CABLE BETWEEN ELECTRICAL MACHINE ELECTRONICS AND HIGH-VOLTAGE BATTERY UNIT (PRODUCTION DATE UNTIL 12/2014)**

**WARNING:** High-voltage system - risk of serious injury or death.

**WARNING:** The following points must be strictly observed prior to starting work :

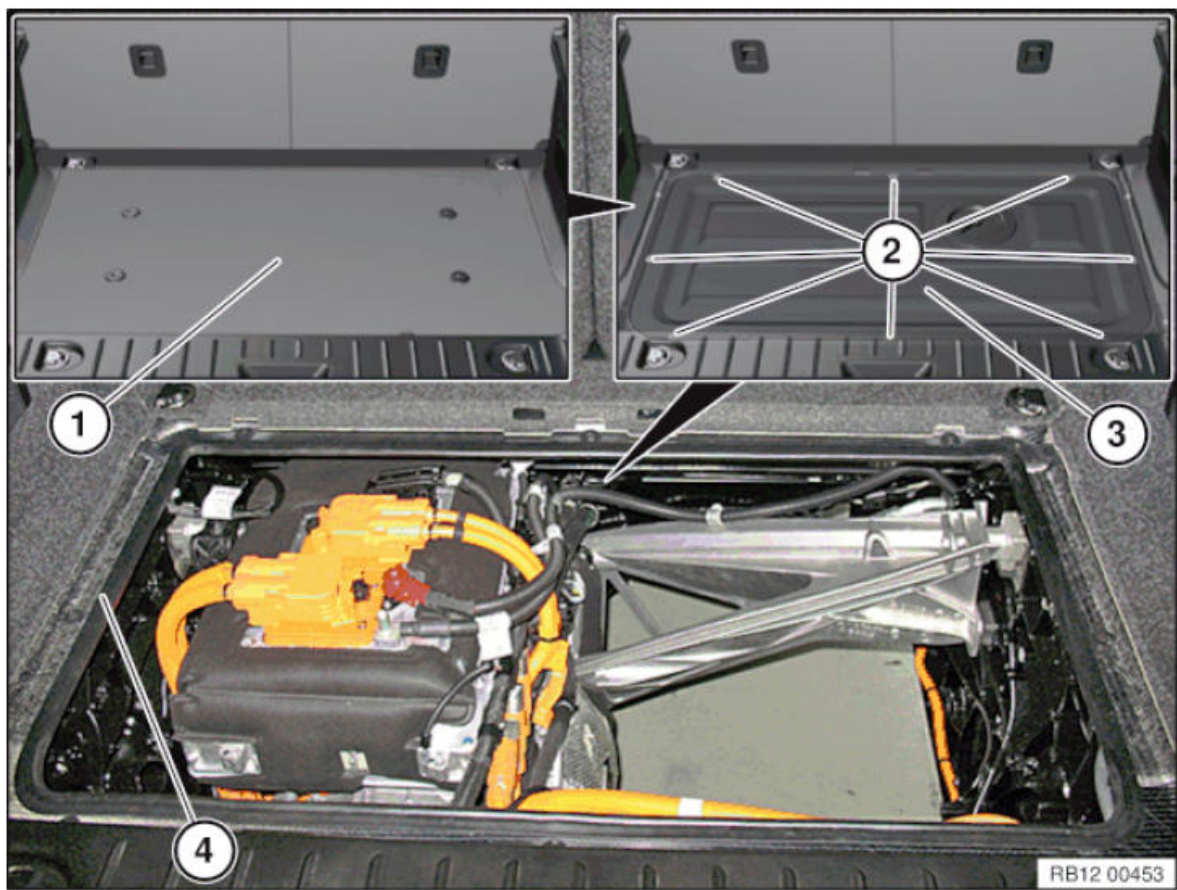
- Disconnect **HIGH-VOLTAGE SYSTEM** from power
- **SAFETY INFORMATION** for handling electric/hybrid vehicles.

Necessary preliminary tasks:

- Remove LEFT HORIZONTAL STRUT

Removal:





**Fig. 80: Identifying Luggage Compartment Floor Trim Panel And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

Release screws (2) and remove service cap (3) towards top.

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

IMPORTANT: Observe the notes on **OPENING AND CLOSING CABLE STRAPS** in electric vehicles.

Unlock and disconnect the connector for the high-voltage cable (1).

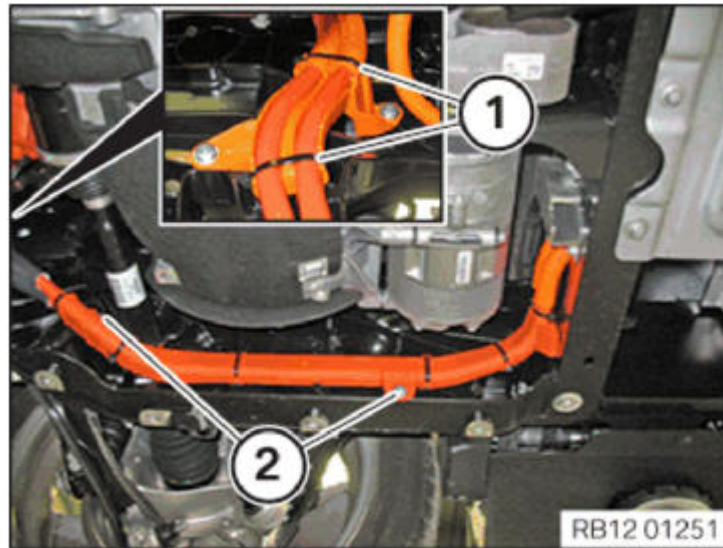


**Fig. 81: Identifying High-Voltage Cable Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe the notes on **OPENING AND CLOSING CABLE STRAPS** in electric vehicles.

Cut open cable strap (1).

Unfasten screws (2).



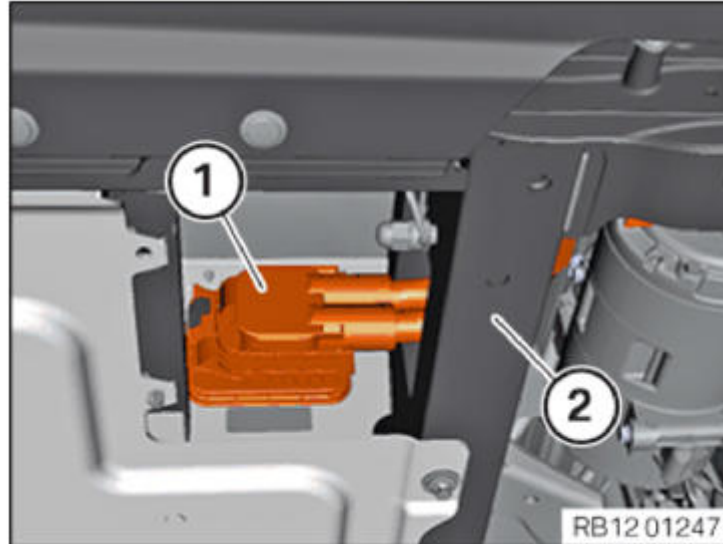
**Fig. 82: Identifying Cable Strap And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Unlock and disconnect the connector for the high-voltage cable (1).

Remove the high-voltage cable (1) through the rear axle module (2).



**Fig. 83: Identifying High-Voltage Cable And Rear Axle Module**

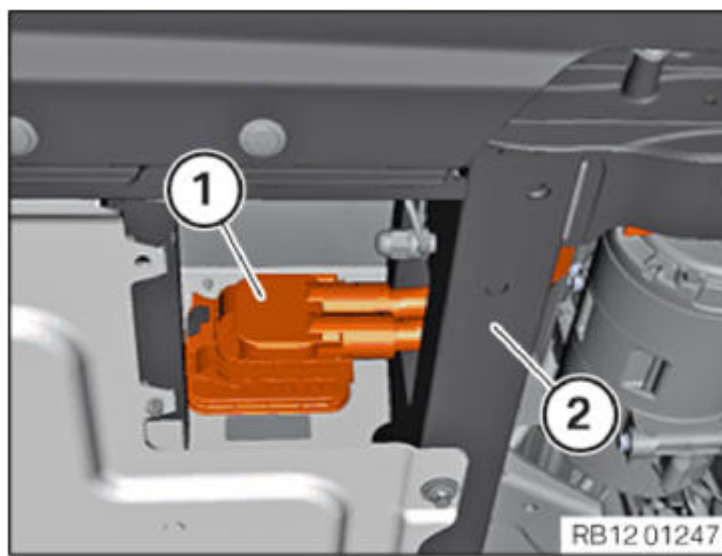
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Insert the high-voltage cable (1) through the Drive module (2).

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Connect and lock the connector for the high-voltage cable (1) on the high-voltage battery unit.



**Fig. 84: Identifying High-Voltage Cable And Rear Axle Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

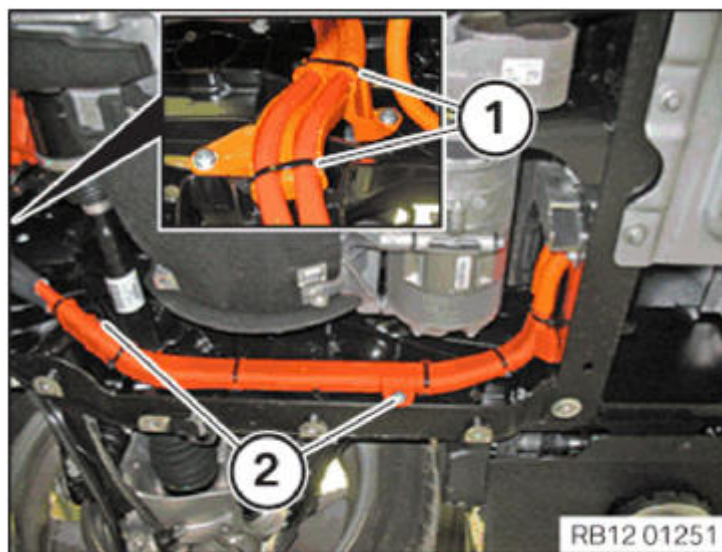
Insert the high-voltage cable towards the top.

Tighten down screws (2).

Tightening torque [61 12 4AZ](#) .

IMPORTANT: Observe the notes on [OPENING AND CLOSING CABLE STRAPS](#) in electric vehicles.

Clip in the high-voltage cable and secure using the cable straps (1).



**Fig. 85: Identifying Cable Strap And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

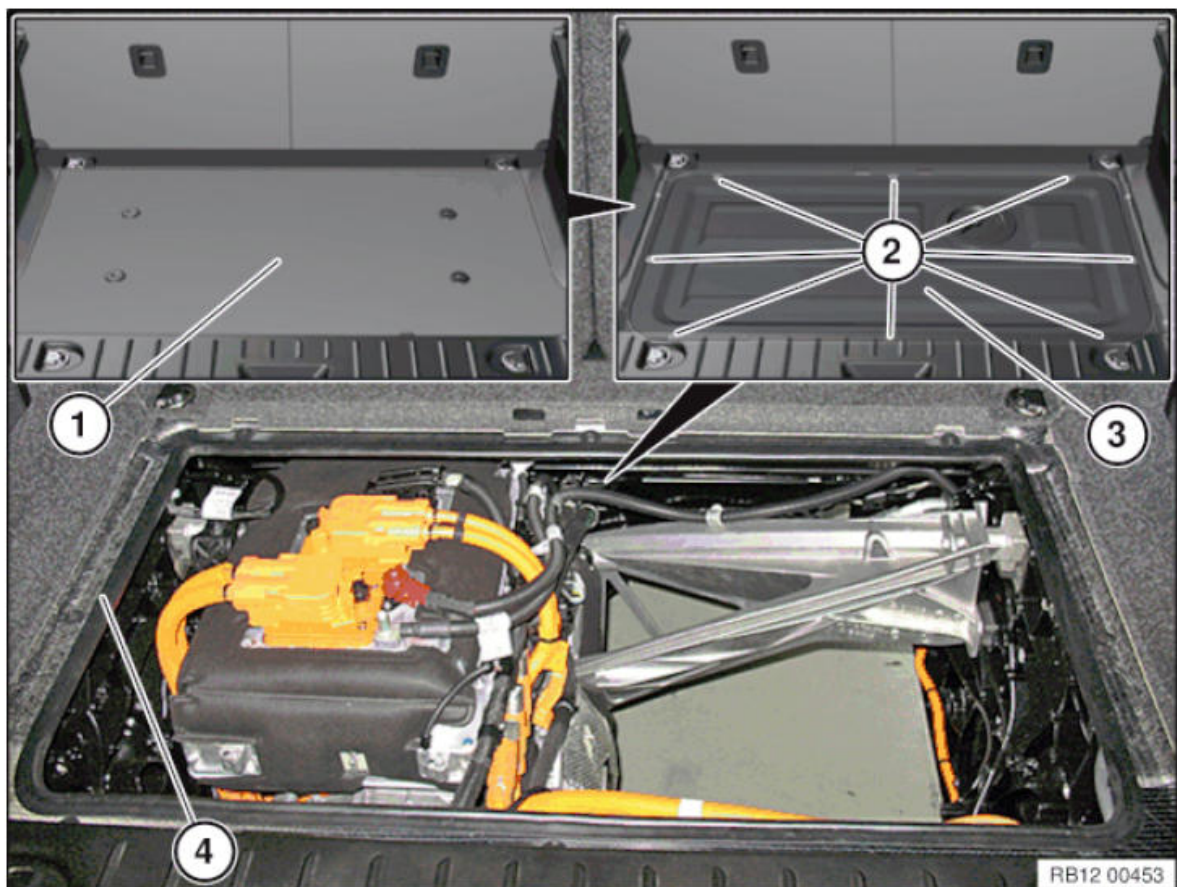
IMPORTANT: Observe notes on [UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS](#) on electric vehicles.

Connect and lock the connector for the high-voltage cable (1).





**Fig. 86: Identifying High-Voltage Cable Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 87: Identifying Luggage Compartment Floor Trim Panel And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

**IMPORTANT:** Position service cap and tighten screws (2).

Tightening torque [51 47 4AZ](#) .

Insert luggage compartment floor trim panel (1).

**Required reworking:**

- Install the HORIZONTAL STRUT ON THE LEFT



### Preconditions:

The following procedure must be followed without exception to loosen cable straps on electric and hybrid cars and in the high-voltage battery unit.

Do not use pointed or sharp-edged tools.

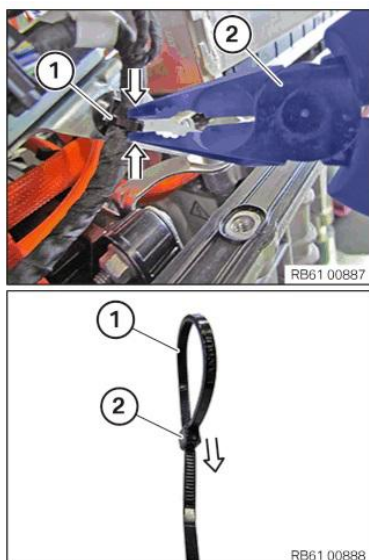
The following tools are permitted: combination pliers and coolant pump pliers

Remove the protruding end of the cable strap using the appropriate special tool.

**WARNING:** Damaged high-voltage cables, high-voltage connectors and high-voltage components. Risk of deadly electric shock.

- The touch protection on the high-voltage cables, high-voltage connectors, and high-voltage components must not be damaged.
- Do not repair. Always completely replace damaged high-voltage cables, high-voltage connectors and high-voltage components with parts available via BMW parts catalogue/parts department.

### Opening cable straps, option 1:

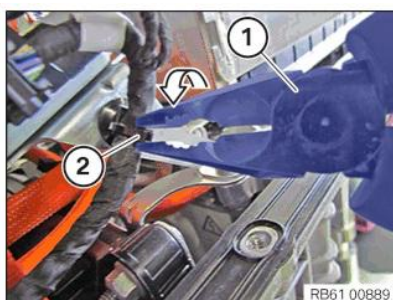


Grip and compress the cable strap (1) (as shown in the graphic) using the combination pliers or coolant pump pliers (2).

The cable strap (1) is opened at the closure (2) by pulling in the direction of arrow.

**Fig. 88: Opening Cable Straps - Option 1**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Opening cable straps, option 2:



Grab the closure (2) with the combination pliers or coolant pump pliers (1) and twist off in direction of arrow.

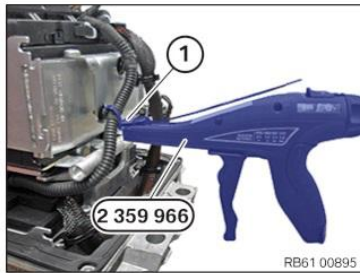
**Fig. 89: Opening Cable Straps - Option 2**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Closing cable straps:



- Setting the starting power above the rotary knob (1)
- Slide stop (2) in direction of arrow
  - Hold stop (2) in position and rotate rotary knob (1) in the desired position.
  - Release stop (2) again and let it be engaged.

Settings	0	1	2	3	4	5	6	7	8
Tensile force in N	20	38	51	68	85	104	125	143	165



- Preload cable strap (1) by hand so that one stroke is enough for tightening and cutting-off.
- Tighten cable strap (1) with special tool **2 359 966** until the protruding end of the cable strap is cut off.
- For cable straps on high-voltage cables in the high-voltage battery unit special tool **2 359 966** must be adjusted to **stage 4**.
- For cable straps on 12 V cables in the high-voltage battery unit special tool **2 359 966** must be adjusted to **stage 3**.

**Fig. 90: Closing Cable Straps**

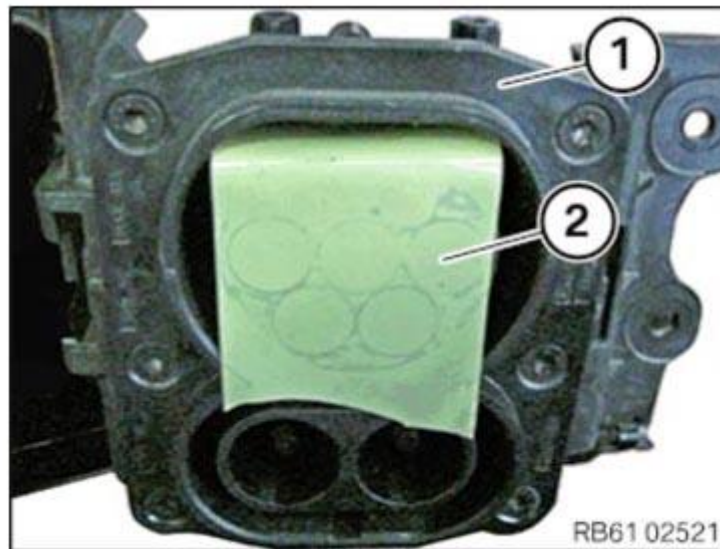
Courtesy of BMW OF NORTH AMERICA, INC.

## 61 12 970 REWORKING THE CHARGING POWER SOCKET

Necessary preliminary work:

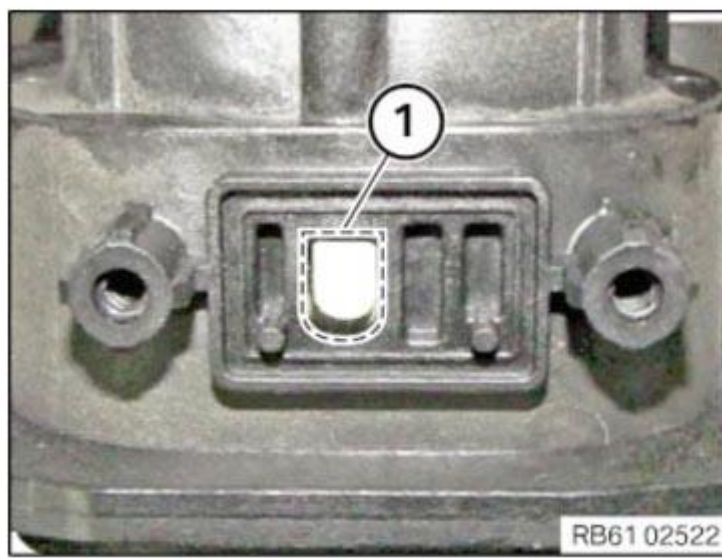
- Remove **CONTROLLER DRIVE FOR CHARGING POWER SOCKET**

Mask off charging power socket (1) with adhesive tape (2) as shown.



**Fig. 91: Identifying Charging Power Socket With Adhesive Tape**

Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 92: Identifying Opening With Small Flat File**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Work on the flat sides of opening (1) with a small flat file.

Work on the round side of opening (1) with a small round file.

Enlarge opening (1) as pictured by approximately **0.3 mm** per side.

**Required follow-up work:**

- **INSTALL CONTROLLER DRIVE FOR CHARGING POWER SOCKET**

## **PLUG CONNECTION, TERMINAL, POWER DISTRIBUTION BOX**

### **61 13... NOTES FOR OPENING CONTACTS AND LOCKS OF DIFFERENT PLUG CONTACT SYSTEMS**

**Special tools required:**

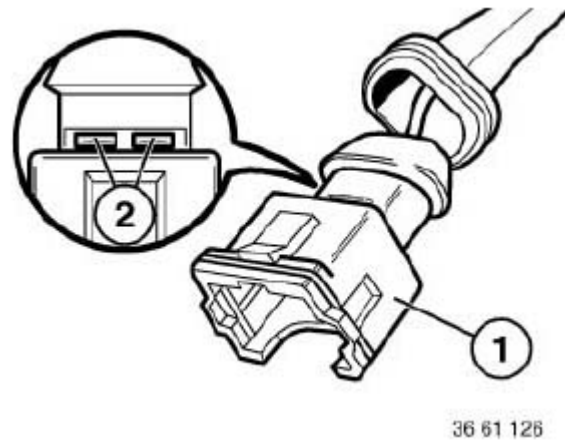
- 61 0 300
- 61 0 400
- 61 1 100

<b>Abbreviations of contacts and what they mean:</b>	
ELA	Strand seal
D 1.5/2.5/3.5	Round contacts with 1.5 mm, 2.5 mm or 3.5 mm diameter
MDK	Miniature double flat spring contact
JPT	Junior Power timer
DFK	Double flat spring contacts
Elo	Electronic contacts
Elo Power	Electronic contacts for heavy load
MQS	Micro Quadlock system
MPQ	Micro Power Quadlock
MLK	Mini laminated contact
SLK	Sensor laminated contact
LSK	Load current contact
MLK	Mini laminated contact
Mcon	Multi contact

**IMPORTANT:** The contacts can be changed on ultrasonically welded connectors (1).

Ultrasonically welded connectors (1) must be replaced completely.

Ultrasonic-welded connectors (1) can be identified by the welds (2) on their longitudinal side.



36 61 126

**Fig. 93: Identifying Ultrasonic-Welded Connectors**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Index of connectors:**

- **CIRCULAR CONNECTOR, 13-PIN, SYSTEM D2.5**
- **CIRCULAR CONNECTOR, 20-PIN, SYSTEM D2.5**
- **CIRCULAR PLUGS, 4-, 7-, 10-12-, 25-PIN, SYSTEM D1.5/D2.5**
- **CIRCULAR PLUGS, 4-, 7-, 10-12-, 25-PIN, SYSTEM D1.5/D2.5**
- **CONNECTOR HOUSING, LCC CONTACT (LOAD CURRENT CONTACT)**
- **CONTROL UNIT PLUGS, 25-, 35-, 55-, 83-, 88-PIN**
- **IN-LINE CONNECTORS, 24-/44-PIN, HYBRID SYSTEM MQS/MPQ**
- **IN-LINE CONNECTORS, 30-PIN, HYBRID SYSTEM MQS/MPQ**
- **IN-LINE CONNECTORS, 30-PIN, SYSTEM D2.5**
- **IN-LINE PLUGS, 2-PIN, SYSTEM JPT ELA**
- **IN-LINE PLUGS, 2-PIN, SYSTEM MDK 3 PLUS 2.8**
- **IN-LINE PLUGS, 20-PIN, SYSTEM D2.5**
- **IN-LINE PLUGS, 4-PIN, SYSTEM DFK ELA**
- **IN-LINE PLUGS, 6- TO 50-PIN, SYSTEM ELO**
- **INLINE CONNECTORS, 15-PIN, SYSTEM D2.5**
- **INLINE CONNECTORS, 6-, 8-PIN, SYSTEM MQS**
- **INLINE PLUGS, 2-PIN, SYSTEM MPQ 2.8**
- **INLINE PLUGS, 3-, 6-PIN, SYSTEM ELO-POWER 2.8**
- **INLINE PLUGS, 4-, 10-PIN, SYSTEM ELO**
- **INLINE PLUGS, 8-, 12-PIN, SYSTEM D2.5**
- **SOCKET HOUSING (RADIO CONNECTOR), HYBRID SYSTEM MQS/MPQ**
- **SOCKET HOUSING 42-, 43-, 46-PIN, HYBRID SYSTEM MQS/MPQ**
- **SOCKET HOUSINGS, 2X21-, 2X27-PIN, HYBRID SYSTEMS MQS/MPQ, ELO/ELO POWER**
- **SOCKET HOUSINGS, 5-PIN, 8-PIN, SYSTEM MQS/MPQ**

61 13... Circular connector, 13-pin, system D2.5

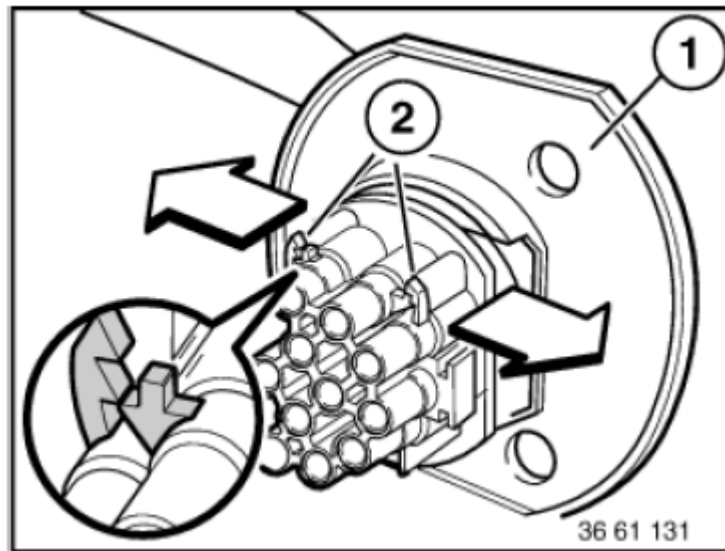
**Special tools required:**

- 61 0 303

Pull off rubber grommet (1).

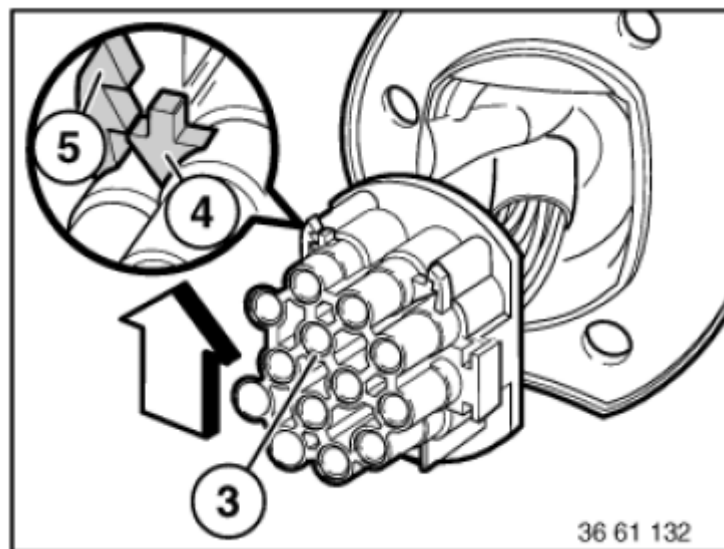


Carefully pull out lock (2) in direction of arrow.



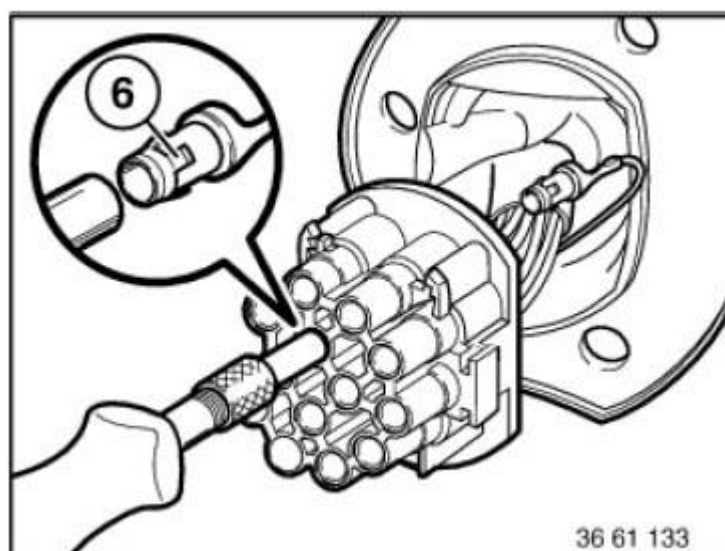
**Fig. 94: Pulling Circular Connector Rubber Grommet (13-Pin, System D2.5)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Move lower section of connector (3) in direction of arrow until retaining lugs (4) snap into release groove (5).



**Fig. 95: Moving Circular Connector Lower Section**  
Courtesy of BMW OF NORTH AMERICA, INC.

With special tool 61 0 303, press down retaining lugs (6) of corresponding contact and pull out cable.



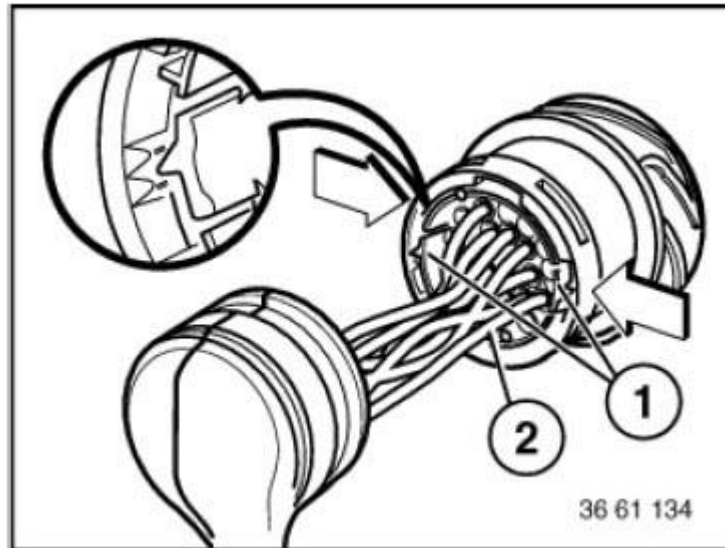
**Fig. 96: Pressing Contact Retaining Lugs Using Special Tool (61 0 303)**  
Courtesy of BMW OF NORTH AMERICA, INC.

61 13... Circular connector, 20-pin, system D2.5

Special tools required:

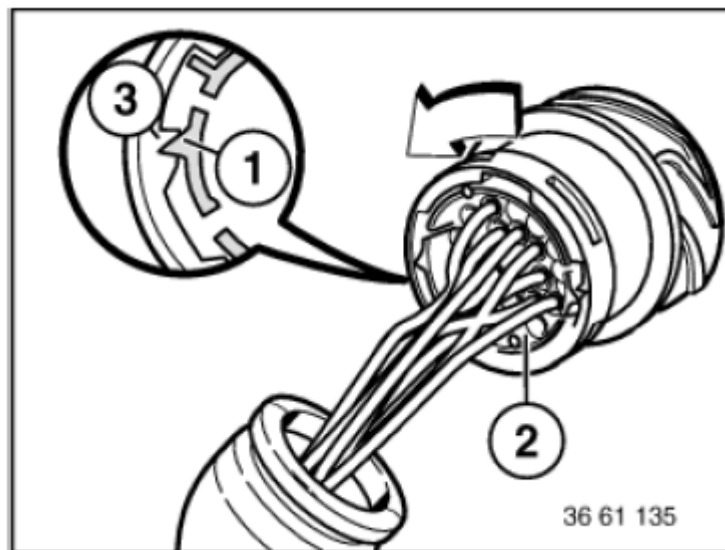
- 61 0 303

Carefully press back retaining tabs (1) of internal connector (2).



**Fig. 97: Pressing Internal Connector Retaining Tabs (20-Pin System D2.5)**  
Courtesy of BMW OF NORTH AMERICA, INC.

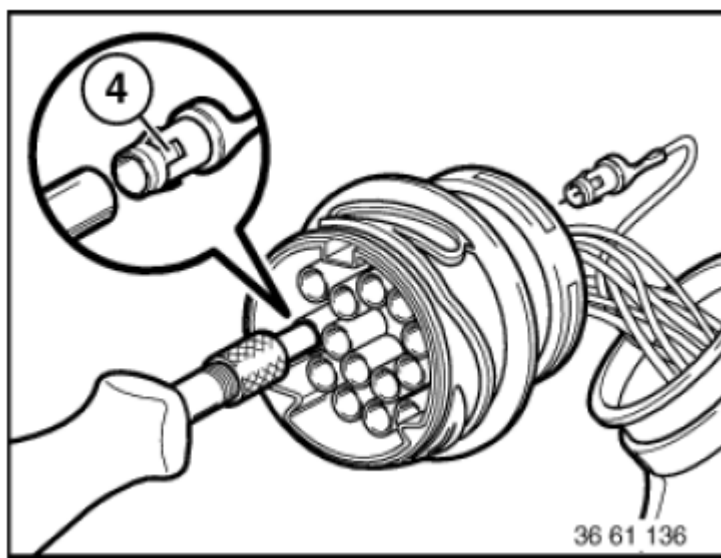
Turn internal connector (2) until retaining lugs (1) snap into release groove (3).



**Fig. 98: Turning Internal Connector (20-Pin System D2.5)**  
Courtesy of BMW OF NORTH AMERICA, INC.

With special tool 61 0 303 press down retaining hook (4) of corresponding contact and pull out cable.





**Fig. 99: Pressing Contact Retaining Hook Using Special Tool (61 0 303)**  
Courtesy of BMW OF NORTH AMERICA, INC.

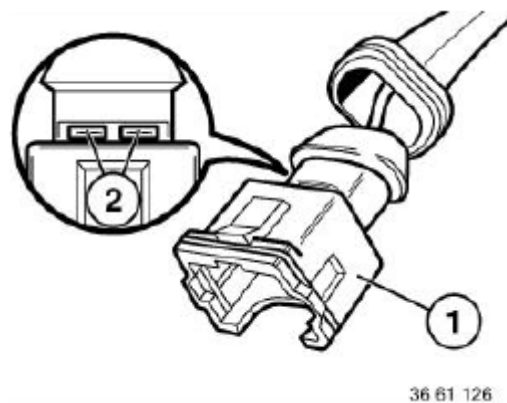
**61 13... Circular connector, 7-pin, 8-pin, system D2.5**

**Special tools required:**

- 61 0 303

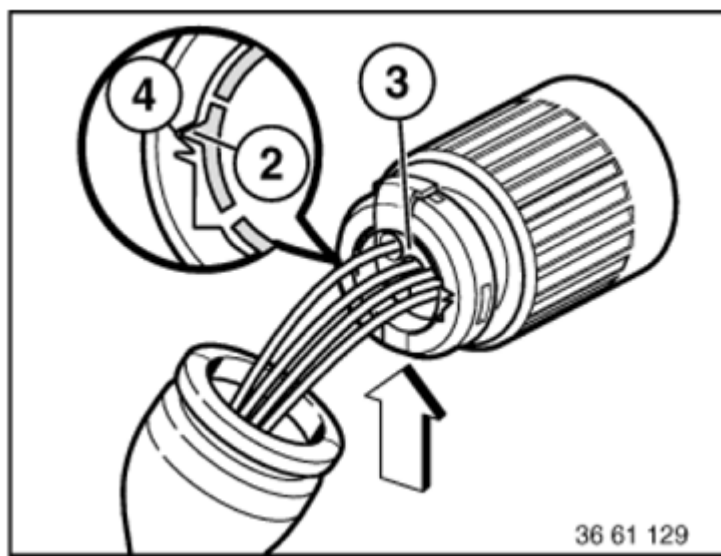
Carefully pull off rubber grommet (1).

Carefully press back retaining tabs (2) of internal connector (3).



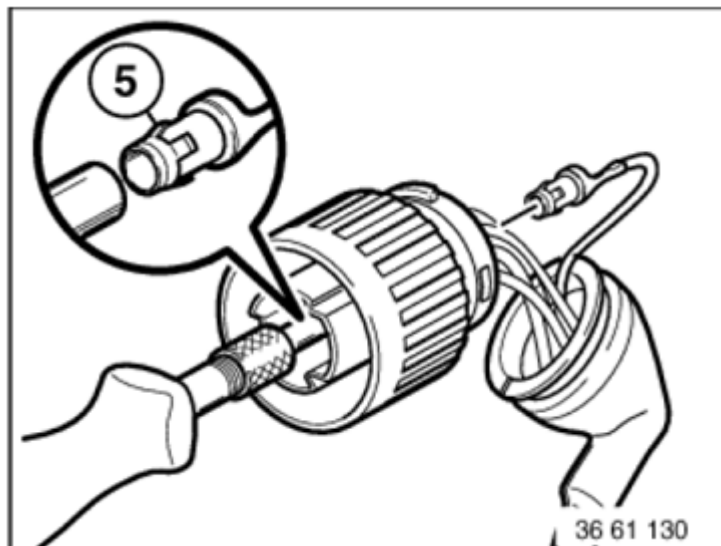
**Fig. 100: Pressing Internal Connector Retaining Tabs (7 And 8 Pin System D2.5)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide internal connector (3) in direction of arrow until retaining tabs (2) lock into locking groove (4).



**Fig. 101: Sliding Internal Connector (7 And 8 Pin System D2.5)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Use special tool 61 0 303 (61 1 132) to press back retaining hook (5) of corresponding contact and pull out cable with contact.



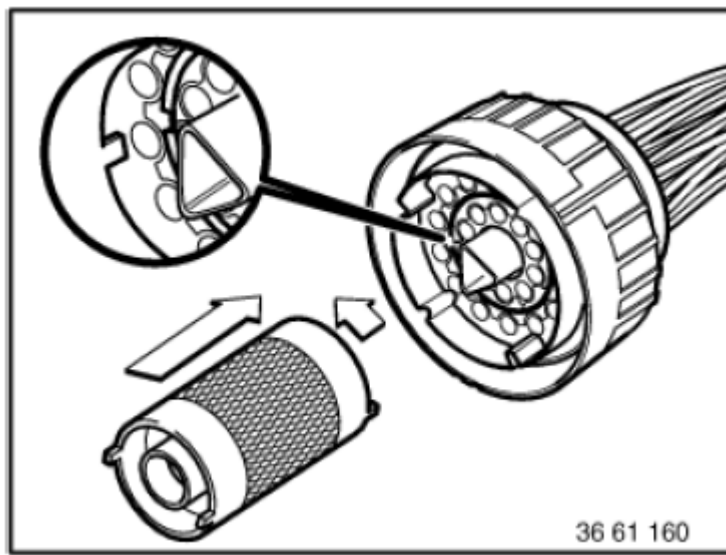
**Fig. 102: Pressing Back Retaining Hook Of Corresponding Contact**  
 Courtesy of BMW OF NORTH AMERICA, INC.

61 13... Circular plugs, 4-, 7-, 10-12-, 25-pin, System D1.5/D2.5

**Special tools required:**

- 61 0 303

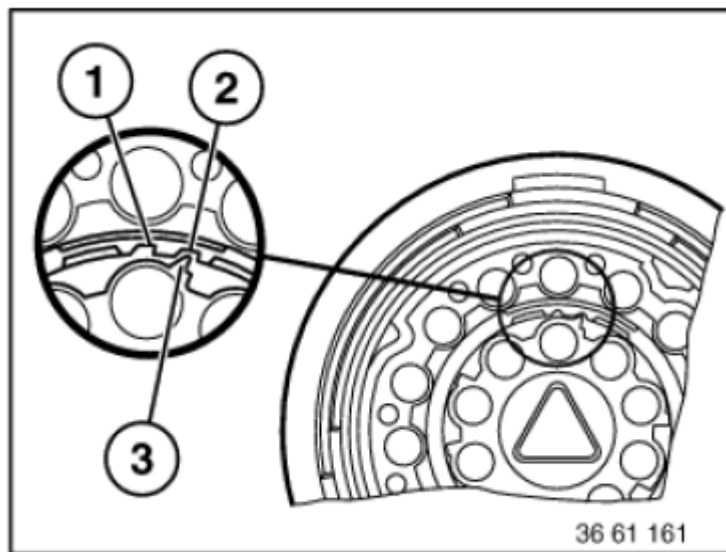
Insert special tool with suitable connection side in connector and twist approx. 3° counter-clockwise.



**Fig. 103: Inserting Special Tool With Suitable Connection Side In Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

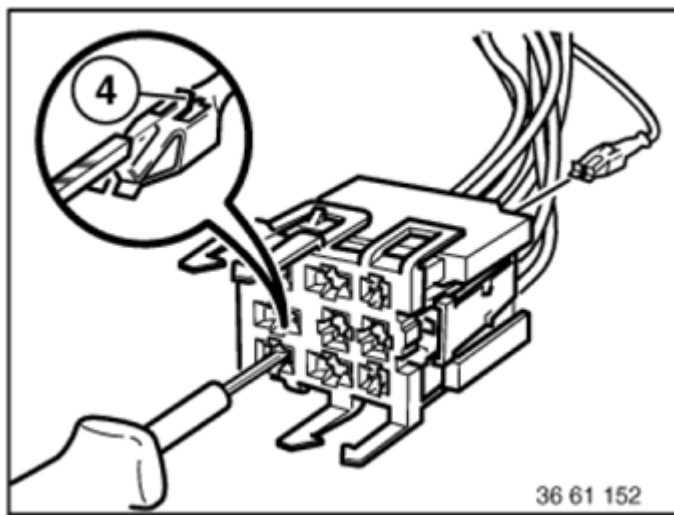
The connector is locked down if retaining lug (3) is located in locking groove (2).

1. Unlocking groove
2. Locking groove
3. Retaining lug



**Fig. 104: Identifying Connector Retaining Lug And Groove**  
 Courtesy of BMW OF NORTH AMERICA, INC.

With special tool 61 0 303 press back retaining hook(4) of corresponding contact and pull out cable with contact.



**Fig. 105: Pressing Back Retaining Hook Of Corresponding Contact**  
 Courtesy of BMW OF NORTH AMERICA, INC.

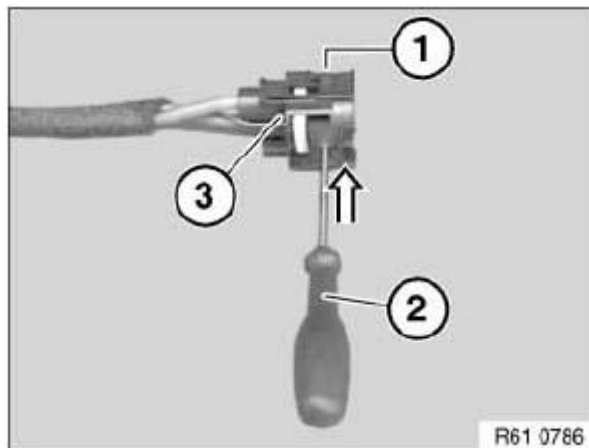
61 13... Connector housing, LCC contact (load current contact)

Special tools required:

- [61 0 317](#)

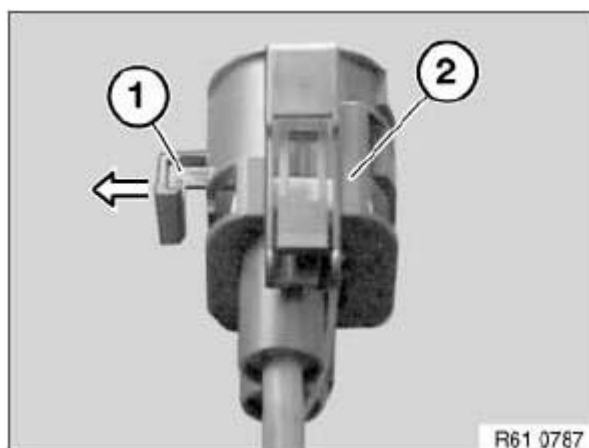
Socket housing:

Press lock (1) with suitable tool (2) in direction of arrow out of socket housing (3).



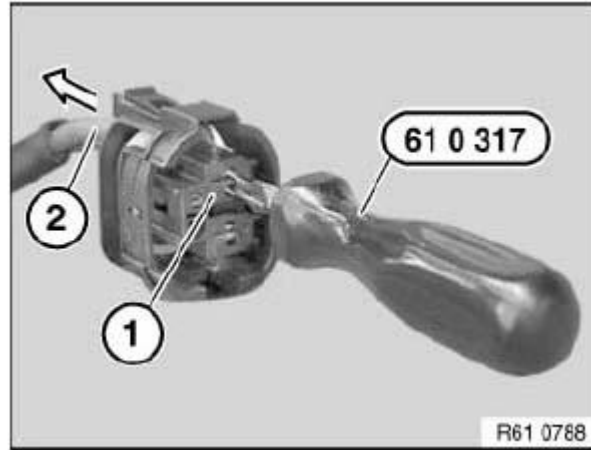
**Fig. 106: Pressing Connector Lock Using Tool**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull lock (1) out of socket housing (2).



**Fig. 107: Pulling Lock Out Of Socket Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

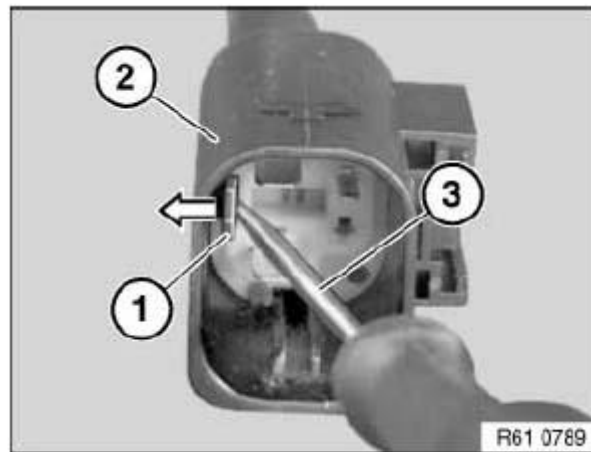
Insert special tool [61 0 317](#) into socket housing (1) and pull out wiring with LCC contact (2) in direction of arrow.



**Fig. 108: Inserting Special Tool (61 0 317) Into Socket Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

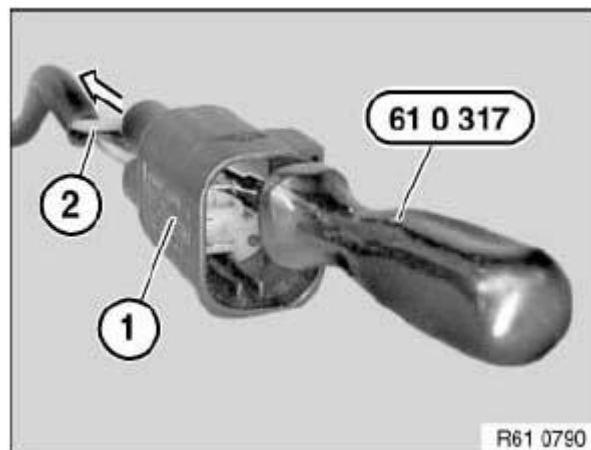
*Pin housing:*

Unlock locking slide (1) of pin housing (2) with suitable tool (3) in direction of arrow.



**Fig. 109: Removing Locking Slide Of Pin Housing With Suitable Tool**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert special tool [61 0 317](#) into pin housing (1) and pull out wiring with LCC contact (2) in direction of arrow.



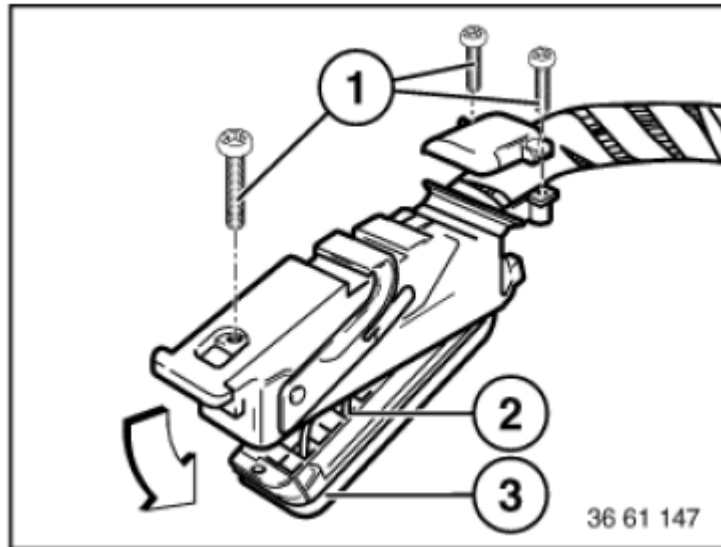
61 13... Control unit plugs, 25-, 35-, 55-, 83-, 88-pin

**Special tools required:**

- 61 0 312
- 61 0 314
- 61 0 315
- 61 0 323

Release screws (1).

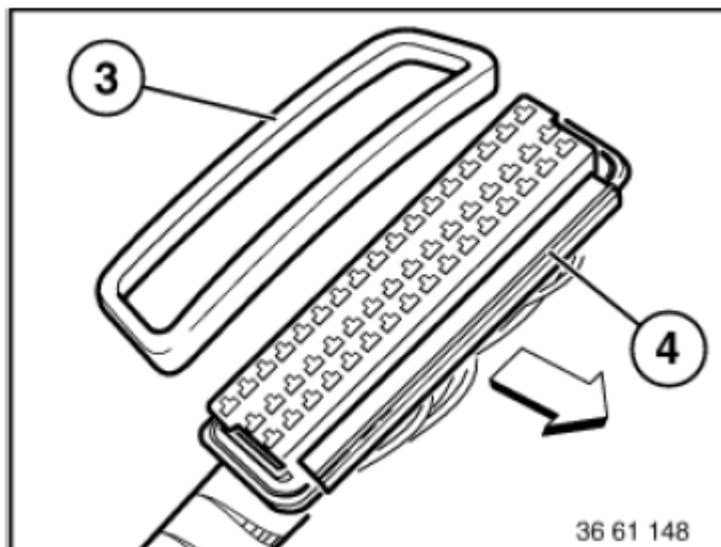
Lever out pin sensor (2) with gasket (3) in direction of arrow.



**Fig. 111: Releasing Screws And Lever Out Pin Sensor With Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove gasket (3).

Pull out housing lock (4) in direction of arrow and unlock.



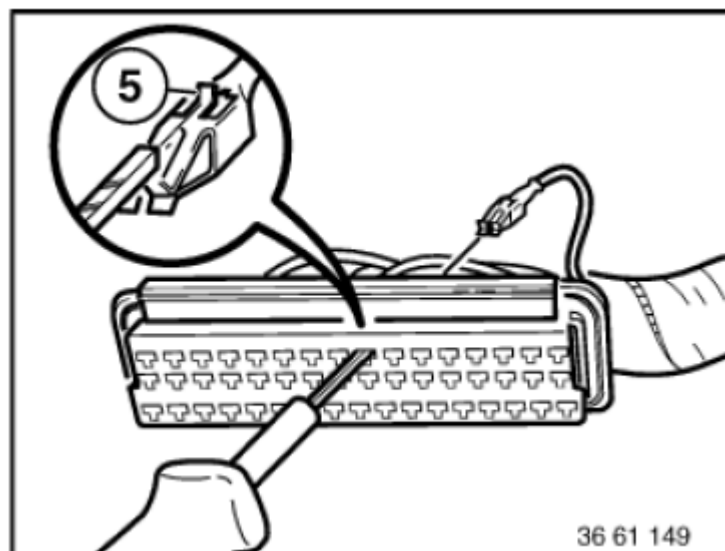
**Fig. 112: Pulling Control Unit Housing Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press down retaining hook (5) of corresponding contact and pull out cable with contact.



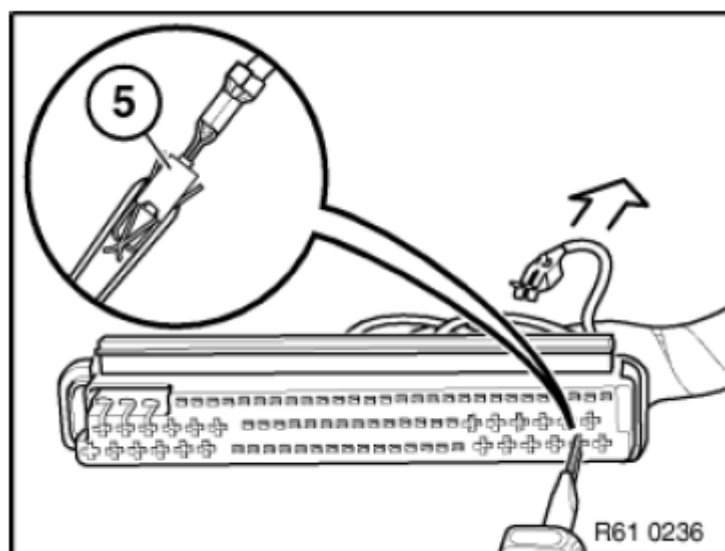
Special tool 61 0 312 (61 1 134) for mini flat spring contacts.

Special tool 61 0 314 (61 1 135) for mini flat spring contacts.



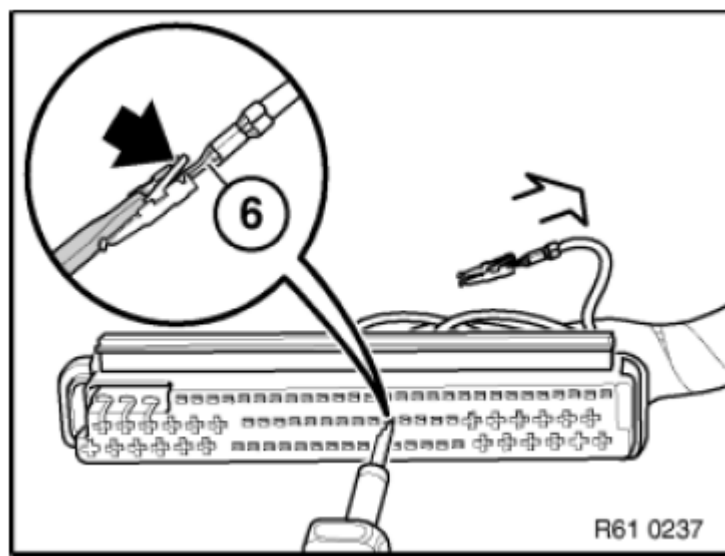
**Fig. 113: Pressing Down Retaining Hook Of Corresponding Contact**  
Courtesy of BMW OF NORTH AMERICA, INC.

Special tool 61 0 315 (61 1 151) for double flat spring contacts (dual retaining hooks).



**Fig. 114: Identifying Double Flat Spring Contacts (Dual Retaining Hooks)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Special tool 61 0 323 (61 1 152) for double flat spring contacts (special retaining hook).



**Fig. 115: Identifying Double Flat Spring Contacts (Special Retaining Hook)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... In-line connectors, 24-/44-pin, Hybrid System MQS/MPQ**

**Manufactured by AMP:** The following contact types without strand sealing can be fitted in the connector housings:

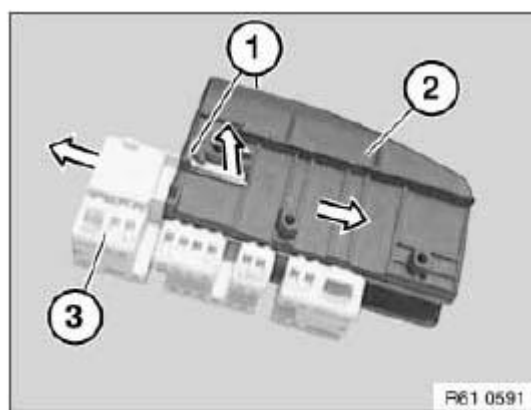
- MQS (Micro Quadlock System)
- MPQ, width 2.8 mm (Micro Power Quadlock)
- MPQ, width 5.2 mm (Micro Power Quadlock)

**Socket housing:**

Press locks (1) on protective cap (2) upwards on both sides.

Detach protective cap from contact carrier (3).

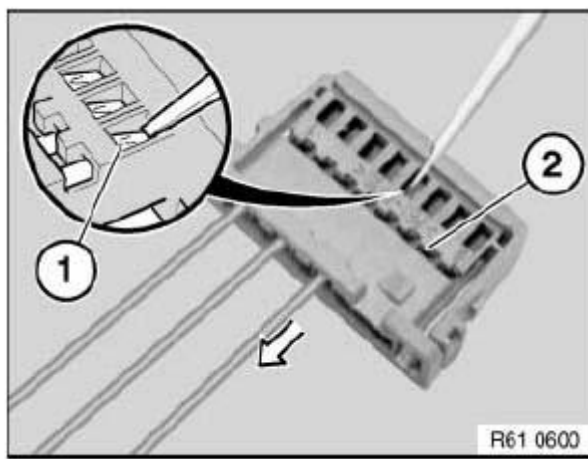
**NOTE:** Detaching the protective cap releases the secondary locks of the socket contacts.



**Fig. 116: Detaching Protective Cap From Contact Carrier**  
 Courtesy of BMW OF NORTH AMERICA, INC.

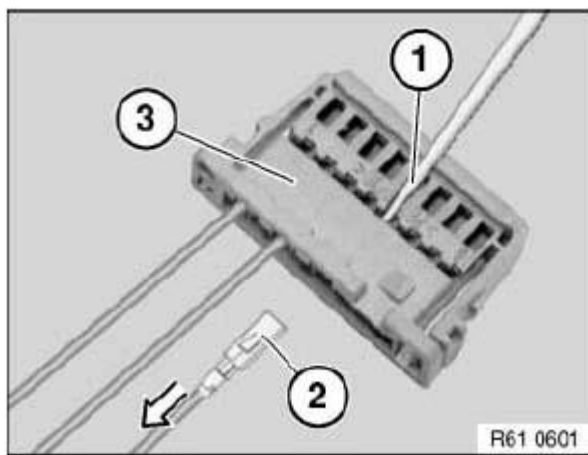
Hold down retaining hook (1) of socket contact in opening of contact carrier with a small screwdriver.

Pull wire with socket contact in direction of arrow as far as secondary lock (2).



**Fig. 117: Pulling Wire With Socket Contact**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook in secondary lock (1) again and pull cable with socket contact (2) completely out of contact carrier (3).



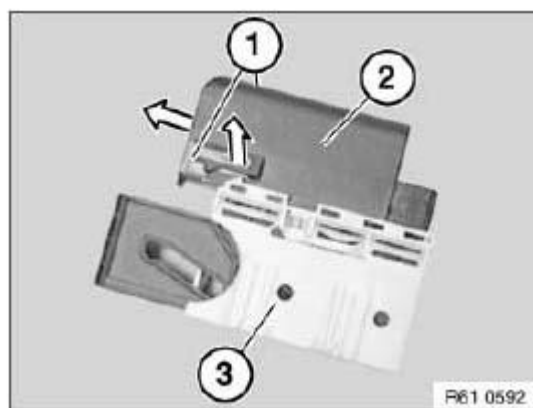
**Fig. 118: Pulling Cable With Socket Contact Out Of Contact Carrier**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Pin housing:**

Press locks (1) on protective cap (2) upwards on both sides.

Detach protective cap from housing carrier (3).

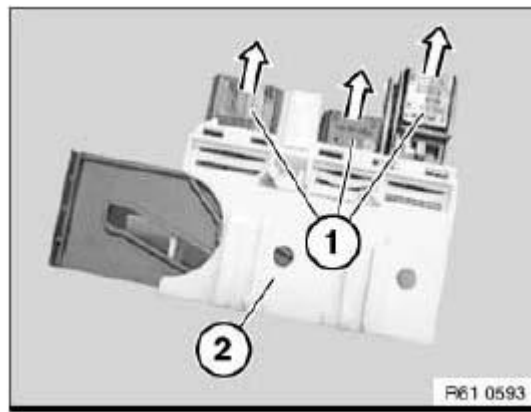
**NOTE:** Detaching the protective cap releases the secondary locks of the pin contacts in the contact carriers.



**Fig. 119: Detaching Protective Cap From Housing Carrier**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull contact carrier (1) out of housing carrier (2).

The pin contacts are pulled out of a contact carrier as described under "Socket housing".



**Fig. 120: Pulling Contact Carrier Out Of Housing Carrier**

Courtesy of BMW OF NORTH AMERICA, INC.

### 61 13... In-line connectors, 30-pin, Hybrid System MQS/MPQ

**Manufactured by AMP:** The following contact types without strand sealing can be fitted in the connector housings:

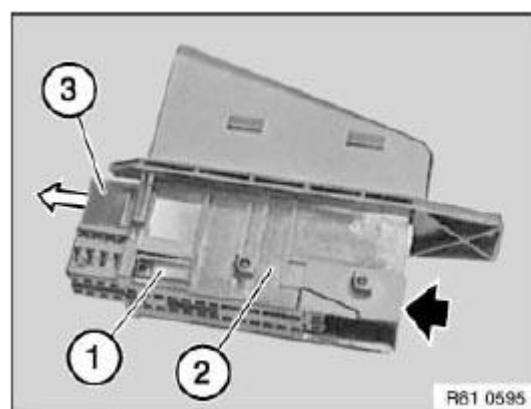
- MQS (Micro Quadlock System)
- MPQ, width 2.8 mm (Micro Power Quadlock)
- MPQ, width 5.2 mm (Micro Power Quadlock)

#### **Socket housing:**

Raise lock (1) on housing (2).

Push contact carrier (3) out of housing (2).

**NOTE:** Pushing out the contact carrier releases the secondary locks of the socket contacts.

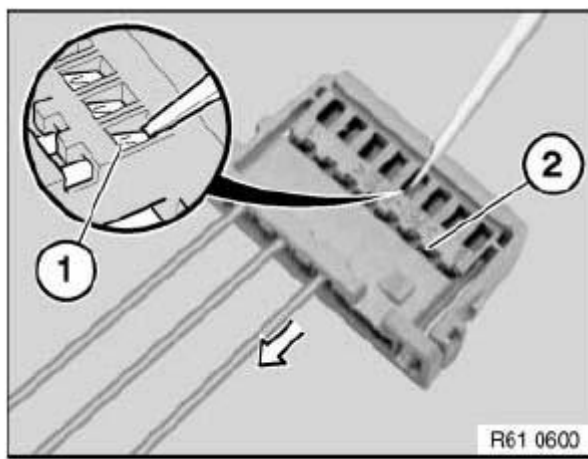


**Fig. 121: Pushing Contact Carrier Out Of Housing**

Courtesy of BMW OF NORTH AMERICA, INC.

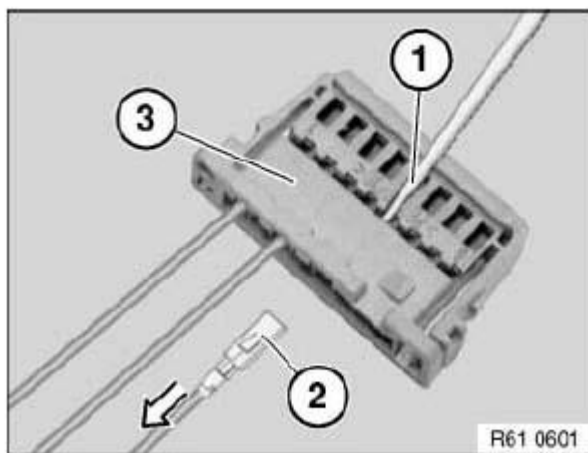
Hold down retaining hook (1) of socket contact in opening of contact carrier with a small screwdriver.

Pull wire with socket contact in direction of arrow as far as secondary lock (2).



**Fig. 122: Pulling Wire With Socket Contact**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook in secondary lock (1) again and pull cable with socket contact (2) completely out of contact carrier (3).



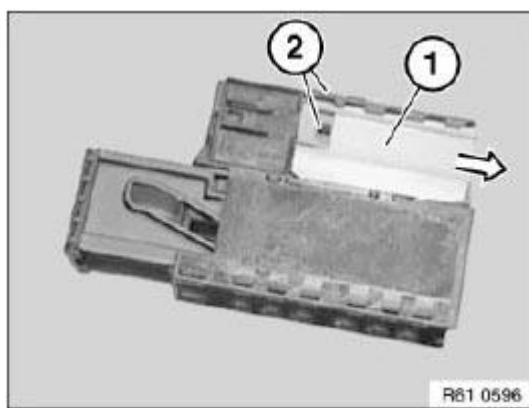
**Fig. 123: Pulling Cable With Socket Contact Out Of Contact Carrier**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Pin housing:**

**Contacts 1... 13 and 19... 27:**

Raise locking slide (1) on both sides (2) of housing and detach.

**NOTE:** Detaching the locking slide releases the secondary locks of the pin contacts.



**Fig. 124: Detaching Connector Pin Housing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

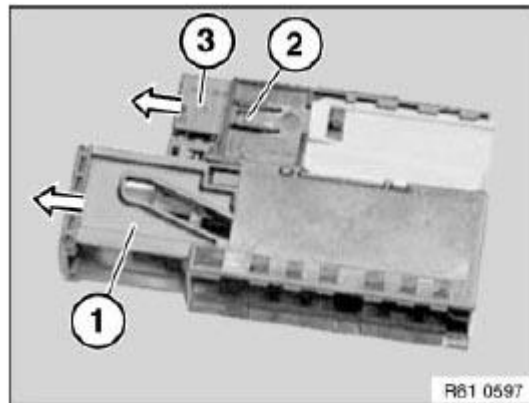
**Contacts 14... 18 and 28... 30:**

Pull slide (1) outwards completely.

Raise lock (2) on housing.

Pull contact carrier (3) out of housing.

**NOTE:** Pulling out the contact carrier releases the secondary locks of the pin contacts.



**Fig. 125: Pulling Contact Carrier Out Of Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

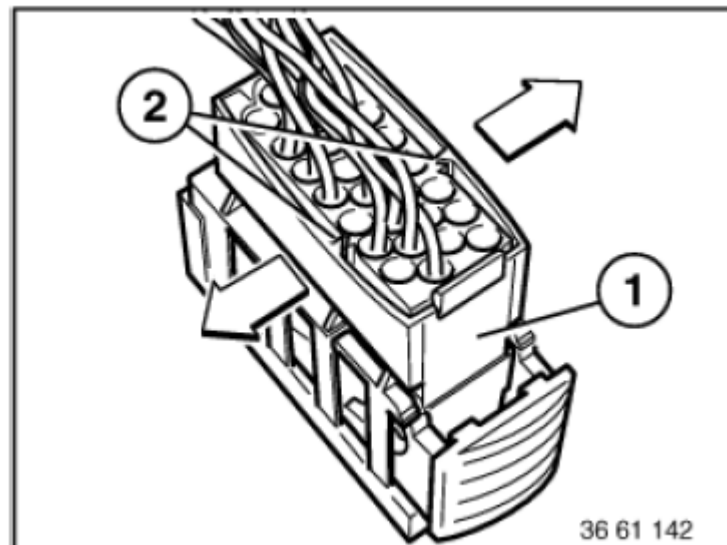
The pin contacts are pulled out of a contact carrier as described under "Socket housing".

### 61 13... In-line connectors, 30-pin, System D2.5

**Special tools required:**

- 61 0 303

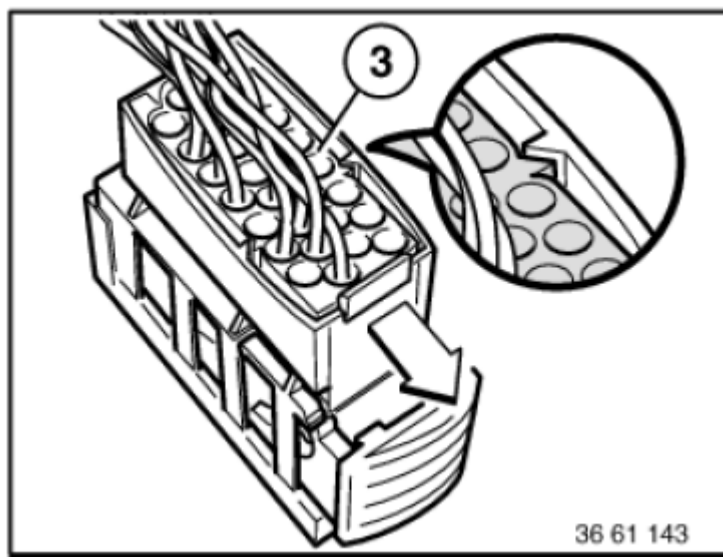
Carefully pull external connector (1) in area of retaining lugs (2) apart slightly.



**Fig. 126: Pulling External Connector Of Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull internal connector (3) until limit position in direction of arrow.

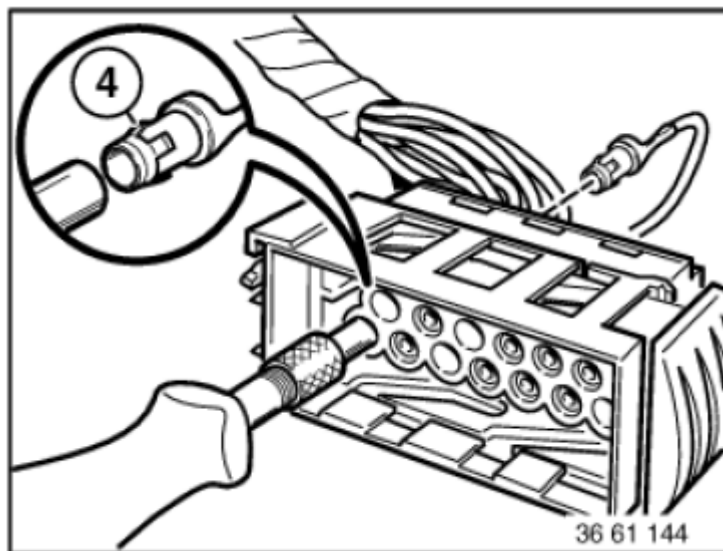




**Fig. 127: Pulling Internal Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

With special tool 61 0 303 press back retaining hook(4) of corresponding contact and pull out cable with contact.



**Fig. 128: Pressing Back Retaining Hook Using Special Tool (61 0 303)**

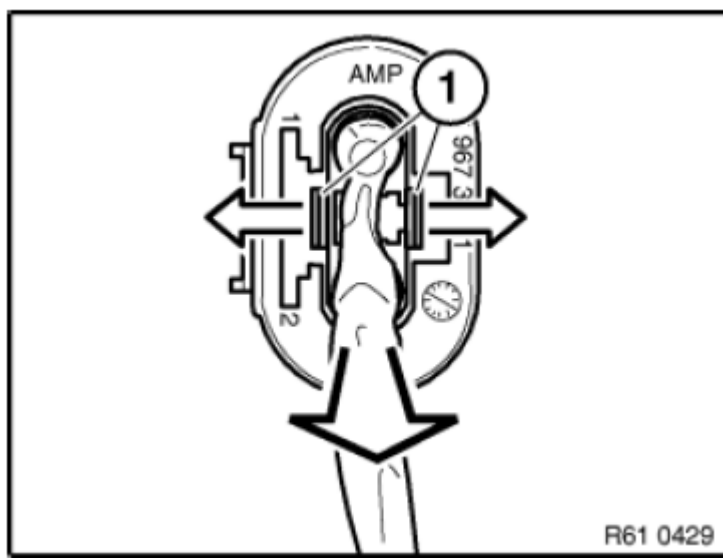
Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... In-line plugs, 2-pin, System JPT ELA**

**Special tools required:**

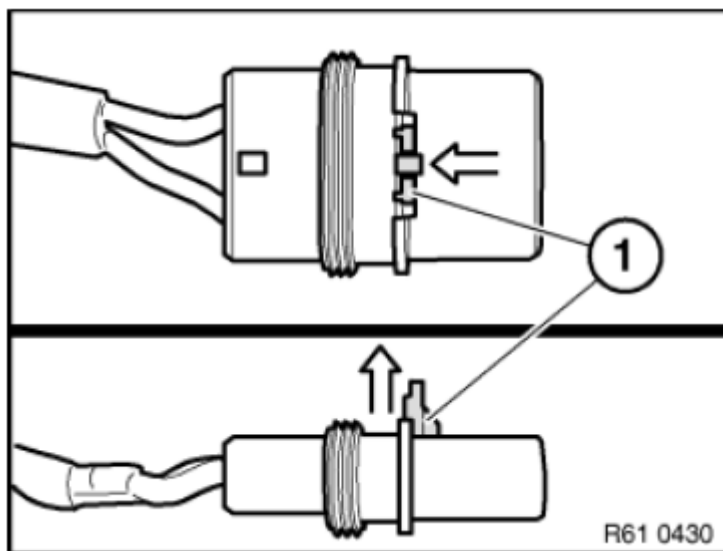
- **61 0 316**

Press lock (1) in direction of arrow and slide connector forward.



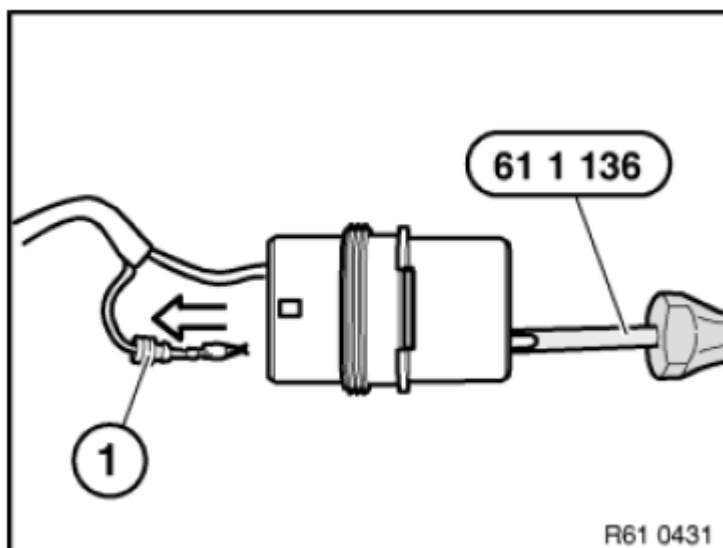
**Fig. 129: Pressing Lock**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Press lock (1) downward and slide out to one side.



**Fig. 130: Pressing Lock**  
 Courtesy of BMW OF NORTH AMERICA, INC.

With special tool [61 0 316](#) (61 1 136), unlock contact and pull out cable with contact (1) towards rear.



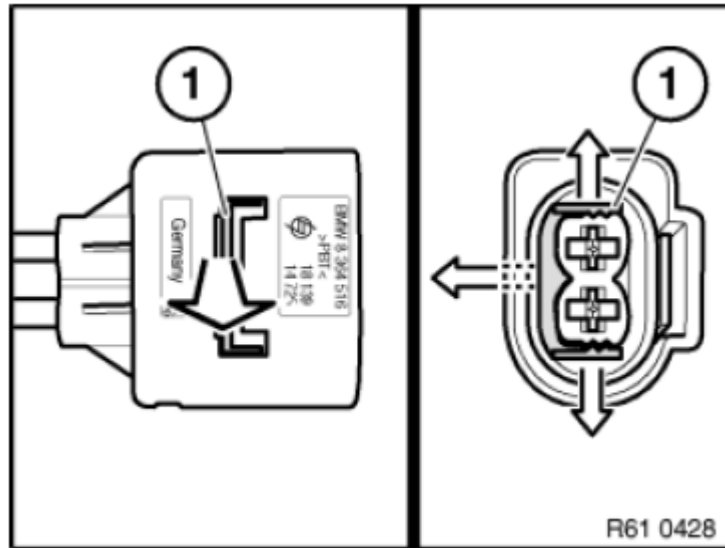
**Fig. 131: Pulling Cable With Contact Towards Rear**  
Courtesy of BMW OF NORTH AMERICA, INC.

61 13... In-line plugs, 2-pin, System MDK 3 plus 2.8

Special tools required:

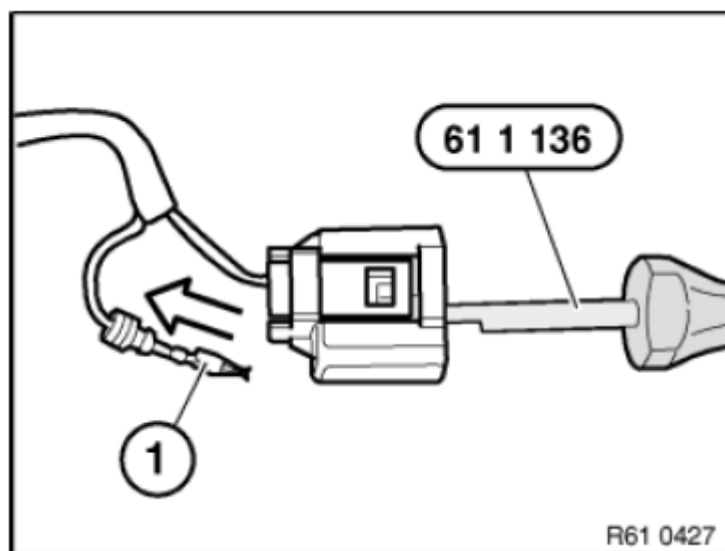
- [61 0 316](#)

Unlock lock (1) on outside at retaining hook and slide out lock (1) to side.



**Fig. 132: Removing Lock (2-Pin, System MDK 3 Plus 2.8)**  
Courtesy of BMW OF NORTH AMERICA, INC.

With special tool [61 0 316](#) (61 1 136), unlock contact and pull out cable with contact (1) towards rear.



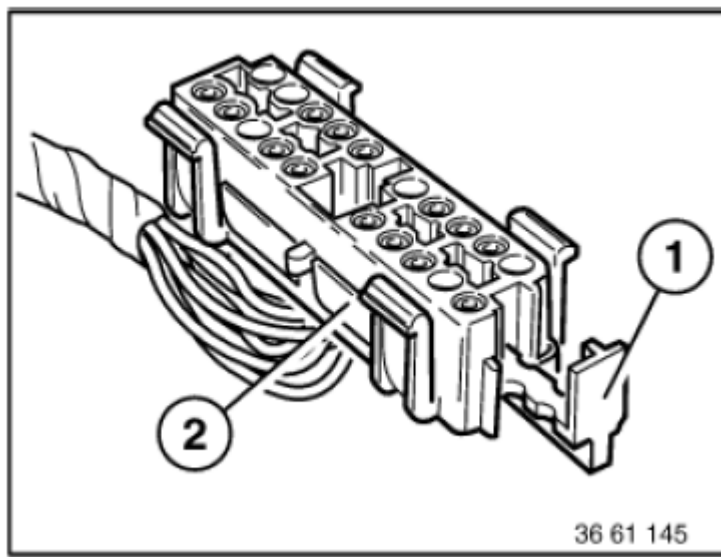
**Fig. 133: Pulling Out Cable With Contact Towards Rear**  
Courtesy of BMW OF NORTH AMERICA, INC.

61 13... In-line plugs, 20-pin, System D2.5

Special tools required:

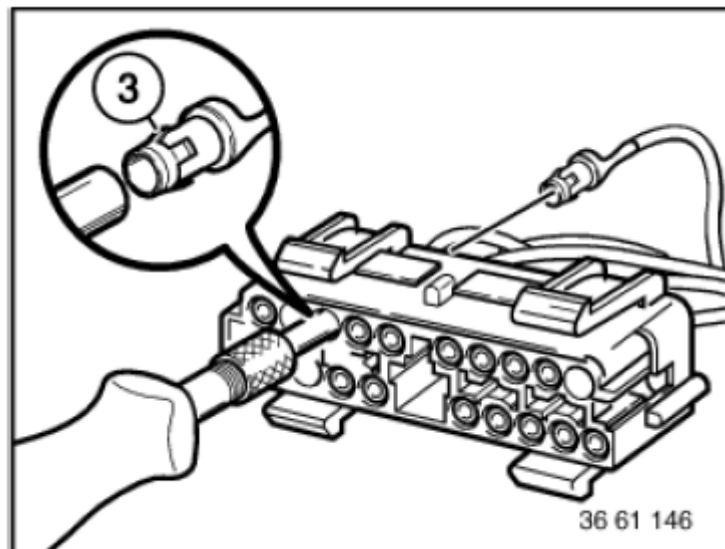
- 61 0 303

Pull locking slide (1) out of connector (2).



**Fig. 134: Identifying Locking Slide And Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

With special tool 61 0 303, press down retaining hook (3) of corresponding contact and pull out cable with contact.



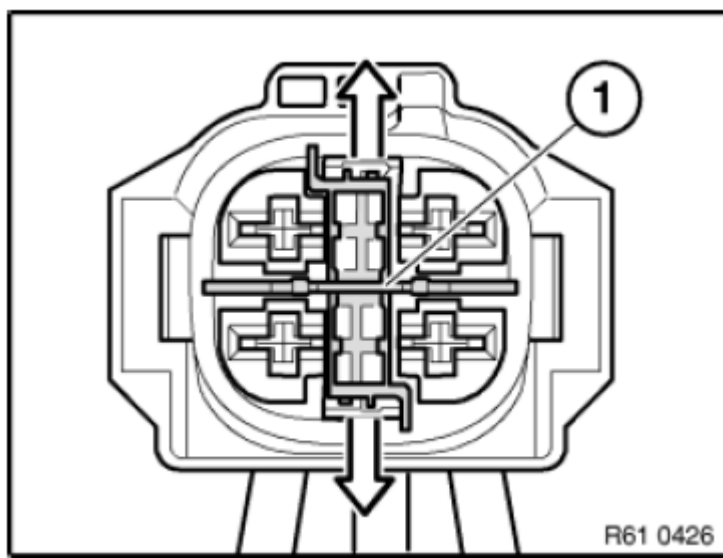
**Fig. 135: Pressing Contact Retaining Hook Using Special Tool (61 0 303)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... In-line plugs, 4-pin, System DFK ELA**

**Special tools required:**

- **61 0 316**

Press retaining hook in direction of arrow and remove lock (1).

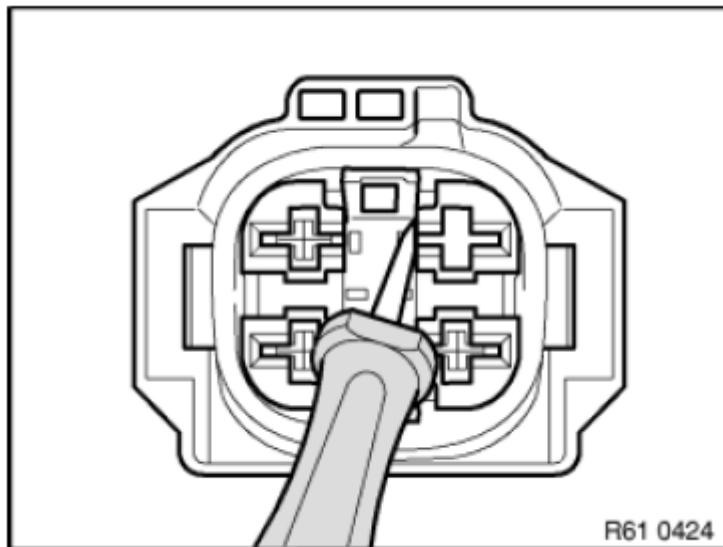


**Fig. 136: Pressing Retaining Hook**

Courtesy of BMW OF NORTH AMERICA, INC.

**Installation notes:**

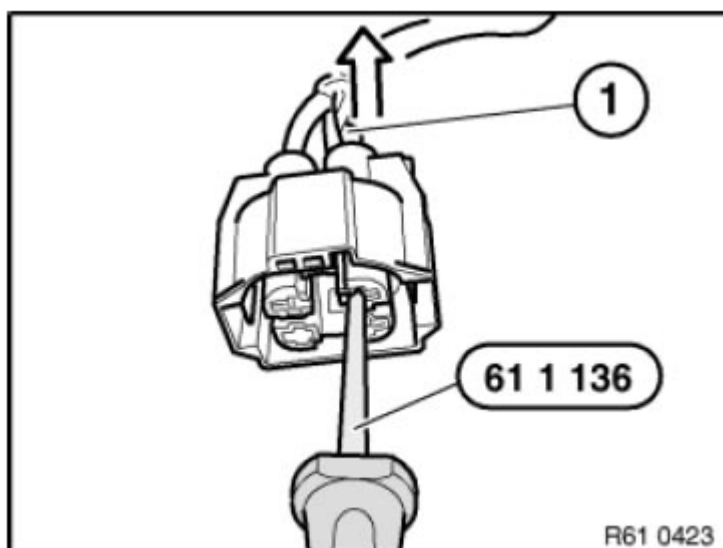
If necessary, side lock must also be unlocked with screwdriver.



**Fig. 137: Installing Side Lock Using Screwdriver**

Courtesy of BMW OF NORTH AMERICA, INC.

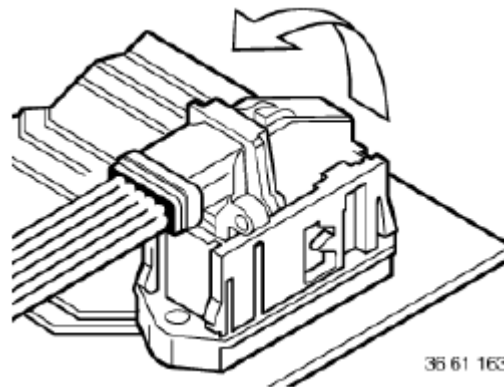
With special tool [61 0 316](#) (61 1 136), unlock contact and pull out cable with contact (1) towards rear.



**Fig. 138: Pulling Cable Contact Using Special Tool (61 1 136)**  
Courtesy of BMW OF NORTH AMERICA, INC.

61 13... In-line plugs, 6- to 50-pin, System Elo

Open lock.

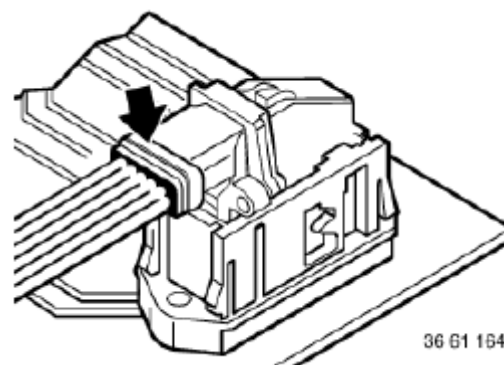


**Fig. 139: Opening Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach cable strap.

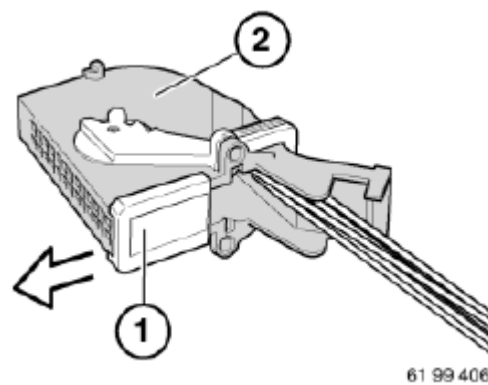
*Installation note:*

Cable strap must be reinstalled.



**Fig. 140: Locating Cable Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

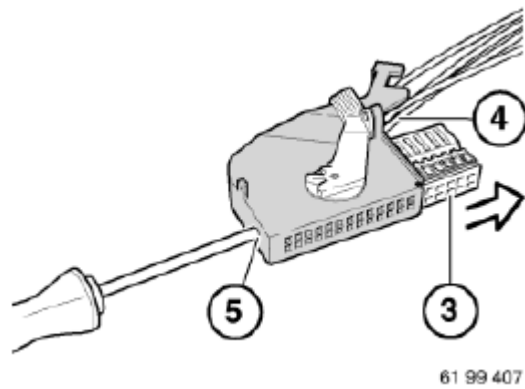
Detach catch (1) from connector housing (2).



**Fig. 141: Detaching Catch From Connector Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

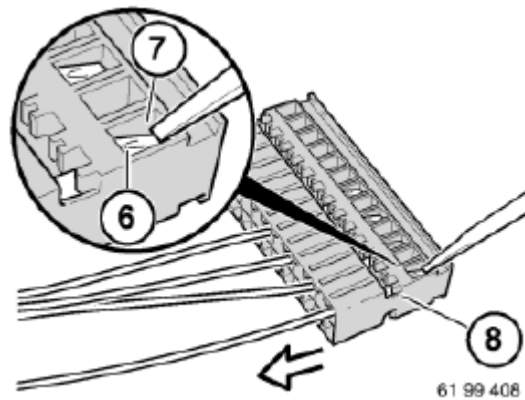
Press out contact carrier (3) with wiring harness (4) through opening (5).





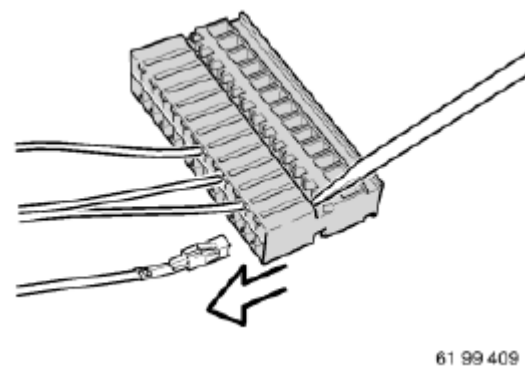
**Fig. 142: Pressing Contact Carrier With Wiring Harness Through Opening**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook (6) of defective contact and pull cable and contact up to secondary lock (8).



**Fig. 143: Holding Defective Contact Retaining Hook Using Screwdriver**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook once again in secondary lock (8) and pull cable and contact completely out of contact carrier.



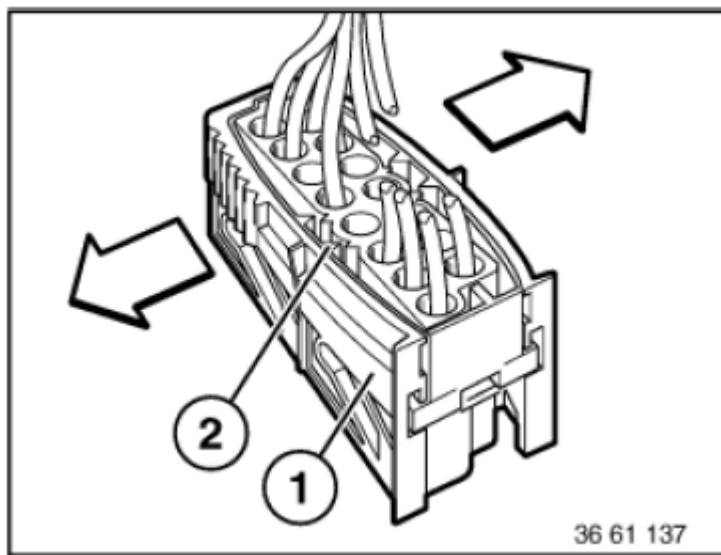
**Fig. 144: Holding Down Arrestor Hook In Secondary Lock**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... Inline connectors, 15-pin, System D2.5**

**Special tools required:**

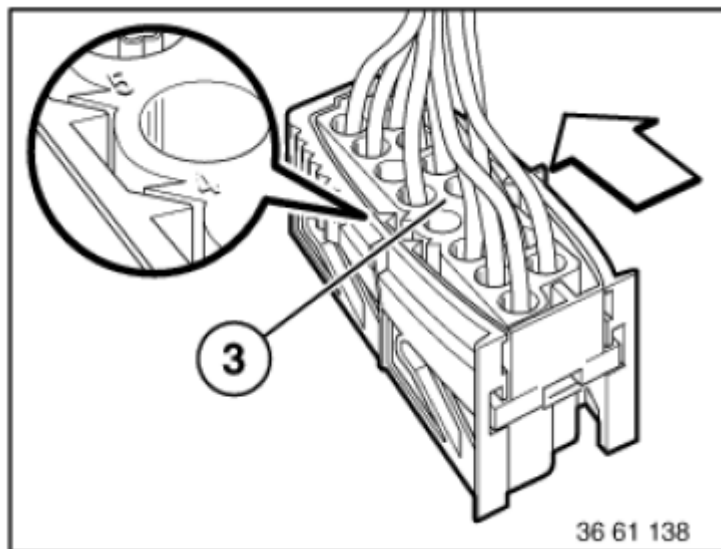
- 61 0 303

Carefully pull external connector (1) in area of retaining lugs (2) apart slightly.



**Fig. 145: Pulling External Connector Of Retaining Lugs**  
 Courtesy of BMW OF NORTH AMERICA, INC.

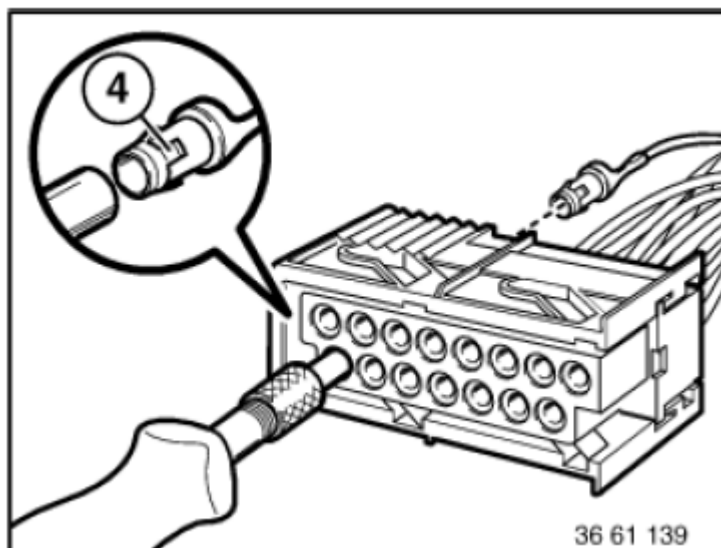
Pull internal connector (3) until limit position in direction of arrow.



**Fig. 146: Pulling Internal Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

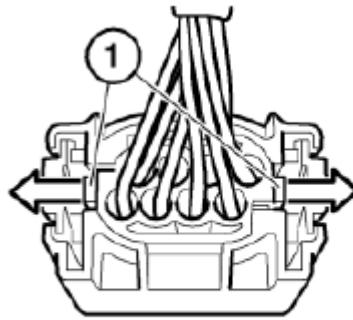
With special tool 61 0 303 press back retaining hook(4) of corresponding contact and pull out cable with contact.



**Fig. 147: Pressing Back Retaining Hook Using Special Tool (61 0 303)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... Inline connectors, 6-, 8-pin, System MQS**

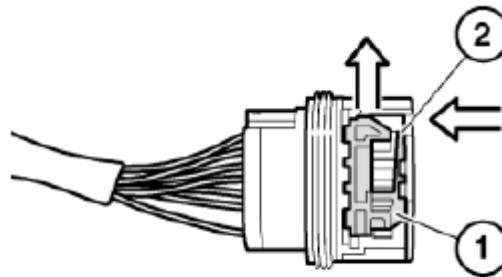
Press lock (1) in direction of arrow and slide connector forward.



F61 0415

**Fig. 148: Pressing Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

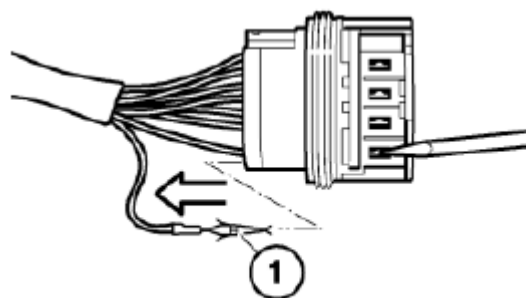
Press locking hook (2) downward and slide lock (1) out.



F61 0416

**Fig. 149: Pressing Locking Hook**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press down retaining hook (1) with screwdriver and pull out cable with contact towards rear.

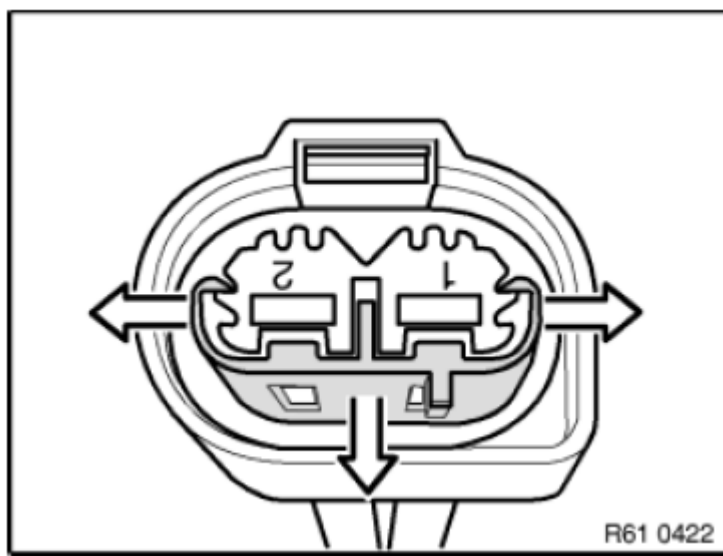


F61 0417

**Fig. 150: Pressing Down Retaining Hook Using Screwdriver**  
Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... Inline plugs, 2-pin, System MPQ 2.8**

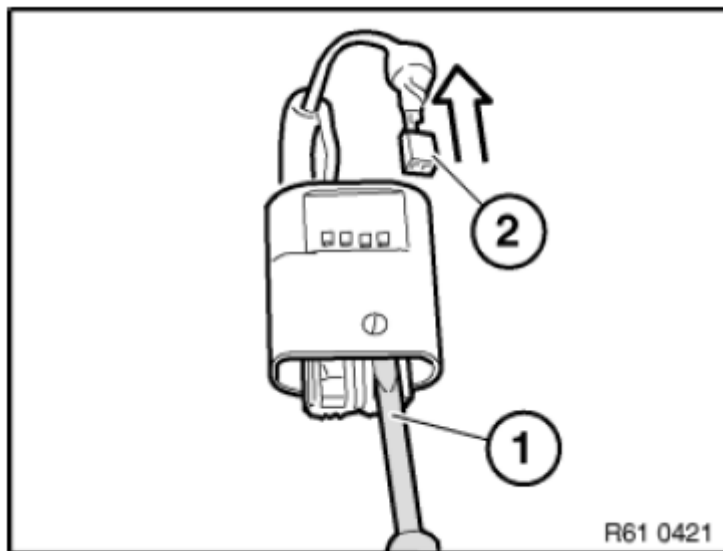
Press catch on outside in direction of arrow and remove towards top.



**Fig. 151: Pressing Catch On Outside**

Courtesy of BMW OF NORTH AMERICA, INC.

Press down retaining hook (1) with screwdriver and pull out cable and contact (2) towards rear.

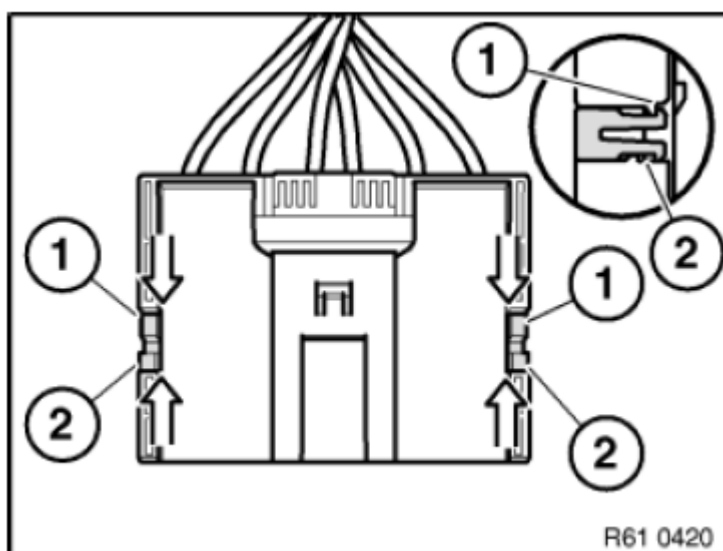


**Fig. 152: Pressing Down Retaining Hook Using Screwdriver**

Courtesy of BMW OF NORTH AMERICA, INC.

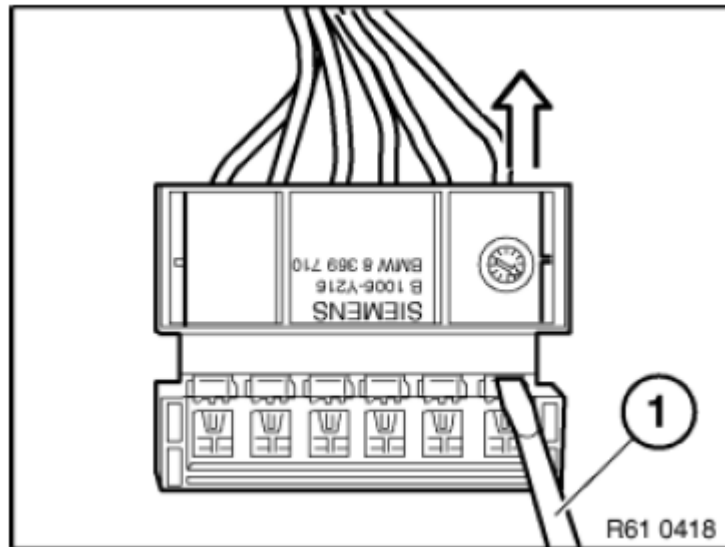
61 13... Inline plugs, 3-, 6-pin, System Elo-Power 2.8

Press locking hook (1) in direction of arrow and disengage. Then unlock locking hook (2) and remove lock.



**Fig. 153: Pressing Locking Hook**  
Courtesy of BMW OF NORTH AMERICA, INC.

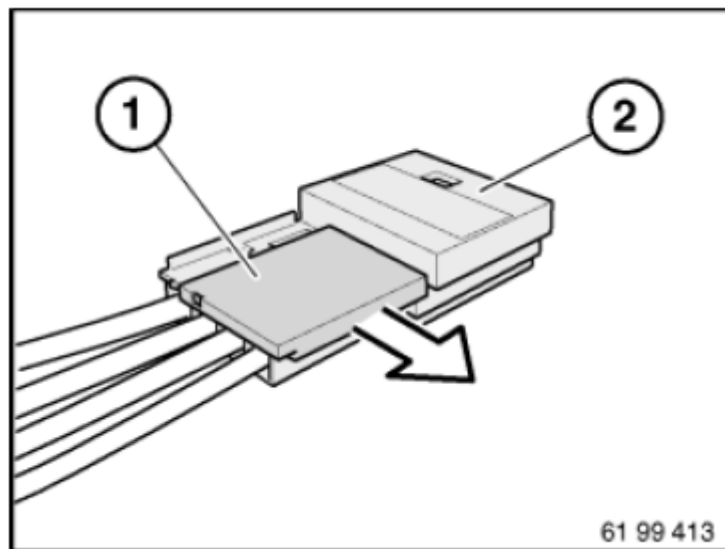
Press down retaining hook with screwdriver (1) and pull out cable with contact towards rear.



**Fig. 154: Pressing Down Retaining Hook Using Screwdriver**  
Courtesy of BMW OF NORTH AMERICA, INC.

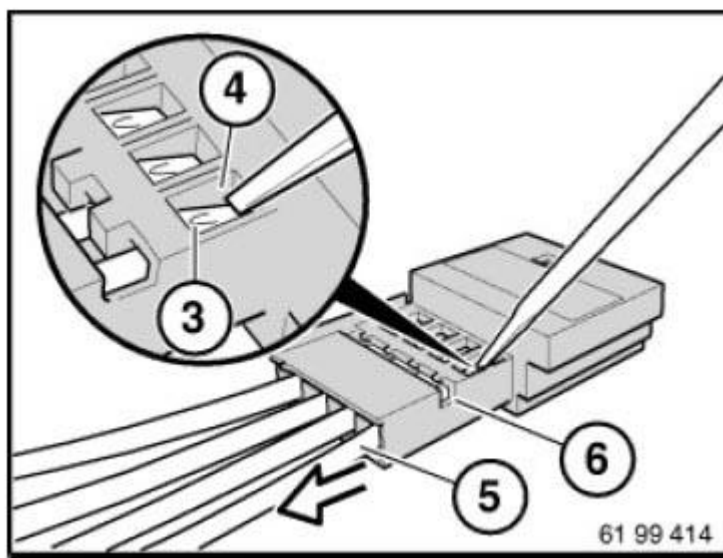
61 13... Inline plugs, 4-, 10-pin, System Elo

Detach fastener (1) from contact carrier (2).



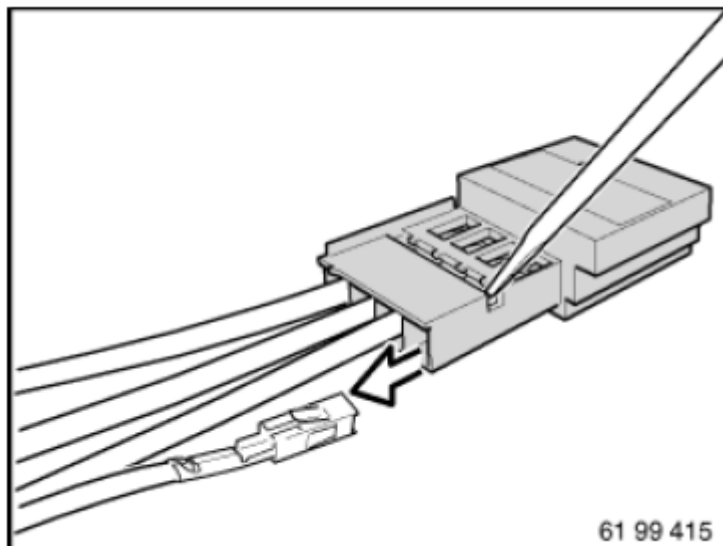
**Fig. 155: Detaching Fastener From Contact Carrier**  
Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook (3) of defective contact and pull cable and contact up to secondary lock (6).



**Fig. 156: Holding Defective Contact Retaining Hook**  
Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook once again in secondary lock and pull cable and contact completely out of contact carrier.



**Fig. 157: Holding Down Retaining Hook In Secondary Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

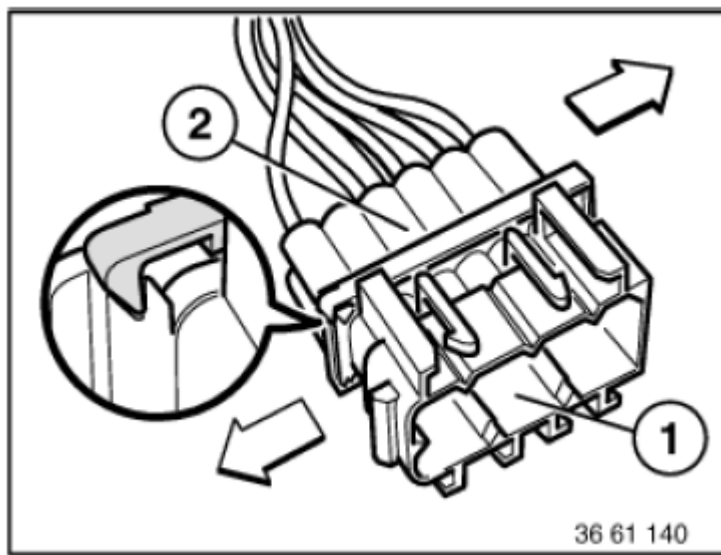
61 13... Inline plugs, 8-, 12-pin, System D2.5

**Special tools required:**

- 61 0 303

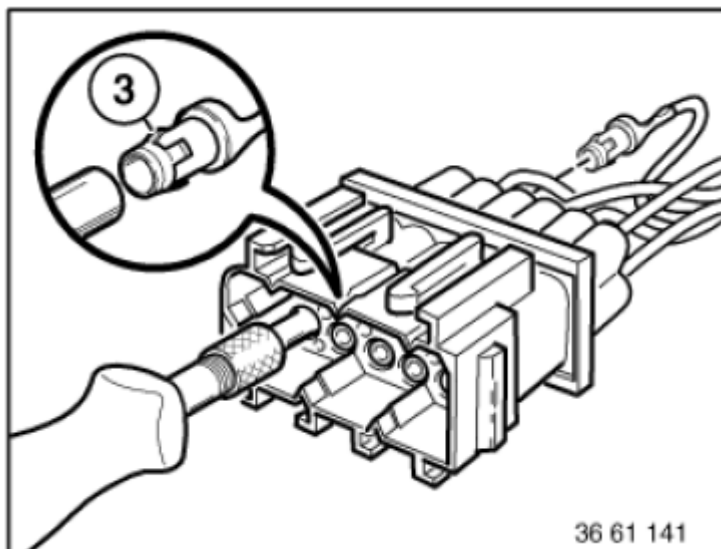
Move upper section of connector (1) and lower section of connector (2) against each other in direction of arrow.





**Fig. 158: Moving Connector Upper And Lower Section**  
 Courtesy of BMW OF NORTH AMERICA, INC.

With special tool 61 0 303, press down retaining hook (3) of corresponding contact and pull out cable with contact.



**Fig. 159: Pressing Down Retaining Hook Using Special Tool (61 0 303)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... Socket housing (radio connector), Hybrid System MQS/MPQ**

**Special tools required:**

- 61 0 314

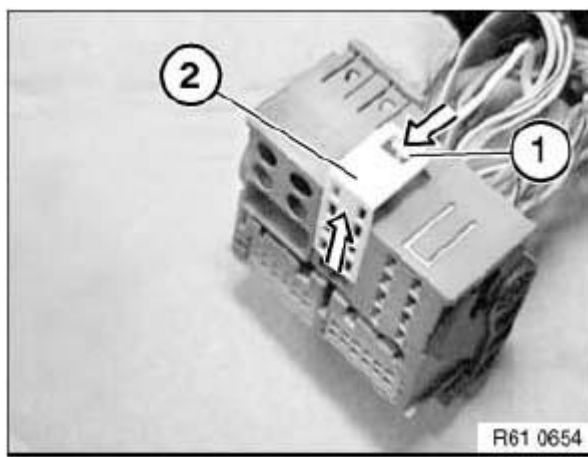
**Manufactured by AMP:** The following contact types without strand sealing can be fitted in the connector housings:

- MQS (Micro Quadlock System)
- MPQ, width 2.8 mm (Micro Power Quadlock)
- MPQ, width 5.2 mm (Micro Power Quadlock)

**Removing MPQ contacts from radio connector:**

Press lock (1) in direction of arrow.

Detach secondary lock (2) from radio plug.

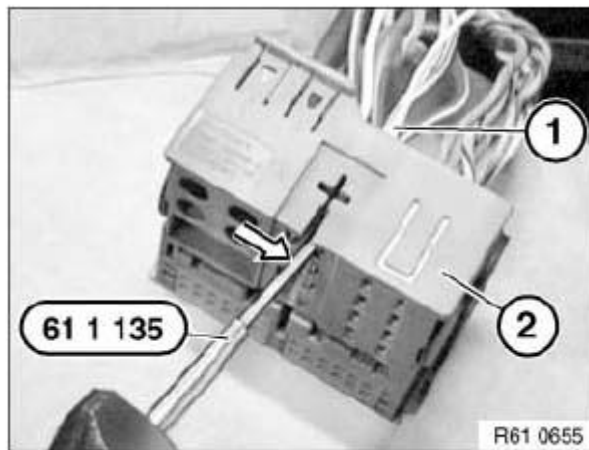


**Fig. 160: Detaching Secondary Lock From Radio Plug**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Feed special tool 61 0 314 (61 1 135) past side of contact.

Press special tool 61 0 314 (61 1 135) in direction of arrow.

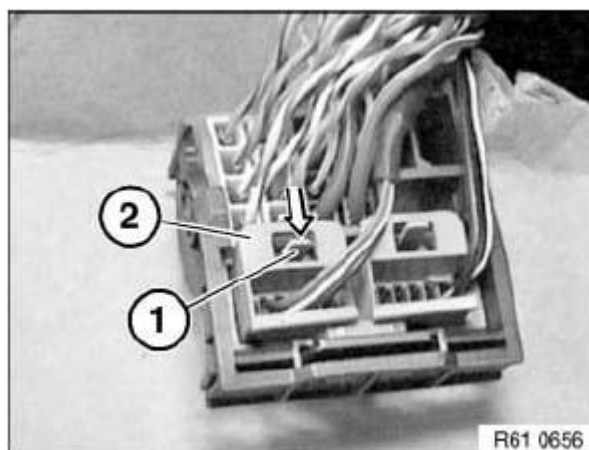
Pull wire (1) with socket contact out of radio connector (2).



**Fig. 161: Pulling Wire With Socket Contact Out Of Radio Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Removing MQS contacts from contact carrier:**

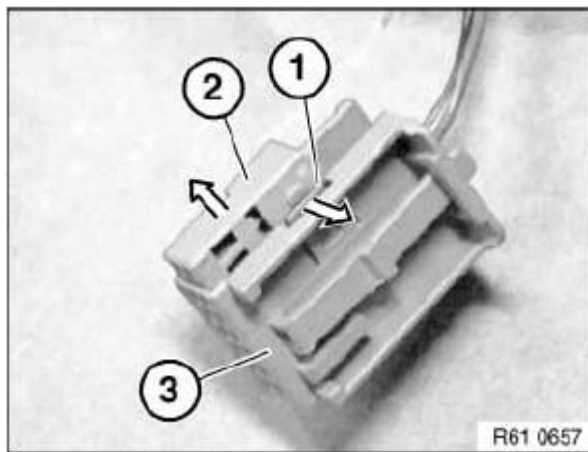
Press lock (1) in direction of arrow and pull housing (2) out of radio connector.



**Fig. 162: Pressing Lock**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Press lock (1) in direction of arrow. Pull contact carrier (2) out of housing (3).

**NOTE:** When the contact carrier is pulled out, the secondary locks of the socket contacts are raised.

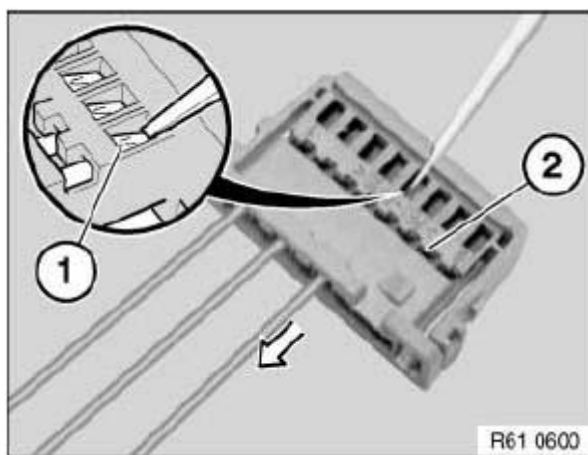


**Fig. 163: Pulling Contact Carrier Out Of Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Schematic diagram shows the 8-pin socket housing by way of example.

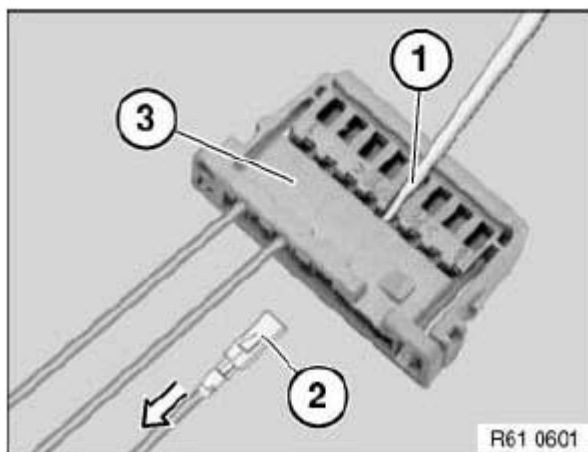
Hold down retaining hook (1) of socket contact in opening of contact carrier with a small screwdriver.

Pull wire with socket contact in direction of arrow as far as secondary lock (2).



**Fig. 164: Pulling Wire With Socket Contact**  
Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook in secondary lock (1) again. Pull wire with socket contact (2) out of contact carrier (3).



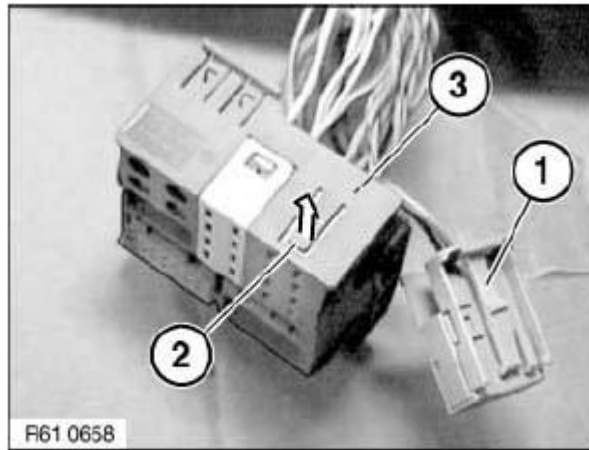
**Fig. 165: Pulling Cable With Socket Contact Out Of Contact Carrier**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Removing MPQ contacts from contact carrier:**

Remove contact carrier (1) with MQS contacts from radio connector.

Raise lock (2) on radio connector.

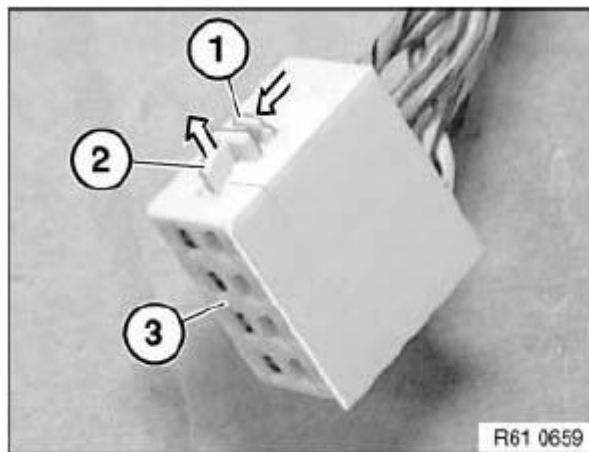
Pull contact carrier (3) out of radio connector.



**Fig. 166: Pulling Contact Carrier Out Of Radio Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press lock (1) in direction of arrow.

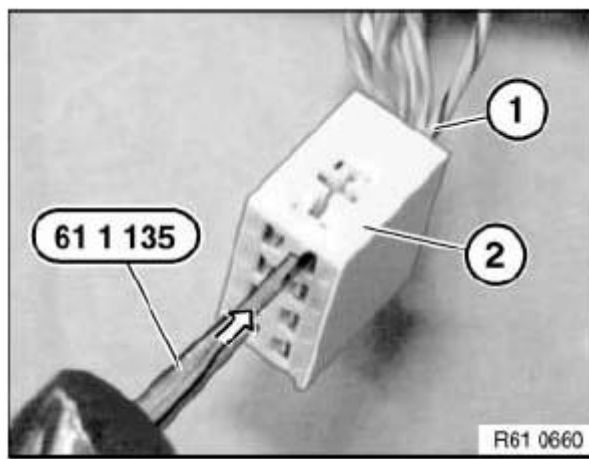
Pull secondary lock (2) in direction of arrow completely out of contact carrier (3).



**Fig. 167: Pulling Contact Carrier Secondary Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press special tool 61 0 314 (61 1 135) on inside of contact into contact carrier (2).

Pull wire with socket contact (1) out of contact carrier (2).



**Fig. 168: Pressing Special Tool (61 0 314) Into Contact Carrier**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... Socket housing 42-, 43-, 46-pin, Hybrid System MQS/MPQ**

**Special tools required:**

- 61 0 312

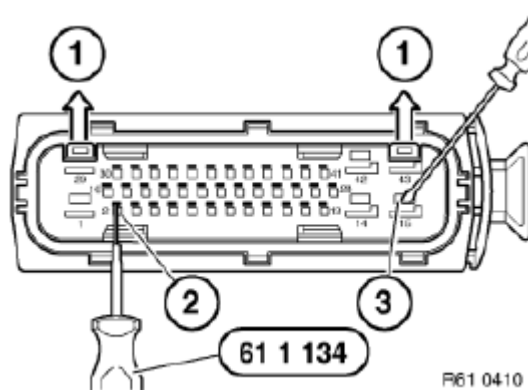
**Manufactured by AMP:** The following contact types without strand sealing can be fitted in the socket housings:

- MQS (Micro Quadlock System)
- MPQ, width 2.8 mm (Micro Power Quadlock)
- MPQ, width 5.2 mm (Micro Power Quadlock)

Open secondary locks (1) on socket housing.

Press back retaining hook of MQS contacts (2) with special tool 61 0 312 61 1 134 and pull out cable with contact.

Press back retaining hook of MPQ contacts (3) with screwdriver and pull out cable with contact.

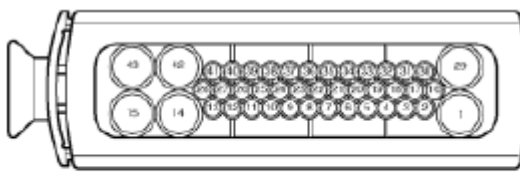


**Fig. 169: Opening Secondary Locks On Socket Housing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Bend open retaining hook of contacts gently before inserting into connector housing.

For installation of contacts, observe chamber numbers on reverse side of socket housing.



R61 0411

**Fig. 170: Identifying Cavity Numbers On Reverse Side Of Socket Housing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 13... Socket housings, 2x21-, 2x27-pin, Hybrid Systems MQS/MPQ, Elo/Elo Power**

**Manufactured by AMP:** The following contact types without strand sealing can be fitted in the socket housings:

- MQS (Micro Quadlock System)
- MPQ, width 2.8 mm (Micro Power Quadlock)
- MPQ, width 5.2 mm (Micro Power Quadlock)

**Manufactured by Siemens:** The following contact types without strand sealing can be fitted in the socket housings:

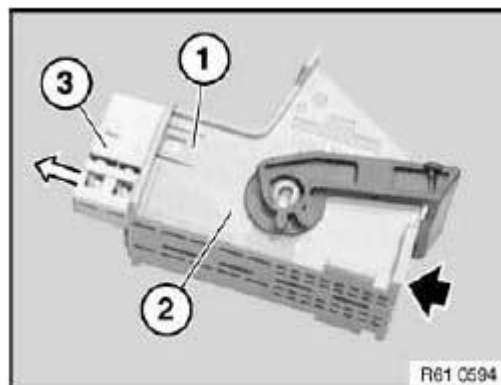
- Elo (electrical contact)
- Elo Power 2.8 mm width (electrical contact for heavy loads)
- Elo Power 5.2 mm width (electrical contact for heavy loads)

Raise lock (1) on housing (2).

Push contact carrier (3) from rear out of housing.

**NOTE:** The second contact carrier is pushed out in the same way.

Pushing out the contact carrier releases the secondary locks of the socket contacts.

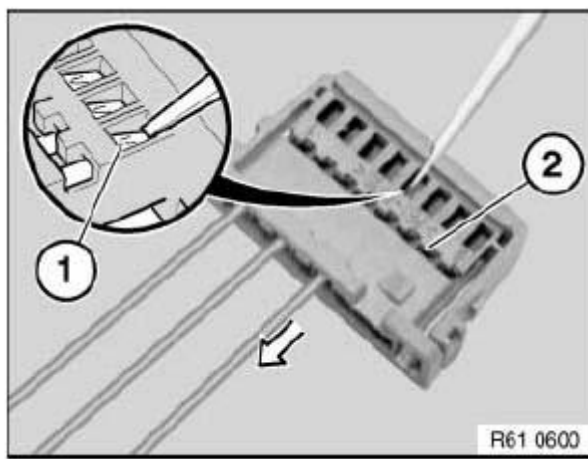


**Fig. 171: Pushing Contact Carrier From Rear Out Of Housing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook (1) of socket contact in opening of contact carrier with a small screwdriver.

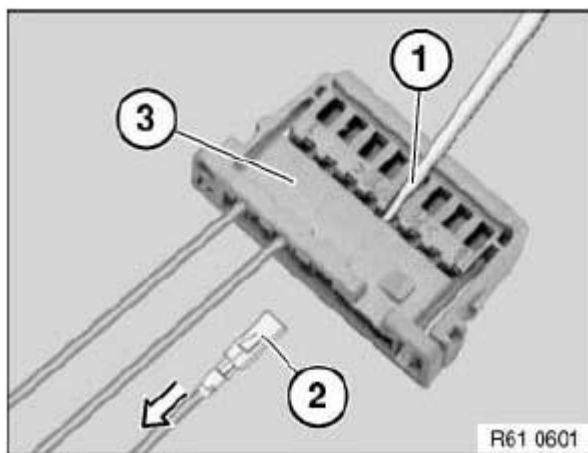
Pull wire with socket contact in direction of arrow as far as secondary lock (2).





**Fig. 172: Pulling Wire With Socket Contact**  
Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook in secondary lock (1) again and pull cable with socket contact (2) completely out of contact carrier (3).



**Fig. 173: Pulling Cable With Socket Contact Out Of Contact Carrier**  
Courtesy of BMW OF NORTH AMERICA, INC.

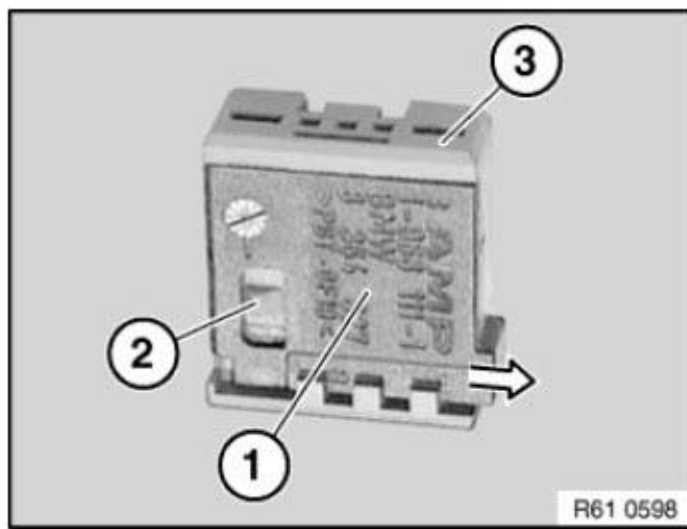
### 61 13... Socket housings, 5-pin, 8-pin, System MQS/MPQ

**Manufactured by AMP:** The following contact types without strand sealing can be fitted in the connector housings:

- MQS (Micro Quadlock System)
- MPQ, width 2.8 mm (Micro Power Quadlock)
- MPQ, width 5.2 mm (Micro Power Quadlock)

### Socket housing, 5-pin (Hybrid System MQS/MPQ)

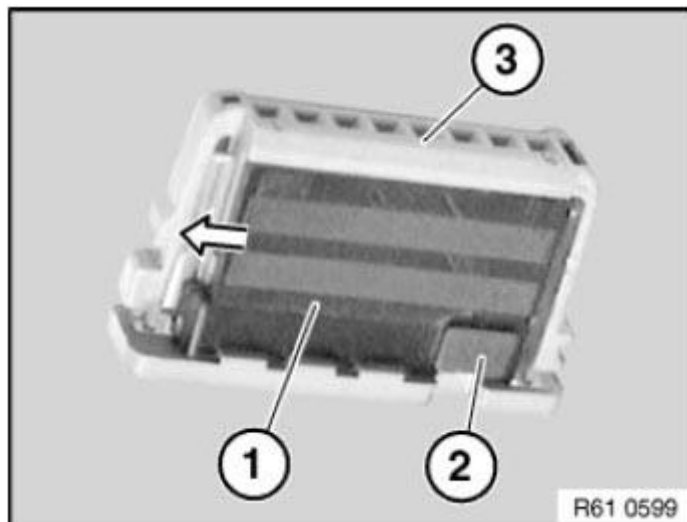
Raise fastener (1) over retaining lug (2) and pull off from contact carrier (3).



**Fig. 174: Pulling Contact Carrier (Socket Housing, 5-Pin)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

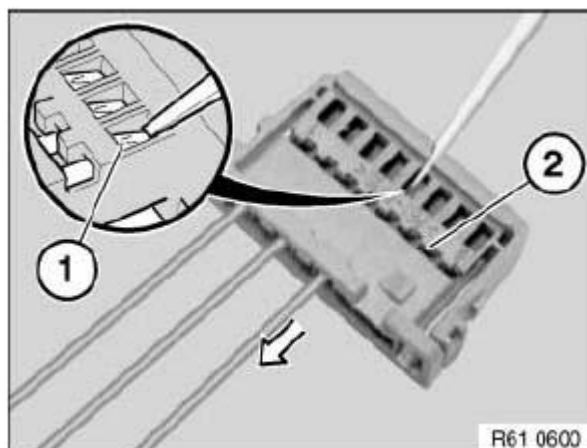
**Socket housing, 8-pin (MQS):**

Raise fastener (1) over retaining lug (2) and pull off from contact carrier (3).



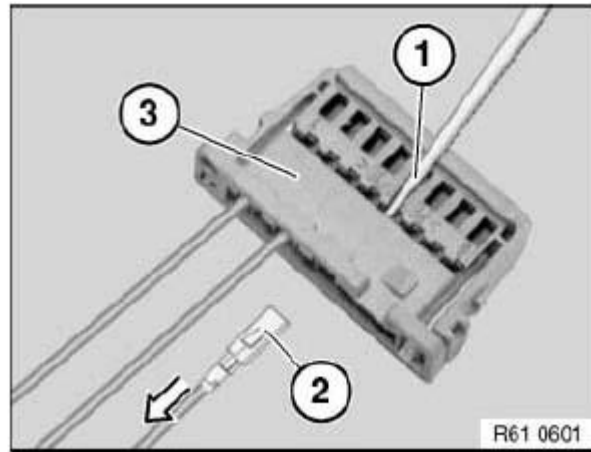
**Fig. 175: Pulling Contact Carrier (Socket Housing, 8-Pin)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook (1) of contact and pull cable with contact as far as secondary lock (2).



**Fig. 176: Pulling Wire With Socket Contact**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Hold down retaining hook in secondary lock (1) again and pull cable with contact (2) completely out of contact carrier (3).



**Fig. 177: Pulling Cable With Socket Contact Out Of Contact Carrier**

Courtesy of BMW OF NORTH AMERICA, INC.

### **61 13... BUTT CONNECTOR FOR REPAIRING A PLUG CONNECTION**

**Special tools required:**

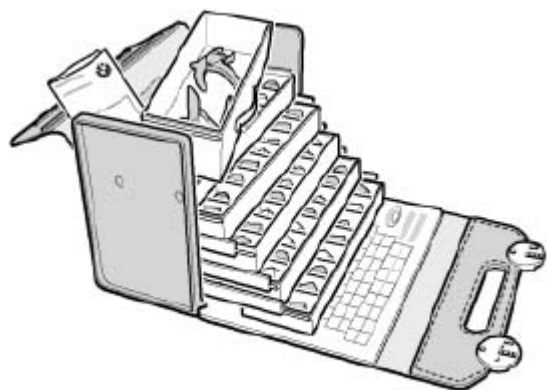
- 61 0 300
- 61 4 340
- 61 0 240

**IMPORTANT:**

1. Identify cause of damage (e.g. sharp-edged body components, faulty electrical loads, jammed mechanisms, corrosion caused by ingress of water, etc.).
2. Read out fault memory
3. Eliminate cause of damage.
4. Disconnect battery negative terminal
5. Make sure that no safety-related system according to circuit diagram (e.g. antilock braking system, active rear-axle kinematics, airbags, etc.) are influenced. Otherwise replace faulty wiring harness or use repair cable.
6. Carry out function test and read out fault memories again
7. Eliminate new faults if applicable and clear fault memories

**NOTE:**

**The repair range IV for vehicle electrical system contained the required special tools and individual parts for retrofitting and repair work with the aid of fan connectors. The case can no longer be ordered. Order individual parts for wiring harness repair via BMW parts catalogue.**

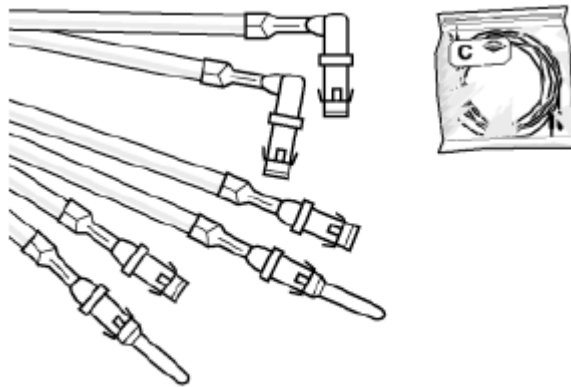


R61 0628

**Fig. 178: Identifying Special Tools Kit**  
Courtesy of BMW OF NORTH AMERICA, INC.

Choose repair kit.

Example: Repair kit, circular connector system D 2.5.

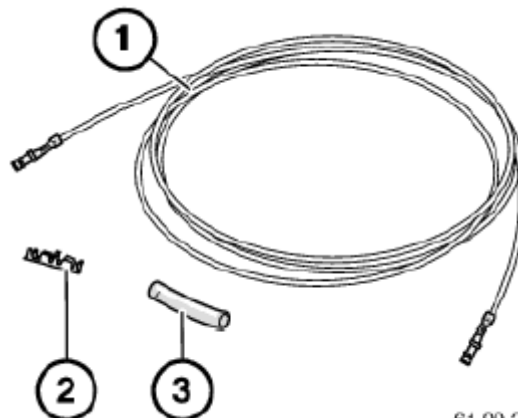


R61 99 257

**Fig. 179: Identifying Circular Connector And Repair Kit**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove following parts:

1. Pre-packaged end of cable with requisite wire cross-section
2. Crimp connector for selected wire cross-section
3. Shrink-fit hose



61 99 265

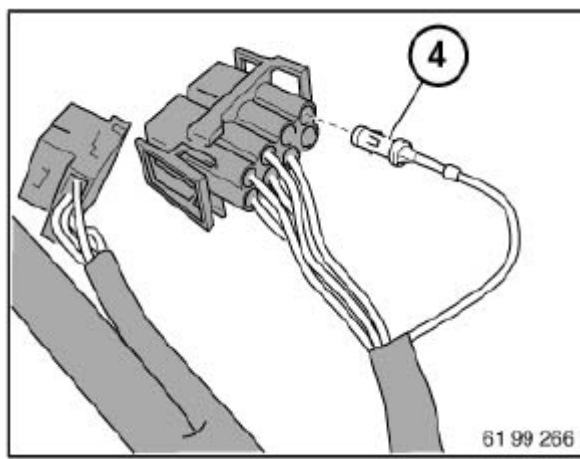
**Fig. 180: Identifying Cable End, Crimp Connector And Shrink-Fit Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open secondary lock on housing.

Mark damaged contact (4) with socket number of housing and press it out of housing using appropriate special tool contained in special tool set 61 0 300).

*See repair instructions:*

**NOTES FOR OPENING CONTACTS AND LOCKS OF DIFFERENT PLUG CONTACT SYSTEMS.**

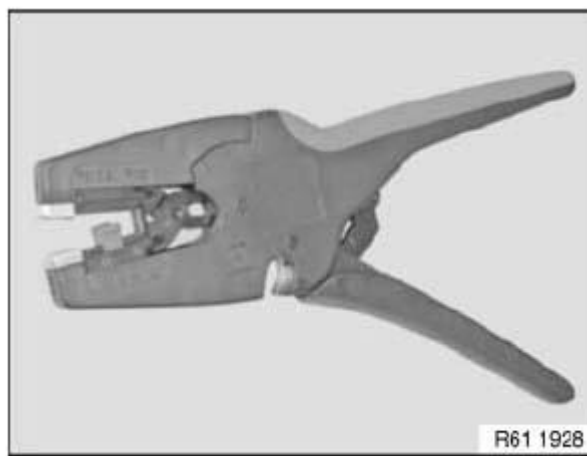


**Fig. 181: Identifying Cable Damage Contact**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- IMPORTANT:
- Check maximum length of repair cable
  - If more than one wire is to be repaired, the individual interfaces must be offset so that the wiring harness is not too thick at the repaired point.

Adhere to following procedure:

- Cut off wire with faulty contact at point which is easily accessible
- Strip insulation from end of wire at wiring harness end
- Cut preassembled wire end to length and strip insulation



**Fig. 182: Identifying Wire Stripper**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Refer also to repair instruction:*

**CUTTING TO LENGTH AND STRIPPING INSULATION FROM CABLES**

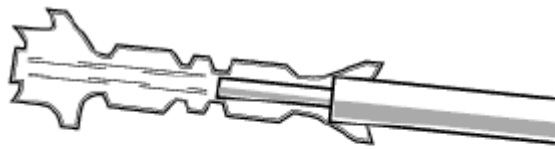
Crimp butt connector on preassembled wire end.

Special tools:

- 61 4 340 (0.35 - 2.5 sq mm)
- 61 0 240 (4.0 - 6.0 sq mm)

*See repair instructions:*

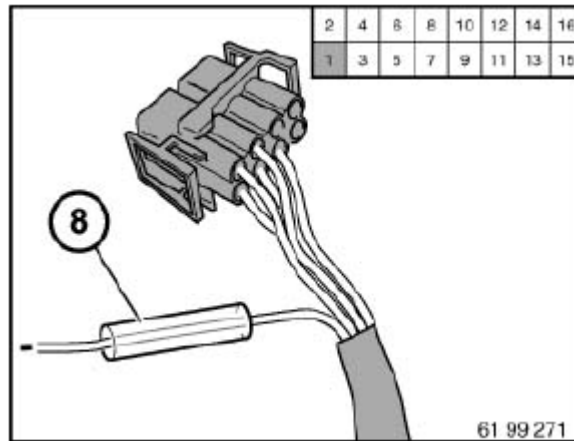
**CRIMPING ON STOP PARTS**



61 99 270

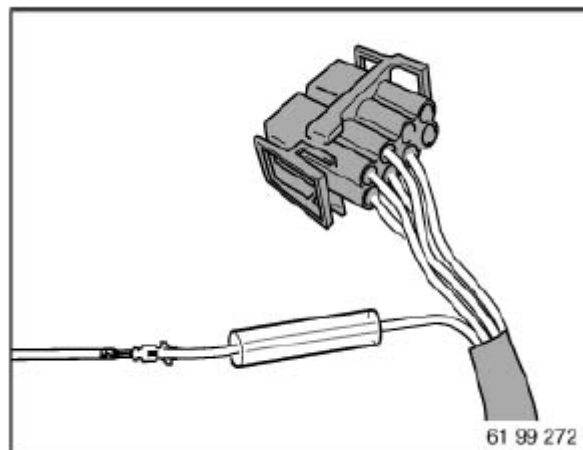
**Fig. 183: Identifying Butt Connector Crimp On Preassembled Wire End**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push shrink-fit hose (8) onto free wire end.



**Fig. 184: Identifying Free Wire End Shrink-Fit Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

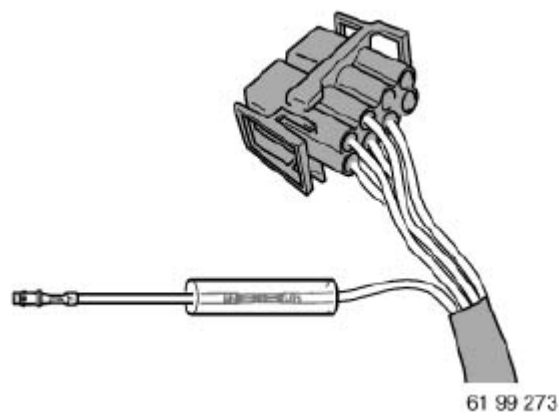
Crimp unused wire end to butt connector.



**Fig. 185: Identifying Crimp Unused Wire End To Butt Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull shrink-on sleeve over butt connector.





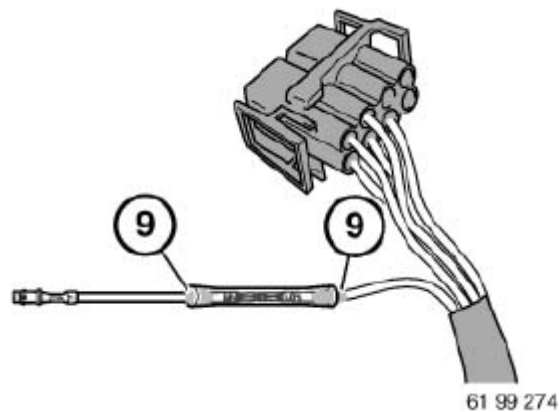
**Fig. 186: Pulling Shrink-On Sleeve Over Butt Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Do not burn shrink-on sleeve.

With hot air blower, shrink the shrink-on sleeve on both sides (9) of shrink-fit hose until glue emerges uniformly all round.

Insert contact in housing.

Close secondary lock on housing.



**Fig. 187: Identifying Butt Connector Shrink-On Sleeve**  
Courtesy of BMW OF NORTH AMERICA, INC.

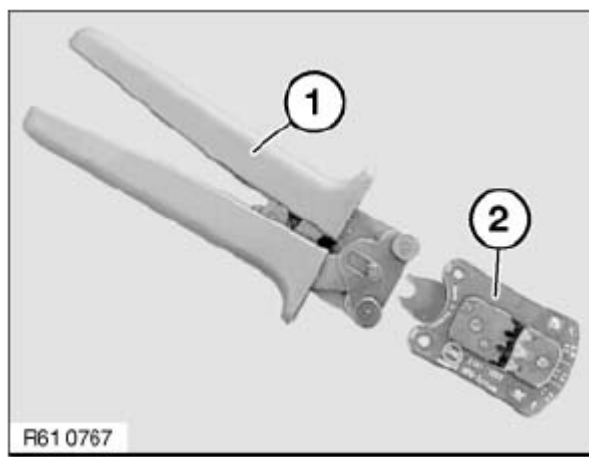
### **61 13... CRIMPING MICRO POWER QUADLOCK CONTACTS (MPQ)**

Special tools required:

- [61 4 320](#)

To crimp MPQ contacts, use hand pliers 61 4 321 (1) in conjunction with crimping head 61 4 325 (2) from crimping set [61 4 320](#) .

**NOTE:** Hand pliers (1) open automatically until limit position when handles are pressed together.



**Fig. 188: Crimping MPQ Contacts Using Hand Pliers (61 4 321)**

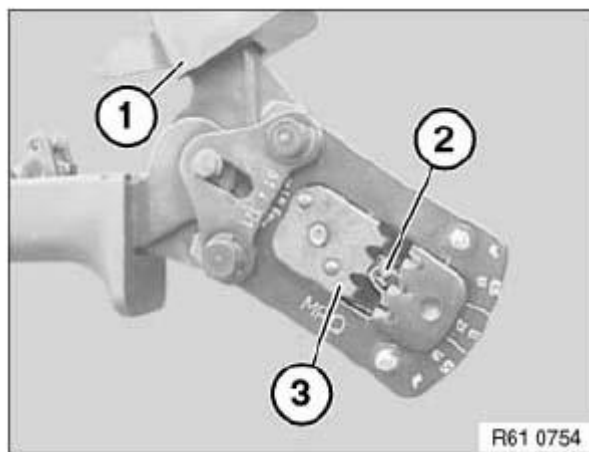
Courtesy of BMW OF NORTH AMERICA, INC.

Open hand pliers (1).

**NOTE:** Place contact (2) with utmost care in designated nest (observe line cross-section) in crimping head (3). Make sure it is exactly positioned.

Place MPQ contact (2) in crimping head (3).

Close hand pliers (1) one notch.



**Fig. 189: Identifying Hand Pliers With Crimping Head And MPQ Contact**

Courtesy of BMW OF NORTH AMERICA, INC.

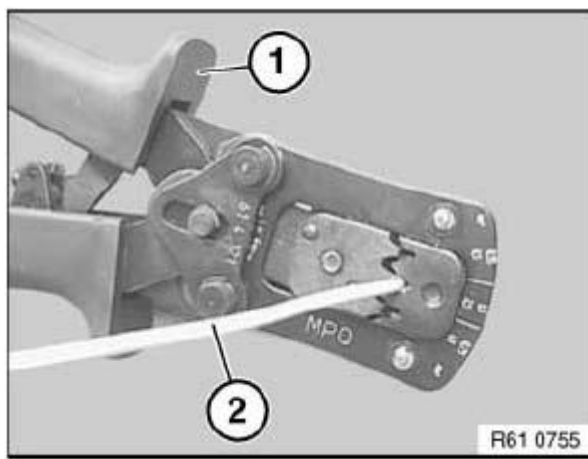
**NOTE:** Follow procedure for **CUTTING AND STRIPPING INSULATION** from cables.

Insert stripped cable (2).

Close hand pliers (1) fully.

Open hand pliers (1) and remove cable (2).

**IMPORTANT:** Check contact for correct crimping.



**Fig. 190: Inserting Stripped Cable Using Hand Pliers**  
Courtesy of BMW OF NORTH AMERICA, INC.

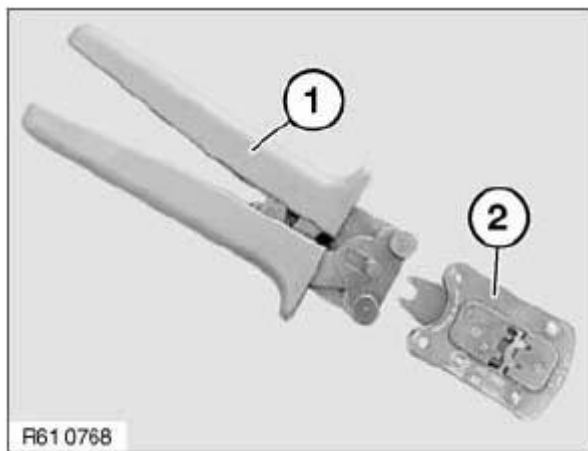
### **61 13... CRIMPING MICRO QUADLOCK SYSTEM CONTACTS (MQS)**

**Special tools required:**

- [61 4 320](#)

To crimp MPQ contacts, use hand pliers 61 4 321 (1) in conjunction with crimping head 61 4 324 (2) from crimping set [61 4 320](#).

**NOTE:** Hand pliers (1) open automatically until limit position when handles are pressed together.



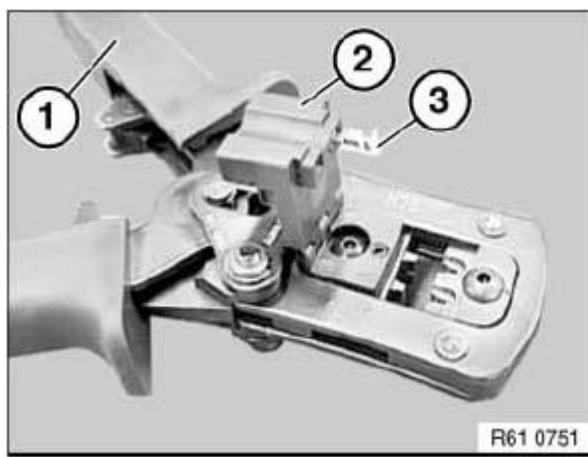
**Fig. 191: Crimping MPQ Contacts Using Pliers (61 4 321)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open hand pliers (1).

Fold up contact carrier (2).

Insert MQS contact (3) in contact carrier (2).

Fold back contact carrier (2).



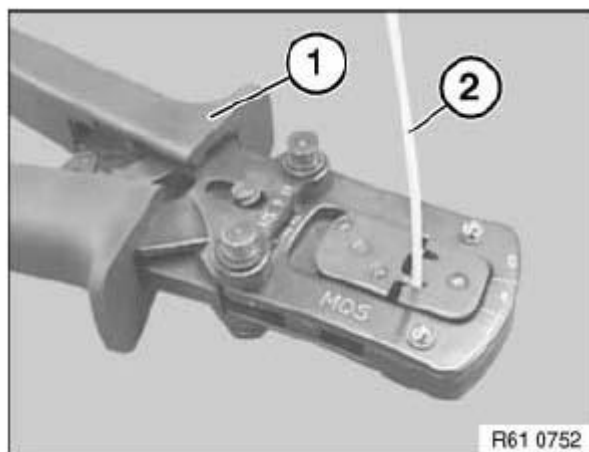
**Fig. 192: Identifying Hand Plier, Contact Carrier And MQS Contact**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Follow procedure for **CUTTING AND STRIPPING INSULATION** from cables.

Close hand pliers (1) one notch.

Insert stripped cable (2).

Close hand pliers (1) fully.

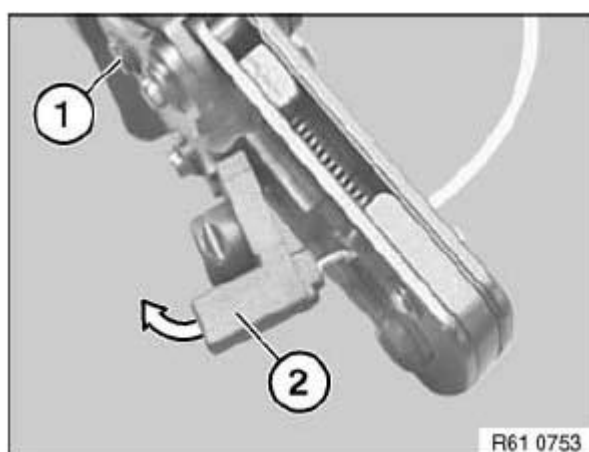


**Fig. 193: Inserting Stripped Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open hand pliers (1).

Open contact carrier (2) gently and carefully remove MQS contact.

**IMPORTANT:** Check contact for correct crimping.



**Fig. 194: Opening Contact Carrier**  
Courtesy of BMW OF NORTH AMERICA, INC.

### 61 13... CRIMPING ANNULAR CONTACTS

Special tools required:

- [61 4 320](#)

Crimping annular contacts:

Special tool [61 4 320](#)

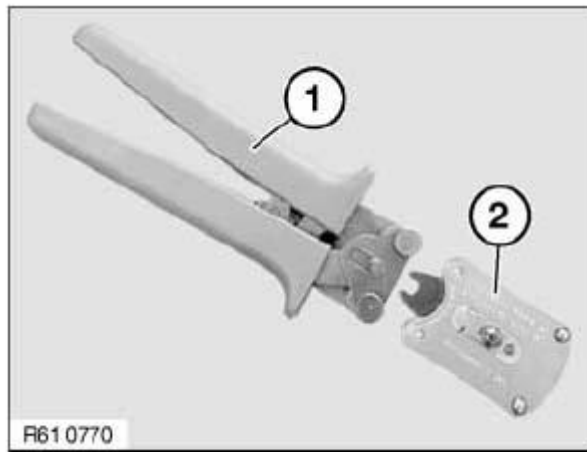
### 61 13... CRIMPING OPTICAL FIBRES

Special tools required:

- [61 4 320](#)

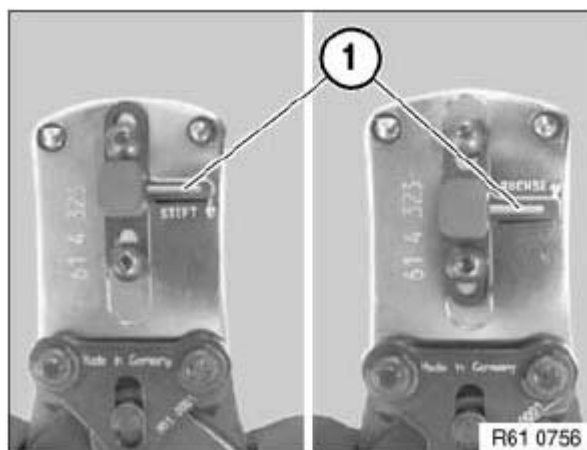
To crimp optical fibres, use hand pliers 61 4 321 (1) in conjunction with crimping head 61 4 323 (2) from crimping set [61 4 320](#).

**NOTE:** Hand pliers (1) open automatically until limit position when handles are pressed together.



**Fig. 195: Crimping Optical Fibers Using Hand Pliers (61 4 321).**  
Courtesy of BMW OF NORTH AMERICA, INC.

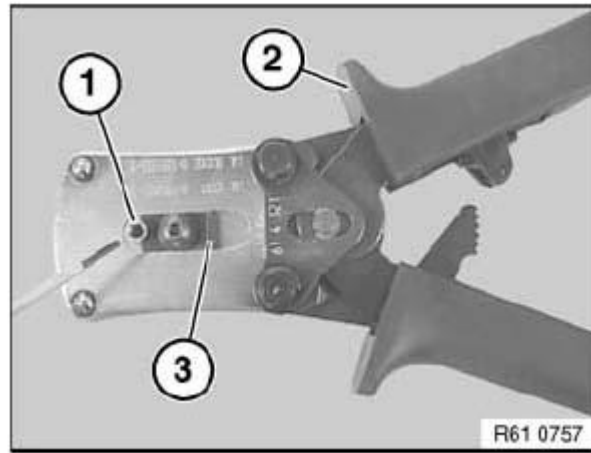
Move contact guide by means of stop lever (1) into corresponding position (pin contact or jack).



**Fig. 196: Identifying Crimping Head Stop Lever**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open hand pliers (2).

Place pin contact or jack (1) in crimping head and secure with locking lever (3).



**Fig. 197: Identifying Hand Pliers And Pin Contact/Jack**  
Courtesy of BMW OF NORTH AMERICA, INC.

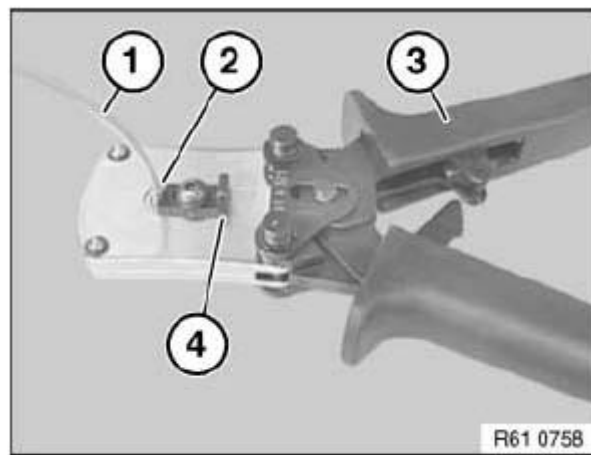
**NOTE:** Follow procedure for **CUTTING AND STRIPPING INSULATION FROM OPTICAL FIBRES.**

Insert stripped optical fibre(1) until limit position into pin contact or jack (2).

Close hand pliers (3) fully.

Open hand pliers (3) and locking lever (4).

Remove optical fibre (1).



**Fig. 198: Inserting Stripped Optical Fibre Into Pin Contact And Jack**  
Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Make sure optical fibre is correctly seated in jack.

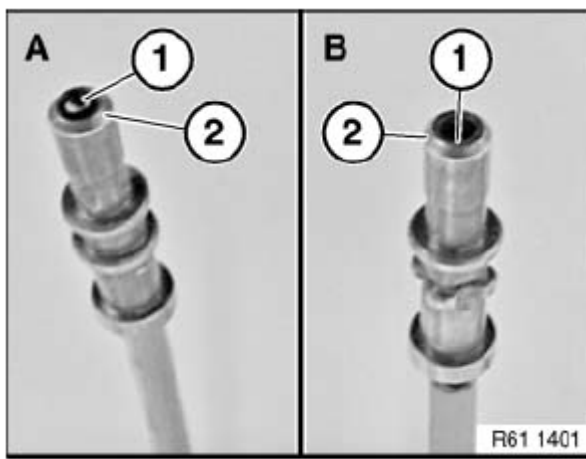
**Correct (A)**

End of optical fibre (1) must be flush with tip of pin contact (2).

**Wrong (B)**

End of optical fibre (1) is not flush with tip of pin contact (2).





**Fig. 199: Identifying Correct And Incorrect Optical Fiber Flushing With Pin Contact Tip**

Courtesy of BMW OF NORTH AMERICA, INC.

### **61 13... CRIMPING STOP PARTS**

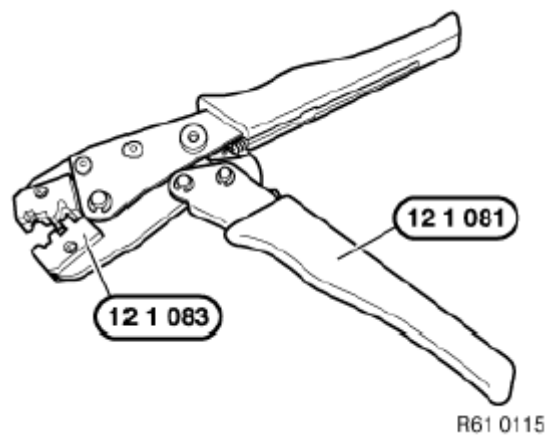
**Crimping contact sleeves for 4 mm<sup>2</sup> comb connectors and ignition cable contacts**

**Use special tool kit 12 1 080 to attach ignition cable contacts and crimp 4 mm<sup>2</sup> contact sleeves for comb connectors.**

- 12 1 081 (hand pliers)
- 12 1 083 (nest)

*See repair instructions:*

### **SPECIAL TOOLS FOR WIRING HARNESS REPAIRS.**



**Fig. 200: Crimping Contact Sleeves**

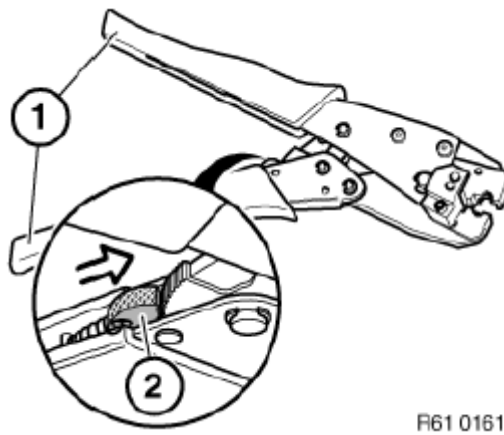
Courtesy of BMW OF NORTH AMERICA, INC.

Release special tool 12 1 081:

Squeeze grips (1) lightly and push release lever (2) in direction of arrow.

Or:

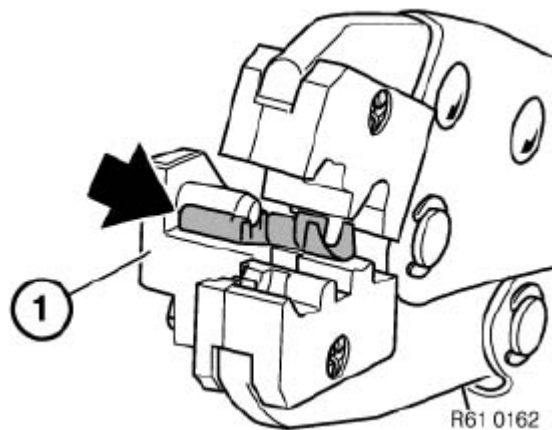
Compress handles until limit position, hand pliers unlock automatically.



R61 0161

**Fig. 201: Pushing Release Lever**  
 Courtesy of BMW OF NORTH AMERICA, INC.

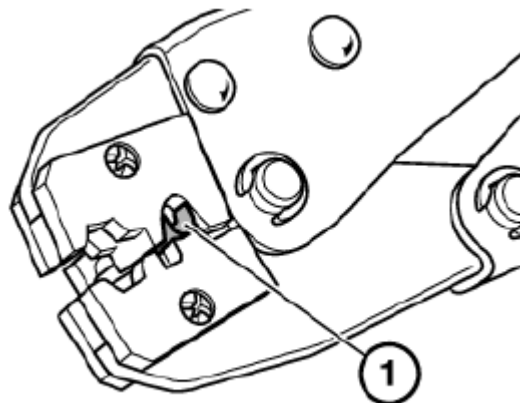
Place 4 mm<sup>2</sup> contact sleeve in nest with anti-twist safeguard (1) as far as possible.



R61 0162

**Fig. 202: Locating Anti Twist Safeguard**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Preload contact by squeezing matrix in crimping tool. Grip contact (1) firmly only, do not crimp.



R61 0163

**Fig. 203: Griping Contact Using Crimping Tool**  
 Courtesy of BMW OF NORTH AMERICA, INC.

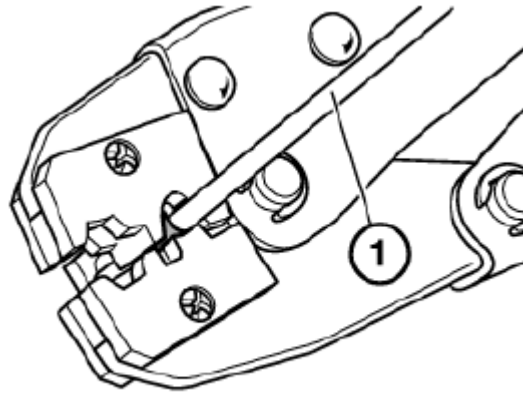
**NOTE:** Follow procedure for cutting and stripping insulation from cables.

Insert stripped end of wire (7) in the contact. Ensure insulation and stripped wire end are correctly laid in contact.

Compress crimping tool to limit position.

Crimping tool unlocks automatically.

Take contact out of crimping tool.



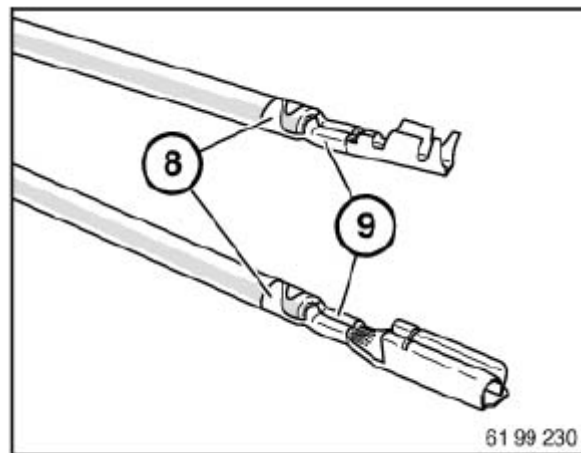
R61 0164

**Fig. 204: Inserting Stripped End Of Wire In Contact**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Checking crimping

Check insulation crimping (8) and wire crimp (9) against following illustrations to ensure crimps are correctly located.

**NOTE:** Illustration shows butt connectors and contact sleeves for comb connectors knocked on one side. The crimping procedure is identical here.



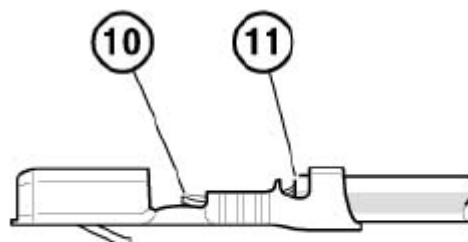
61 99 230

**Fig. 205: Checking Insulation Crimping And Wire Crimp**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Correct crimping:

Visible conductor end (10).

Visible insulation end (11).



61 99 231

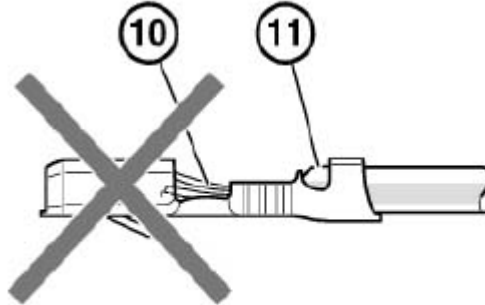
**Fig. 206: Identifying Conductor And Insulation End (Correct Crimping)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Incorrect crimping:**

Conductor end (10) inserted too far.

Insulation end (11) in wire crimp.

If necessary, repeat crimping with a new contact.



61 99 232

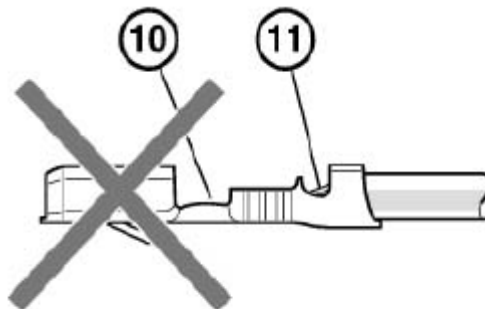
**Fig. 207: Identifying Conductor And Insulation End (Incorrect Crimping)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Incorrect crimping:**

Conductor end (10) not visible.

Insulation end (11) not visible.

If necessary, repeat crimping with a new contact.



61 99 233

**Fig. 208: Identifying Conductor And Insulation End (Incorrect Crimping)**  
Courtesy of BMW OF NORTH AMERICA, INC.

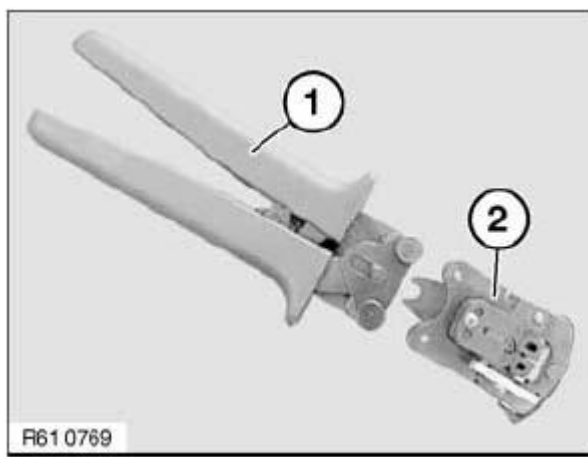
**CUTTING OFF, STRIPPING INSULATION AND CUTTING OPTICAL FIBRES TO LENGTH**

**Special tools required:**

- [61 4 320](#)

To cut off, strip insulation and cut optical fibres to length, use hand pliers 61 4 321 (1) in conjunction with crimping head 61 4 322 (2) from crimping set [61 4 320](#) .

**NOTE:** Hand pliers (1) open automatically until limit position when handles are pressed together.



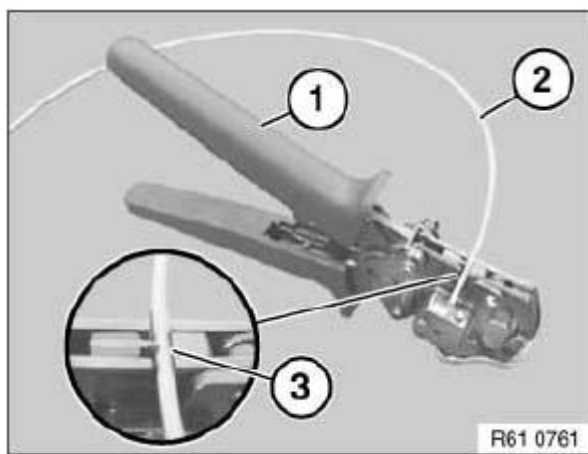
**Fig. 209: Identifying Hand Pliers And Crimping Head**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Cutting optical fibre**

Open hand pliers (1).

Place optical fibre (2) in cutting device (3).

Close pliers (1) and remove optical fibre (2).

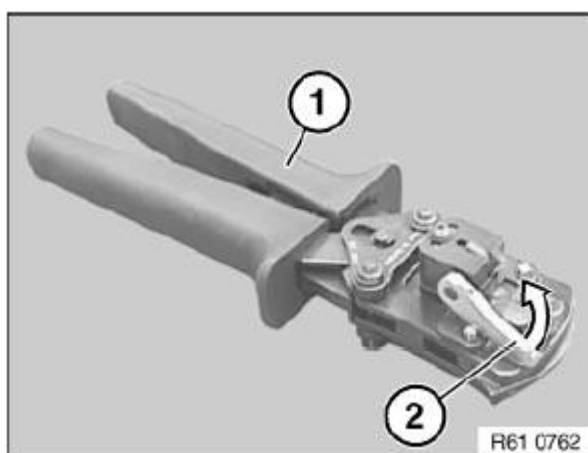


**Fig. 210: Cutting Optical Fibre Using Hand Pliers**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Stripping insulation from optical fibre**

Open hand pliers (1).

Open lever (2) in direction of arrow.



**Fig. 211: Opening Lever**

Courtesy of BMW OF NORTH AMERICA, INC.

Slide optical fibre (1) into stripping device (2) until flush at point (3).

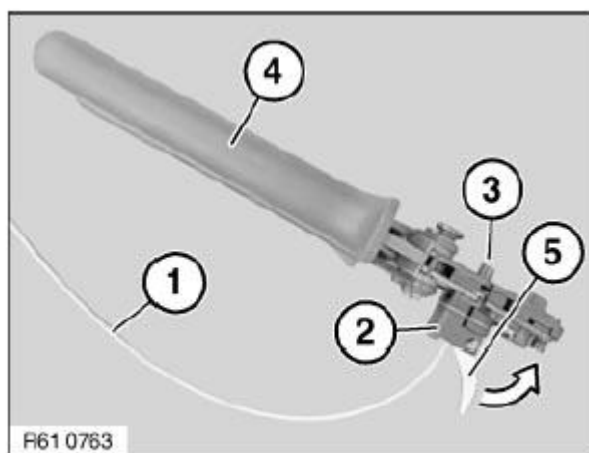
Close hand pliers (4) fully.

Close clamping lever (5) in direction of arrow.

Open hand pliers (4) by one tooth notch.

Open clamping lever (5) against direction of arrow again and remove optical fibre (1).

**NOTE:** A stripping replacement blade set is available under number 61 4 327.



**Fig. 212: Closing Clamping Lever**

Courtesy of BMW OF NORTH AMERICA, INC.

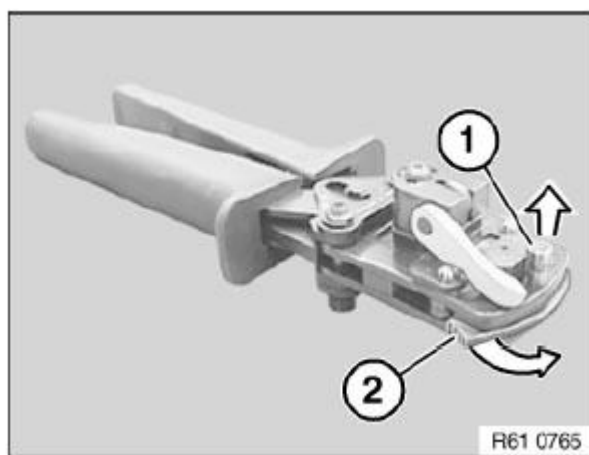
**Cutting optical fibre to length**

The cutting blade must be replaced prior to each cutting of the optical fibre.

Pull pin (1) in direction of arrow.

Fold up blade retaining link (2) in direction of arrow.

IMPORTANT:



**Fig. 213: Folding Blade Retaining Link**

Courtesy of BMW OF NORTH AMERICA, INC.

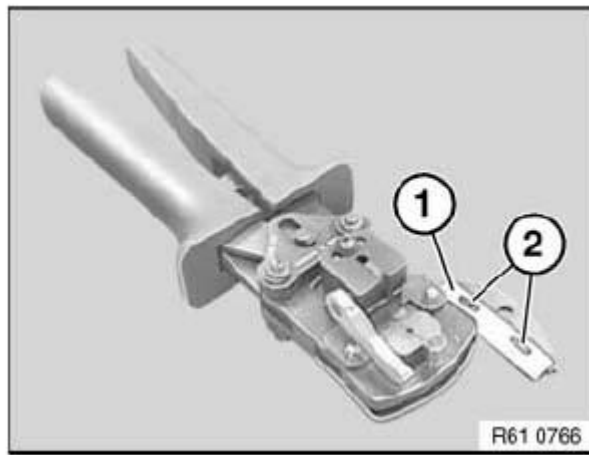
**WARNING:** Danger of injury when changing the blade.

Remove blade (1) and replace.

*Installation note:*



Make sure blade (1) is correctly seated on locating points (2).



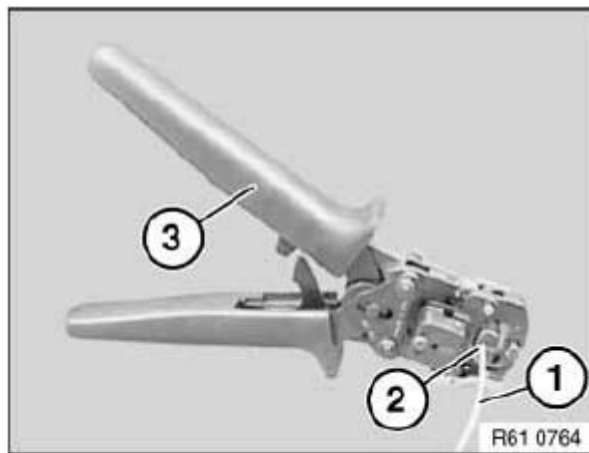
**Fig. 214: Identifying Blade And Locating Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open hand pliers (3).

Slide optical fibre (1) into cutting device (2) until insulation of optical fibre (1) butts against clamping fixture.

Close hand pliers (3) fully and keep closed.

Remove optical fibre (1).



**Fig. 215: Removing Optical Fibre**  
Courtesy of BMW OF NORTH AMERICA, INC.

### 61 13... CUTTING TO LENGTH AND STRIPPING INSULATION FROM CABLES

Stripped length:

Wire cross-section (mm <sup>2</sup> )	Stripped length (mm)
0.35... 0.50	4.0
0.75... 1.00	4.5
1.00... 2.50	5.0

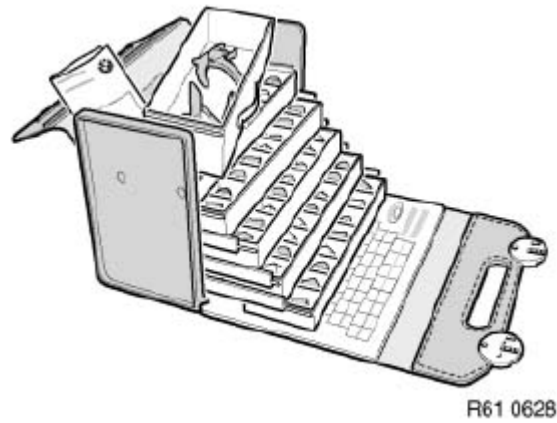
### 61 13... INSTALLING COMB CONNECTOR FOR RETROFITTING/REPAIRS

Special tools required:

- 61 9 041
- 61 9 042

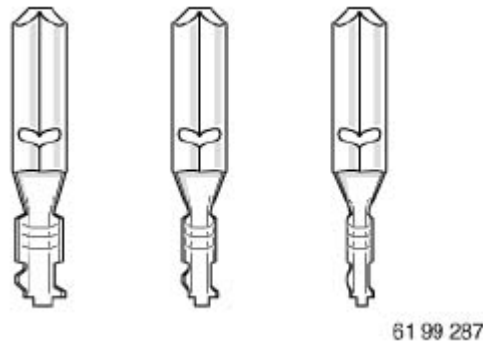
**NOTE:** The repair range IV for vehicle electrical system contained the required

special tools and individual parts for retrofitting and repair work with the aid of fan connectors. The case can no longer be ordered. Order individual parts for wiring harness repair via BMW parts catalogue.



**Fig. 216: Identifying Special Tools Kit**  
Courtesy of BMW OF NORTH AMERICA, INC.

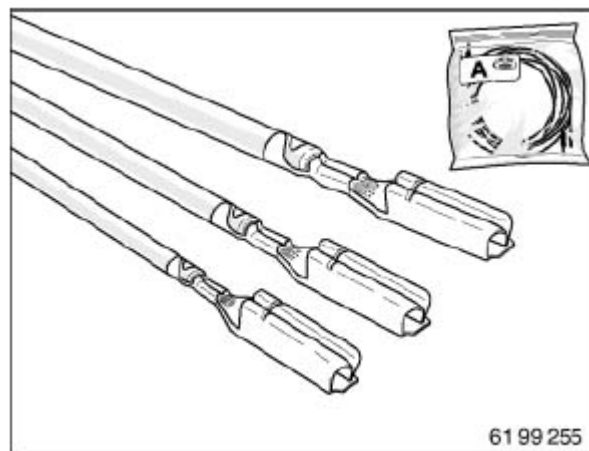
Choose contact sleeve (up to 4 mm<sup>2</sup>) in accordance with wire cross-section.



**Fig. 217: Identifying Comb Connector Contact Sleeve With Wire Cross-Section**  
Courtesy of BMW OF NORTH AMERICA, INC.

Alternatively:

Choose contact sleeves (up to 2.5 mm<sup>2</sup>) or comb connectors.



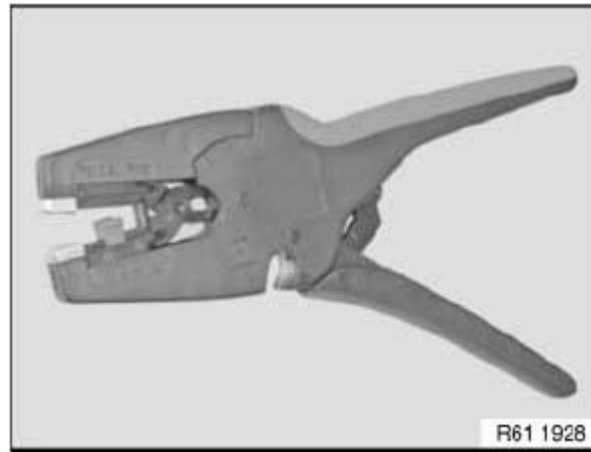
**Fig. 218: Identifying Comb Connector Contact Sleeves**  
Courtesy of BMW OF NORTH AMERICA, INC.

Cut through wire loop in wiring harness at established point.

Strip insulation from both wire ends.

See repair instructions.

## CUTTING TO LENGTH AND STRIPPING INSULATION FROM CABLES



**Fig. 219: Identifying Wire Stripper**

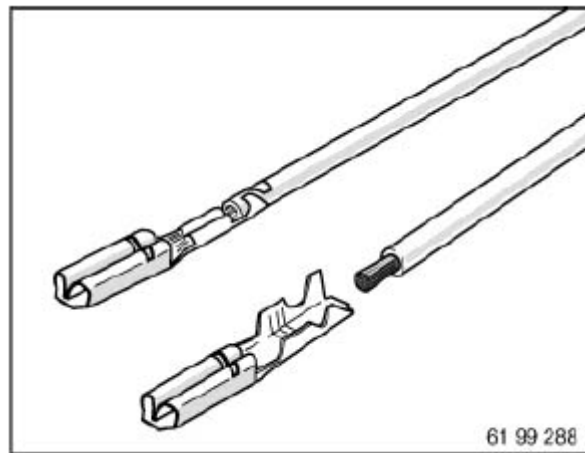
Courtesy of BMW OF NORTH AMERICA, INC.

Crimp contact sleeves on both wire ends.

See repair instructions:

## CRIMPING ON STOP PARTS

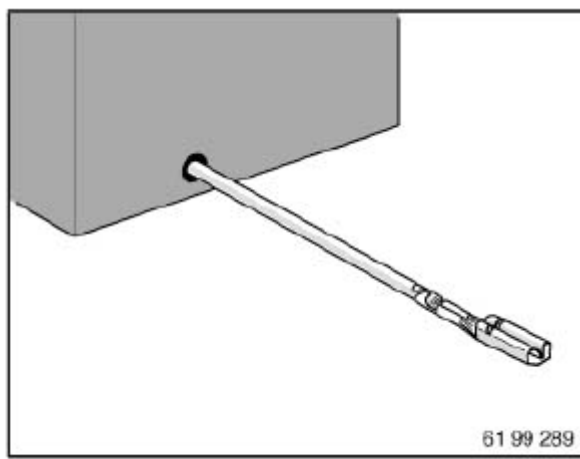
**NOTE:** If using repair kit for contact sleeves, refer to repair instructions: **BUTT CONNECTORS AND HEAT-SHRINK TUBING**



**Fig. 220: Identifying Connector Crimping Parts**

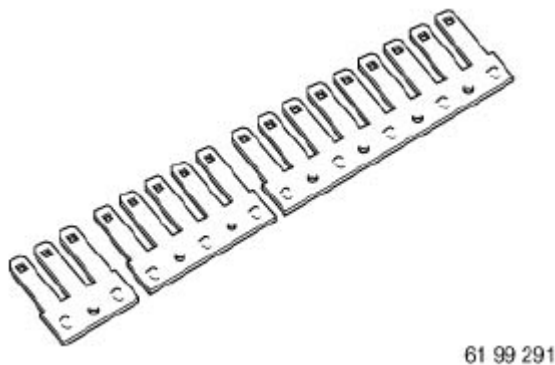
Courtesy of BMW OF NORTH AMERICA, INC.

Crimp connecting cable for retrofitting likewise with contact sleeve.



**Fig. 221: Crimping Connecting Cable For Retrofitting Likewise With Contact Sleeve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Cut required number of poles to length for comb connectors.

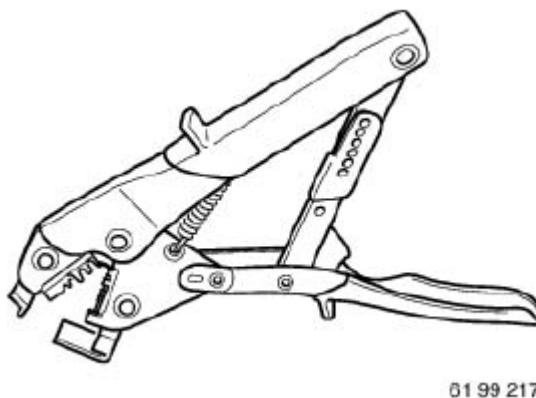


**Fig. 222: Cutting Required Number Of Poles To Length For Comb Connectors**  
Courtesy of BMW OF NORTH AMERICA, INC.

Special tool 61 9 041 (hand pliers) in conjunction with 61 9 042 (matrix) are used for pushing contact sleeves onto comb connectors.

*See repair instructions:*

### **SPECIAL TOOLS FOR WIRING HARNESS REPAIRS.**



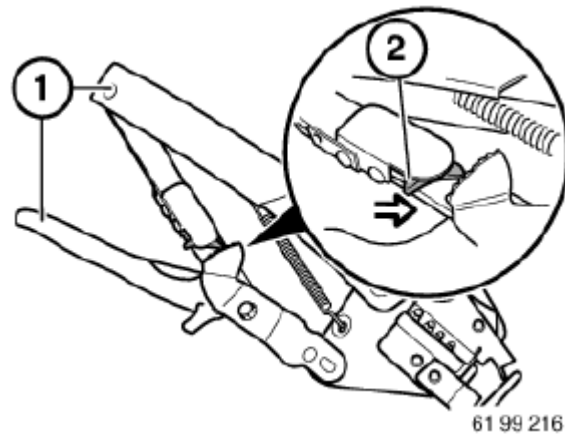
**Fig. 223: Identifying Hand Plier**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock special tool 61 9 041:

Squeeze grips (1) lightly and push release lever (2) in direction of arrow.

Or:

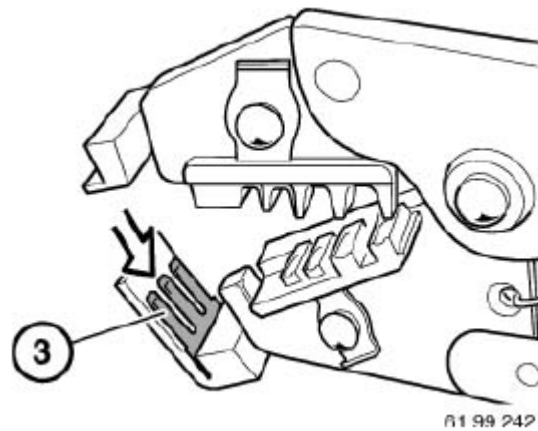
Compress handles until limit position, hand pliers unlock automatically.



**Fig. 224: Pushing Release Lever**

Courtesy of BMW OF NORTH AMERICA, INC.

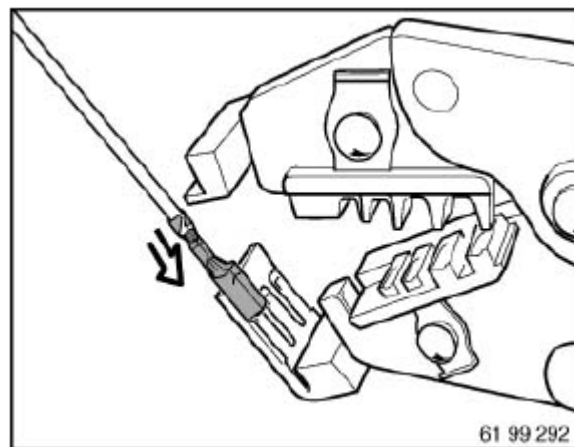
Insert prepared comb connectors (3) in special tool 61 9 041/61 9 042.



**Fig. 225: Inserting Comb Connectors In Special Tool (61 9 041)**

Courtesy of BMW OF NORTH AMERICA, INC.

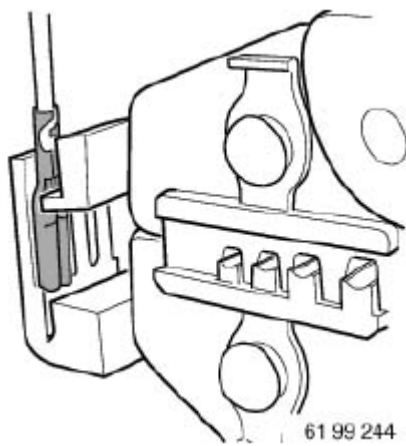
Attach wire with contact sleeve to comb connector.



**Fig. 226: Attaching Contact Sleeve Wire To Comb Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

Press hand pliers together and slide on contact sleeve until limit position.

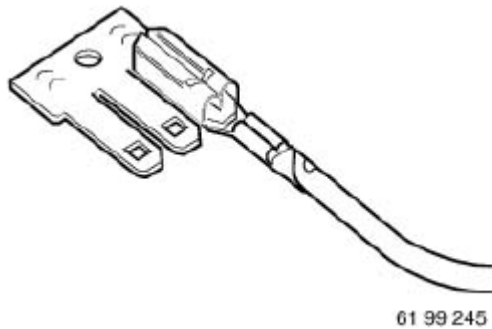


**Fig. 227: Pressing Hand Pliers And Contact Sleeve**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Once contact sleeves have been pushed on, they should not be detached again from the comb connector or reused.

Push on further contact sleeves for potential branching.

IMPORTANT:



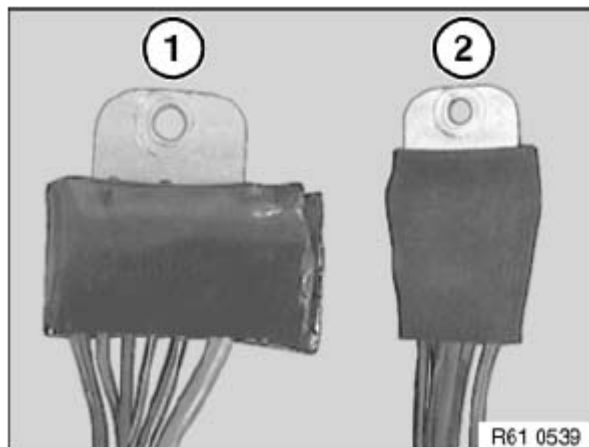
**Fig. 228: Identifying Comb Connector Contact Sleeves**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Installation in wet area (engine compartment, wheel arch):**

Apply sealing compound on both sides and press into contacts (1).

Fit heat-shrink tubing and heat up with hot air blower (2) (approx. 250 °C).

**NOTE:** Ensure that comb connector has sufficient contact surface on attachment point.  
 Do not heat-shrink tubing on edges of comb connector too strongly, risk of cracking.





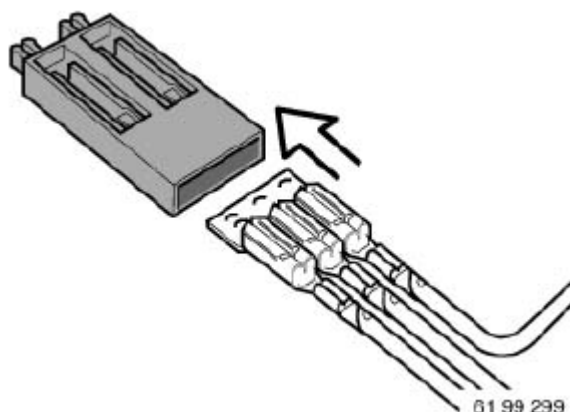
**Fig. 229: Identifying Contacts And Hot Air Blower**  
Courtesy of BMW OF NORTH AMERICA, INC.

Allow heat-shrink tubing to cool down until hand-warm. Then press sealing material again into contacts and onto edges of comb connector.

If necessary, carefully heat-shrink tubing again.

**Installation in dry area (interior, luggage compartment):**

Slide assembled comb connector into insulation housing until it locks into place.



**Fig. 230: Installing Assembled Comb Connector Into Insulation Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

**61 00... NOTES ON HANDLING OPTICAL FIBRES**

To avoid damage when handling optical fibres, comply with the following points:

- IMPORTANT:
- The minimum permitted bending radius is 25 mm
  - Do not subject optical fibres to compressive and tensile load
  - Protect optical fibres against the effects of heat  $\geq 85 \text{ }^{\circ}\text{C}$  (e.g. during welding work, drying work with infrared beams or hot air blower)
  - Fibre-optic cables are permitted to show only one junction point (bridge), replace fibre-optic cables if necessary

**NOTE:**

The optical fibres are colored differently as follows:

- Green = MOST (Media Oriented Systems Transport) optical fibre
- Yellow = ISIS (Intelligent Safety and Integration System) optical fibre
- Orange=repair fibre-optic cables

Follow notes for processing cables and optical fibres. See **CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH** and **CRIMPING OPTICAL FIBRES**.

**61 00... NOTES ON HANDLING WIRING HARNESES AND CABLES**

The following applies in general:

To avoid damage, observe the following instructions:

- Avoid compressive and tensile loads
- To ensure professional repairs, perform repair work only with BMW-approved or recommended special tools and spare parts
- Make sure cables are laid without kinks or abrasions

- Ensure non-contacting routing at sharp-edged body parts; use edge protection if necessary
- Secure additionally laid cables/leads with cable ties

### The following additionally applies

#### Shielded cables

Contact points in the shielding can cause problems with regard to noise radiation and interference immunity. Consequently, distinctions have to be drawn between the following types:

#### Coaxial cable

- Shielded coaxial cables RTK031 may only be repaired with a special crimping tool.
- For aerial lines only the bushing contact may be repaired.
- RG174 Lines and the bushing contact may not be repaired.

#### CVBS cables

- CVBS cables may not be repaired.
- CVBS cables must be replaced in their entirety.

#### HSD cables

- HSD cables may not be repaired.
- HSD cables must be replaced in their entirety.

#### Fibre-optic cables:

**NOTE:** Fibre-optic cables are colored differently as follows:

- **Green = MOST (Media Oriented Systems Transport) optical fibre**
- **Yellow = ISIS (Intelligent Safety Integration System) optical fibres**
- **Orange=repair fibre-optic cables**

#### IMPORTANT:

- Optical fibres are permitted to show only **one** junction point (bridge). Replace optical fibres if necessary
- Smallest permissible bending radius is 25 mm
- Avoid effects of heat  $\geq 85 \text{ }^{\circ}\text{C}$

Follow notes for processing cables and optical fibres. See [CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH](#) and [CRIMPING OPTICAL FIBRES](#).

#### FlexRay (twisted cables):

It is possible to repair the FlexRay. In the event of damage, the cables can be joined with conventional [BUTT CONNECTORS AND HEAT-SHRINK TUBING](#).

#### NOTE:

- **FlexRay lines may only reveal one separation point (bride); renew complete line if necessary.**
- **If possible, maintain twisted cable after repair.**
- **After repairs, twist cables as close as possible to the connector/separation point.**
- **Twisting must be as symmetrical as possible.**

#### Airbag lines:

## Replacement of wiring harnesses:

If after replacing wiring harnesses connectors remain, they should be sealed outside the vehicle interior, for example, with butyl tape so that moisture ingress can be eliminated permanently.

## 61 13... OPENING PLUG HOUSINGS AND REMOVING CONTACTS OF DIFFERENT PLUG SYSTEMS

### Special tools required:

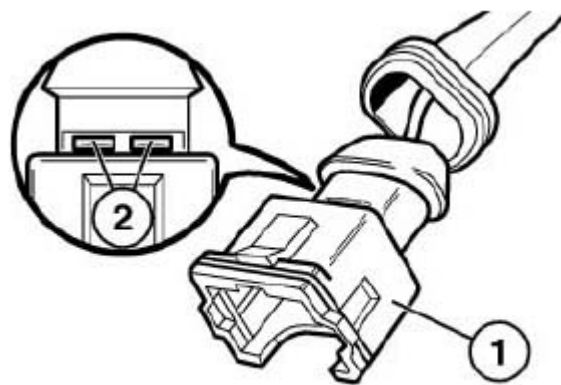
- 61 0 300
- 61 0 400
- 61 1 100
- 61 1 150

Abbreviations of contacts and what they mean:	
ELA	Strand seal
D 1.5/2.5/3.5	Round contacts with 1.5 mm, 2.5 mm or 3.5 mm diameter
MDK	Miniature double flat spring contact
JPT	Junior Power timer
DFK	Double flat spring contacts
Elo	Electronic contacts
Elo Power	Electronic contacts for heavy load
MQS	Micro Quadlock system
MPQ	Micro Power Quadlock
MLK	Mini laminated contact
SLK	Sensor laminated contact
MLK	Mini laminated contact
Mcon	Multi contact

IMPORTANT: The contacts can be changed on ultrasonically welded plugs (1).

Ultrasonically welded plugs (1) must be replaced completely.

Ultrasonic-welded connectors (1) can be identified by the welds (2) on their longitudinal side.



36 61 126

**Fig. 231: Identifying Ultrasonic-Welded Connectors**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Special tools referred to in the repair instructions below are contained in the following special tool kits:

- **Release and press-out tool 61 1 150 is replaced from 09/2005 by 61 0 300 (BMW) and 61 0 400 (MINI)**
- **Release and press-out tool 61 1 100 (engine)**

## **Repair instructions for opening plug housings and removing contacts of different plug systems:**

### **Plug system D 1.5/D 2.5:**

- Circular plugs, 7-, 8-pin, System D 2.5
- Circular plugs, 13-pin, System D 2.5
- Circular plugs, 20-pin, System D 2.5
- Circular plugs, 4-, 7-, 10-, 12-, 25-pin, System D 1.5/D 2.5
- In-line plugs, 15-pin, System D 2.5
- In-line plugs, 8-, 12-pin, System D 2.5
- In-line plugs, 30-pin, System D 2.5
- In-line plugs, 20-pin, System D 2.5

### **Plug system JPT/MDK/DFK:**

- In-line plugs, 2-pin, System JPT ELA
- In-line plugs, 2-pin, System MDK 3plus 2.8
- In-line plugs, 4-pin, System DFK ELA

### **Plug system Elo/Elo-Power:**

- In-line plugs, 4-, 10-pin, System Elo
- In-line plugs, 6- to 50-pin, System Elo
- In-line plugs, 3-, 6-pin, System Elo-Power 2.8

### **Plug system MQS/MPQ:**

- In-line plugs, 6-, 8-pin, System MQS
- In-line plugs, 2-pin, System MPQ 2.8
- Control unit plugs, 25-, 35-, 55-, 83-, 88-pin
- In-line plugs, 24-pin, Hybrid System MQS/MPQ
- Socket housing 42-, 43-pin, Hybrid System MQS/MPQ
- Socket housings 2x21-, 2x27-pin, Hybrid System MQS/MPQ, Elo/Elo-Power
- In-line plugs, 30-pin, Hybrid System MQS/MPQ
- Socket housings, 5-, 8-pin, System MQS/MPQ
- Socket housing (radio plug), Hybrid System MQS/MPQ

## **61 00... REPAIRING AIRBAG CABLES**

**IMPORTANT:** Only repair those cables which show visible signs of damage. In the event of visible damage, make sure there is only one cable repair in effect after the repair work. If no visible damage can be identified, the entire cable must be replaced. When carrying out repairs to the airbag wiring harness, you must use the spare parts available via BMW.

Safety regulations for **HANDLING COMPONENTS OF AIRBAG SYSTEM** .

**INSTRUCTIONS FOR DISCONNECTING AND CONNECTING BATTERY** .

### **In event of non-visible damage to wiring harness:**

Disconnect plug connection on airbag module or on adapter plug. It is absolutely vital to disconnect the contacts in succession as there is a risk of mixing up (similar parts). Cut through one cable after the other at an appropriate position, do not under any circumstances cut through both cables at the same time. Insulate

cables remaining in wiring harness with insulating tape. Now disconnect plug connection on airbag control unit. Unpin contacts. Cut through one cable after the other at an appropriate position and insulate with insulating tape, do not under any circumstances cut through both cables at the same time. Pin contacts of repair cable for airbag control unit in control unit plug, assignment of repair cables is relevant. Lay repair cable in vehicle parallel to existing airbag lead. Now pin in contacts for airbag control unit or contacts of adapter plug, assignment of repair cables is relevant. Cut off excess length of repair cable in proximity (visible area) of airbag module or of adapter plug. Twist open cables. With the butt connectors and heat-shrink tubings obtained via BMW, reconnect the cables with the same cable colors. Twist cables again, open length (twist) must not exceed 40 mm. Secure interface (heat-shrink tubing) with insulating tape to prevent cables from twisting open.

Instructions for cutting off, insulating, crimping cables, installing and removing contacts:

### CUTTING OFF AND INSULATING CABLES.

### REPAIRING A PLUG CONNECTION USING BUTT CONNECTORS.

### INSTALLING AND REMOVING CONTACTS.

#### **In event of visible damage:**

Expose cable at damaged areas. Cut through one cable after the other at an appropriate position and insulate cables no longer required in wiring harness with insulating tape, do not under any circumstances cut through both cables at the same time. Now, depending on the scope of work, unpin contacts either on airbag control unit/airbag module or on adapter plug. Cut off unpin cables. Insulate cables remaining in wiring harness with insulating tape. Now pin in contacts of repair cable, assignment of repair cables is relevant. Lay repair cable in vehicle parallel to existing airbag lead up to separation point. Cut off excess length of repair cable. Twist open cables. Connect cables with butt connectors and heat-shrink tubings obtained via BMW, assignment of repair cables is relevant. Twist cables again, open length (twist) must not exceed 40 mm. Secure interface (heat-shrink tubing) with insulating tape to prevent cables from twisting open.

Instructions for cutting off, insulating, crimping cables, installing and removing contacts:

### CUTTING OFF AND INSULATING CABLES.

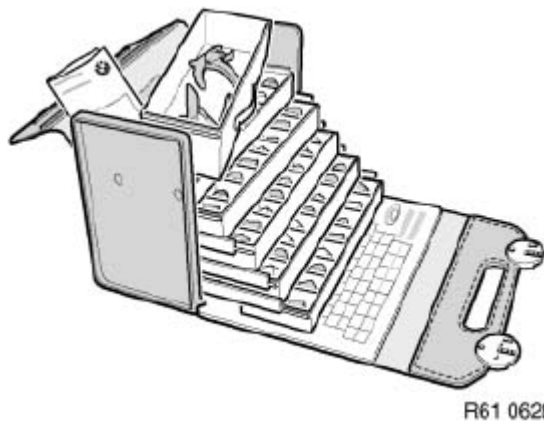
### REPAIRING A PLUG CONNECTION USING BUTT CONNECTORS.

### INSTALLING AND REMOVING CONTACTS.

## **61 13... SPECIAL TOOLS FOR WIRING HARNESS REPAIRS**

#### **Special tools required:**

- 61 0 300
- 61 0 400
- 61 1 100
- **61 4 320**
- 61 0 200
- 61 0 210
- **61 0 220**
- 61 0 230
- 61 0 240



**Fig. 232: Identifying Special Tools Kit**

Courtesy of BMW OF NORTH AMERICA, INC.

**Release and press-out tool:**

- Special tool 61 0 300
- Special tool 61 0 400 (MINI N12/N14)
- Special tool 61 1 100 (engine)

**Handling:**

- See **NOTES FOR OPENING CONTACTS AND LOCKS OF DIFFERENT PLUG CONTACT SYSTEMS**



**Fig. 233: Identifying Special Tools Kit**

Courtesy of BMW OF NORTH AMERICA, INC.

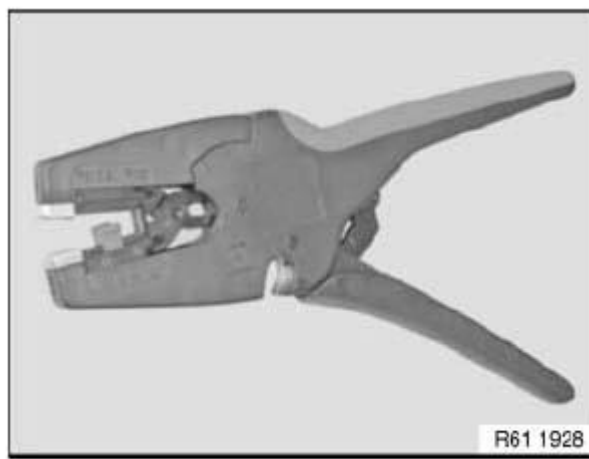
**Cutting to length and stripping insulation from cables:**

Wire stripper MultiStrip10

**Handling:**

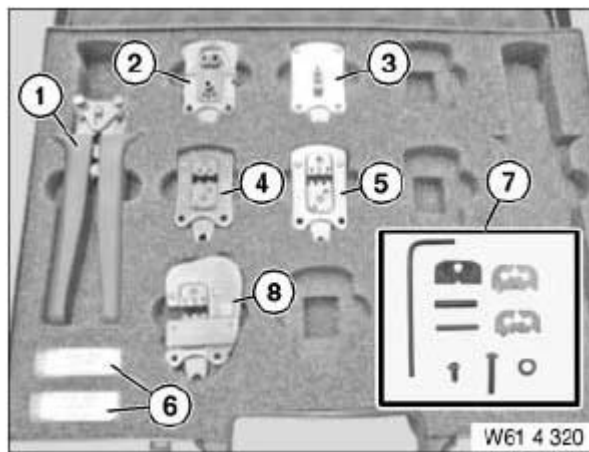
- **CUTTING CABLES TO LENGTH AND STRIP INSULATION**





**Fig. 234: Identifying Wire Stripper**

Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 235: Identifying Crimping Stop Parts (Small Contacts) And Butt Connectors**

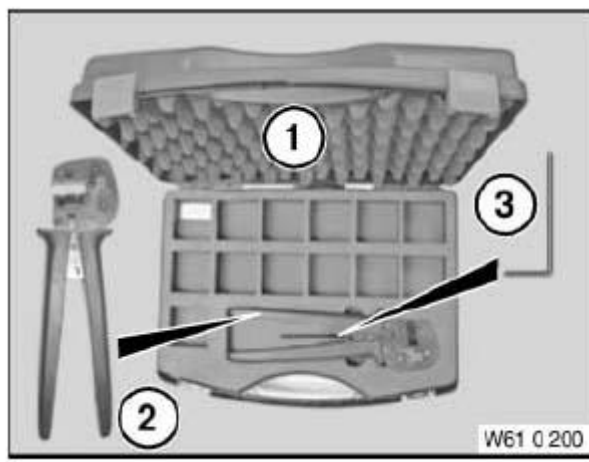
Courtesy of BMW OF NORTH AMERICA, INC.

**Crimping stop parts (small contacts) and butt connectors:**

- Special tool **61 4 320**
  1. Tool without crimping head
  2. Crimping head (**STRIPPING INSULATION AND CUTTING FIBRE-OPTIC CABLES TO LENGTH**)
  3. Crimping head (**CRIMPING FIBRE-OPTIC CABLE CONTACTS**)
  4. Crimping head (**CRIMPING MQS CONTACTS**)
  5. Crimping head (**CRIMPING MPQ CONTACTS**)
  6. Replacement blade (face-cutting fibre-optic cables)
  7. Replacement blade with tool (insulation stripping unit)
  8. Universal crimping head

**Crimping stop parts (large contacts) and butt connectors:**

- Special tool 61 0 200 (crimping set)
- Special tool 61 0 210 (matrix set SLK 8)
- Special tool **61 0 220** (matrix set SLK 2.8)
- Special tool 61 0 230(matrix set MAK 8/DFK4)
- Special tool 61 0 240 (butt connector 4.0 - 6.0 mm<sup>2</sup> )



**Fig. 236: Identifying Crimping Tool (610200)**

Courtesy of BMW OF NORTH AMERICA, INC.

### 61 13... TREATING CABLES AND OPTICAL FIBRES

Special tools required:

- [61 4 320](#)
- 61 0 200

**NOTE:** Special tools referred to in the repair instructions below are contained in the following special tool sets:

Repair range for vehicle electrical system	Â
Crimping set with pliers for optical fibres, Micro Power Quadlock (MPQ), Micro Quadlock System (MQS) contacts and universal crimping head	<a href="#">61 4 320</a> 61 0 200

Subject of repair instructions

- [SPECIAL TOOLS FOR WIRING HARNESS REPAIRS](#)
- [CUTTING CABLES TO LENGTH AND STRIP INSULATION](#)
- Crimping stop parts (contacts): see [CRIMPING MICRO QUADLOCK SYSTEM CONTACTS \(MQS\)](#), [CRIMPING MICRO POWER QUADLOCK CONTACTS \(MPQ\)](#), and [CRIMPING STOP PARTS](#)
- [REPAIRING A PLUG CONNECTION USING BUTT CONNECTORS](#)
- [COMB CONNECTOR FOR RETROFITTING/REPAIRS](#)
- Processing cables and optical fibres: [CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH](#) and [CRIMPING OPTICAL FIBRES](#).

### 61 13... UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS IN ELECTRICAL AND HYBRID VEHICLES

Observe the following instructions for handling high-voltage plug connections:

- IMPORTANT:
- Damaged high-voltage plug connections must be replaced completely. Repair is not permitted.
  - Dirt contamination must be removed before opening the plug connection.

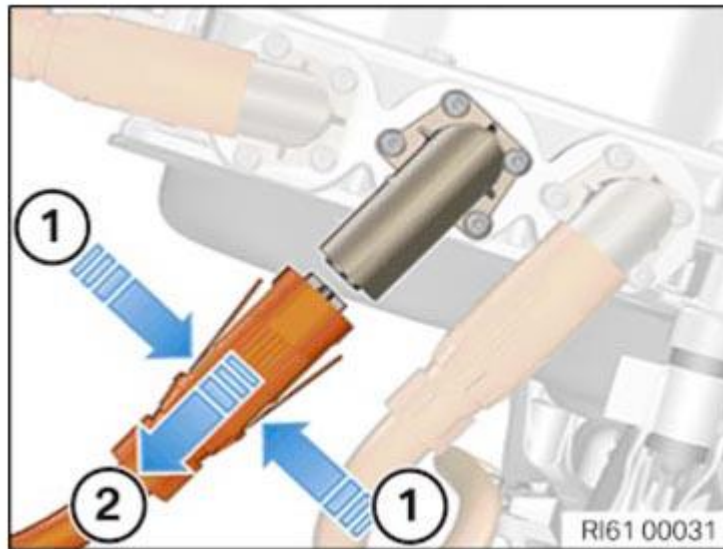
**Disconnect the Hirschmann high-voltage connector:**

Press the lock (1) on the left and right on the connector in the direction of the arrow.

Pull off connector (2) in direction of arrow.

IMPORTANT: Connector (2) is difficult to pull off.

In the event of damage to high-voltage connector (2), the complete high-voltage cable must be replaced.

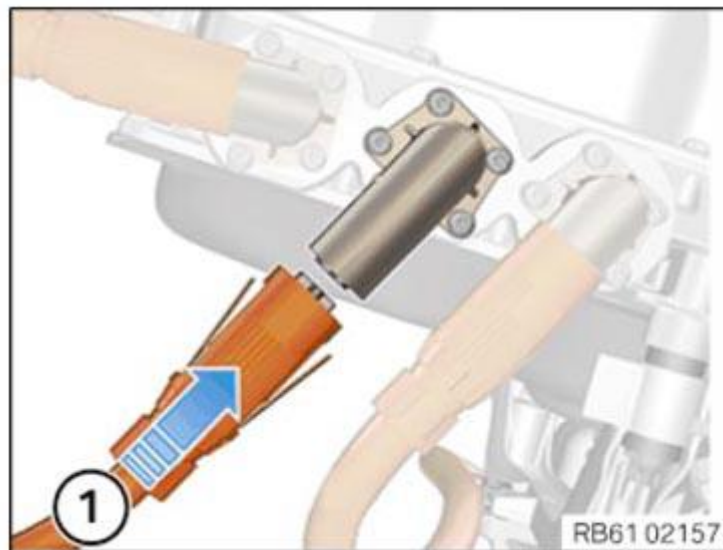


**Fig. 237: Disconnecting Hirschmann High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Connect the Hirschmann high-voltage connectors:**

Slide the connector (1) on in the direction of the arrow.

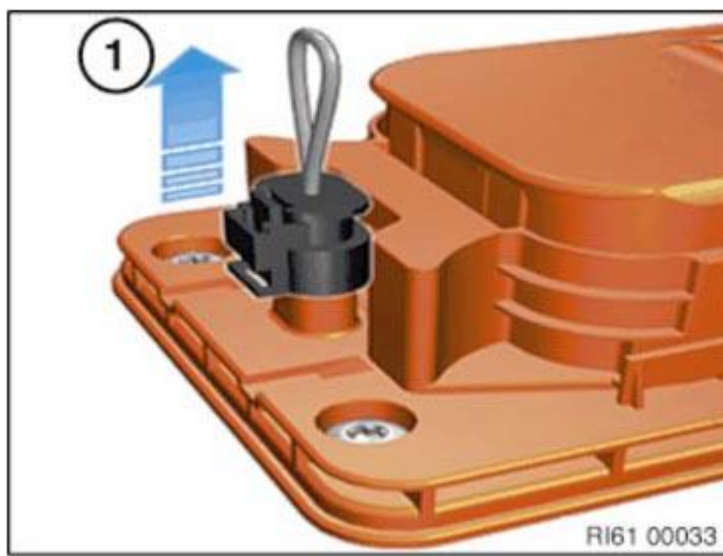
**NOTE:** Connector (2) must lock audibly.



**Fig. 238: Connecting Hirschmann High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Disconnect the Kostal high-voltage connector:**

Unlock and disconnect high-voltage interlock loop (1).



**Fig. 239: Disconnecting Kostal High Voltage Connector Interlock Loop**  
 Courtesy of BMW OF NORTH AMERICA, INC.

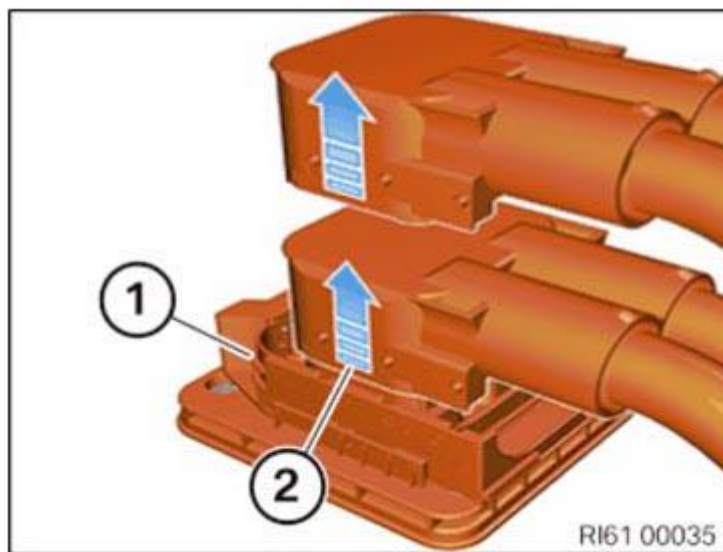
Push the lock (1) fully to the front.

Lift the connector (2) and remove it entirely.

Plug connection (3) is difficult to pull off.

The connector (2) must be completely pulled off the opposite housing in one step. Damage may be caused to contact protection if connector is only partly pulled off and then closed again.

IMPORTANT:



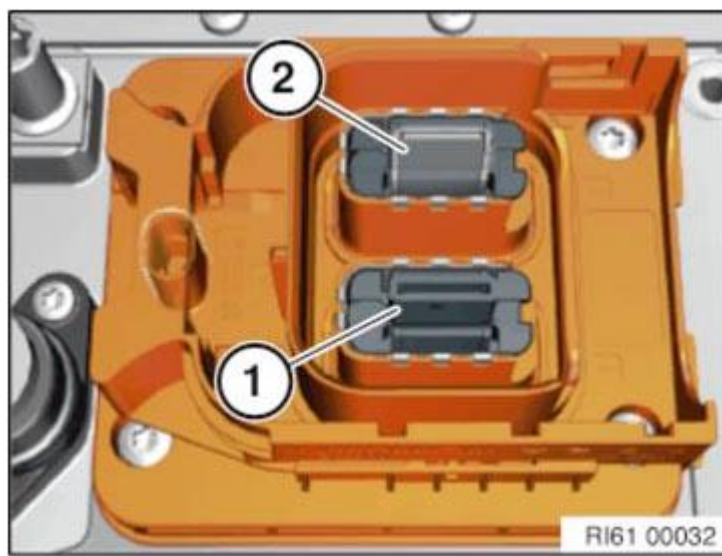
**Fig. 240: Removing Kostal High Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Check the Kostal high-voltage connector and connection for damage:**

Check the touch protection for damage and correct positioning (1).

**WARNING:**

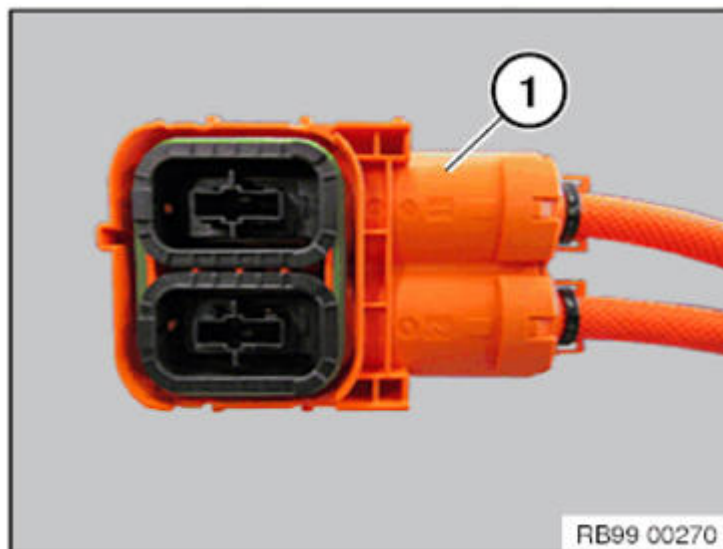
**Do not touch unprotected connector (2).  
 If the contact protection (1) has been pushed to the bottom (2), the high-voltage connector must be refitted.  
 If contact protection (1) remains in bottom position (2) after reinstallation, the contact protection is faulty and the component must be replaced.**



**Fig. 241: Identifying Kostal High Voltage Contact Protection And Connector Bottom**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check the high-voltage connector (1) for damage.

**WARNING:** In the event of damage to the high-voltage connector (1), the complete high-voltage cable must be replaced.



**Fig. 242: Identifying High Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

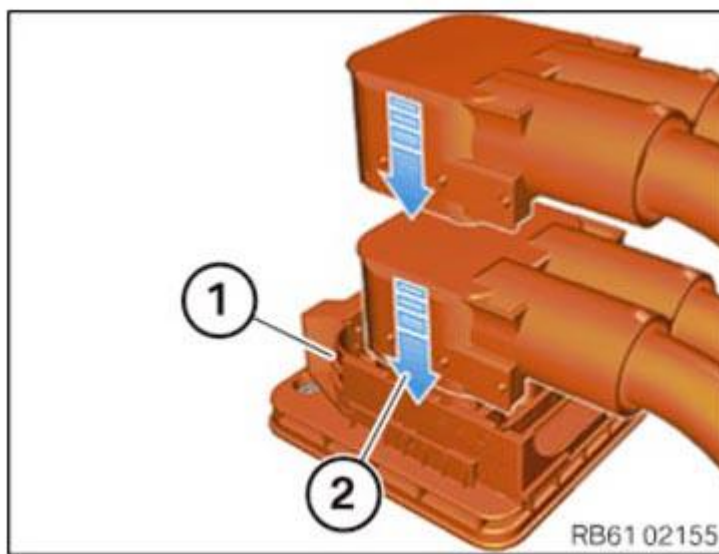
**Connect the Kostal high-voltage connector:**

Connect the connector (2) in one single movement to the counter-housing.

Push the lock (1) fully to the rear.

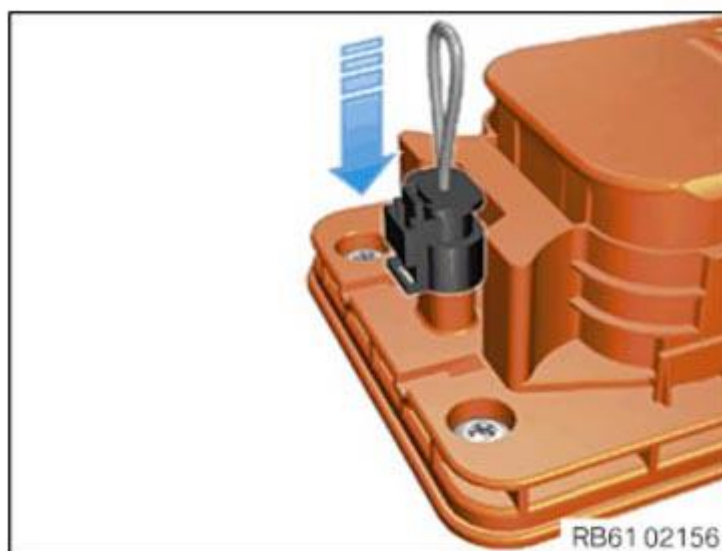
**IMPORTANT:** Plug connection (3) must be correctly locked by lock (2), otherwise there is a risk of damage.





**Fig. 243: Connecting Kostal High Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

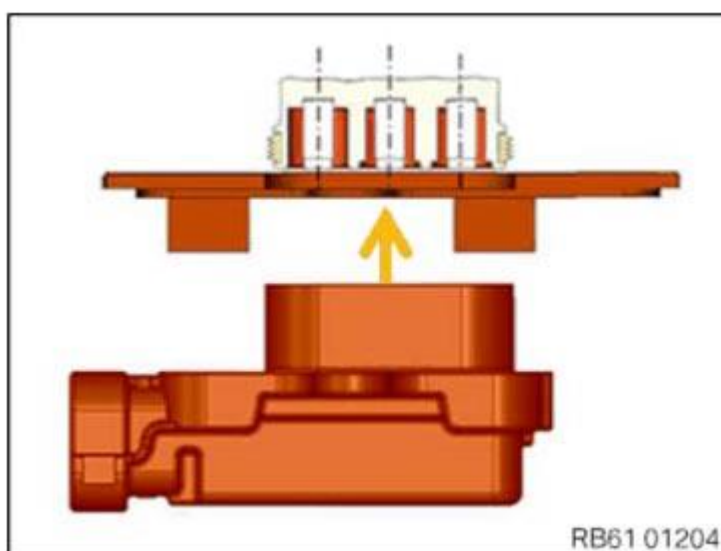
Connect the connector for the high-voltage interlock.



**Fig. 244: Connecting Kostal High Voltage Interlock Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Three-phase high-voltage connector:**

Connect and disconnect the connector straight.



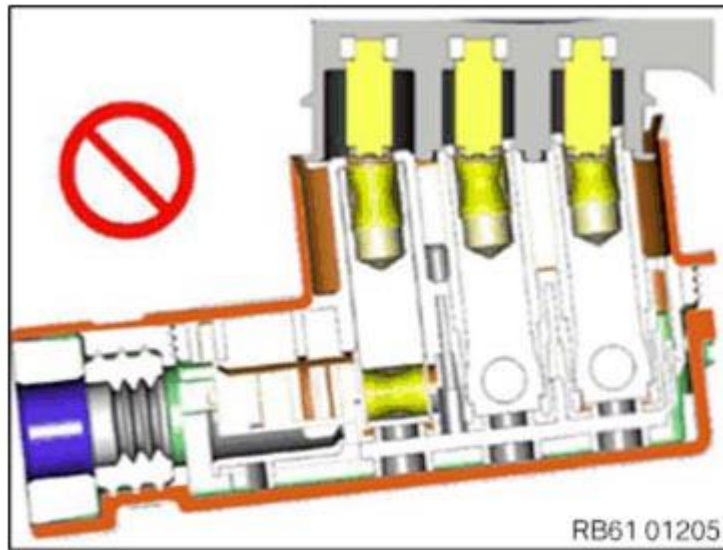


**Fig. 245: Disconnecting Three Phase High Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

The system is designed to only offer limited protection against damage caused by connectors that are inserted at an angle.

Increased tilted connections will increase the connecting force and the risk of danger.

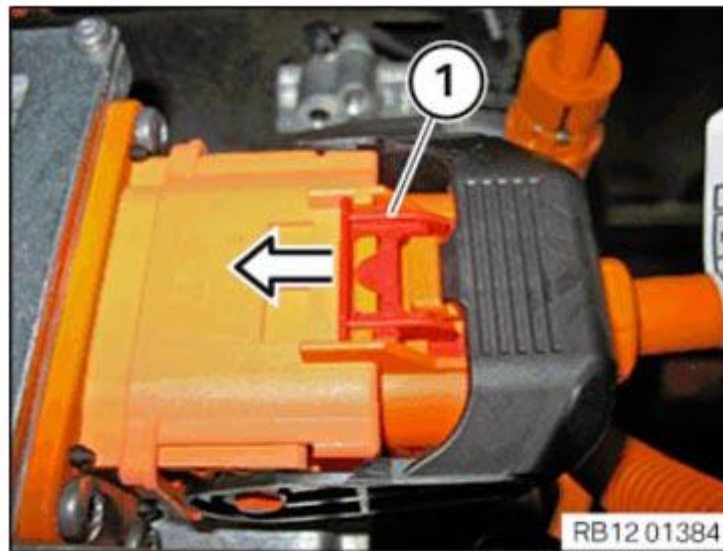
IMPORTANT:



**Fig. 246: Caution For Three Phase High Voltage Connector Damage**  
Courtesy of BMW OF NORTH AMERICA, INC.

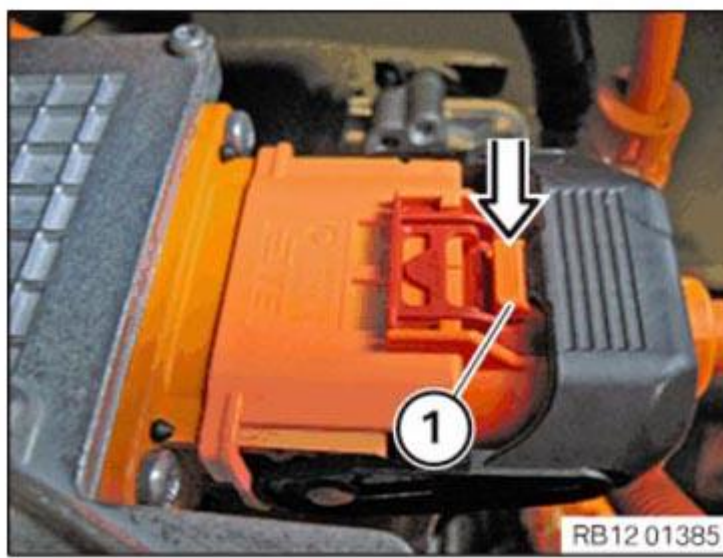
**Disconnect the high-voltage connector from the high-voltage connection of the KLE:**

Slide lock (1) in direction of arrow up to stop.



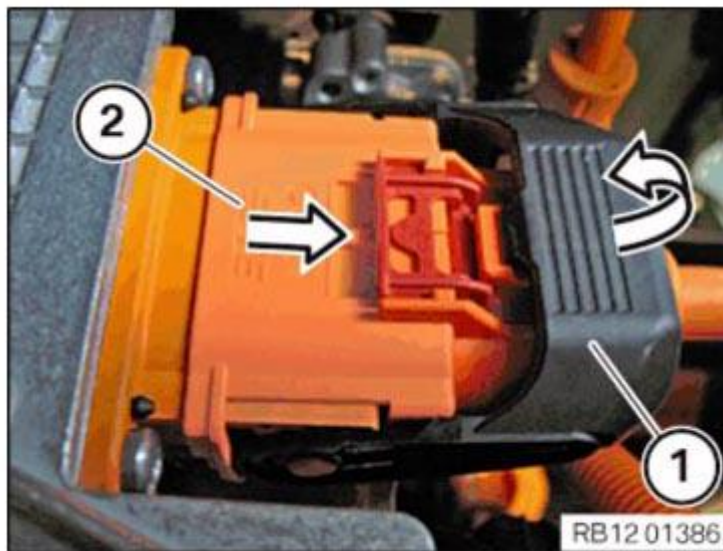
**Fig. 247: Disconnecting KLE High Voltage Connector Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press lock (1).



**Fig. 248: Pressing KLE High Voltage Connector Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open the lock (1) completely and disconnect the connector (2).



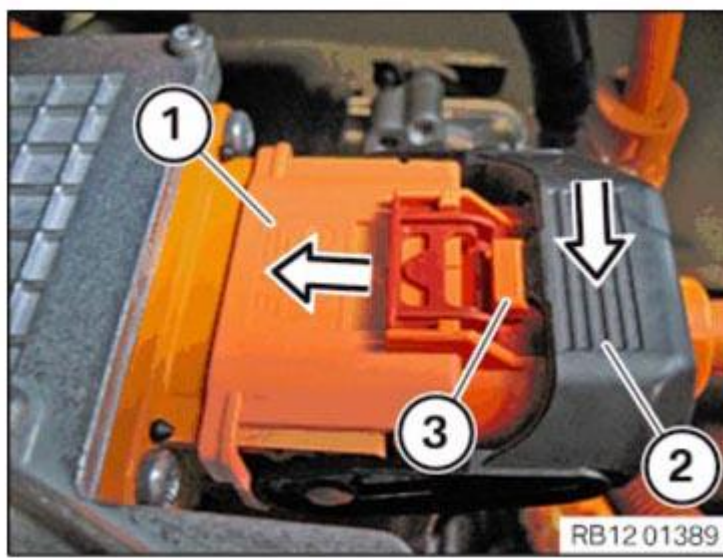
**Fig. 249: Disconnecting KLE High Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Connect the high-voltage connector to the high-voltage connection of the KLE:**

Connect the connector (1) to the limit position and close the lock (2).

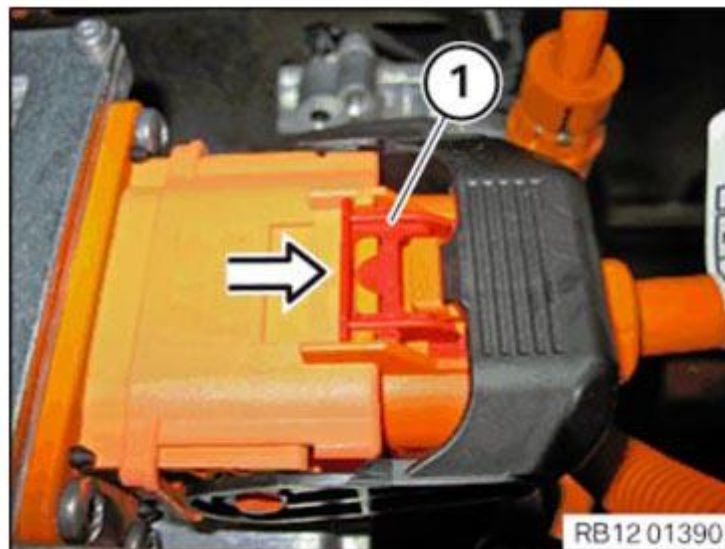
IMPORTANT: Lock (2) must snap audibly into place.

The retaining lug of the lock (2) must be positioned completely under the lock (2).



**Fig. 250: Connecting KLE High Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide the lock (1) on to the stop in the direction of the arrow.



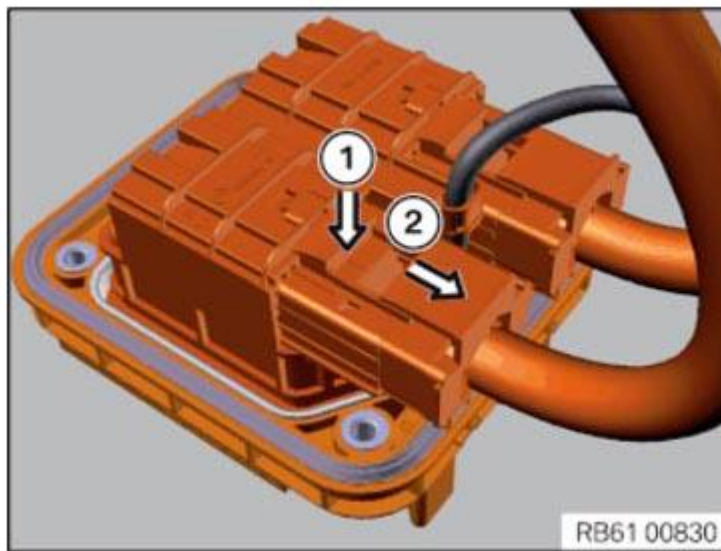
**Fig. 251: Sliding KLE High Voltage Connection Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

**High-voltage connector on the high-voltage connection of the high-voltage battery unit:**

Press down unlocking (1) in direction of arrow and pull off connector in direction of arrow (2).

**IMPORTANT:** Contact protection is no longer provided in the event of a damaged connector housing.

In this case, contact technical support.



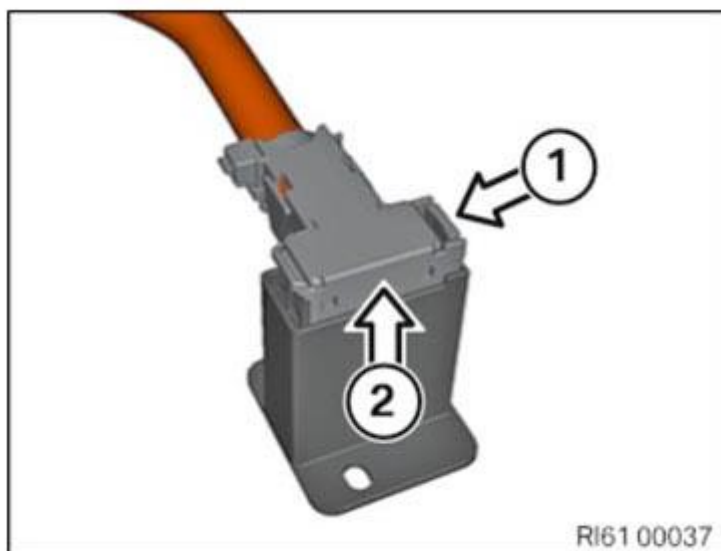
**Fig. 252: Removing High Voltage Battery Unit Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**High-voltage connector on the cell module I01:**

Press unlocking device (1) together and pull off connector upwards (2).

Contact protection is no longer provided in the event of a damaged connector housing.

In this case, contact technical support.



IMPORTANT:

**Fig. 253: Pressing Cell Module High Voltage Connector Unlocking Device**  
Courtesy of BMW OF NORTH AMERICA, INC.

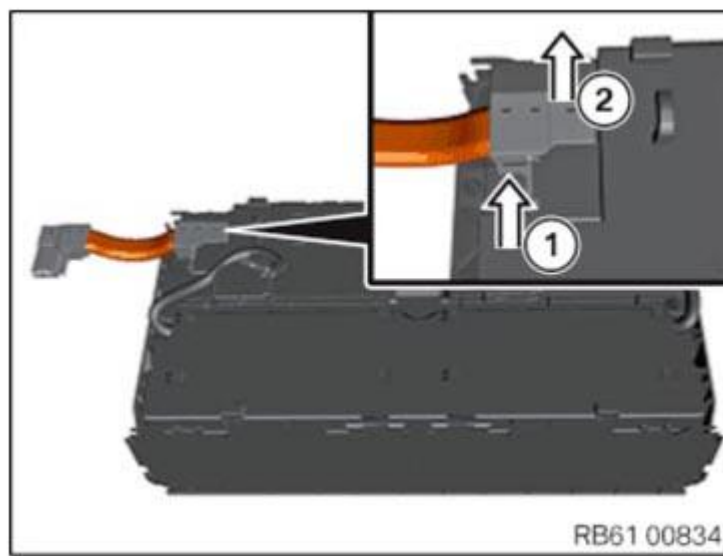
**High-voltage connector on the cell module (cell module connecting line):**

Press unlocking (1) in direction of arrow and pull off connector in direction of arrow (2).

IMPORTANT: Contact protection is no longer provided in the event of a damaged connector housing.

In this case, contact technical support.





**Fig. 254: Removing Cell Module High Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **DISTRIBUTION BOX, POWER SUPPORT POINTS**

### **61 14 035 REMOVE & INSTALL/REPLACE POWER DISTRIBUTION BOX FRONT POSITIVE BATTERY CABLE**

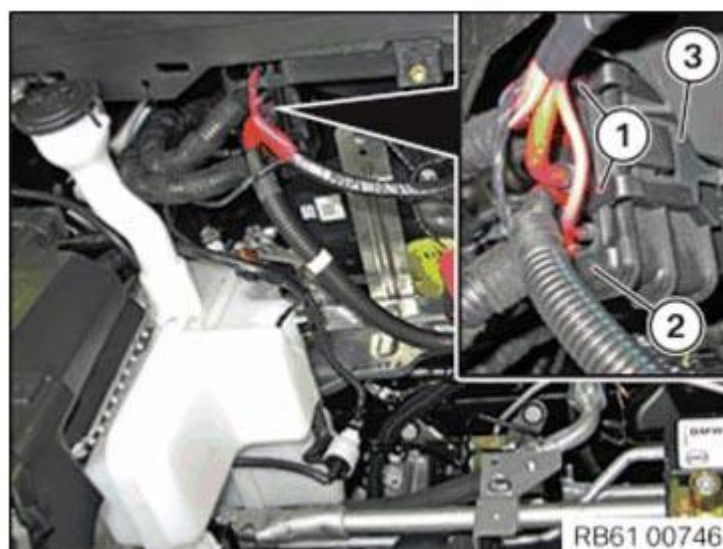
**WARNING:** High-voltage system - risk of serious injury or death.  
 The following points must be strictly observed prior to starting work :  
 Disconnect **HIGH-VOLTAGE SYSTEM** from power  
 Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

**WARNING:** Observe **SAFETY INFORMATION** for handling vehicle battery.

Necessary preliminary tasks:

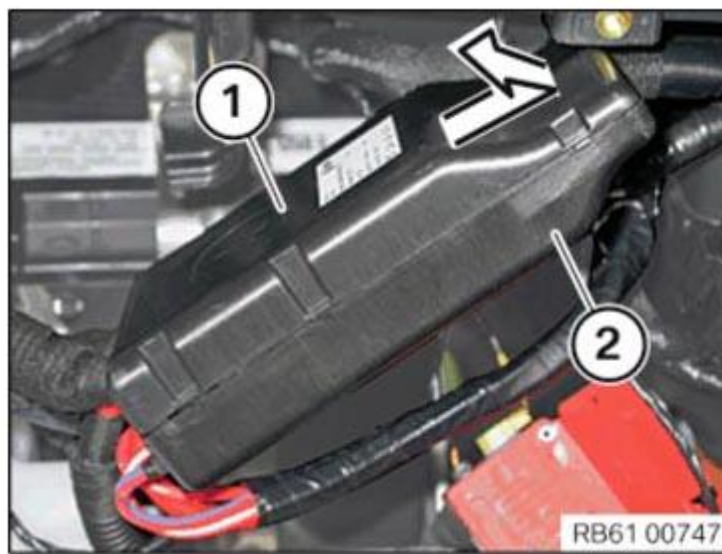
- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Remove **FRONT LUGGAGE COMPARTMENT WELL**

Unlock latch mechanisms (1) and release power distribution box positive battery cable (2) out of holder (3) in direction of arrow.



**Fig. 255: Releasing Power Distribution Box For Positive Battery Cable From Holder**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release upper housing section (1) from lower housing section (2) in direction of arrow and remove.

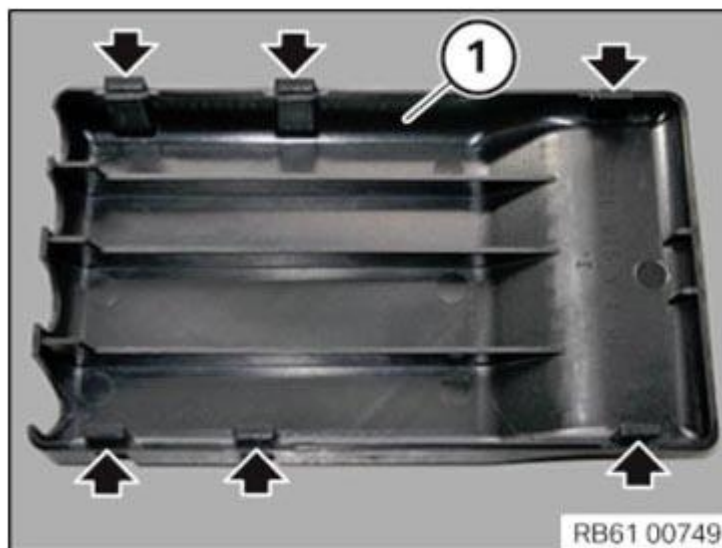


**Fig. 256: Releasing Upper Housing Section From Power Distribution Box For Positive Battery Cable**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Retaining lugs must not be missing or damaged.

Ensure upper housing section (1) engages correctly.



**Fig. 257: Locating Retaining Lugs**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Label positive pole flat cables to prevent incorrect assembly.

Unscrew nuts (1).

Tightening torque [61 14 1AZ](#) .

Remove positive pole flat cables (2) from power distribution box positive battery cable (5).

Unscrew nut (3).

Tightening torque [61 14 2AZ](#) .

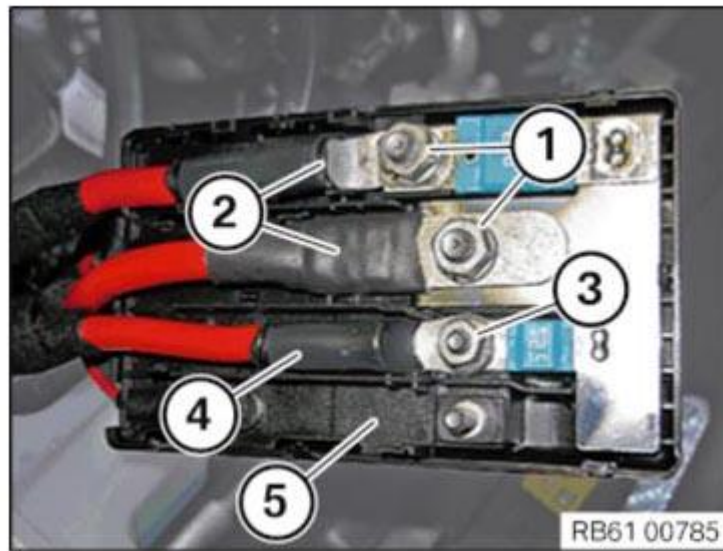
Remove positive pole flat cable (4) from power distribution box positive battery cable (5).

*Installation note:*

**Risk of short circuits.**

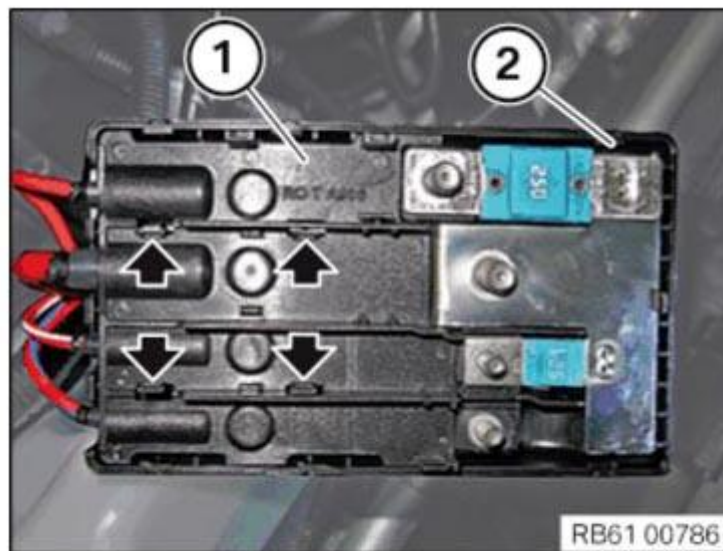


Make sure all positive pole flat cables (2; 4) are fitted correctly.



**Fig. 258: Identifying Positive Pole Flat Cables And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release middle part (1) of latch mechanisms and remove from power distribution box positive battery cable (2).



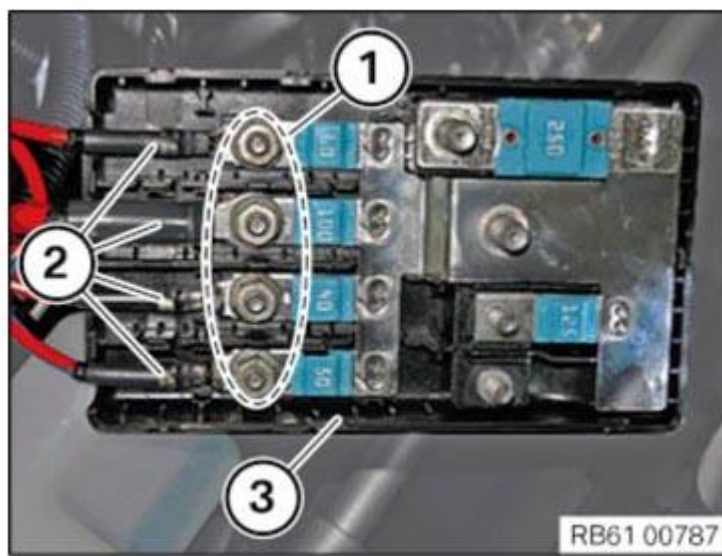
**Fig. 259: Locating Middle Part Of Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Label positive pole flat cables to prevent incorrect assembly.

Unscrew nuts (1).

Tightening torque [61 14 2AZ](#) .

Remove positive pole flat cables (2) from power distribution box positive battery cable (3).



**Fig. 260: Identifying Positive Pole Flat Cables And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

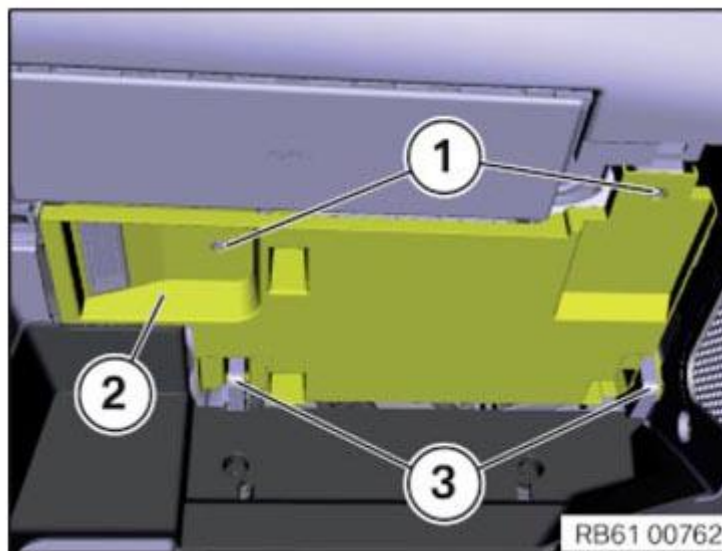
**Risk of short circuits.**

Make sure positive pole flat cables (2) are fitted correctly.

**61 14... REMOVING AND INSTALLING POWER DISTRIBUTION BOX (FRONT)**

Release screws (1).

Fold out power distribution box holder (2) and unhook from attachment points (3).



**Fig. 261: Identifying Power Distribution Box Holder And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 14... REPLACE FRONT POWER DISTRIBUTION BOX**

Special tools required:

- [61 0 316](#)
- [61 0 317](#)
- [61 0 325](#)

**WARNING:** Observe [SAFETY INFORMATION](#) for handling vehicle battery.

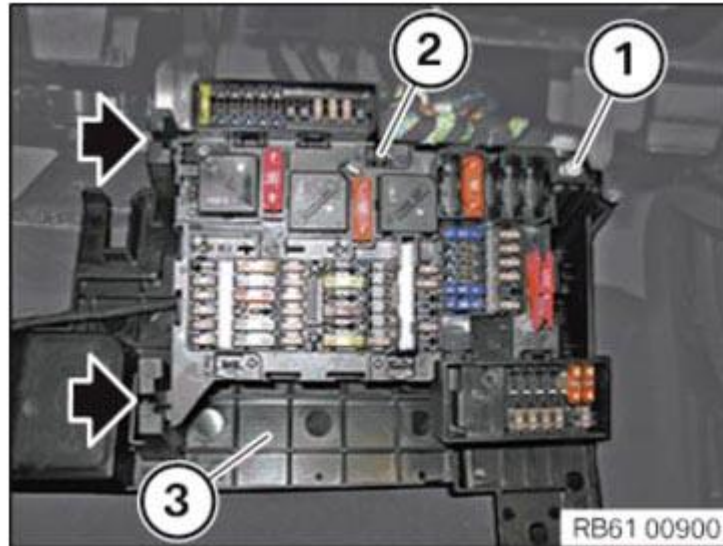
**Necessary preliminary tasks:**

- Disconnect **BATTERY EARTH LEAD**
- Remove **FRONT POWER DISTRIBUTION BOX**

**NOTE:** Removal and installation are described separately.

**Removal:**

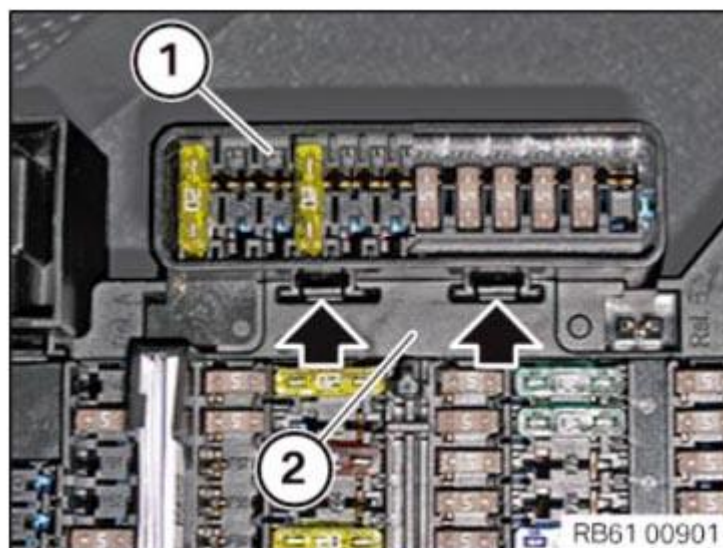
Release screw (1) and detach power distribution box (2) from holder power distribution box (3).



**Fig. 262: Locating Power Distribution Box And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Use this operation for all existing SV fuse modules (1).

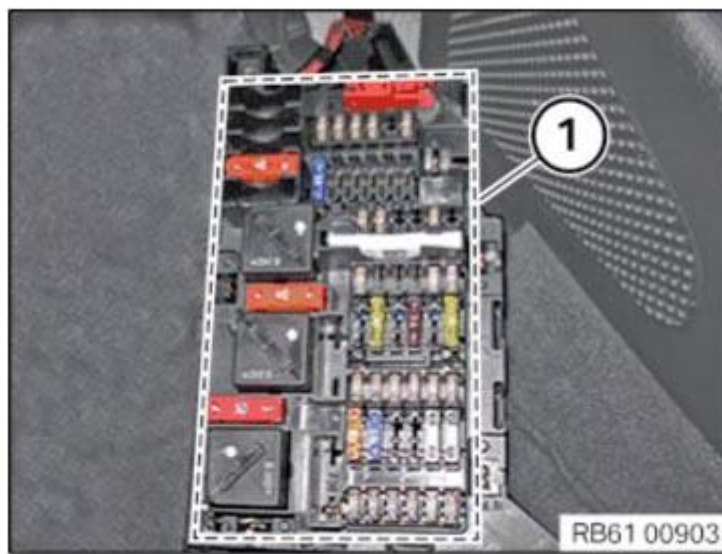
Release latch mechanisms and remove SV fuse module (1) from power distribution box (2).



**Fig. 263: Locating SV Fuse Module Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

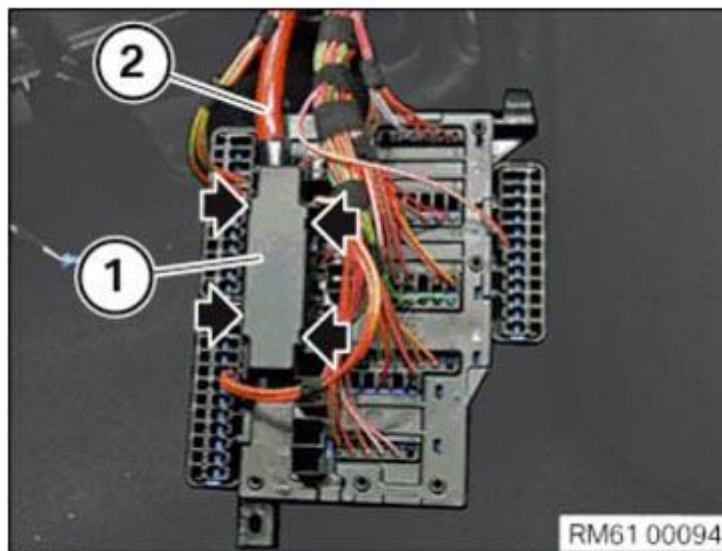
Take notes, and photographs where necessary, of fuse assignment and relay assignment.

Remove all fuses and relays from power distribution box (1).



**Fig. 264: Identifying Power Distribution Box**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release cover of B+ feed (1) on latch mechanisms and remove.



**Fig. 265: Locating Cover Of B+ Feed On Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

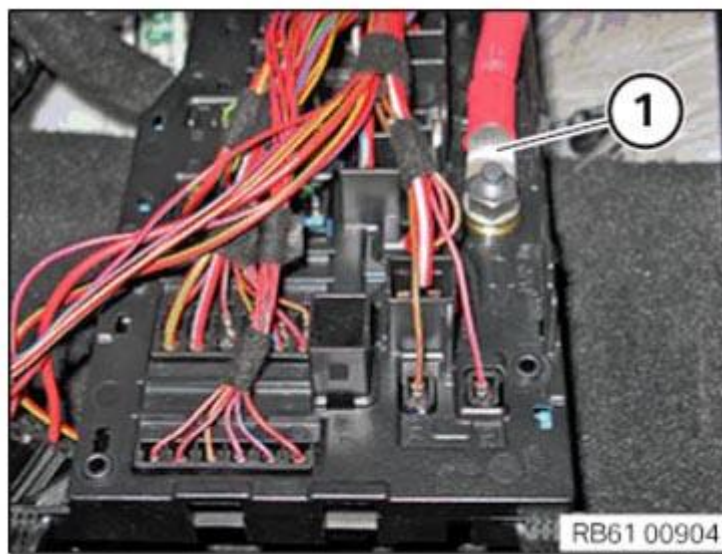
Turn power distribution box over.

Release and remove positive battery cable (1) at nut.

Enter cable assignment according to pin no. (see rear side of power distribution box) in table and photograph if necessary.

**IMPORTANT:** In the case of several different cable colors these cables must be marked again.



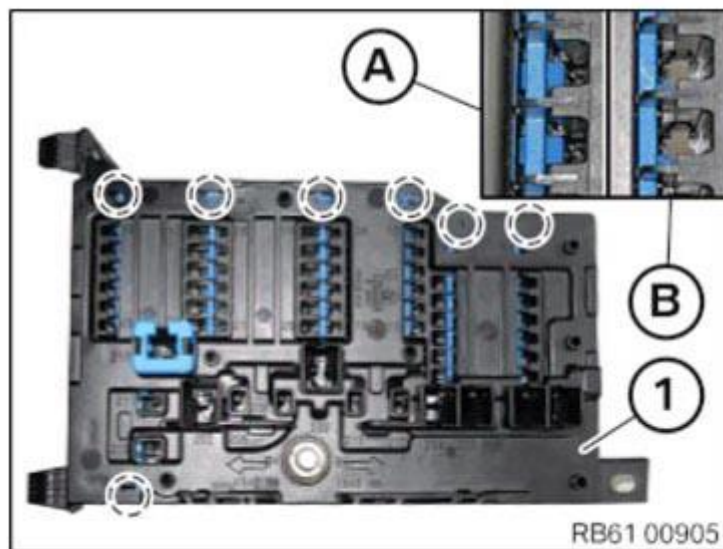


**Fig. 266: Identifying Positive Battery Cable Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open all locking pins at power distribution box and at new part.

Detail (A) shows closed locking pin, detail (B) shows open locking pin.

Unpin all cables running through front of power distribution box by means of special tool [61 0 316](#) , [61 0 317](#) , [61 0 325](#) .



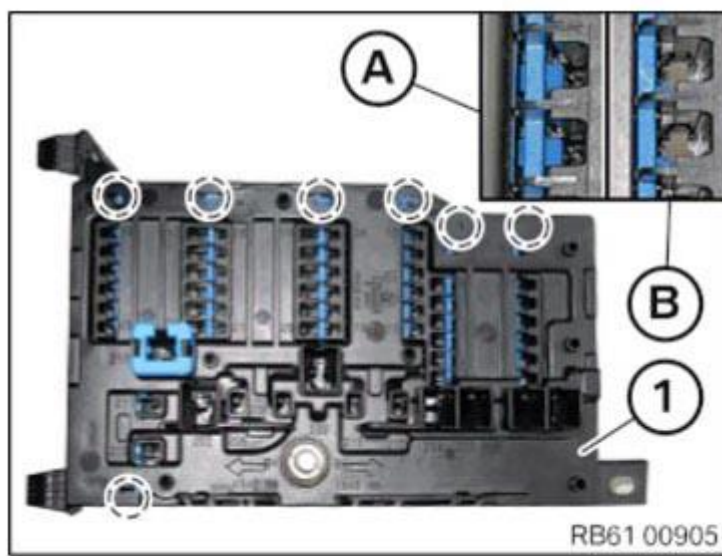
**Fig. 267: Identifying Power Distribution Box Locking Pins**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Pin cable according to the noted pin no. in power distribution box.

Close locking pins at power distribution box.

Detail (A) shows closed locking pin, detail (B) shows open locking pin.



**Fig. 268: Identifying Power Distribution Box Locking Pins**  
Courtesy of BMW OF NORTH AMERICA, INC.

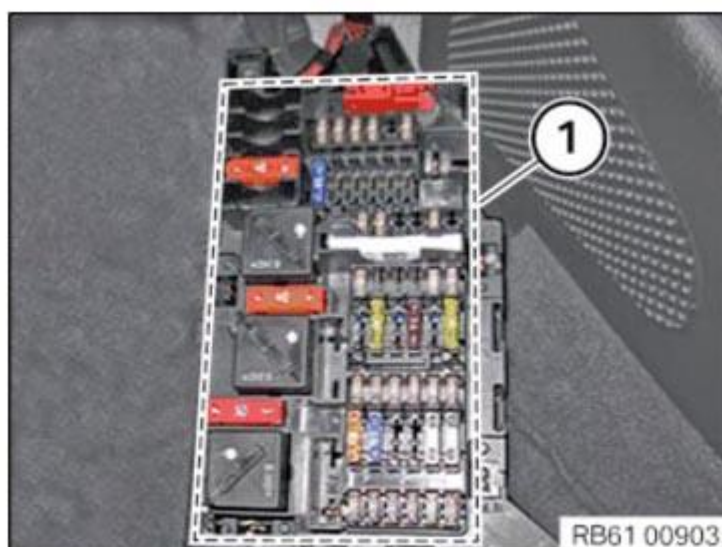
Turn power distribution box over.

Tighten positive battery cable (1) at nut.



**Fig. 269: Identifying Positive Battery Cable Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Join all fuses and relays according to the noted assignment diagram in power distribution box (1).



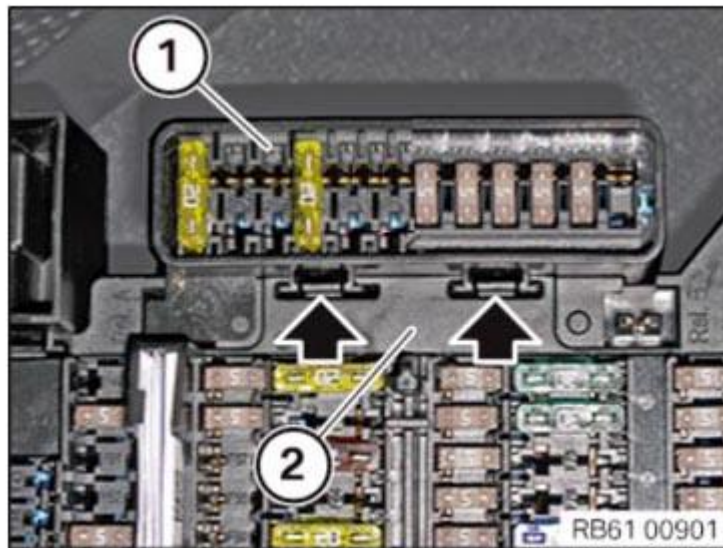


**Fig. 270: Identifying Power Distribution Box**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Use this operation for all existing SV fuse modules (1).

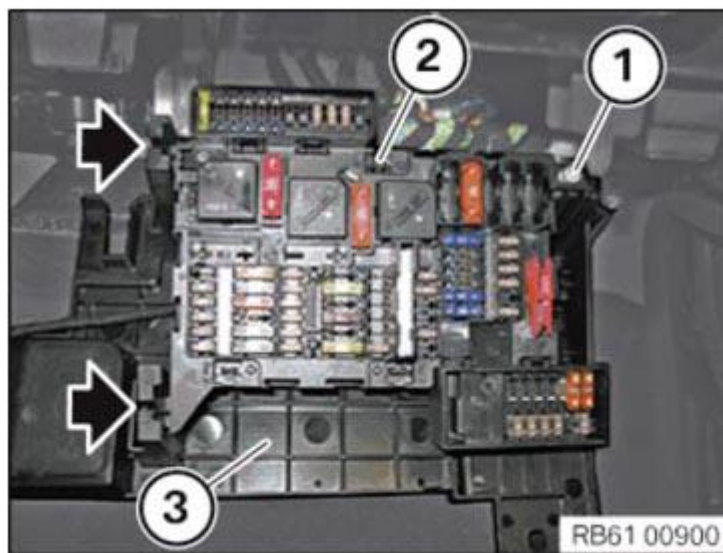
Join SV fuse module (1) in power distribution box (2).

**NOTE:** Ensure correct locking.



**Fig. 271: Locating SV Fuse Module Latch Mechanisms**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Attach power distribution box (2) to holder power distribution box (3) and tighten screw (1).



**Fig. 272: Locating Power Distribution Box And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Install **FRONT POWER DISTRIBUTION BOX**
- Connect **BATTERY EARTH LEAD**

Pin no.	Cable color
1	Â
2	Â
3	Â
4	Â

<b>Pin no.</b>	<b>Cable color</b>
5	Â
6	Â
7	Â
8	Â
9	Â
10	Â
11	Â
12	Â
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202	Â
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Pin no.	Cable color
210	Â
211	Â
217	Â
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### BATTERY (VEHICLES WITH RANGE EXTENDER)

#### 61 00... SAFETY INSTRUCTIONS FOR HANDLING VEHICLE BATTERY

Do not allow any battery acid to come into contact with the eyes, the skin or clothing. Therefore wear protective clothing, gloves and eye protection.

Do not tilt the battery, acid may emerge from the vent hole.

If acid is splashed into the eyes, rinse them immediately for several minutes with clear water. You must then consult a doctor without delay.

If acid is splashed onto the skin or clothing, neutralize it immediately with a soap solution and rinse with lots of water.

Seek medical attention immediately if battery acid is accidentally swallowed.

Strictly no flames, sparks, naked light or smoking.

A highly explosive detonating gas is created when batteries are charged. The rooms where charging is carried out must therefore always be well ventilated.

Avoid the formation of sparks when handling cables, wiring and electrical devices.

Turn the ignition lock to the 0 position before disconnecting or connecting the battery.

Do not place tools or any similar object on the battery (danger of short circuit and explosion hazard.).

#### 61 00... SAFETY INFORMATION FOR HANDLING ELECTRIC/HYBRID VEHICLES

1. *Qualification:*

All repair work on high-voltage components **must be performed by qualified technicians** (qualification: training for work on high-voltage vehicles).

2. *Identification:*

Observe **warning notices** on high-voltage components. When replacing individual high-voltage components, check if warning stickers are present. Independently attaching warnings is only allowed on the locations provided for them. Use only approved and appropriately identified original new parts.

3. *Rules of conduct/protective measures:*

- Note operating instructions for handling high-voltage battery units.
- Do not under any circumstances touch open high-voltage cables and high-voltage components on damaged vehicle before shutting down the high-voltage electrical system.
- In the event of damage (mechanical, thermal) transition metal oxides, carbon, electrolyte solvents and their products of decomposition may be released.

Damaged high-voltage battery units must be stored in an acid-resistant pan in a location in the open that is protected against the weather (sun, rain) and secured against unauthorized access. Do not inhale escaping gasses.

- Prevent escaping substances from entering drains, pits and the sewer system.
- Collect any material that is discharged and have it disposed of according to the work instruction, wear acid-resistant protective clothing when doing so.
- Notify the fire brigade if fire breaks out, clear the area immediately and make accident scene safe.

Attempt to extinguish the fire without putting persons in danger (suitable extinguishant: water and water foam).

- A cut 2nd emergency separation point must be repaired with a butt connector.

#### 4. Measures before starting work:

- Each job on the vehicle must be assigned by appropriately trained personnel. Before work is started, this electrician must place the vehicle in the operating condition required to perform the relevant activity. The qualified personnel's instructions and directions absolutely must be followed. **No work may be carried out without this qualified personnel being consulted first.**
- The readiness to drive must be ended before shutting off the voltage of the high-voltage system. The readiness to drive is ended when the driver is absent only under the following conditions:
  1. seat belt buckle unlocked **and**
  2. the driver's door is open **and**
  3. no brake activated **and**
  4. no accelerator pressing **and**
  5. speed < 3 km/h (2 mph)
- Work on live high-voltage components is expressly prohibited. Before each operation on the high-voltage system, the system must be isolated from the power supply by qualified personnel (high-voltage safety connector Off) and secured against unauthorized return to service (padlock).
- Before beginning work, it is mandatory to check that the equipment is de-energized and is protected against being energized again.

Work is only permitted to begin if:

1. Corresponding display in instrument cluster: **High-voltage system switched off**

When a high-voltage warning is active (indicator light, Check Control, etc.), it is essential to determine and eliminate the cause of this warning via the diagnosis system before continuing with any other work.

**If it cannot be definitively established that the equipment is de-energized**, work is not permitted to begin. **risk of serious injury or death.** Before work begins, a qualified electrician (1000 V DC) must verify that the system is de-energized using appropriate measuring devices and procedures.

**=> In this case, a qualified electrician or Technical Support must be contacted.**

- Do not carry out any work whatsoever on high-voltage components while the batteries are charging. Before starting work, disconnect the charging cable from the vehicle.
- The vehicle must not be charged and refuelled at the same time.
- No repair work may be carried out at the high-voltage system when a combustion engine is currently running.

- The coolant pump and electric fan can be switched on automatically when terminal 15 is switched on or the high-voltage battery unit is charging. The following preliminary work must be performed prior to working on the electric fan to prevent injuries caused by an automatically activated electric fan.

1. Disconnect any connected charging cables.
2. Switch off terminal 15.
3. Disconnect high-voltage system from power.
4. Disconnect plug connections from the electric fan.

5. *Measures during/after activities:*

- Identifiable mechanical damage to or tampering with high-voltage components must be reported immediately to the qualified personnel in charge.
- When carrying out any work on the high-voltage system, it is prohibited to drive externally all the drive train components (wheels, gearbox, drive shafts, etc.).
- Check all connectors and plug connections of the high-voltage components for damages after disconnecting them and/or before connecting them.
- High-voltage cables (orange coating) and their connectors and ferrules **may not** be repaired. If damaged, a cable must always be replaced completely.
- High-voltage cables must not be twisted or kinked. Crushed high-voltage cables must be replaced.
- After a bending operation, the resulting bend may only be returned to its original shape. To repeat bending at the same place is not permitted.
- When working in the vicinity of high-voltage components (identified accordingly with warning stickers and orange-colored coating), protect these components against damage.
- The specified work steps in the repair instructions must be adhered to exactly.
- High-voltage components and their holders must be screwed/bolted to the defined tightening torque. Tightening torques and tightening specifications must be observed.
- Connecting high-voltage components to body ground is crucial to safety for reasons of equipotential bonding. For this reason, it is prohibited to operate any high-voltage components without them being correctly connected to body ground. The measurement (insulation measurement) is performed by the vehicle automatically and therefore manual measurement is not required.

For a correct ground connection, the retaining elements of high-voltage components must not be painted. Follow further PAINTING NOTES .

- Removed high-voltage battery units must be stored in a manner that protects them from misuse and damage.

6. *Potential compensation:*

Potential compensation wires, high-voltage cable, and the battery earth lead of the electrical machine electronics have a safety screw connection.

- Clean contact faces and have then checked by a second person.
- Tighten down screws/bolts to specified torque.
- Have tightening torque checked by a second person.
- Both persons must document that the work has been carried out correctly in the vehicle records.

## 61 20... CHARGING BATTERY

**WARNING:** Read and comply with safety information pertaining to **VEHICLE BATTERY**.

**Lead-acid battery, AGM battery:**

**IMPORTANT:** To prevent the intelligent battery sensor from malfunctioning, use the charging points in the engine compartment.

Observe instructions on **INTELLIGENT BATTERY SENSOR/BATTERY ELECTRONICS**.

**NOTE:** Use BMW-recommended charging computers to charge the battery.

**Lithium ion battery:**

The charging voltage that is generated by existing chargers that are designed for the lead-acid or AGM battery is too high for the lithium ion battery.

**IMPORTANT:** This excessive charging voltage may **in some cases** result in that **the separating switch** of the lithium ion battery **will be opened. This does not damage the lithium ion battery** . The separator switch will close again when a charging voltage of < 14 V is applied at the battery terminals.

**Before charging a lithium ion battery, adjust the charging voltage of existing charger adapters once .**

## **61 20... BATTERY REPLACEMENT INFORMATION**

A vehicle battery is constructed for the installation location and the individual power requirements of the particular vehicle. These individual power requirements depend on the motorization and different types of equipment. The individually assigned vehicle battery is the ideal compromise between the power requirements of the vehicle electrical system and the weight and service life of the vehicle battery.

Vehicles with the automatic engine start-stop function or particular engine types and optional equipment are equipped with a special vehicle battery (AGM battery), since only this battery type can provide elevated power requirements over the extended service life. Installing a different vehicle battery can cause problems with vehicle electronics, can reduce functions or can cause leakage of battery acid.

In the event of an accident where the airbags are deployed in vehicles with a vehicle battery in the luggage compartment, the electrical connection between the vehicle battery and the trigger is automatically disconnected through pyrotechnics. This prevents possible short-circuiting.

Proper operation of all of these safety and convenience functions requires a battery that conforms with specifications and that is properly registered in vehicles with energy management systems (IBS, power module).

### **Vehicles with energy management systems (IBS, power module): Register battery replacement**

The vehicle electrical system is informed about the vehicle battery characteristic data, such as type, size, age and current power capacity. Therefore, there will always be only one work scope provided that is permitted by the current status of information.

If the performance readiness drops below a defined minimum, a Check Control message will be generated to advise the driver that the battery must be replaced.

When installing a new vehicle battery, the battery must be registered and thus must also be registered with the vehicle electrical system.

**NOTE:** **Only this registration/logon will ensure that the corresponding Check Control message will go out again.**

*Diagnosis system:*

Register battery replacement

- Service functions
- Body
- Voltage supply
- Register battery replacement

When retrofitting, a more powerful battery may be used. Standard batteries may always be replaced by AGM batteries with the same specifications.



When installing a battery of a different size or a different battery type, this change in vehicle data must be programmed into the vehicle data in accordance with specifications.

*Programming system:*

- Battery retrofitting

## **61 20 908 CARRYING OUT A VOLTAGE INTERRUPTION OF THE 12V BATTERY**

IMPORTANT: Observe **SAFETY INFORMATION** for handling vehicle battery.

**There are two ways to carry out a voltage interruption of the 12-V battery:**

1. Manually by disconnecting the battery earth lead
2. With the diagnosis system

### **1. Manually: Carry out the following steps:**

- Switch off and disconnect battery charger
- Turn off ignition.

**For vehicles with ignition key:** Ignition key in neutral position

**Vehicles with ID transmitter:** Remove ID transmitter from slot

**For vehicles with Comfort Access:** Secure terminal 30

- **DISCONNECT NEGATIVE BATTERY LEAD**
- **RECONNECT BATTERY EARTH LEAD** (to ensure bus activity)
- Observe a waiting period of 5-10 s
- **DISCONNECT NEGATIVE BATTERY LEAD**
- Observe a waiting period of approx. 1 minute
- **CONNECT BATTERY EARTH LEAD**

Tightening torque: **61 21 1AZ**

- Connect and switch on battery charger
- Switch on ignition.

### **2. With the diagnosis system:**

- 03 Body
- Voltage supply
- Activate rest state
- Power-down command

## **61 20 900 DISCONNECTING AND CONNECTING BATTERY NEGATIVE LEAD**

**WARNING:** High-voltage system - risk of serious injury or death.  
The following points must be strictly observed prior to starting work :  
Disconnect **HIGH-VOLTAGE SYSTEM** from power  
Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

**WARNING:** Observe **SAFETY INFORMATION** for handling vehicle battery.  
Follow instructions for **DISCONNECTING AND CONNECTING BATTERY** .  
Follow instructions on **INTELLIGENT BATTERY SENSOR (IBS)**.

**Necessary preliminary tasks:**

- Remove **COVER IN FRONT RIGHT LUGGAGE COMPARTMENT**

IMPORTANT: Before disconnecting the negative lead, it must be ensured that the vehicle goes to sleep.

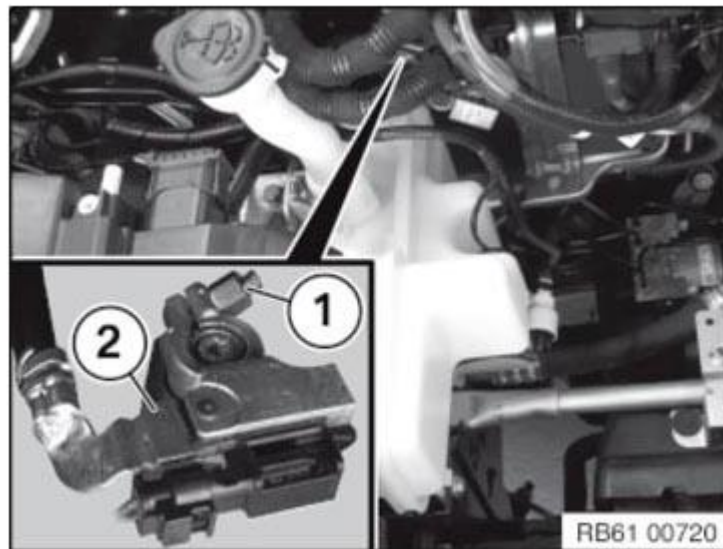
Observe a waiting period of at least 2 minutes.

**IMPORTANT:** Do not under any circumstances detach or lever off intelligent battery sensor (2) from battery by force.

Loosen nut (1).

Tightening torque [61 21 1AZ](#) .

Remove intelligent battery sensor (2) from battery and fix negative wire to side.



**Fig. 273: Identifying Intelligent Battery Sensor And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 20... INFORMATION ON AGM BATTERY**



T6104516

**Fig. 274: Identifying AGM Battery**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **Introduction**

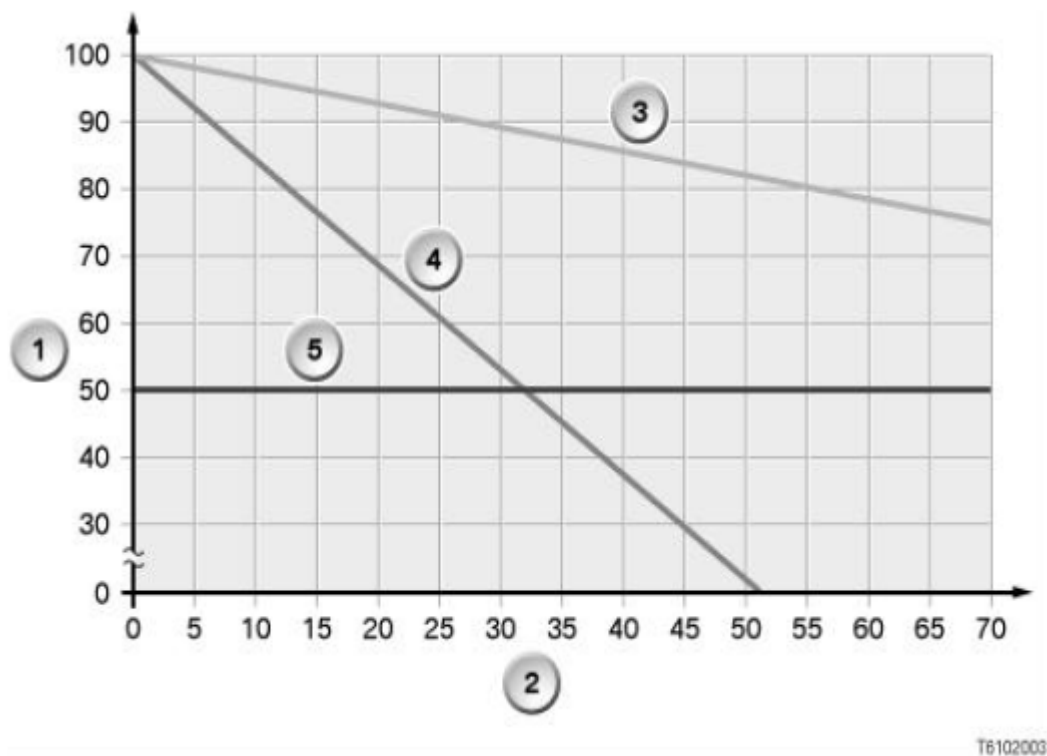
In September 2002, the first so-called VRLA batteries, better known as **AGM batteries** came into use. (VRLA stands for **V**alve **R**egulated **L**ead **A**cid, i.e. lead-acid battery with pressure relief valve; **AGM** stands for **A**bsorbent **G**lass **M**at, i.e. absorbent glass-fibre fleece).

The constantly increasing energy demand of modern vehicle electrical systems calls for ever more powerful battery solutions. A modern luxury-class vehicle has some 100 actuator motors that have to be fed with electrical current. Added to these are safety, environmental and comfort elements which are increasingly becoming standard features, such as e.g. Antilock Brake System (ABS), Dynamic Stability Control (DSC), steering assistance (EPS), electronic chassis and suspension control, air conditioning and navigation system. Current consumption is considerable even when the vehicle is not in use.

The somewhat higher price compared with a battery of similar size is fully balanced by the following benefits:

- greatly longer service life
- improved starting reliability at low temperatures
- reliable starting of engines with high starting current requirements, e.g. high-performance diesel engines
- 100 % freedom from maintenance
- low risk in the event of an accident (reduced environmental risk)

### Service life of AGM batteries



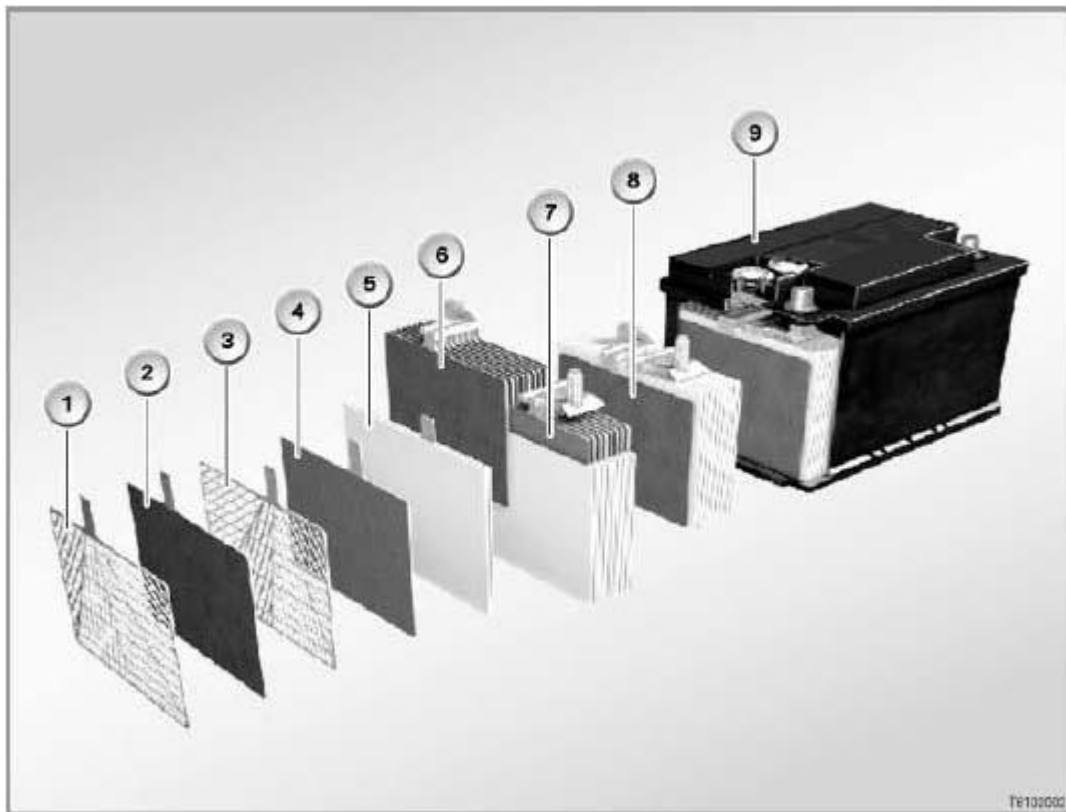
**Fig. 275: AGM Batteries Service Graph**  
Courtesy of BMW OF NORTH AMERICA, INC.

Item	Explanation
1	Available capacity [%]
2	Mileage [thousand km]
3	AGM battery
4	Lead-calcium battery
5	50 % capacity limit
Â	Â

In contrast to conventional lead-calcium batteries, the sulfuric acid in a battery with fleece technology is not held freely in the battery housing. Rather, 100% of the sulfuric acid is bound into the mats of the glass-fibre fleece (separators). For this reason, no battery acid can escape if the battery housing is damaged. In addition, the AGM battery is sealed to be airtight. This is possible because the gases are converted back into water by the permeability of the separators.

### Brief component description

The AGM battery has a black housing and the so-called "Magic Eye" is missing.



**Fig. 276: Identifying AGM Battery Related Components**

Courtesy of BMW OF NORTH AMERICA, INC.

Item	Explanation
1	Positive grille with silver alloy
2	Positive plate
3	Negative grille
4	Negative plate
5	Separator made of glass-fibre fleece
6	Set of positive plates
7	Set of negative plates
8	Block of plates
9	Block box with base strips
Â	Â

### Construction

The AGM battery differs from the conventional lead calcium battery as follows:

- larger plates: Larger plates allow a 25% larger power density.
- Separators made of glass-fibre fleece: These can cause an up to 3-times higher cycle stability to be reached. This improves the cold starting capability, the power consumption and service life.
- Airtight housing with pressure relief valve (refer to "How it works "):

The inspection plugs are sealed and can not be opened.

- Battery acid bound in glass-fibre fleece: Battery acid is not found free in the housing as before, but is rather bound 100% in the glass-fibre fleece. This gives increased security against the acid escaping and thus reduces the environmental risk.

### How it works

The AGM battery differs from conventional batteries in its non-polluting and substance-retaining behavior during charging.

When a battery is charged, the electrolysis process emits the gases oxygen and hydrogen.

- In a conventional wet lead calcium battery, the two gases hydrogen and oxygen are dissipated into the atmosphere.
- In an AGM battery, the two gases are converted back into water: The oxygen which is created at the positive electrode during charging passes through the permeable glass fibre fleece to the negative electrode. At the negative electrode the oxygen reacts with the arriving hydrogen ions in the electrolyte to form water (oxygen cycle).

In this manner, the gas and thus also the electrolyte are not lost.

Only in the event of an excessively heavy build-up of gas, i.e. excessively high pressure build-up (20 to 200 mbar), does the pressure relief valve discharge the gas. In this process, the pressure relief valve does not allow any oxygen in the air to enter. Because the pressure in the battery is regulated by a valve, the AGM battery is also known as the VRLA battery (valve-regulated lead acid).

### Notes for service technicians:

It is necessary when handling an AGM battery to observe some particular points pertaining to battery changing and installation location.

#### *Charging*

**WARNING:** Do not charge the AGM battery with  $\geq 14.8$  V. Do not use rapid-charging programs.

When charging removed batteries (so-called stand-alone batteries), do not exceed the maximum charging voltage of 14.8 V at room temperature. Also, for charging via the external start connection point, the maximum charging voltage of 14.8 V at room temperature must not be exceeded. The battery can be damaged even if the AGM battery is only briefly charged with a charging voltage higher than 14.8 V. A charging voltage of more than 14.8 V is usually used in quick-charging routines.

#### *Installation location*

**WARNING:** Do not install the AGM battery in the engine compartment.

The AGM battery must not be installed in the engine compartment on account of the high spatial temperature differences, otherwise its service life will be significantly shortened.

#### *Housing*

**WARNING:** Do not open AGM batteries.

On no account may AGM batteries be opened, as the ingress of oxygen from the atmosphere would cause the battery to lose its chemical balance, rendering it unserviceable.

### 61 12... INFORMATION ON INTELLIGENT BATTERY SENSOR (IBS)

**NOTE:** Do not connect the charger to the 12 V charging socket

The 12 V charging socket is supplied with voltage by the rear power distribution box via relay. This relay drops out after terminal 15 OFF. This means that a trickle charger connected at the 12 V charging socket will be disconnected from the battery. Only charge the battery via the jump start terminal point. Only then can the voltage supply be registered by the vehicle.

**WARNING:** Danger of destruction in event of mechanical strain

- Do not introduce any additional connections at the battery negative terminal.
- Do not modify the grounding cable. The ground cable also serves heat dissipation.
- Do not establish any connection between the IBS and the sensor screw.
- Do not use force when disconnecting the pole shoe from the battery terminal:

- Do not pull on the ground cable.
- Do not place any tools under the IBS to lever off the pole shoe.
- Do not use IBS connections as levers.
- Use a torque wrench and set tightening torque in accordance with repair instructions.
- Do not release or tighten down sensor screw (Torx screw).
- Avoid contact between IBS and ground.

**WARNING:** **Danger of destruction to IBS and wiring upon battery replacement**

- The IBS and wiring can be destroyed by mechanical strain upon battery replacement. Therefore avoid mechanical strain.
- The size (capacity) of the battery required for the car is coded in the Car Access System (CAS).
- Use the battery size (capacity) installed as standard upon battery replacement.
- Recode the Car Access System (CAS) when installing a battery with a different capacity.
- Register battery replacement via Service functions in diagnosis system.
- Delete fault code entries in the Digital Engine Electronics (DME) associated with battery replacement.
- Always proceed in accordance with the repair instructions.

**NOTE:** **Battery draining possible in spite of the intelligent battery sensor IBS being fault-free.**

- A battery can be drained (e.g. with lights or radio switched on) even when the IBS functions perfectly in conjunction with power management.
- **For this reason, only exchange the IBS when there is a corresponding fault code entry.**

**61 00... NOTES FOR DISCONNECTING AND CONNECTING BATTERY**

Observe [SAFETY INFORMATION](#) for handling vehicle battery.

**Before disconnecting battery:**

Turn off the ignition and other electrical loads/consumers to prevent sparking when reconnecting.

**NOTE:** **If the ignition is not turned off when the battery is disconnected, fault memories may be set in some control units.**

- IMPORTANT:
- There is a danger of mixing up battery cables: If the battery positive and negative leads are the same color and you are in doubt, follow the polarity to the battery, then mark and cover the leads.
  - The on-board computer and clock may lose your data.

**General notes on disconnecting battery:**

- Do not disconnect battery leads and leads from alternator and starter motor while engine is running.
- Disconnect terminal of battery earth lead from the battery. Cover battery negative terminal(s) and secure.
- Disconnect both battery earth leads in version with auxiliary battery. Cover battery negative terminal(s) and secure.
- When work is carried out on the electrical system, faults may be caused in the fault memories of some control units when the battery is connected.
- When installing battery terminal: Tightening torque [61 21 1AZ](#).

Only lead AGM battery:

- On vehicles with IBS at negative battery terminal:



**Do not under any circumstances pull/lever off pole shoes by force.**

**Do not under any circumstances release socket-head cap screw of IBS.**

**After connecting battery:**

The scope of application of some systems may be restricted after an open circuit.

Personal Profiles may also be lost.

Settings or activations must be carried out, depending on the equipment specification.

For example:

**IMPORTANT:**

- Activate **SLIDE/TILT SUNROOF** , if necessary
- Activate **POWER WINDOW** , if necessary

## **61 20 503 VEHICLE BATTERY - CLOSED-CIRCUIT CURRENT MONITORING**

**Necessary preliminary tasks:**

To access the ground cable of the battery, perform the necessary preliminary work described in **DISCONNECTING BATTERY EARTH LEAD**.

**Do not disconnect negative lead of battery.**

Connect diagnosis system.

Connect clip-on probe to negative lead of battery. The arrow on the current clamp must point towards the battery.

Measure closed-circuit current.

## **61 21... REMOVE AND INSTALL (REPLACE) BATTERY TRAY**

**WARNING:** High-voltage system - risk of serious injury or death.  
The following points must be strictly observed prior to starting work :  
Disconnect **HIGH-VOLTAGE SYSTEM** from power  
Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

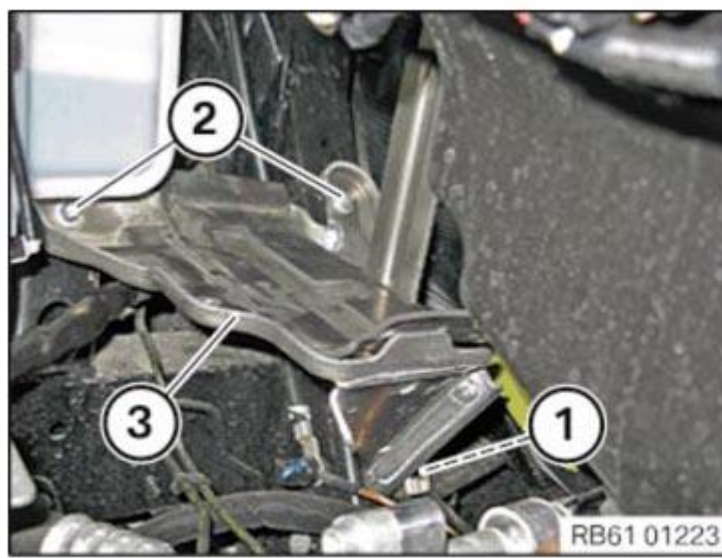
**Necessary preliminary tasks:**

- Remove **BATTERY**

Release screws (1; 2).

Tightening torque **61 21 3AZ** .

Remove battery tray (3).



**Fig. 277: Identifying Battery Tray And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 21 010 REMOVE AND INSTALL OR REPLACE BATTERY**

**WARNING:** High-voltage system - risk of serious injury or death.  
 The following points must be strictly observed prior to starting work :  
 Disconnect **HIGH-VOLTAGE SYSTEM** from power  
 Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

**WARNING:** Observe **SAFETY INFORMATION** for handling vehicle battery.  
 Follow instructions for **DISCONNECTING AND CONNECTING BATTERY** .  
 Follow instructions on **INTELLIGENT BATTERY SENSOR (IBS)**.

To ensure the correct safety and convenience functions, install only the original battery (battery size and type) stored in the vehicle order. Observe notes on **BATTERY REPLACEMENT**.

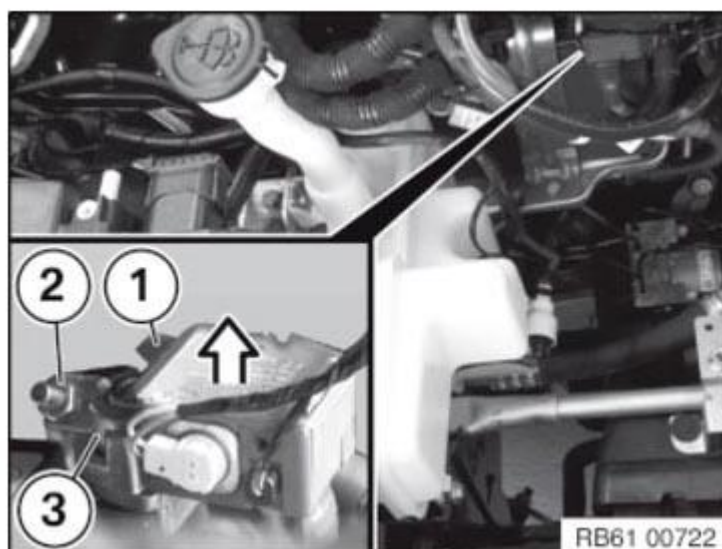
**Necessary preliminary work:**

- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Remove **FRONT LUGGAGE COMPARTMENT WELL**

Open cover (1) and release nut (2) below it.

Tightening torque **61 21 1AZ** .

**IMPORTANT:** Do not under any circumstances pull or lever off safety battery terminal (3) by force.



**Fig. 278: Opening Battery Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove safety battery terminal (3) towards top, lay to one side and fix in position.

Release screws.

Tightening torque **61 21 5AZ** .

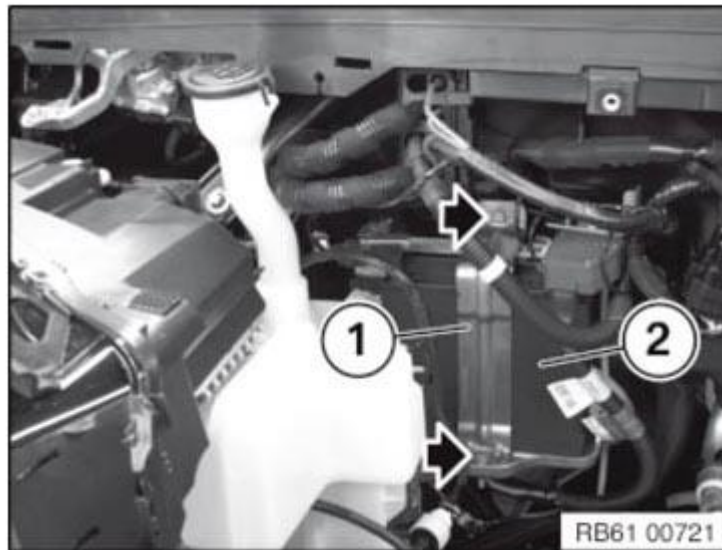
Remove retaining brackets (1).

Pull off vent hose.

Remove battery (2).

*Installation note:*

Make sure battery (2) is correctly seated in fixture.



**Fig. 279: Locating Battery Retaining Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

- Register **BATTERY REPLACEMENT**

## **HIGH-VOLTAGE STORAGE SYSTEM**

### **61 00... SAFETY INFORMATION FOR HANDLING ELECTRIC/HYBRID VEHICLES**

1. *Qualification:*

All repair work on high-voltage components **must be performed by qualified technicians** (qualification: training for work on high-voltage vehicles).

2. *Identification:*

Observe **warning notices** on high-voltage components. When replacing individual high-voltage components, check if warning stickers are present. Independently attaching warnings is only allowed on the locations provided for them. Use only approved and appropriately identified original new parts.

3. *Rules of conduct/protective measures:*

- Note operating instructions for handling high-voltage battery units.
- Do not under any circumstances touch open high-voltage cables and high-voltage components on damaged vehicle before shutting down the high-voltage electrical system.

- In the event of damage (mechanical, thermal) transition metal oxides, carbon, electrolyte solvents and their products of decomposition may be released.

Damaged high-voltage battery units must be stored in an acid-resistant pan in a location in the open that is protected against the weather (sun, rain) and secured against unauthorized access. Do not inhale escaping gasses.

- Prevent escaping substances from entering drains, pits and the sewer system.
- Collect any material that is discharged and have it disposed of according to the work instruction, wear acid-resistant protective clothing when doing so.
- Notify the fire brigade if fire breaks out, clear the area immediately and make accident scene safe.

Attempt to extinguish the fire without putting persons in danger (suitable extinguishant: water and water foam).

- A cut 2nd emergency separation point must be repaired with a butt connector.

#### 4. Measures before starting work:

- Each job on the vehicle must be assigned by appropriately trained personnel. Before work is started, this electrician must place the vehicle in the operating condition required to perform the relevant activity. The qualified personnel's instructions and directions absolutely must be followed. **No work may be carried out without this qualified personnel being consulted first.**
- The readiness to drive must be ended before shutting off the voltage of the high-voltage system. The readiness to drive is ended when the driver is absent only under the following conditions:
  1. seat belt buckle unlocked **and**
  2. the driver's door is open **and**
  3. no brake activated **and**
  4. no accelerator pressing **and**
  5. speed < 3 km/h (2 mph)
- Work on live high-voltage components is expressly prohibited. Before each operation on the high-voltage system, the system must be isolated from the power supply by qualified personnel (high-voltage safety connector Off) and secured against unauthorized return to service (padlock).
- Before beginning work, it is mandatory to check that the equipment is de-energized and is protected against being energized again.

Work is only permitted to begin if:

1. Corresponding display in instrument cluster: **High-voltage system switched off**

When a high-voltage warning is active (indicator light, Check Control, etc.), it is essential to determine and eliminate the cause of this warning via the diagnosis system before continuing with any other work.

**If it cannot be definitively established that the equipment is de-energized**, work is not permitted to begin. **risk of serious injury or death.** Before work begins, a qualified electrician (1000 V DC) must verify that the system is de-energized using appropriate measuring devices and procedures.

**=> In this case, a qualified electrician or Technical Support must be contacted.**

- Do not carry out any work whatsoever on high-voltage components while the batteries are charging. Before starting work, disconnect the charging cable from the vehicle.
- The vehicle must not be charged and refuelled at the same time.
- No repair work may be carried out at the high-voltage system when a combustion engine is currently running.
- The coolant pump and electric fan can be switched on automatically when terminal 15 is switched on or the high-voltage battery unit is charging. The following preliminary work must be performed prior to working on the electric fan to prevent injuries caused by an automatically activated electric fan.

1. Disconnect any connected charging cables.
2. Switch off terminal 15.
3. Disconnect high-voltage system from power.
4. Disconnect plug connections from the electric fan.

5. *Measures during/after activities:*

- Identifiable mechanical damage to or tampering with high-voltage components must be reported immediately to the qualified personnel in charge.
- When carrying out any work on the high-voltage system, it is prohibited to drive externally all the drive train components (wheels, gearbox, drive shafts, etc.).
- Check all connectors and plug connections of the high-voltage components for damages after disconnecting them and/or before connecting them.
- High-voltage cables (orange coating) and their connectors and ferrules **may not** be repaired. If damaged, a cable must always be replaced completely.
- High-voltage cables must not be twisted or kinked. Crushed high-voltage cables must be replaced.
- After a bending operation, the resulting bend may only be returned to its original shape. To repeat bending at the same place is not permitted.
- When working in the vicinity of high-voltage components (identified accordingly with warning stickers and orange-colored coating), protect these components against damage.
- The specified work steps in the repair instructions must be adhered to exactly.
- High-voltage components and their holders must be screwed/bolted to the defined tightening torque. Tightening torques and tightening specifications must be observed.
- Connecting high-voltage components to body ground is crucial to safety for reasons of equipotential bonding. For this reason, it is prohibited to operate any high-voltage components without them being correctly connected to body ground. The measurement (insulation measurement) is performed by the vehicle automatically and therefore manual measurement is not required.

For a correct ground connection, the retaining elements of high-voltage components must not be painted. Follow further PAINTING NOTES .

- Removed high-voltage battery units must be stored in a manner that protects them from misuse and damage.

6. *Potential compensation:*

Potential compensation wires, high-voltage cable, and the battery earth lead of the electrical machine electronics have a safety screw connection.

- Clean contact faces and have then checked by a second person.
- Tighten down screws/bolts to specified torque.
- Have tightening torque checked by a second person.
- Both persons must document that the work has been carried out correctly in the vehicle records.

## **61 25... ASSESSING THE TRANSPORT CAPABILITY OF CELL BLOCK IN SERVICE WORKSHOPS**

**WARNING:** High-voltage system - risk of serious injury or death.  
The following points must be strictly observed prior to starting work :

- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Visual check of the high-voltage battery unit following an accident

### **Initiating:**

For analysis and disposal purposes, it is necessary to transport an already used cell module. These lithium-ion based cell blocks are to be classified as hazardous material according to UN 38.3, and may only be

transported under particular prerequisites.

Obtaining the certified transportability between the assessment and delivery of the cell block to the disposal/transportation company is the responsibility of a qualified person. For shipping one also needs to take into account the influence of the storage requirements and other possible occurring events for the determined transportability.

The transport in the sense of the hazardous goods legislation is organized in three areas:

1. Assessment of the transportability
2. Transport preparation
3. Performing the transport

The following contains all the necessary information in order to assess the transportability of a used cell block. The transport preparation and execution is **not** included in this information.

It will be explained which measures are necessary in order to assess the transportability.

How these measures are to be performed individually depends on the particular situation at the location and is not included in this information. These procedures are to be defined according to the local regulations/laws and recorded as valid local work instructions.

**Prerequisites from a security perspective:**

The analysis and assessment of the cell block is to be performed by an "expert for working on HV intrinsically safe vehicles".

The certificate of the transportability is the responsibility of the qualified person.

The following specifications for work safety must also be observed:

Storage of cell blocks

**NOTE:** The following must be printed out and archived with the vehicle data.

**Assessment cell block**

NAME	Date	Serial no.	VIN
Â	Â	Â	Â

**Signature:** -----

The electrical assessment of the cell module takes place via the **diagnosis and test module** .

The de-energized state of the high-voltage battery unit is to be determined **before** it is removed from the vehicle.

De-energize the high-voltage system.

Transport preventing faults according to the diagnosis or the test module	Yes	No
---	-----	----

**Visual assessment:**

Smoke	Yes	No
Evidence of fire damage	Yes	No
Heat development	Yes	No
Crack or opening on the housing	Yes	No
Dents on the housing, deformation, damage	Yes	No



Loose connections, loose or damaged	Yes	No
Serial number not readable	Yes	No
Suspected water damage	Yes	No

The serial number must be clearly legible. If the serial number can no longer be read, the housing of the cell block must be clearly marked with the serial number.

The electrical and visual assessment must be set down in writing.

**If one or more points is answered with yes, the next procedure must be clarified by technical support. Furthermore, the removed high-voltage battery unit must be blocked off with barrier tape. If the high-voltage battery unit is still in the vehicle, the vehicle must be made inaccessible and blocked off.**

## **61 25 900 DISCONNECTING HIGH-VOLTAGE SYSTEM FROM POWER**

**WARNING:** High-voltage system - risk of serious injury or death.

**WARNING:** The following points must be strictly observed prior to starting work :

- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

Stick to the procedure absolutely.

IMPORTANT:

1. Disconnect any connected high-voltage charging cable.
2. Open engine compartment lid
3. Switch off ignition
4. Before disconnecting the high-voltage safety connector, ensure that the vehicle is in "sleep" state.

Comply with procedure for return to service.

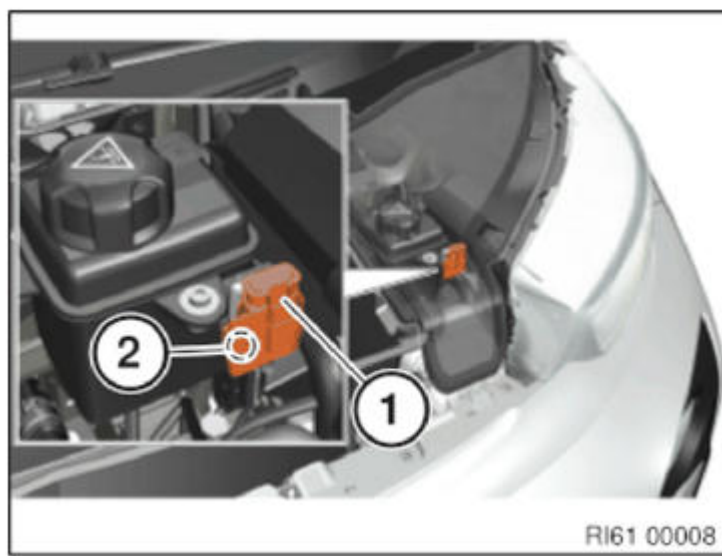
IMPORTANT:

1. If connected, disconnect 12V charger
2. Remove shackle lock
3. Connect high-voltage safety connector
4. Perform double terminal change (operate START-STOP button 4 times with a 1-second between each operation)

### **Disconnect high-voltage system from power:**

IMPORTANT: The high-voltage safety connector cannot be fully disconnected.

Unlock high-voltage safety connector (1) and pull out until bore holes (2) on connector and bushing are fully exposed. The labelling "OFF" is visible on the high-voltage safety connector.

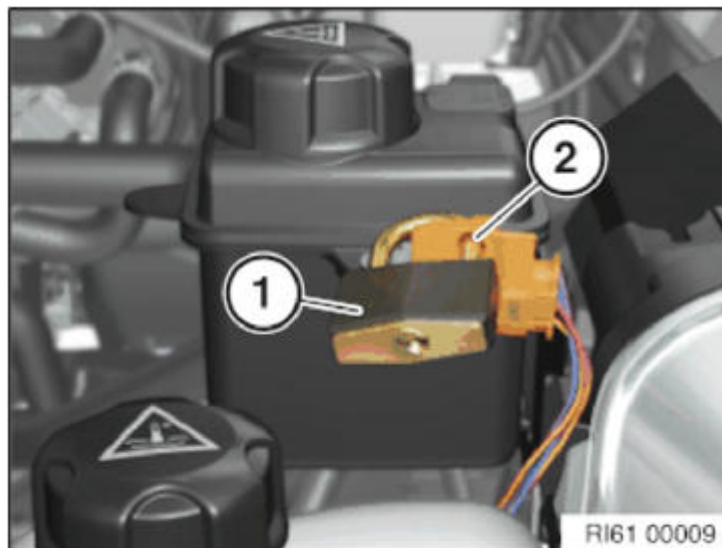


**Fig. 280: Identifying High-Voltage Safety Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Secure high-voltage system against being switched back on:**

Insert and lock shackle lock (1) in exposed bore hole (2) of high-voltage safety connector (2).

IMPORTANT: Store shackle lock key in a safe place.

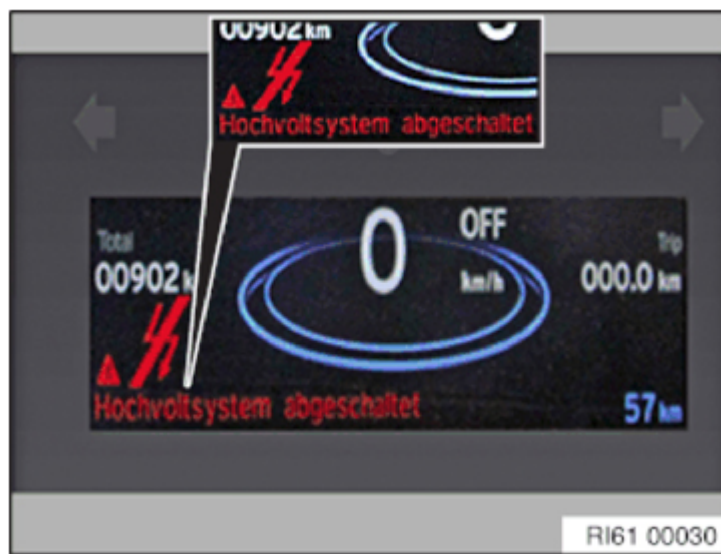


**Fig. 281: Identifying Shackle Lock And High-Voltage Safety Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Determine voltage free status:**

**WARNING:** Mandatory steps prior to carrying out further repair work:

- **Activate ignition and check that there is zero voltage in the instrument cluster. Check Control message "High-voltage system deactivated" must be displayed.**



**Fig. 282: Display - Check Control Message High-Voltage System Deactivated Screen**

Courtesy of BMW OF NORTH AMERICA, INC.

- Pay attention to active high-voltage warnings (indicator light, check control, etc.), determine cause and correct problem.
- The **12V BATTERY MAY BE DISCONNECTED** only when Check Control Message "high-voltage system switched off" is displayed in the instrument cluster.

**NOTE:**

With the ignition off and the high-voltage safety connector disconnected, the Check Control message "Hybrid system faulty" is displayed as standard. Zero voltage (high-voltage system switched-off) is only displayed with the ignition on.

**WARNING:**

risk of serious injury or death.  
 If it cannot be established beyond doubt that the instrument cluster is de-energized, work is not permitted to begin. risk of serious injury or death.  
 Before work begins, a qualified, certified electrician must verify that the system has been disconnected from the power supply (1000 V DC) using appropriate measuring devices and measuring procedures.  
 => In this case, Technical Support must be contacted. Furthermore, the vehicle must be made inaccessible and blocked off with barrier tapes.

**61 25... NOTES ON CHARGING THE 12 V BATTERY/HIGH-VOLTAGE BATTERY IN BOOTH VEHICLES (NEW AND USED CARS)**

Experience has shown that failure to comply with the following points will damage batteries  
 IMPORTANT: in the vehicle and they must be replaced consequently.  
 This bears significant costs.

**1st charging interval**

IMPORTANT: With stationary vehicles, the 12 V battery/high-voltage battery must be recharged at least every 6 weeks.

**2. Charging the 12 V battery/high-voltage battery on booth vehicles:**

**NOTE:**

When charging the high-voltage battery by means of the charging cable, the 12 V battery will be automatically charged as well.



Â	12 V battery must be charged	High-voltage battery must be charged	Charging by means of charging cable	12 V battery is also charged
after 6 weeks	x	x	x	x

## 61 25... NOTES ON REPAIR OF HIGH-VOLTAGE BATTERY UNIT

### 1. Prerequisite

Various organizational prerequisites need to be fulfilled before the repair of a high-voltage battery unit is permitted and can be carried out in an expedient way. These prerequisites concern both, the commercial company and the service employee.

The repair of a high-voltage battery unit is intended to be carried out exclusively by commercial companies featuring the service format BMW i Service Extended Battery or BMW i Service Full.

A commercial company featuring the service format BMW i Service Basic is able to remove and install a high-voltage battery unit but cannot perform any repair work on or in the high-voltage battery unit. If a repair is required according to the test schedule in the diagnosis system, the vehicle or the high-voltage battery unit must be transported to a commercial company featuring the service format BMW i Service Extended Battery or BMW i Service Full. The repair is to be carried out in such a workshop.

The commercial company must make available the required special tools and a suitable workbay for the repair.

The most important special tools are the following:

- Mobile lift table MHT 1200 + set of adapters to remove and install the high-voltage battery unit.
- Charger for cell blocks of high-voltage battery unit.
- Diagnosis system for the repaired high-voltage battery unit.
- Lifting tool to remove and install cell blocks.
- Panel wedges made of plastic to remove clips within the high-voltage battery unit.
- Lifting traverse for the complete high-voltage battery unit.
- High-voltage barrier tape.
- Yellow cones relating to high-voltage recommended.

Only service employees being qualified for the repair of the high-voltage battery unit may carry out this procedure.

This includes training for "experts for work on high-voltage-intrinsically safe vehicles".

Before removing and opening the high-voltage battery unit, troubleshooting is to be carried out by means of the relative diagnosis system. Only if determined by the test schedule and if the prerequisite "no mechanical damage on the outside" is satisfied, the high-voltage battery unit may be opened and the faulty component identified by the test schedule can be replaced. No other repair work relating to the high-voltage battery unit than the replacement of faulty components is planned.

It is essential to observe the operational steps specified in the repair instructions very precisely in order to carry out the replacement of a faulty component. The use of the special tools listed therein is absolutely essential as well.

### 2. Safety rules

- The first step after opening the housing cover to repair the high-voltage battery unit is a visual inspection for mechanical damage.
- A thorough visual inspection of the components inside the working area is required during and/or before and after every operation. When removing one component, all other involved components being accessible need to be checked for damages. If the housing or other internal high-voltage components are damaged, a qualified electrician or Technical Support must be contacted. All repair works relating to the high-voltage battery unit must be stopped immediately for safety reasons.

- Check the correct latch mechanism of the connector of the insulation monitoring line at the control unit of the high-voltage battery unit. If this is not fully locked, an isolation fault may not have been detected.
- The separation of the high-voltage cable between the two cell modules mounted on the inside of the housing (across from the connection side of the high-voltage battery unit) is to be always carried out before working on the opened high-voltage battery unit. This procedure ensures the interrupt of the series connection (additional safety).
- The workbay required for the repair of the high-voltage battery unit must be clean (free of grease, dirt and debris), dry (no leaking fluid) and free of flying sparks. Therefore, avoid close vicinity to areas intended for cleaning of vehicles and to workbays intended for repair work relating to the body. Use movable walls for separation, if needed.
- High-voltage barrier tape is required to secure the workbay against unauthorized access (insufficient qualification, customers, visitors, etc.). It is also required in case the high-voltage intrinsic safety is not established or the status is not determined yet.

Placing yellow cones with lightning bolt to indicate high-voltage when leaving the working area is recommended.

- Do not use tools or other objects with pointed and sharp blades/edges when working on high-voltage components or high-voltage cables and/or in their close vicinity. Diagonal cutting pliers, knives etc. are prohibited. Cable straps inside the low-voltage wiring harness may be opened by means of diagonal cutting pliers.

**Allowed** : Plastic wedges

- Cable straps relating to high-voltage cables or 12V lines may not be cut open. Damaged clips remain on the high-voltage cable or 12V line. The remaining, damaged clip must be pushed to a position on the high-voltage line where the clip can not rub. A new clip must then be installed.
- Defective or damaged high-voltage cables must be made unusable to ensure they are not reused.
- No tools must be forgotten inside the high-voltage battery unit. Check whether all tools are present in the tool box before closing the housing cover
- It is absolutely essential to remove all small parts/screws that fell into the high-voltage battery unit. The use of magnetized screws is generally recommended in order not to lose any screws in the high-voltage battery unit during the repair.
- When interruptions of work occur: Secure housing cover against unintended opening by screwing in several screws. Enclose the working area by means of high-voltage barrier tape.
- Due to the very slim construction of the radiator, the risk of damage during disassembly and installation is high. Careful handling is absolutely necessary as the cooling of the cell blocks may not be guaranteed when the radiator is damaged (bent, dented). The consequence is a major loss of the electrical range and of the power of the vehicle. In extreme cases, even a breakdown may occur.
- Very careful handling is necessary when disconnecting and connecting the insulation detector line at the control unit of the high-voltage battery unit (safety box coming) since high-voltage is present in the thin orange lines. Do not pull on the lines (e.g. to unplug the connector etc.). The connector must be locked securely when plugged in.
- Make sure the plastic lids of the modules are not removed when working on the cell modules (loosing screws, raising and lifting...). The live cell contacting system is located thereunder. Continuing to work with the lid being removed is not permitted. A qualified electrician or Technical Support must be contacted.
- A schematic diagram with limiting sample examples in the training is necessary to get to know the limits. These show when the further work for the "experts for intrinsically safe vehicles" is no longer possible due to absent intrinsic safety, and the Technical Support or a qualified electrician must be contacted.
- Remove residual moisture and coarse contamination around the lid of the high-voltage battery unit before beginning the disassembly.
- Clean gaskets and sealing surfaces (venting unit, high-voltage connector, signal connector, radiator connection) with a specified cleaning agent before reassembly.

- If contamination is present in the high-voltage battery unit, check the cause and carefully clean the affected areas.

Approved cleaning agent:

- Spirit
- Windscreen cleaner
- Glass cleaner
- Distilled water
- Vacuum cleaner with plastic top
- Visual inspection for contamination and damage of housing as well as of connections and degassing unit when installed (underfloor). A damaged diaphragm within the venting unit may indicate damaged storage cells. In this case, special carefulness is required when checking and opening the high-voltage battery unit.
- Electrolyte

The majority of the electrolyte is a mixture of lithium-nickel-manganese-cobalt oxide in bound state. The quantity of free electrolyte in the high-voltage battery unit is very small. It is a noxious and irritant fluid. Absolutely avoid direct contact of skin with leaking fluid as acid burns may occur. In case of contact with eyes or skin, flush with plenty of clear water and consult a doctor immediately. Burning or evaporating electrolyte is also hazardous. Careful, do not inhale. Ensure sufficient fresh air supply. If breathing ceases, apply artificial respiration and immediately consult a doctor. Notify fire brigade in case of fire. Clear the area immediately and make accident scene safe. Attempt to extinguish the fire without putting persons in danger and use suitable extinguishant, e.g. water.

### 3. Repair of removed high-voltage battery unit

- The high-voltage battery unit is a component of large dimensions and heavy weight. Only the combination of the housing and the cell blocks mounted therein provides the high-voltage battery unit with complete stability (rigidity), as required for driving. Therefore, it is necessary to ensure that the housing is positioned on the relative mounting/adaptor of the lifting table during replacement and fixation of cell blocks. In this way, one can prevent the housing from bracing during the repair work and ensure the high-voltage battery unit is not installed in the BMW I01 in this condition.
- It is extremely important to enter the serial numbers and the installation positions of the replaced components in the SME via the testing device, as well as to carry out the transmission into the diagnosis system. Otherwise, the new installation position will be assigned automatically by the SME. The consequence is an incorrect location data, as the SME does not set correct positions. For a renewed repair of the high-voltage battery unit, the diagnosed faults for the incorrect installation position will be displayed. The consequence is that replacement is done at the wrong location.

**IMPORTANT:**

- In diagnosis, it is not possible to enter the serial numbers of the cell supervision circuits. The serial numbers are transmitted from the cell supervision circuit to the SME using the CAN bus. The SME then sets a corresponding position assignment. This assignment is not always fault-free. That is why the serial number and installation position of the exchanged cell supervision circuit must be checked in the diagnosis after completed repair. If the positions do not match, a position change can be performed with diagnosis. A new serial number of a cell supervision circuit is not entered.
- Do not use powered wrenches as the screws/threads located in the high-voltage battery unit may break due to the low torques.
- The seal must be renewed every time the housing cover is removed to guarantee tightness of the high-voltage battery unit.
- The screws are thread-tapping, so pre-insert them manually before tightening them with a tool. Otherwise, the threads of the lower housing section may be damaged.



## 61 25 010 REMOVING AND INSTALLING HIGH-VOLTAGE BATTERY UNIT

### Special tools required:

- [32 1 270](#)
- [2 184 136](#)
- [2 357 071](#)
- [2 356 946](#)
- [2 220 718](#)
- [2 356 947](#)
- [2 357 271](#)
- [2 357 270](#)
- [2 357 269](#)
- [2 360 081](#)

### **WARNING:**

High-voltage system - risk of serious injury or death.

The following points must be strictly observed prior to starting work :

- Disconnect [HIGH-VOLTAGE SYSTEM](#) from power
- Observe [SAFETY INFORMATION](#) for handling electric/hybrid vehicles.

### Necessary preliminary tasks:

- Draw off [AIR CONDITIONING SYSTEM](#)

### **WARNING:**

- Before removing the high-voltage battery unit, ensure that the high-voltage battery unit is sufficiently charged.

The high-voltage battery unit is sufficiently charged if a range is displayed on the instrument cluster.

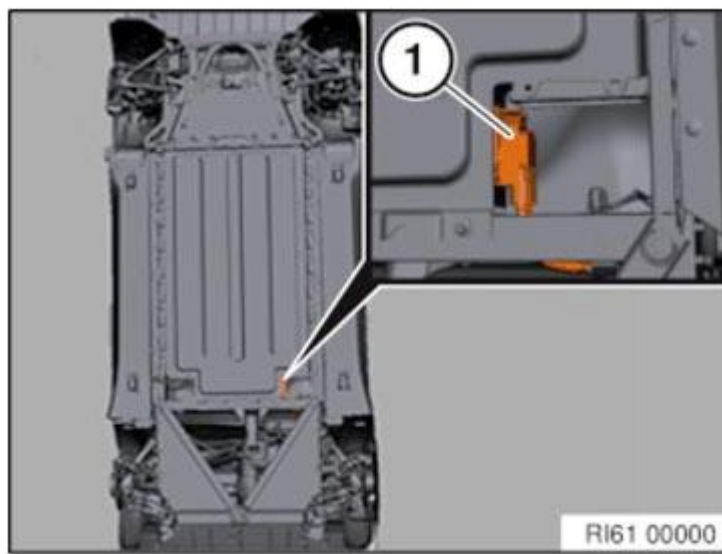
- Check high-voltage battery unit for damage before removal.
- After an accident, the high-voltage battery unit must be subjected to a visual inspection prior to starting work.

Observe [INSPECTION CRITERIA](#) for high-voltage battery unit after an accident.

Disconnect high-voltage plug connection (1).

### **NOTE:**

See [UNLOCKING AND DISCONNECTING HIGH-VOLTAGE PLUG CONNECTIONS](#).



**Fig. 283: Disconnecting High-Voltage Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) on refrigerant line (2) and pull off in direction of arrow.

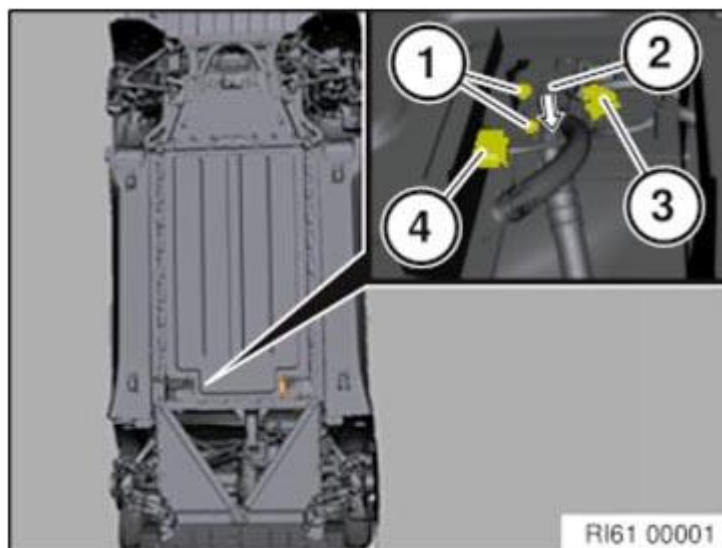
Tightening torque [61 27 7AZ](#).

Seal refrigerant line (2) with plugs to protect against contamination.

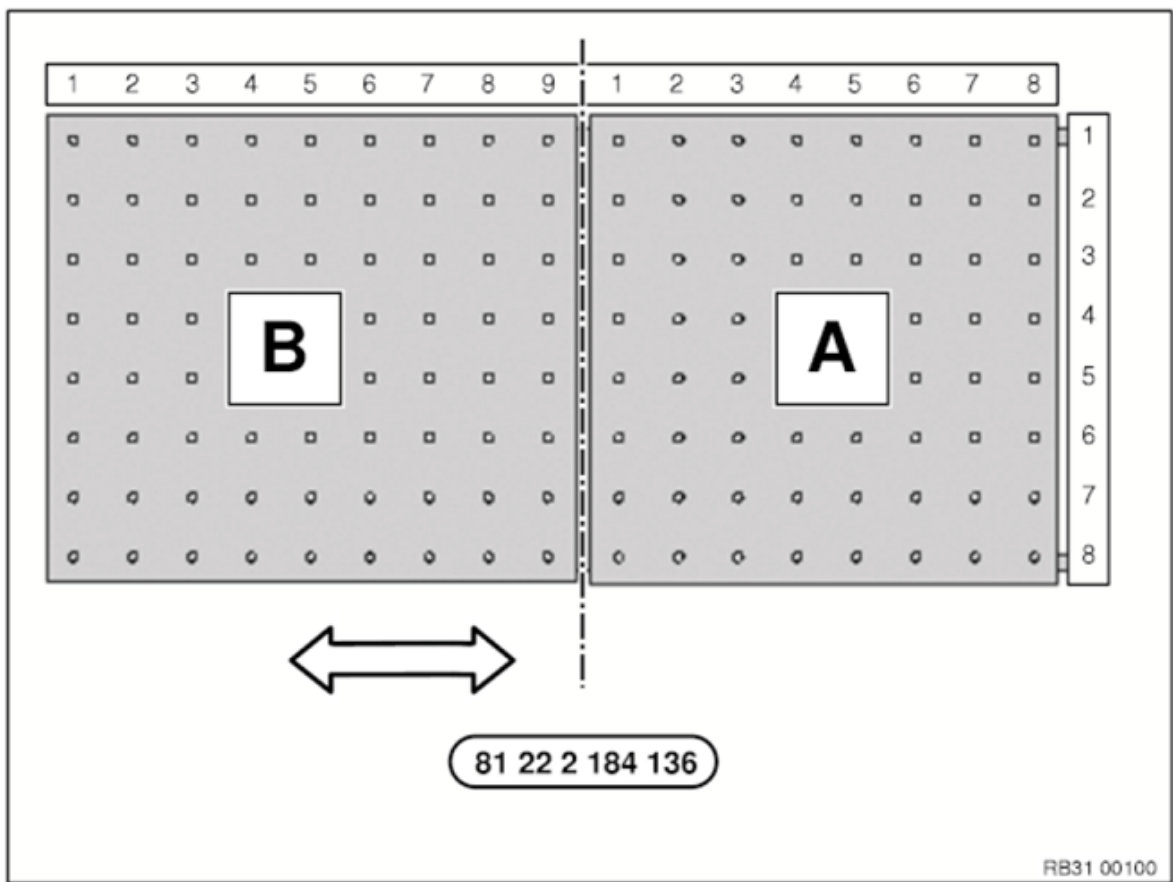
If an electrical expansion valve is installed, the connector (3) must be disconnected.

Disconnect signal connector (4).

**NOTE:** Seal all the components and lines in refrigerant circuit and return parts immediately after disassembly with a special tool [32 1 270](#) to prevent penetration of moisture or foreign bodies.



**Fig. 284: Releasing Screws On Refrigerant Line**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 285: Adjusting Table Lift Working Plate (All Wheel Drive Vehicle)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

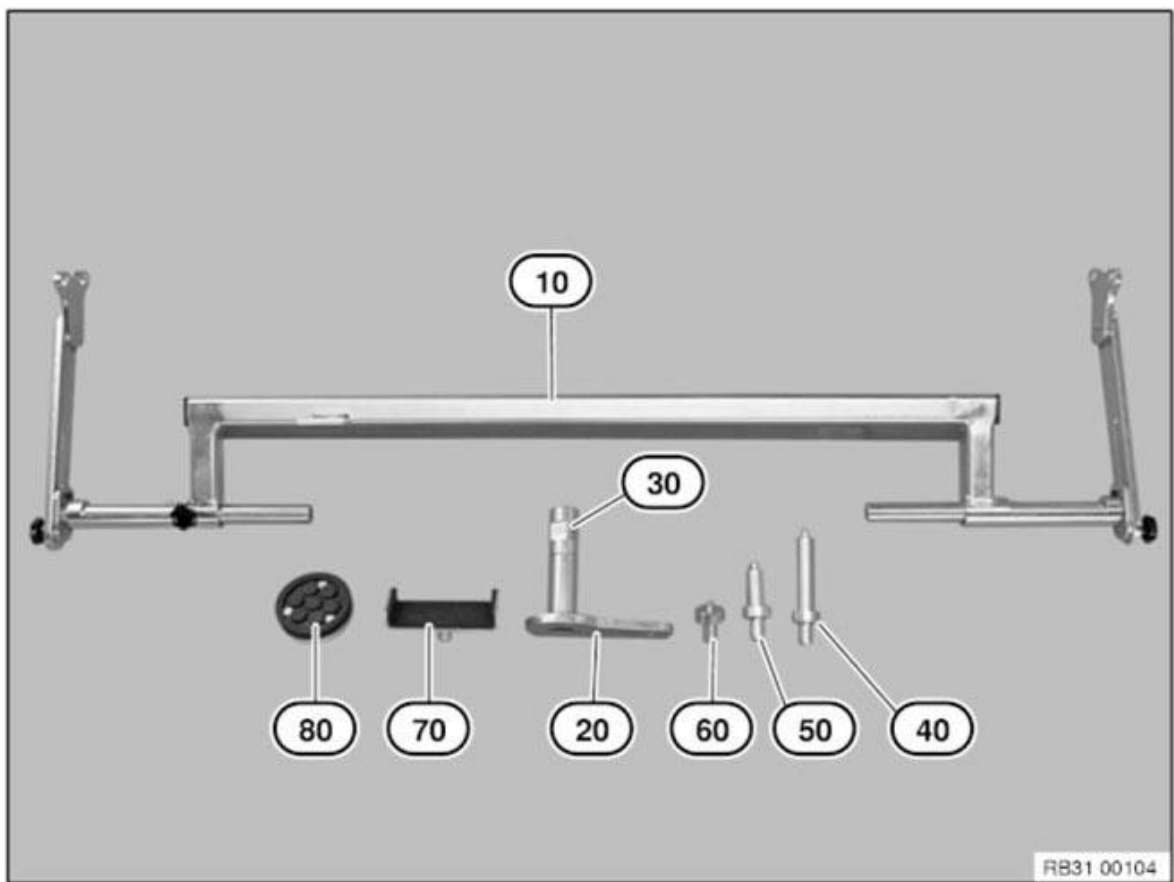
**IMPORTANT: Coordinate determination always begins at the top.**

MHT 1200 mobile lifting table: order number [81 22 2 184 136](#)

The standard equipment of the MHT 1200 mobile lifting table includes 3 size 80 mountings only.

Additional fixture 80

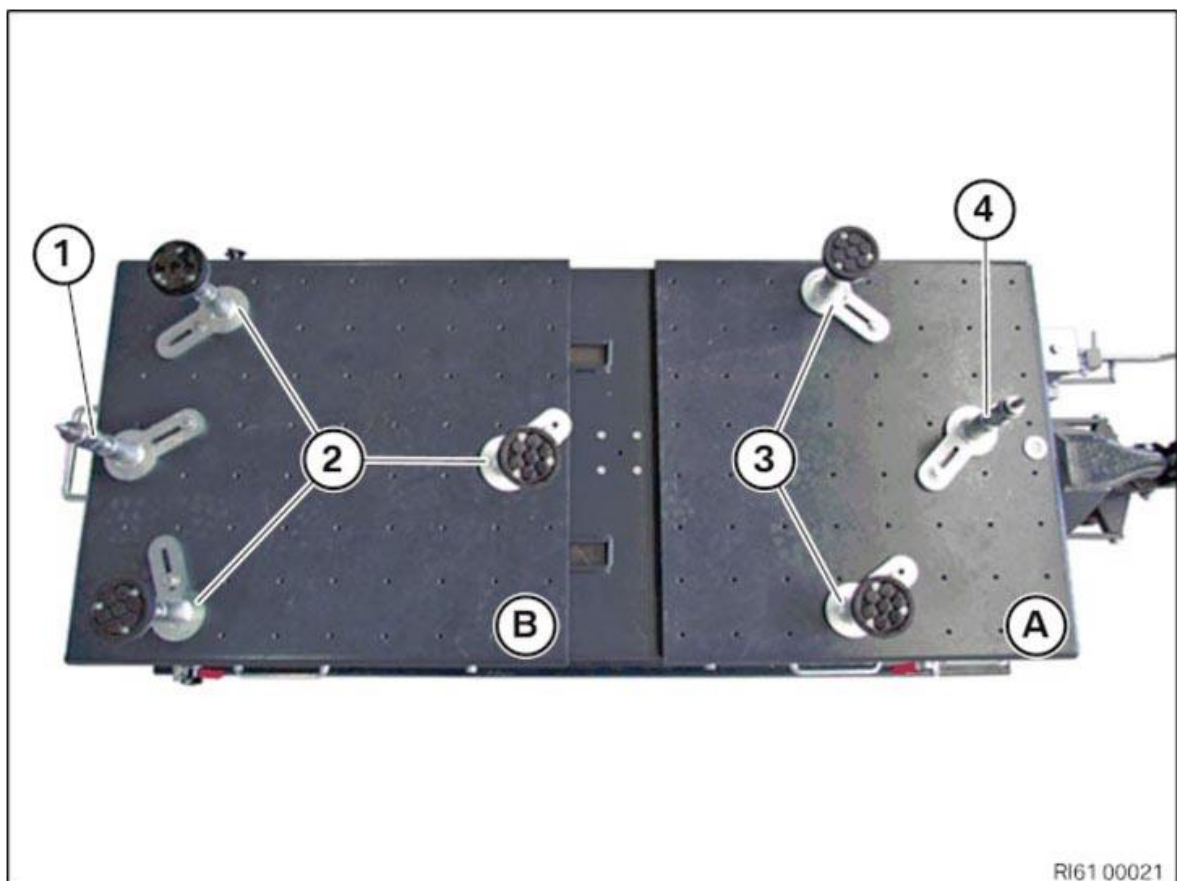
Order number: 81 22 [2 357 071](#)



**Fig. 286: Adaptations For Mounting Front Axle With Engine And Transmission**  
 Courtesy of BMW OF NORTH AMERICA, INC.

The following tools are required to equip the table lift:

Tool number:	Number:
20	7
80	5



**Fig. 287: Identifying Table Lift Structure**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Structure of table lift.**

Position 1: Position retaining element (20) with fixture [2 356 946](#) on table top **B** for high-voltage battery unit at coordinates 2/4.

Position 2: Position the mounting element (20) with mounting (80) on table top **B** for high-voltage battery unit at the coordinates 2/2, 2/7 and 9/4.

Position 3: Position retaining elements (20) with fixture (80) on table top **A** for high-voltage battery unit at coordinates 5/2 and 5/7.

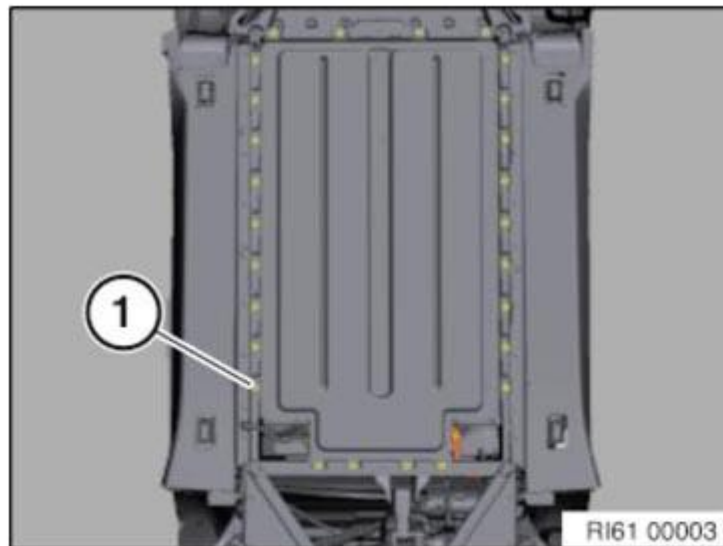
Position 4: Position retaining elements (20) with fixture [2 356 946](#) on table top **A** for high-voltage battery unit at coordinates 6/5.

Release screws (1) on high-voltage battery unit.

Tightening torque [61 27 1AZ](#) .

Slowly lower table lift.

**NOTE:** High-voltage battery unit shown without table lift for reasons of clarity.

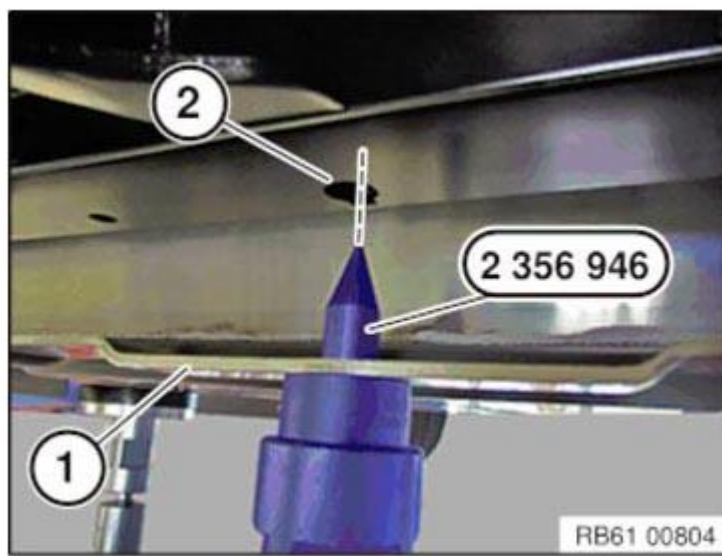


**Fig. 288: Identifying Screws On High-Voltage Battery Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

**Installation should take place with the aid of a second person.**

Fixture [2 356 946](#) ensures high-voltage battery unit (1) is installed centrally in the Drive module (2).



**Fig. 289: Installing High-Voltage Battery Unit In Drive Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

The following sequence must be adhered to if the equipotential bonding screw connection is faulty:

- Drill out to 5.4 mm at position (1).
- Install a new equipotential bonding screw

Tightening torque [61 27 2AZ](#)

IMPORTANT: Observe notes on [EARTH BONDING SCREW CONNECTIONS](#).



**Fig. 290: Identifying Equipotential Bonding Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Before installing the high-voltage battery unit, a test run must be carried out with the high-voltage battery unit test device.

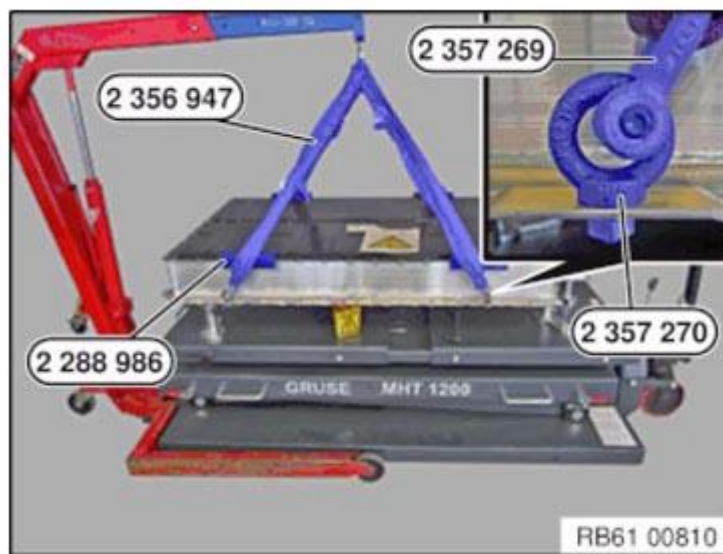
Before installing the high-voltage battery unit, check whether the safety label and information label are affixed.

Missing or damaged labels must be replaced.





**Fig. 291: Identifying High-Voltage Battery Unit Test Device Information Label**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 292: Lifting High-Voltage Battery Unit Using Workshop Crane**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Use the workshop crane to remove the high-voltage battery unit from the MHT1200 mobile lifting table.

To this end, the workshop crane [2 220 718](#) is equipped as follows and attached to the high-voltage battery unit as shown:

Lifting device [2 356 947](#)

Edge protection [2 357 271](#)

Eye bolt [2 357 270](#)

Shackle [2 357 269](#)

Alternatively, the special tool [2 360 081](#) can be used. Follow notes on **LIFTING OF HIGH-VOLTAGE BATTERY UNIT**.

**Visual check of the high-voltage battery unit following an accident**

**Before beginning work:**

IMPORTANT: The following points must be strictly observed prior to starting work:

- Assessment of damaged vehicle

- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**WARNING:** If the message "High-voltage system deactivated " is not displayed in the instrument cluster, work must be stopped. If the high-voltage battery unit is still in the vehicle, the vehicle must be made inaccessible and blocked off. Furthermore, the high-voltage battery unit that has been removed must be blocked off with high-voltage barrier tape.

**Preconditions:**

**NOTE:** It is mandatory to stop repair work and contact technical support when there is an unclear situation, strong deformation, strong heating as well as escape of fluid from the high-voltage battery unit.

Accident vehicle should be parked outdoors on a place for vehicles affected by accident.

If the high-voltage battery unit is still in the vehicle, then the vehicle must be made inaccessible and locked. Furthermore, the removed high-voltage battery unit must be blocked off with high-voltage barrier tape and technical support must be contacted.

**An airbag that has been deployed or safety battery terminal:**

**NOTE:** If at least one of the airbags or the safety battery terminal has triggered, the high-voltage battery unit must be removed and the internal assessment of the high-voltage battery unit outlined in Point 8 must be carried out.

Insofar as the motor vehicle had apparently met with a severe accident when it was stopped (parked, charging) and the airbags or the safety battery terminal were still not triggered, the internal assessment of the high-voltage battery unit outlined in Point 8 must be carried out.

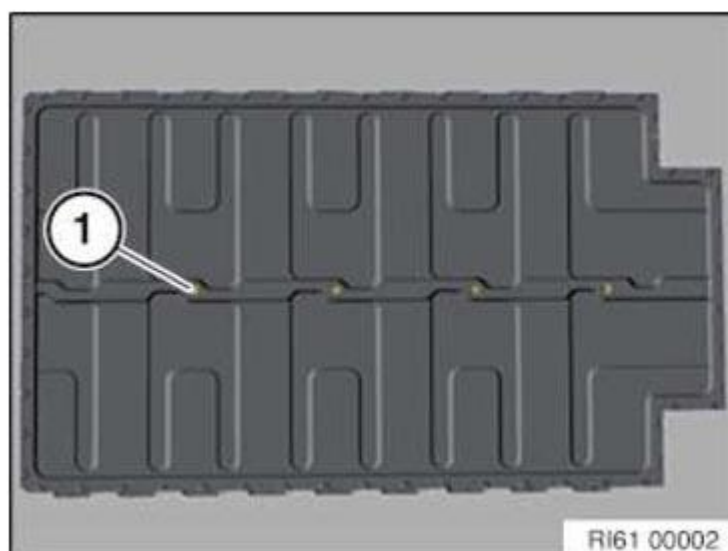
**1. Damage at attachment points:**

The high-voltage battery unit (1) is screwed to the vehicle via the housing.

When the housing bolting points are torn off, bent or deformed, the housing tray must be replaced.

In the case of cracks in the housing, contact technical support.

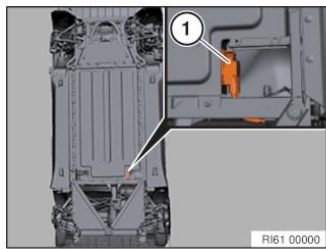
If damage that has not been described is detected or if there are ambiguities in the type of damage/cause of damage, then BMW technical support must be contacted.



**Fig. 293: Identifying High-Voltage Battery Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Damage to electrical interfaces:**

**IMPORTANT:** If the message "**High-voltage system deactivated**" is not displayed in the instrument cluster, work must be stopped. If the high-voltage battery unit is still in the vehicle, the vehicle must be made inaccessible and blocked off. Furthermore, the high-voltage battery unit that has been removed must be blocked off with high-voltage barrier tape.



The high-voltage battery unit is connected to the vehicle through the following interfaces on the housing:

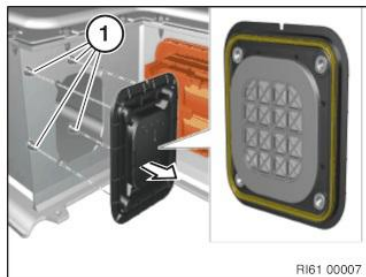
- Signal line interface
- High-voltage cable interface
- High-voltage interlock interface

If these interfaces are damaged, the damaged wiring harness or connector must be replaced. The following types of damage are considered to be relevant:

- bent plug-in contacts
- destroyed connector housing
- connectors that are torn off the housing
- loss of ability to connect the mating plug

**Fig. 294: Checking For Damage To Electrical Interfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

**3. Damage to venting unit/refrigerant connection:**



Visually check the following interface on the housing:

- Degassing unit

If this interface is damaged, the venting unit must be replaced.

If the diaphragm is damaged, BMW technical support must be contacted!

Visually check the following interfaces on the housing:

- Refrigerant connections

If this interface is damaged, the radiator must be replaced. The following types of damage are considered to be relevant:

- Faulty threads (1) on the refrigerant connection/expansion valve
- Deformation (e.g. refrigerant lines can no longer be installed)
- Leak between the refrigerant connection and housing
- loss of ability to connect the mating plug

**Fig. 295: Checking For Damage To Venting Unit/Refrigerant Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**4. Damage to the rest of the housing:**



Visually check the housing:

Relevant damage for the replacement of the high-voltage battery unit:

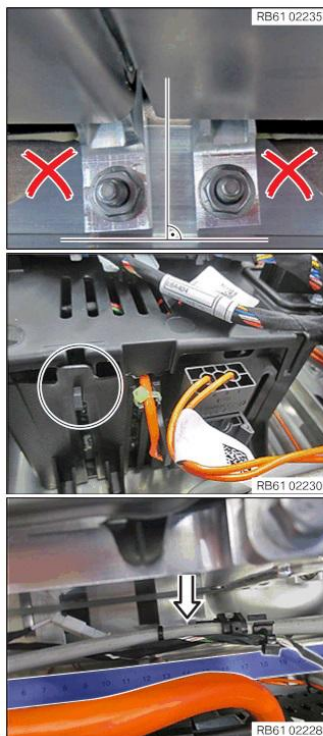
- Cracks, holes and other leaks on the housing
- Dents and deformation on the housing, especially on large-area housing sections

Scratch marks are not classed as critical. This type of damage does not require replacements.

If damage that has not been described is detected or if there are ambiguities in the type of damage/cause of damage, then BMW technical support must be contacted.

**Fig. 296: Checking For Damage To Rest Of Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

**5. Internal assessment of the high-voltage battery unit:**



Attachment points must be at right angles to the cell module.

If the attachment points of one or more cell modules are deformed as shown in the illustration, all the cell modules must be replaced.

Carry out a visual inspection for visible damage to the safety box.

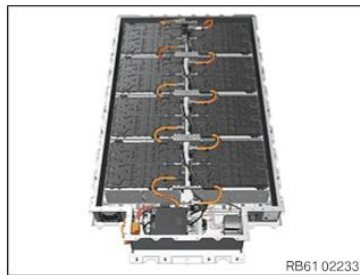
If visible damage (see illustration) to the safety box is established, the protection against contact is not available any more and technical support must be contacted.

Mild deformations of the coolant pipe are to be taken as not critical.

If the coolant pipe is deformed more than as shown in the illustration, the radiator must be replaced.

**Fig. 297: Checking Attachment Points, Safety Box, And Coolant Pipe**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## 6. Visual inspection:



If the lid is opened, a visual inspection of identifiable damage must be immediately performed after opening the lid.

If damage that has not been described is detected or if there are ambiguities in the type of damage/cause of damage, then BMW technical support must be contacted.

**Fig. 298: Checking For Damage To Electrical Interfaces**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## Recycling:

Pay attention to applicable recycling instructions for your country/region.

### Notes for lifting high-voltage battery unit

To safely lift the high-voltage battery unit from the packaging or from the table lift, the special tool [2 360 081](#) is to be used.

The following information describes the use of special tool [2 360 081](#) with the different high-voltage battery units.

The position of the adjustment arms, pivot bearings and chain have been numbered or labelled on special tool [2 360 081](#).

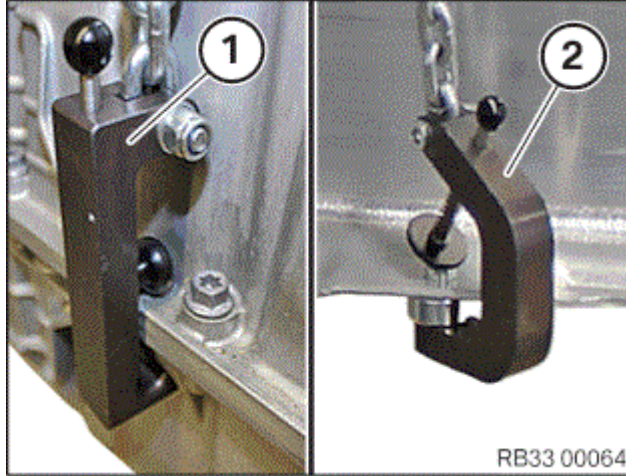
Settings are described individually for each high-voltage battery unit in the tables listed below.

Defined fixtures to attach multifunction hooks have been installed on the high-voltage battery unit housing.

Once special tool [2 360 081](#) has been correctly positioned and set, the multifunction hooks are located precisely at the fixtures of the high-voltage battery unit.

Multifunction hooks (1)

C-hooks (2)



**Fig. 299: Identifying High-Voltage Battery Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.



Equip special tool 2 360 081 with the C-hooks.

Adjusting arm	Pivot bearing position	Chain position
1	I	1
2	I	1
3	H	2
4	H	2

**Fig. 300: Preparing Special Tool**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## 61 25 200 REMOVING AND INSTALLING/REPLACING CONVENIENCE CHARGING ELECTRONICS

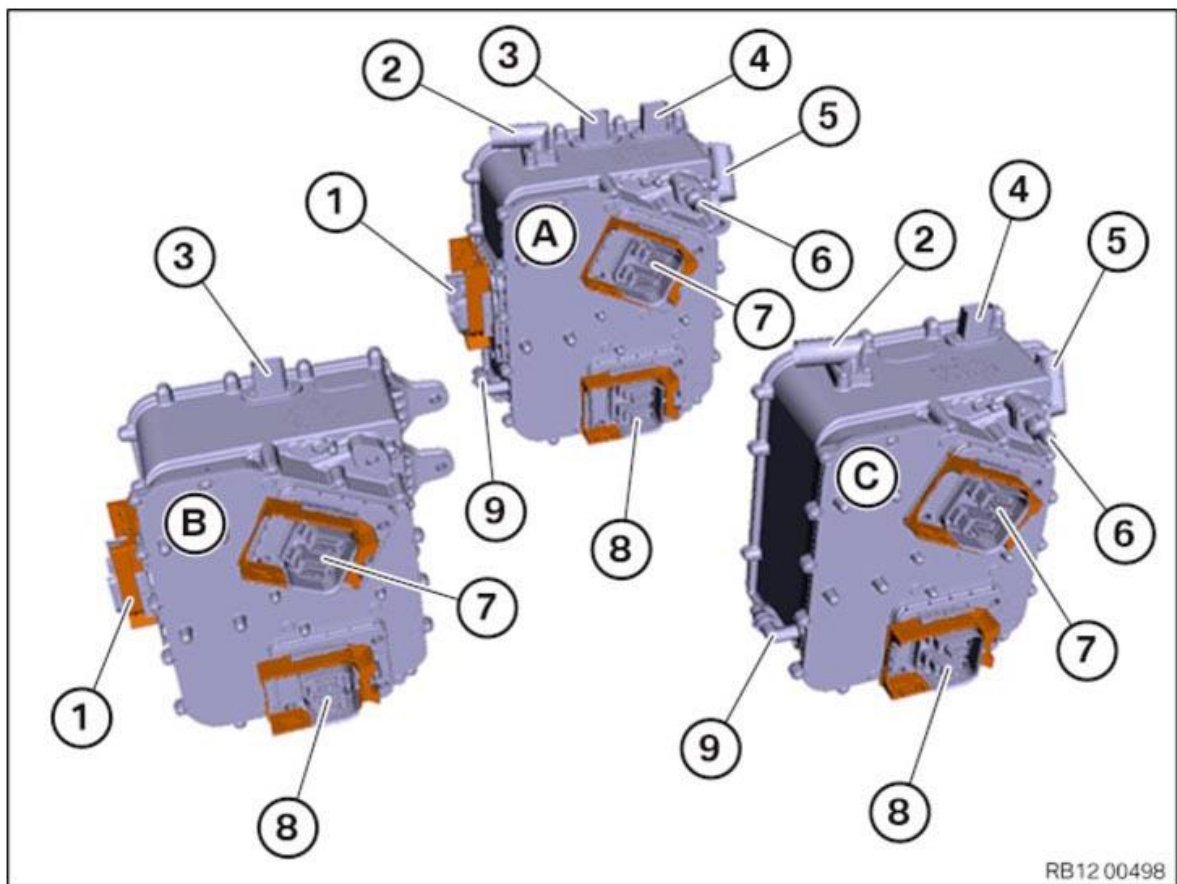
**WARNING:** High-voltage system - danger to life  
 Compliance with the following points is mandatory before beginning work:

Necessary preliminary tasks:

- Disconnect **HIGH-VOLTAGE SYSTEM** from power
  - Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
  - Observe notes on **EARTH BONDING SCREW CONNECTIONS**
- Remove vertical strut. See REMOVING VERTICAL STRUT or REMOVING VERTICAL STRUT (VEHICLES WITH RANGE EXTENDER) .
  - Remove LEFT HORIZONTAL STRUT
  - Only with alternating current rapid charging equipment (SA4U8):

**DRAIN COOLANT**





**Fig. 301: Overview Of Convenience Charging Electronics**

Courtesy of BMW OF NORTH AMERICA, INC.

**Versions of convenience charging electronics:**

Depending on the equipment specification of the vehicle, one of the following convenience charging electronics can be installed:

- {A} Equipment specification rapid charging direct current (SA4U7) and rapid charging alternating current (SA4U8)
- {B} Equipment specification rapid charging direct current (SA4U7)
- {C} Equipment specification rapid charging alternating current (SA4U8)

**Connection overview of convenience charging electronics:**

1. High-voltage cable from charging socket - Charging direct current
2. High-voltage cable from charging socket - Charging alternating current
3. Connection signal line - Charging direct current
4. Connection signal line - Charging alternating current
5. High-voltage connection to EME - Charging alternating current
6. Connection coolant line, fast forward (rapid charging alternating current only)
7. High-voltage cable to EME
8. High-voltage cable from REME (range extender only)
9. Connection coolant line, reverse (rapid charging alternating current only)

**REMOVAL:**

The removal describes the maximum assignment for all equipment specifications (rapid charging direct current SA4U7, rapid charging alternating current SA4U8 and range extender).

Depending on the equipment specification, certain steps of operation may not be necessary.

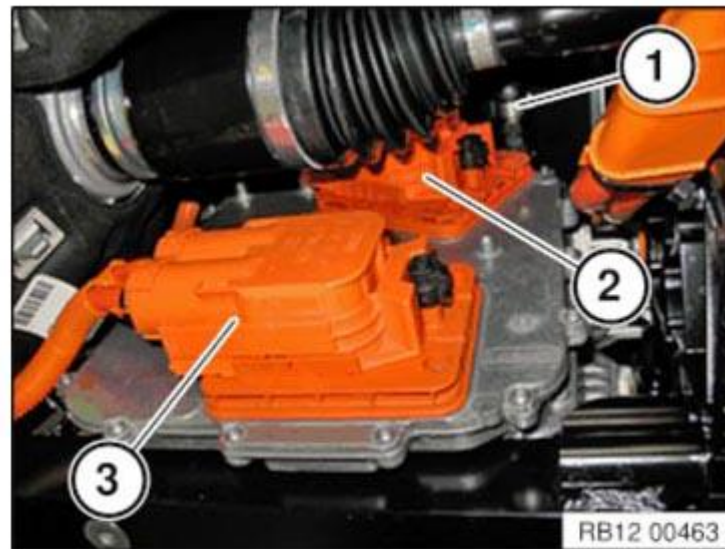
Unlock coolant line (1) and disconnect.



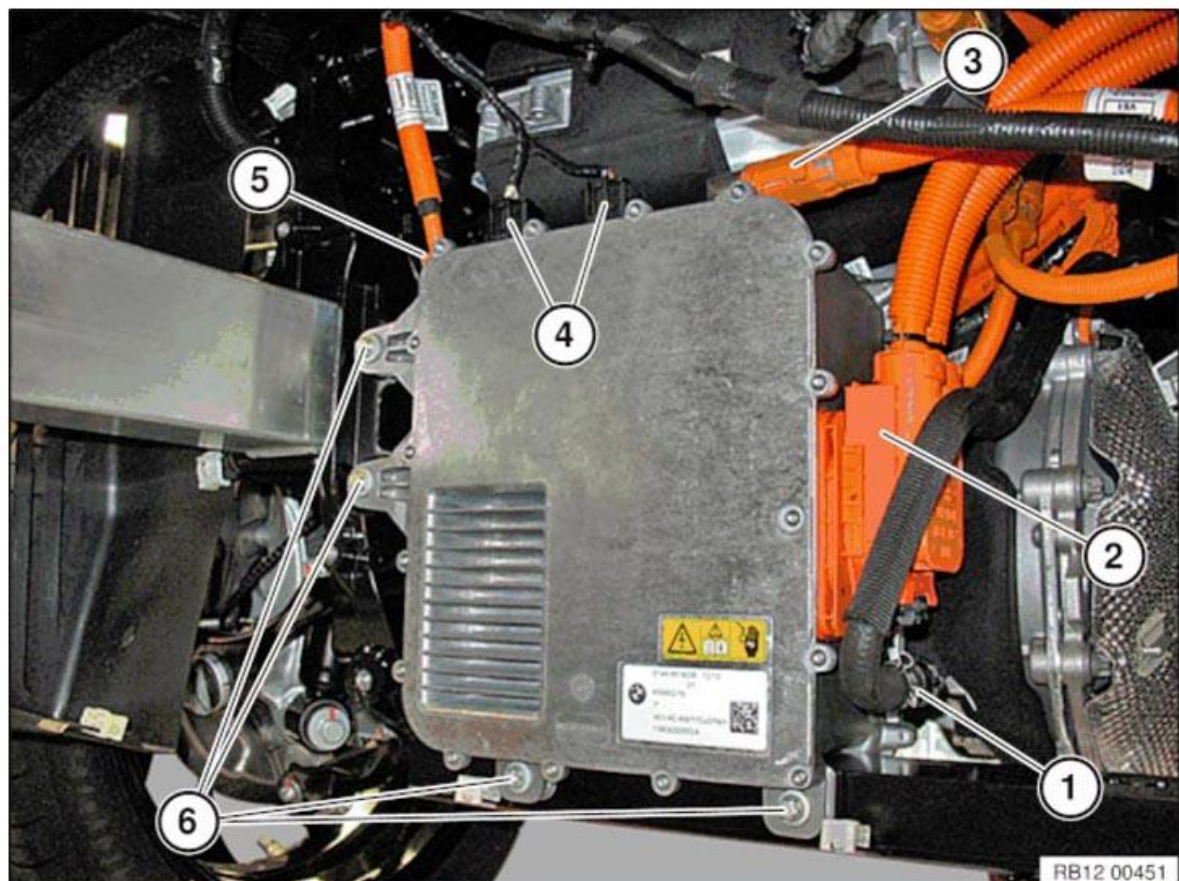
Unlock and disconnect connector (2) of high-voltage cable to electrical machine electronics.

Unlock and disconnect connector (3) of high-voltage cable to range extender electrical machine electronics.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.



**Fig. 302: Identifying Coolant Line And High-Voltage Cable Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 303: Identifying Electrical Machine Electronics Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock coolant line (1) and disconnect.

Unlock and disconnect connector (2) of high-voltage cable to charging socket.

Unlock and disconnect connector (3) of high-voltage cable to charging socket.

Unlock and disconnect connector (4) of signal lines.

Unlock and disconnect connector (5) of high-voltage cable to electrical machine electronics.

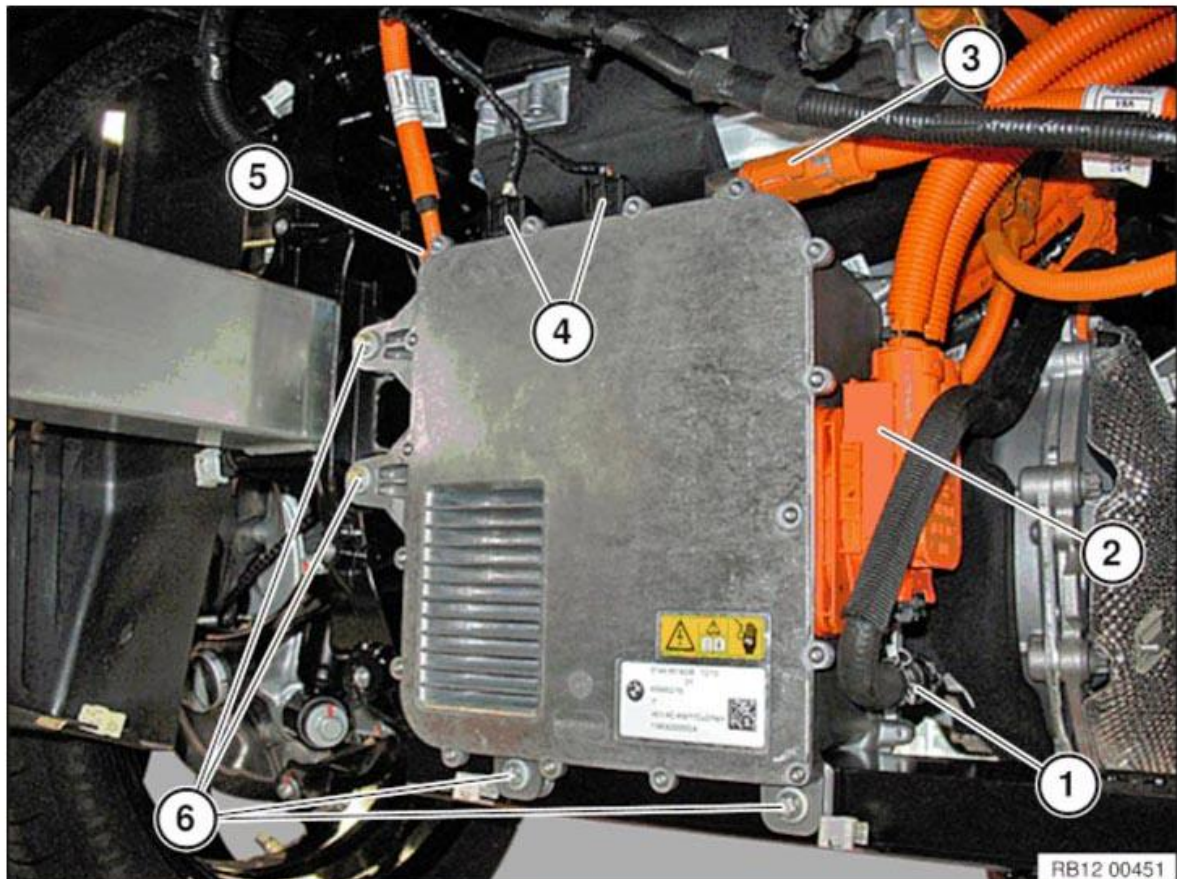
**IMPORTANT:** Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Release screws (6) and remove convenience charging electronics.

### **INSTALLATION:**

The removal describes the maximum assignment for all equipment specifications (rapid charging direct current SA4U7, rapid charging alternating current SA4U8 and range extender).

Depending on the equipment specification, certain steps of operation may not be necessary.



**Fig. 304: Identifying Electrical Machine Electronics Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down screws (6).

**IMPORTANT:** Observe notes on **EARTH BONDING SCREW CONNECTIONS**.

Tightening torque **61 25 1AZ** .

Connect and lock coolant line (1).

Connect and lock plug connection (2) of high-voltage cable to charging socket.

Connect and lock plug connection (3) of high-voltage cable to charging socket.

Connect and lock plug connections (4) of signal lines.

Connect and lock plug connection (5) of high-voltage cable to electrical machine electronics.

**IMPORTANT:** Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

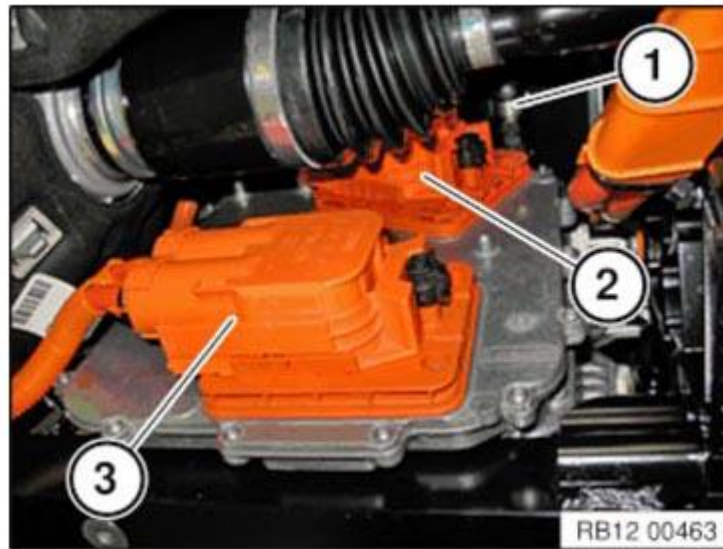


Connect and lock coolant line (1).

Connect and lock plug connection (2) of high-voltage cable to electrical machine electronics.

Connect and lock plug connection (3) of high-voltage cable to range extender electrical machine electronics.

**IMPORTANT:** Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.



**Fig. 305: Identifying Coolant Line And High-Voltage Cable Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- For rapid charging alternating current equipment (SA4U8):

**FILL AND BLEED COOLING SYSTEM** .

**Replacement:**

Carry out **VEHICLE PROGRAMMING/ENCODING**.

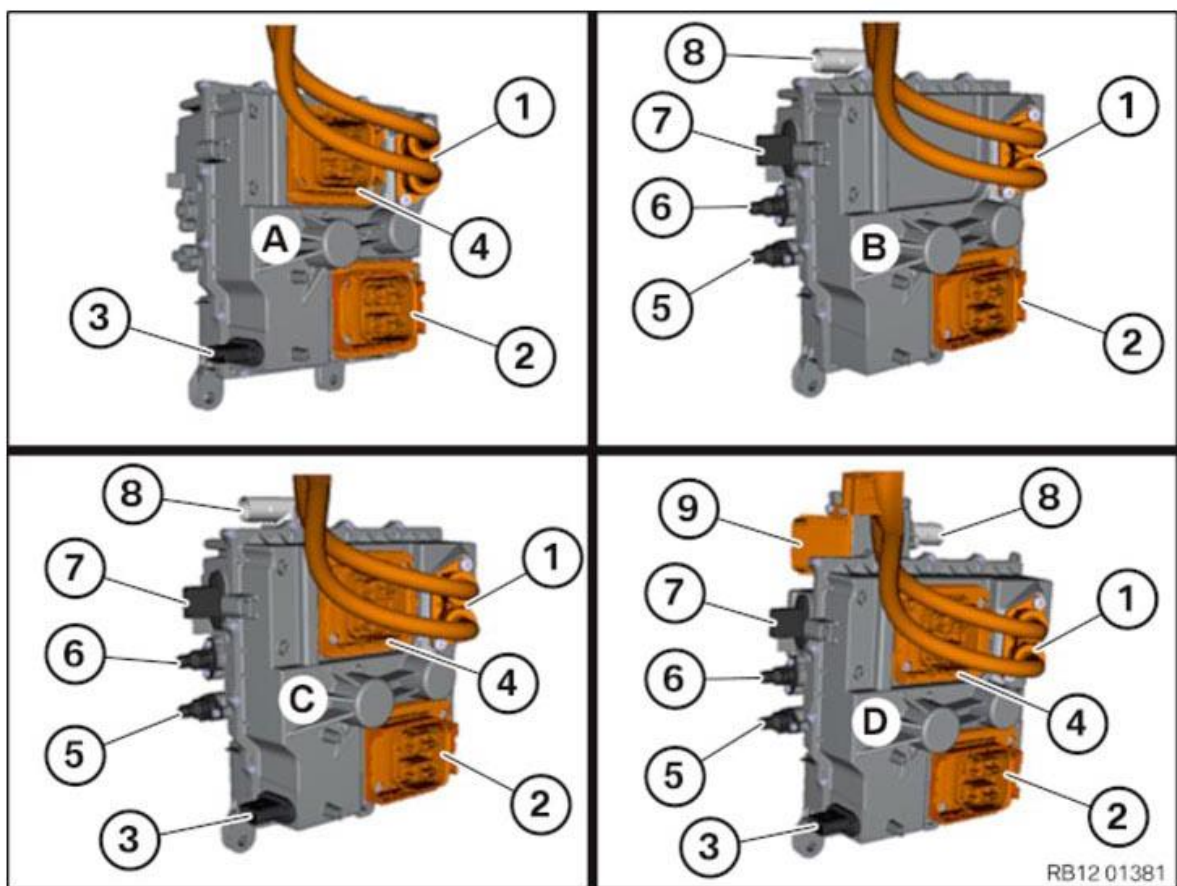
**61 25 200 REMOVING AND INSTALLING/REPLACING CONVENIENCE CHARGING ELECTRONICS**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

**Necessary preliminary tasks:**

- Disconnect **HIGH-VOLTAGE SYSTEM** from power
  - Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
  - Observe notes on **EARTH BONDING SCREW CONNECTIONS**
- 
- Remove vertical strut. See REMOVING VERTICAL STRUT or REMOVING VERTICAL STRUT (VEHICLES WITH RANGE EXTENDER) .
  - Remove LEFT HORIZONTAL STRUT
  - Only for equipment "rapid charging alternating current" (SA4U6 or SA4U8):

**DRAIN COOLANT**



**Fig. 306: Overview Of Convenience Charging Electronics**

Courtesy of BMW OF NORTH AMERICA, INC.

**Versions of convenience charging electronics:**

Depending on the equipment specification of the vehicle, one of the following convenience charging electronics can be installed:

- {A} Equipment specification rapid charging direct current (SA4U7)
- {B} Equipment specification rapid charging alternating current (SA4U8)
- {C} Equipment specification rapid charging direct current (SA4U7) and rapid charging alternating current (SA4U8)
- {D} Equipment specification rapid charging direct current (SA4U7) and rapid charging alternating current multiphase (SA4U6)

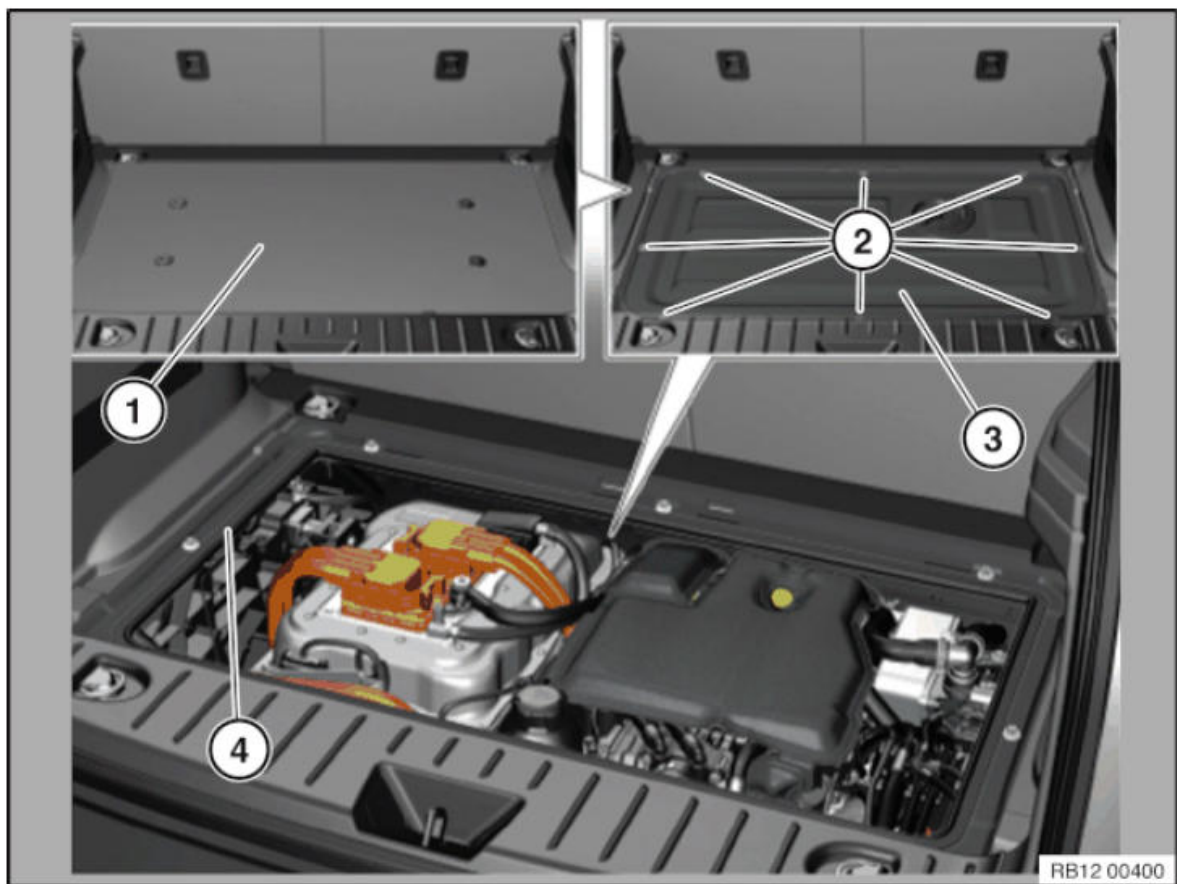
**Connection overview of convenience charging electronics:**

1. High-voltage connection to the EME
2. High-voltage cable from the REME (range extender only)
3. Connection of signal line - DC charging
4. High-voltage cable of charging socket - DC charging
5. Connection of coolant return line (rapid charging alternating current only)
6. Connection of coolant feed line (rapid charging alternating current only)
7. Connection signal line - Charging alternating current
8. High-voltage connection to EME - Charging alternating current
9. High-voltage cable from charging socket - Charging alternating current multiphase

**REMOVAL:**

The removal process describes the maximum assignment for the equipment specification: Rapid charging alternating current multiphase SA4U6, rapid charging direct current SA4U7 and range extender.

Depending on the equipment specification, certain steps of operation may not be necessary.



**Fig. 307: Identifying Luggage Compartment Floor Trim Panel And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

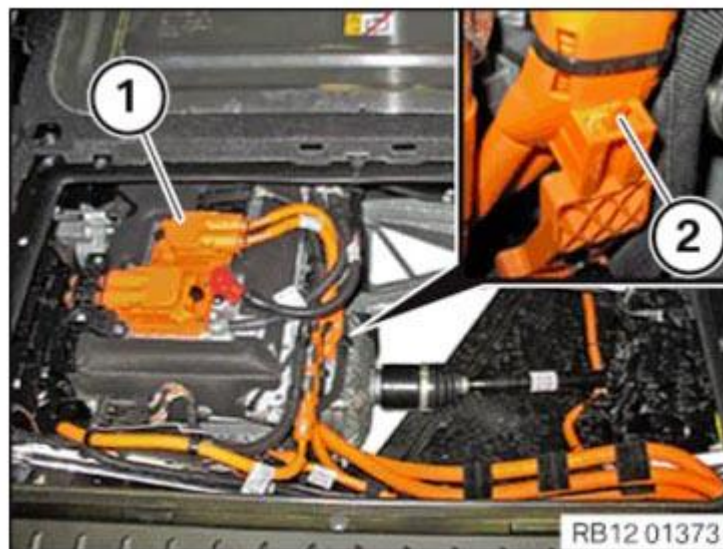
Remove luggage compartment floor trim panel (1).

Release screws (2) and remove service cap (3) toward the top.

Unlock and disconnect connector (1) from the high-voltage cable.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Unlock the retaining lug (2) and pull the high-voltage cable (1) out of the holder towards the top.



**Fig. 308: Disconnecting Connector From High-Voltage Cable**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect signal line connector (1).



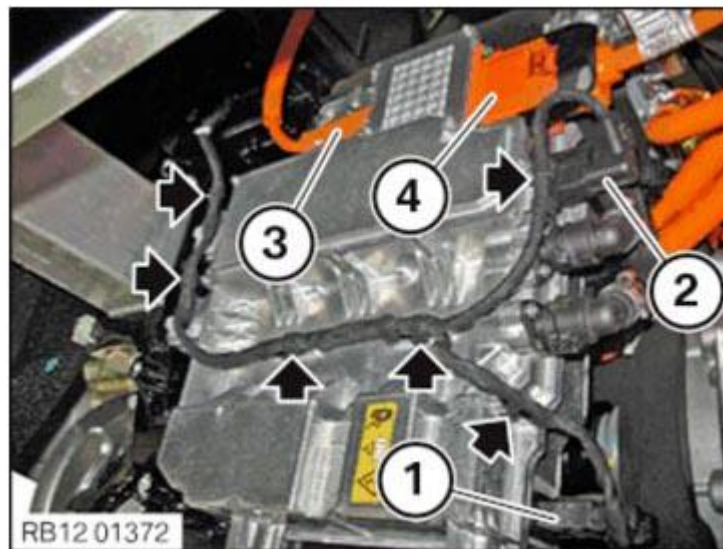
Unlock and disconnect signal line connector (2).

Unclip the signal line from the convenience charging electronics.

Unlock and disconnect connector (3) from the high-voltage cable.

Unlock and disconnect connector (4) from the high-voltage cable.

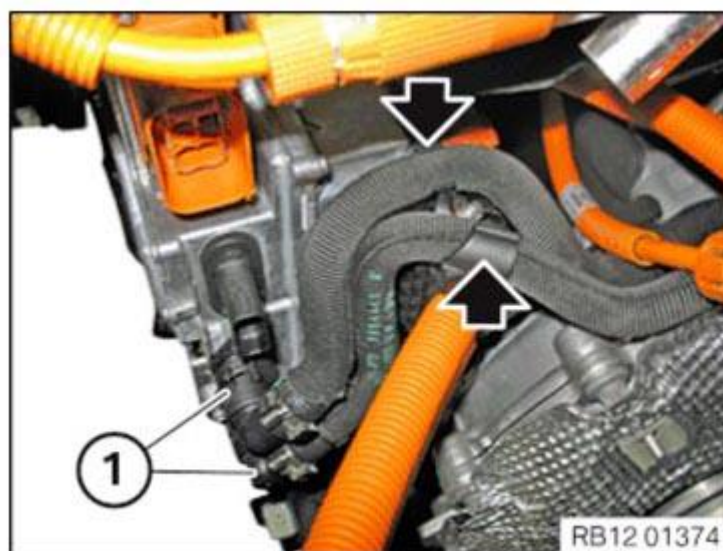
IMPORTANT: Observe notes on [UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS](#) on electric vehicles.



**Fig. 309: Locating Convenience Charging Electronics Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect coolant lines (1).

Detach the coolant lines (1) from the holder.



**Fig. 310: Locating Coolant Lines From Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

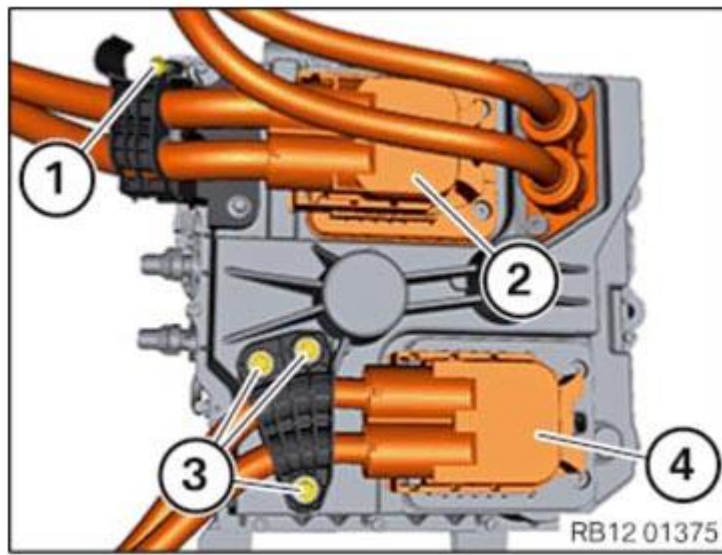
Loosen the screw (1) from the upper section of the tension relief.

Remove the upper section of the tension relief.

Unlock and disconnect connector (2) from the high-voltage cable.

IMPORTANT: Observe notes on [UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS](#) on electric vehicles.





**Fig. 311: Identifying Tension Relief Upper Section Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

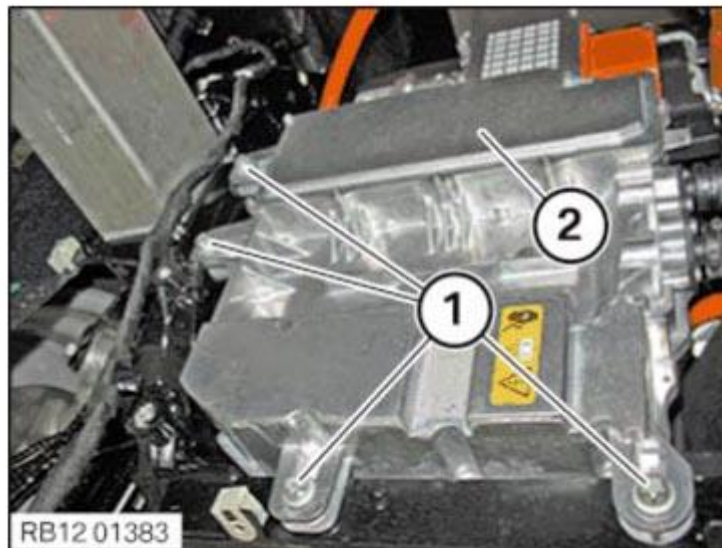
Loosen the screw (3) from the upper section of the tension relief.

Remove the upper section of the tension relief.

Unlock and disconnect connector (4) from the high-voltage cable.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Loosen the screws (1) and remove the convenience charging electronics (2).

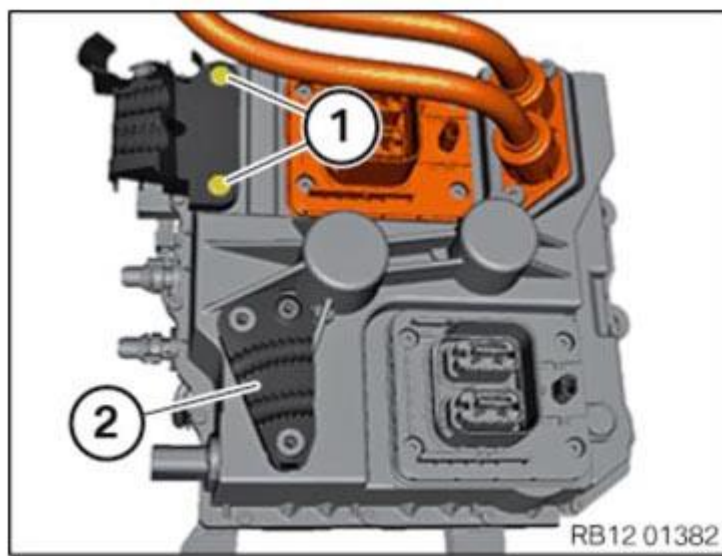


**Fig. 312: Identifying Convenience Charging Electronics Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement only:**

Loosen the screws (1) and remove the lower section of the tension relief.

Pull off the lower section of the tension relief (2).



**Fig. 313: Identifying Tension Relief Lower Section Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**INSTALLATION:**

The removal process describes the maximum assignment for the equipment specification: Rapid charging alternating current multiphase SA4U6, rapid charging direct current SA4U7 and range extender.

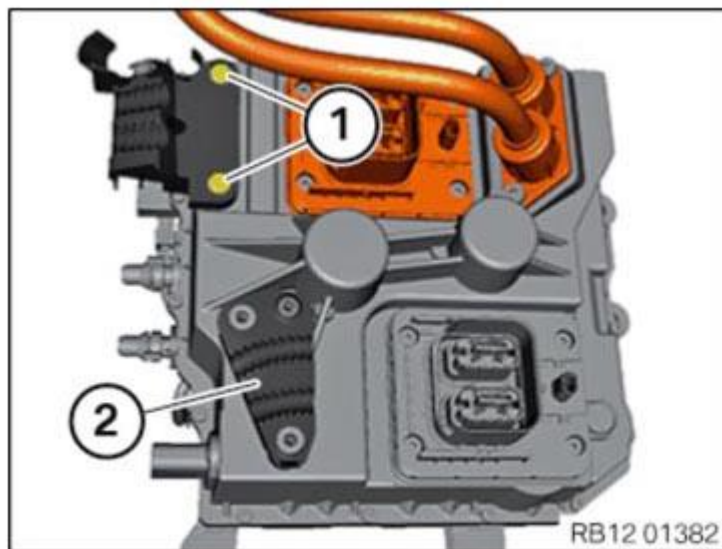
Depending on the equipment specification, certain steps of operation may not be necessary.

**Replacement only:**

Remove the lower section of the tension relief and tighten the screws (1).

Tightening torque [61 25 2AZ](#) .

Attach the lower section of the tension relief (2).



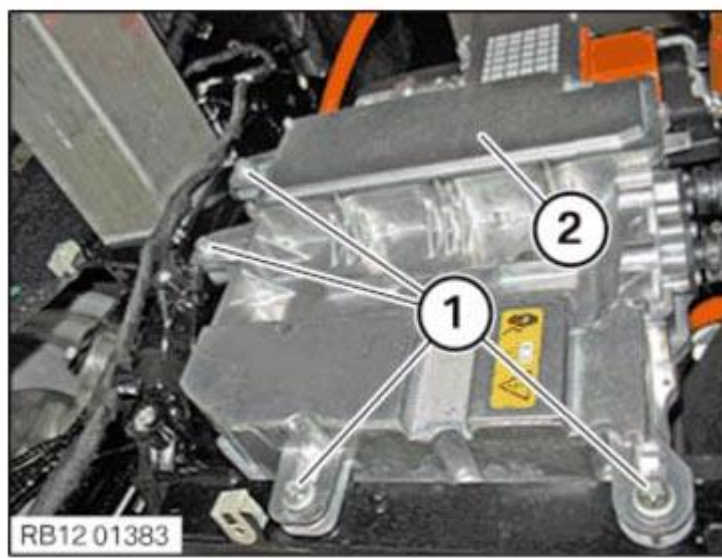
**Fig. 314: Identifying Tension Relief Lower Section Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Position the convenience charging electronics (2) and tighten the screws (1).

IMPORTANT: Observe notes on [EARTH BONDING SCREW CONNECTIONS](#).

Tightening torque [61 25 1AZ](#) .



**Fig. 315: Identifying Convenience Charging Electronics Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

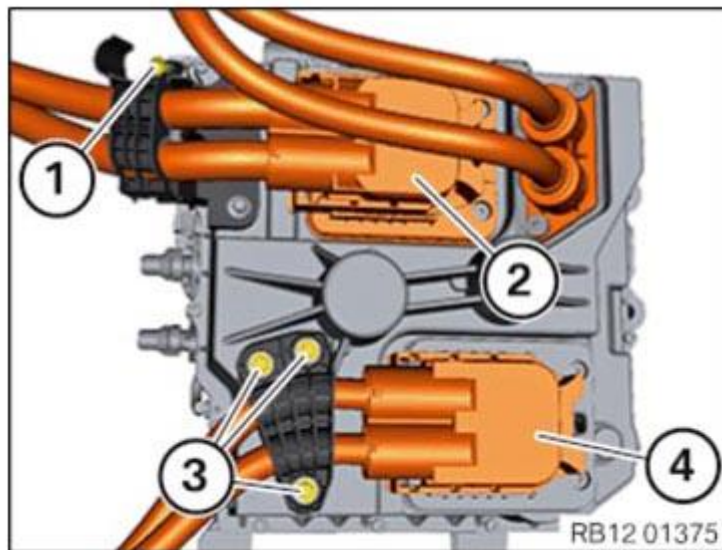
Connect connector (4) of the high-voltage cable and lock.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Position the upper section of the tension relief and tighten the screws (3).

Tightening torque **61 25 2AZ** .

Connect connector (2) of the high-voltage cable and lock.



**Fig. 316: Identifying Tension Relief Upper Section Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

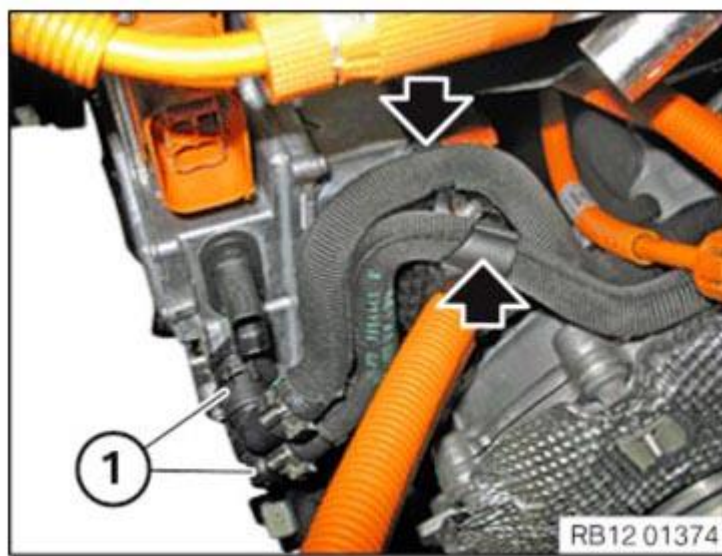
Position the upper section of the tension relief and tighten the screw (1).

Tightening torque **61 25 2AZ** .

Connect and lock the coolant lines (1).

Attach the coolant lines (1) to the holder.



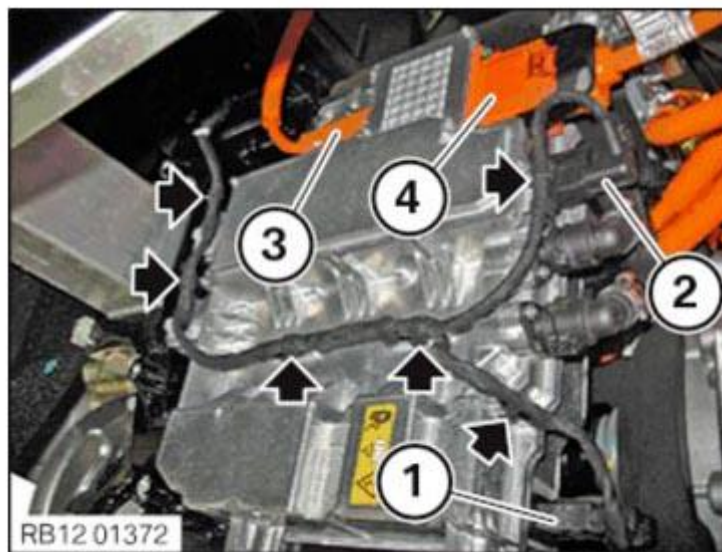


**Fig. 317: Locating Coolant Lines From Holder**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Connect connector (4) of the high-voltage cable and lock.

Connect connector (3) of the high-voltage cable and lock.



**Fig. 318: Locating Convenience Charging Electronics Plug Connections**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect and lock the signal line connectors (2).

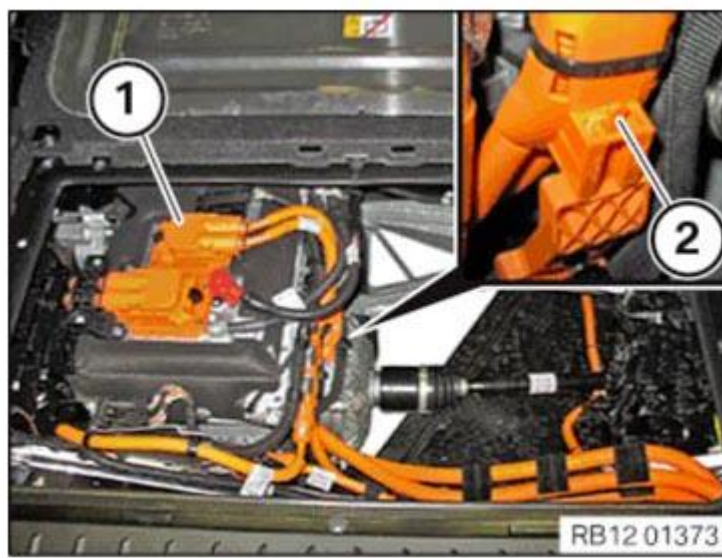
Connect and lock the signal line connectors (1).

Clip in the signal line on the convenience charging electronics.

Clip the high-voltage cable (1) into the holder (2).

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS** on electric vehicles.

Connect connector (1) of the high-voltage cable and lock.



**Fig. 319: Disconnecting Connector From High-Voltage Cable**  
 Courtesy of BMW OF NORTH AMERICA, INC.

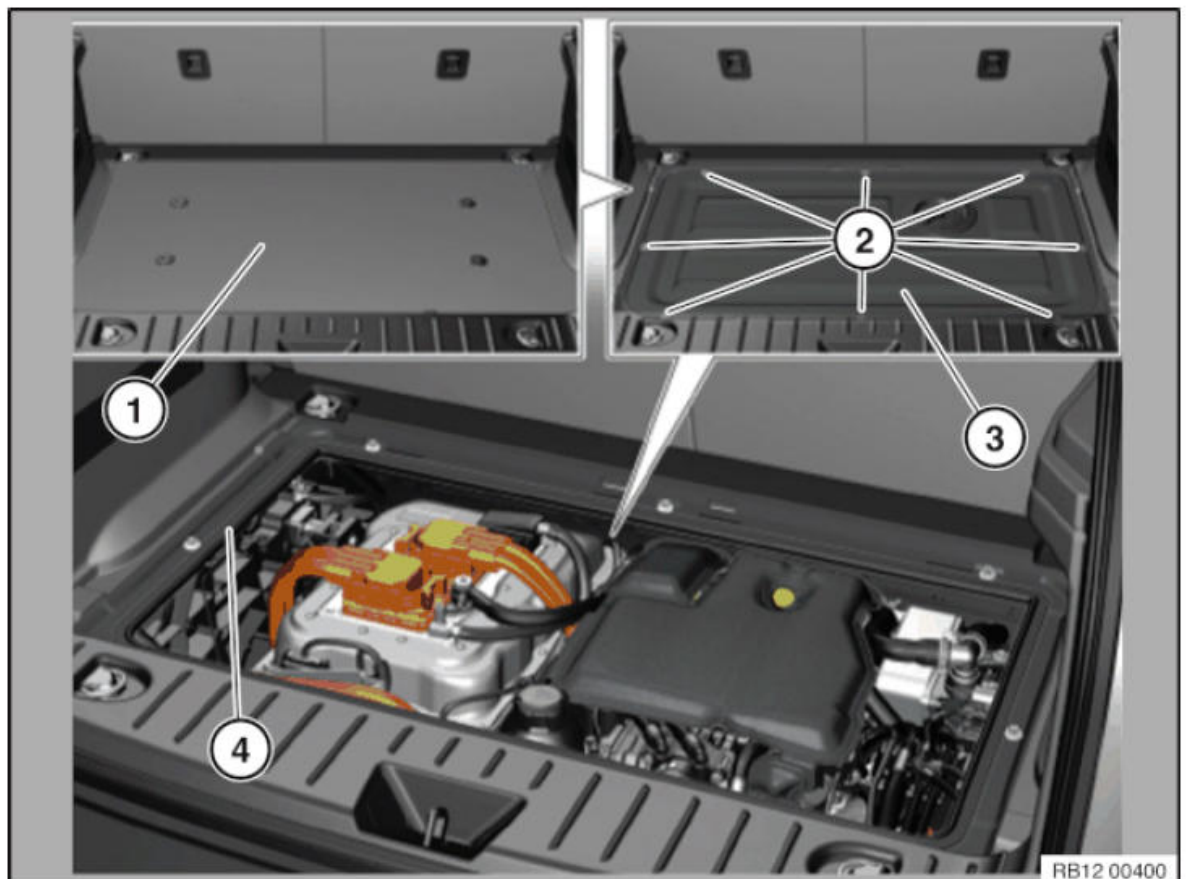
Check the neoprene nuts of the screw connections (2) and the gasket (4) for damage and replace if necessary.

Position the service cap and tighten the screws (2).

Tightening torque [51 47 4AZ](#) .

Insert luggage compartment floor trim panel (1).

IMPORTANT:



**Fig. 320: Identifying Luggage Compartment Floor Trim Panel And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- For equipment "rapid charging alternating current" (SA4U6 or SA4U8):

**Replacement:**Carry out **VEHICLE PROGRAMMING/ENCODING.****HIGH-VOLTAGE BATTERY UNIT INDIVIDUAL COMPONENTS****00 00... ACTIVITY ASSIGNMENT TO THE SERVICE FORMAT**

<b>Job number:</b>	<b>Activity</b>	<b>BMW i Basic Service workshop may not carry out</b>	<b>BMW i Extended Battery Service workshop may not carry out</b>
4111320	Replace the side member before the bulkhead with the left wheel arch	x	x
4111325	Replace the side member before the bulkhead with the right wheel arch	x	x
4111335	Replace side member before L wheel arch	x	x
4111340	Replace side member before R wheel arch	x	x
4111420	Replacing front left side sill	x	x
4111425	Replacing front right side sill	x	x
4111430	Replace front axle module	x	x
4111435	Replace rear axle module	x	x
4111630	Replacing deformation element, middle left (side sill, front left removed)	x	x
4111635	Replacing deformation element, middle right (side sill, front right removed)	x	x
4112595	Replacing rear cross member upper part (rear trim panel removed)	x	x
4112600	Replacing cross member, rear left (rear trim panel removed)	x	x
4112605	Replacing cross member, rear right (rear trim panel removed)	x	x
4112608	Replacing cross member, rear complete (rear trim panel removed)	x	x
4112610	Replace outer lower left D-pillar	x	x
4112615	Replace outer lower right D-pillar	x	x
4112620	Replacing D-pillar, bottom outer and inner left	x	x
4112625	Replacing D-pillar, bottom outer and inner right	x	x
4114020	Replacing front left wheel arch	x	x
4114030	Replace front right wheel arch	x	x
4114041	Replacing both front wheel arches	x	x



<b>Job number:</b>	<b>Activity</b>	<b>BMW i Basic Service workshop may not carry out</b>	<b>BMW i Extended Battery Service workshop may not carry out</b>
4114540	Replace C-pillar, outer left (rear trim panel removed)	x	x
4114545	Replacing C-pillar, outer right (rear trim panel removed)	x	x
4114550	Replacing C-pillar reinforcement, rear left (outer C-pillar removed)	x	x
4114555	Replacing C-pillar reinforcement, rear right (outer C-pillar removed)	x	x
4114560	Replacing C-pillar reinforcement, left (outer C-pillar removed)	x	x
4114565	Replacing C-pillar reinforcement, right (outer C-pillar removed)	x	x
4121003	Replacing A-pillar with reinforcement on left	x	x
4121004	Replacing A-pillar with reinforcement, right	x	x
4121210	Replace the front deformation element on the bottom left	x	x
4121215	Replace the front deformation element on the bottom right	x	x
4121220	Replace reinforcement of A-pillar, left or right	x	x
4121230	Replace side frame, outer left	x	x
4121235	Replace side frame, outer right	x	x
4121240	Replacing left side frame, complete	x	x
4121245	Replacing right side frame, complete	x	x
4121720	Replacing side sill crash foam on front left or right (A-pillar with reinforcement removed)	x	x
4121725	Replacing side sill crash foam on rear left or right (outer C-pillar removed)	x	x
4131000	Roof outer skin	x	x
4131100	Replace roof outer skin with slide/tilt sunroof	x	x
4134070	Replacing rear trim panel	x	x
6127500	Removing and installing/replacing high-voltage battery unit lid	x	x
6127520	Removing and installing/replacing degassing unit	x	x
6127530	Removing and installing/replacing high-voltage connection	x	x
6127540	Removing and installing/replacing cell supervision circuit	x	x

<b>Job number:</b>	<b>Activity</b>	<b>BMW i Basic Service workshop may not carry out</b>	<b>BMW i Extended Battery Service workshop may not carry out</b>
6127550	Removing and installing/replacing safety box	X	X
6127560	Removing and installing/replacing cell supervision circuit wiring harness	X	X
6127565	Removing and installing/replacing communication wiring harness	X	X
6127570	Removing and installing/replacing high-voltage battery unit control unit	X	X
6127581	Removing and installing/replacing high-voltage battery unit housing tray	X	X
6127590	Removing and installing/replacing high-voltage connection line	X	X
6127595	Removing and installing/replacing high-voltage battery unit cooler	X	X
6127600	Removing and installing/replacing high-voltage battery unit heating temperature sensor	X	X
6127610	Removing and installing/replacing high-voltage module connection line	X	X
6127620	Removing and installing/replacing cell block	X	X

## **61 27 650 SET UP HIGH-VOLTAGE BATTERY UNIT FOR REPLACEMENT**

**WARNING:** High-voltage system.  
The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

### **1. Adjust charging voltage:**

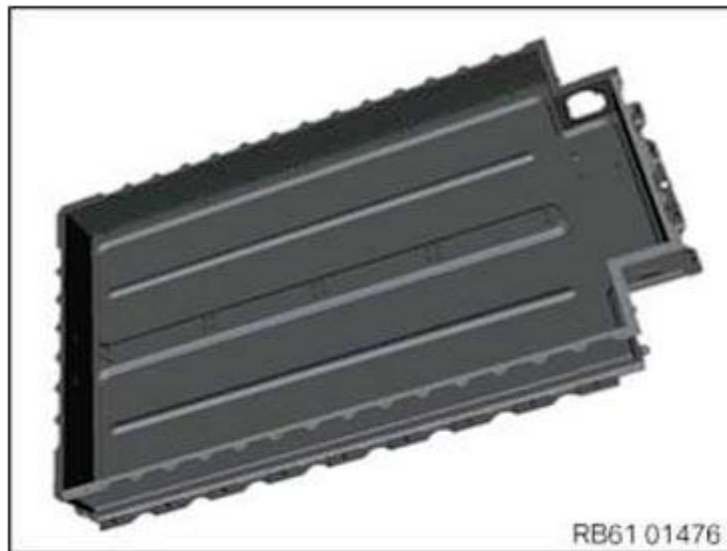
- Before starting work, adjust the module voltage of the new cell module in the removed state using the module charger.

**Only one cell module may be charged.**



**Fig. 321: Identifying Cell Module**  
 Courtesy of BMW OF NORTH AMERICA, INC.

2. **Checking the housing well for contamination and foreign bodies:**
- Check the housing well for contamination and foreign bodies.



**Fig. 322: Identifying Contamination Housing Well**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Housing well contaminated/foreign bodies in the housing well.

**Action:**

- Clean with approved cleaning agent/remove foreign bodies.

3. **Install venting unit:**

- Clean sealing surface before installation.

Insert venting unit in direction of arrow.

Tighten screws (1) from inside.

**VENTING UNIT TO HOUSING WELL SPECIFICATION**

M5	5 Nm
----	------



**Fig. 323: Installing Venting Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**4. Install high-voltage connection:**

- Clean contact surface of high-voltage connection on housing well.
- Insert high-voltage connection in direction of arrow.
- Tighten down screw (2).

**HIGH-VOLTAGE CONNECTOR TO HOUSING WELL SPECIFICATION**

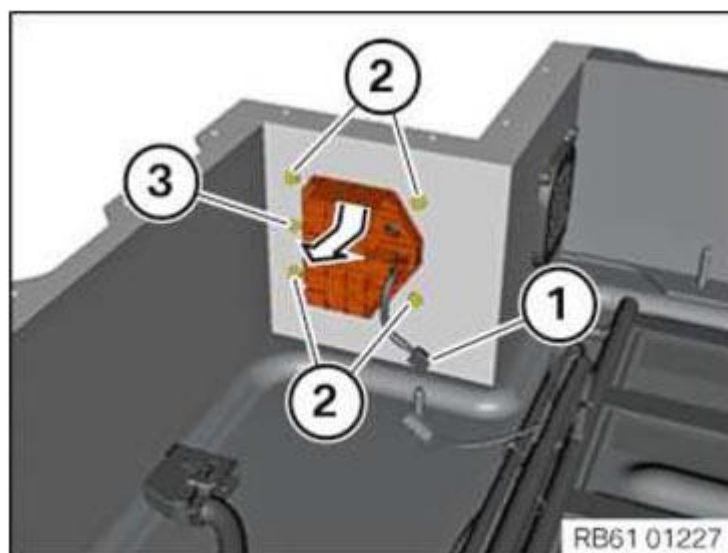
M5	5 Nm
----	------

- Tighten down screws (3).

**HIGH-VOLTAGE CONNECTOR TO HOUSING WELL SPECIFICATION**

M4	2.4 Nm
----	--------

- Connect connector (1).



**Fig. 324: Installing High-Voltage Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**5. Install high-voltage battery unit radiator:**

The radiator must not be damaged.

If the radiator is damaged or has dents/kinks, it must be replaced.

Faulty radiator pins must be replaced.

Exchange the **venting unit** if the radiator is **leaking** .

The sealing rings on the radiator connection must be replaced if the radiator is only removed and installed.

- Clean sealing surface of radiator screw connection.
- Insert radiator with help of a second person.
- Tighten screws (1) from outside.

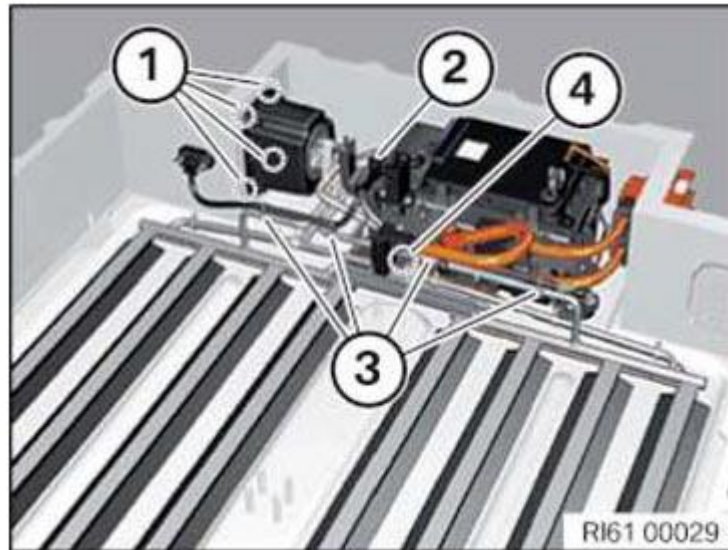
#### **RADIATOR CONNECTION TO HOUSING WELL SPECIFICATION**

M5	5 Nm
----	------

- Connect connector (2) for heating.
- Clip in communication wiring harness (3).
- Tighten equipotential bonding screw (4).

#### **POTENTIAL COMPENSATION TO RADIATOR SPECIFICATION**

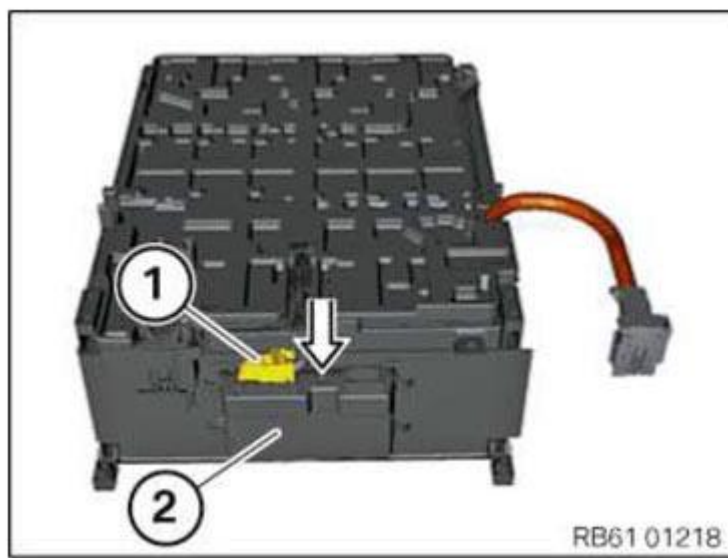
Observe instructions for potential compensation screw connections.	8.5 Nm
--	--------



**Fig. 325: Identifying Heating Connector And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### **6. Installing cell supervision circuit:**

- Push in cell supervision circuit (2) downwards in direction of arrow until it engages.
- Connect connector (1) at cell supervision circuit (2).



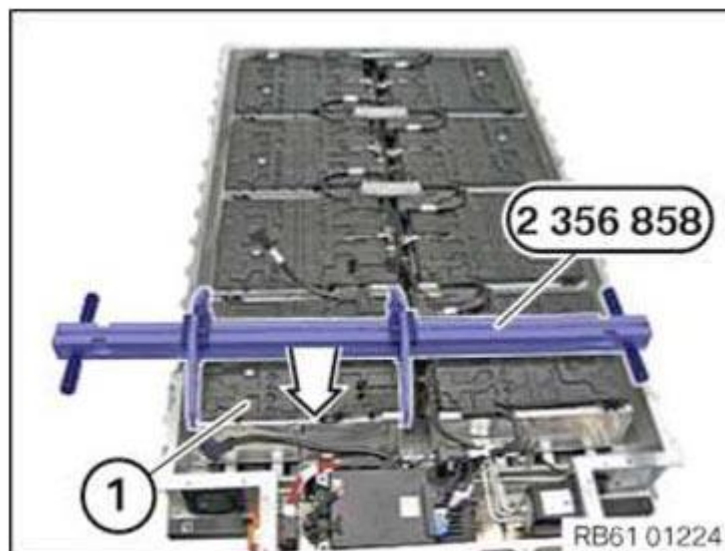
**Fig. 326: Installing Cell Supervision Circuit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

7. Install all cell modules:

**NOTE:** Description is for one component only. Procedure is identical for all further components.

**Install cell module**

- Before installing the cell block (1), it must be ensured that the state of charge of the cell module matches the state of charge of the other cell blocks.
- Before installing the cell module(1), the high-voltage battery unit, radiator and cell module must be cleaned.
- Lower in cell module (1) vertically using special tool 2 356 858 and with help of a second person.



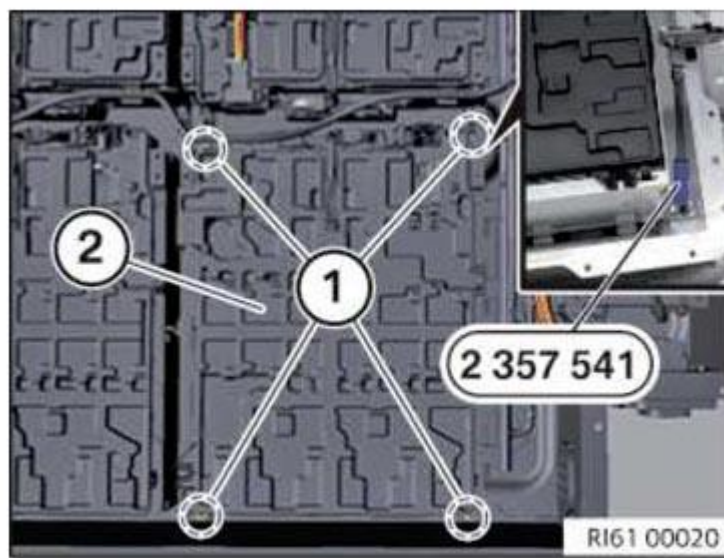
**Fig. 327: Installing Cell Module Using Special Tool (2 356 858)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten nuts (1) at cell module (2) using special tool 2 357 541 .

**CELL MODULE TO HOUSING WELL SPECIFICATION**

M6	Jointing torque	11.8 Nm
∧	Angle of rotation	45 ∆°



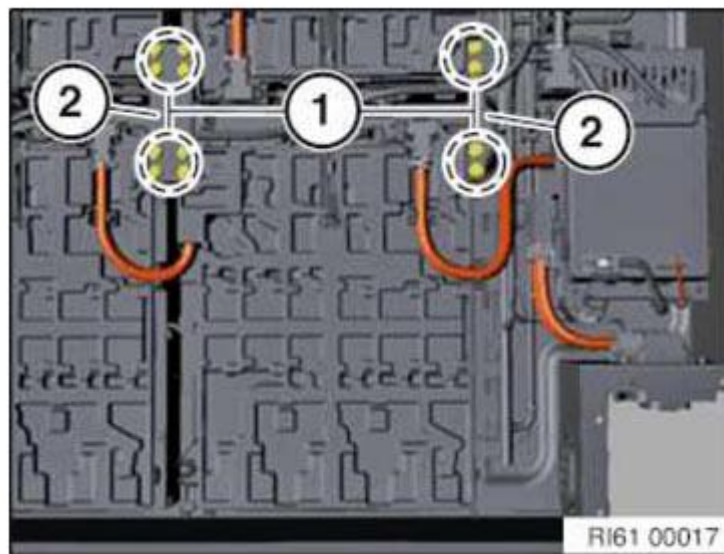


**Fig. 328: Identifying Cell Module And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten screws (1) at module struts (2).

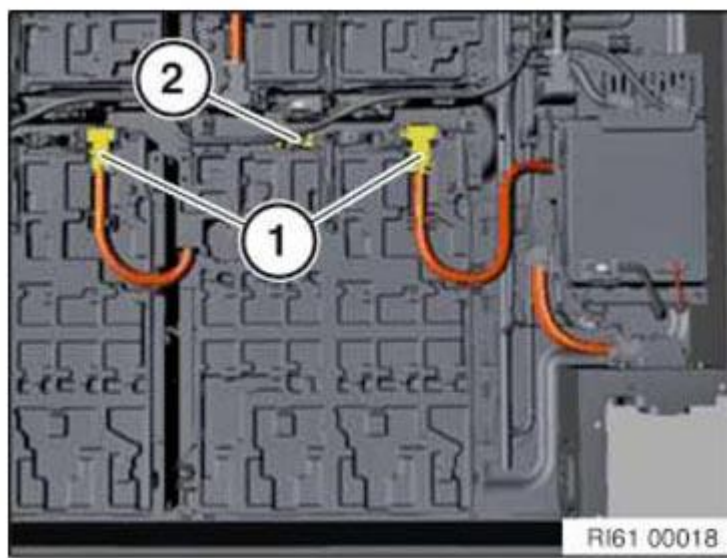
**CELL MODULE STRUT TO CELL MODULE SPECIFICATION**

M6	Renew screws.	Jointing torque	11.8 Nm
∧	∧	Angle of rotation	45 ∨°



**Fig. 329: Identifying Cell Module Struts And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

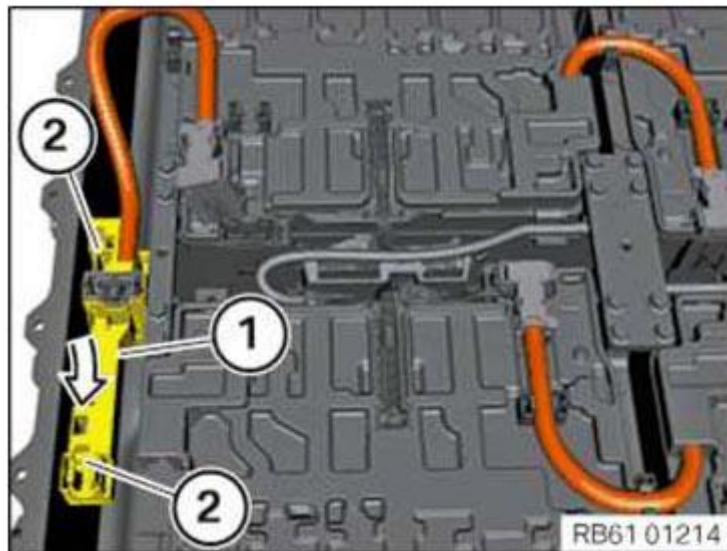
- Connect connector (2) at communication wiring harness.
- Connect high-voltage connector (1).
- Clip in communication wiring harness in area of cell block.



**Fig. 330: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**8. Install module connecting line holder:**

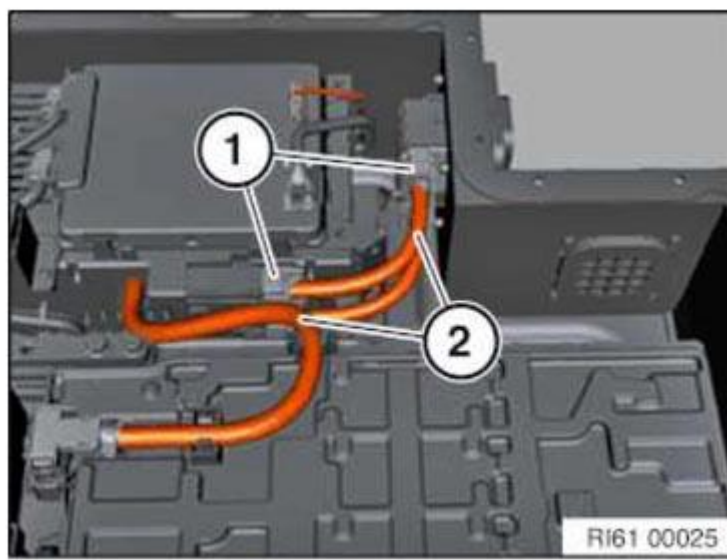
- Insert holder with high-voltage module connecting line (1) at position (2) in direction of arrow.



**Fig. 331: Installing Module Connecting Line Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

**9. Install high-voltage connecting line:**

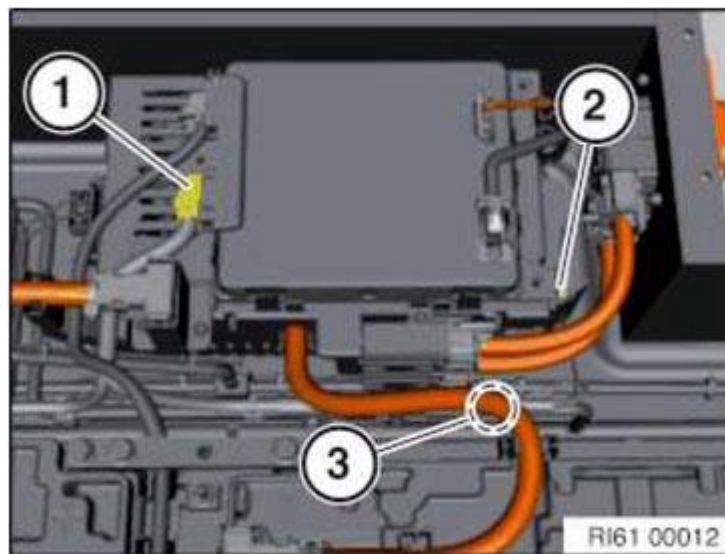
- Connect connector (2) for high-voltage negative terminal.
- Connect connector (1) for high-voltage positive terminal.



**Fig. 332: Identifying High-Voltage Positive Terminal Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

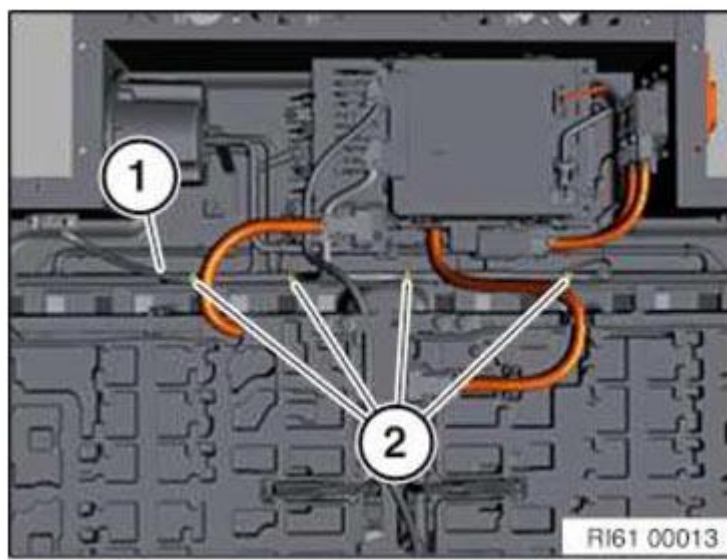
10. **Installing communication wiring harness:**

- Connect connector (1) at battery management electronics (SME).  
Connect connector (2) at high-voltage connection.  
Connect connector (3) at radiator.



**Fig. 333: Identifying Battery Management Electronics (SME) Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

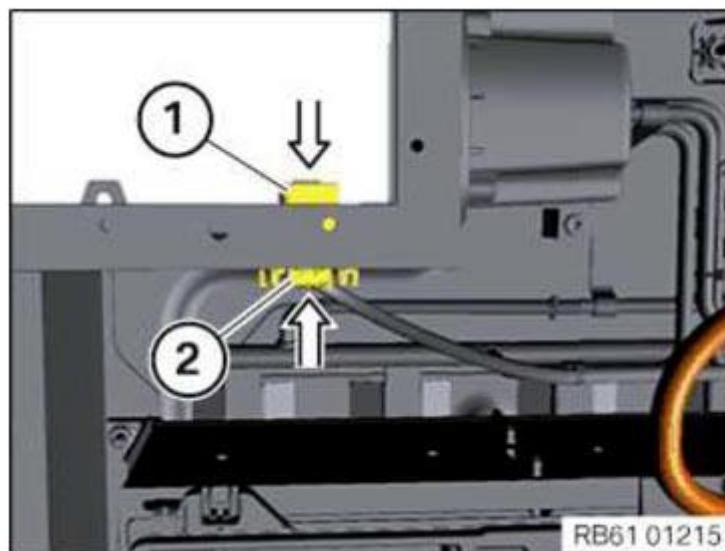
- Insert wiring harness (1).  
Clip in wiring harness (1) at marked points (2).



**Fig. 334: Identifying Wiring Harness Marked Points**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**11. Install communication wiring harness connector:**

- Insert connector housing front section (1) in direction of arrow.
- Insert connector housing rear section (2) in direction of arrow.



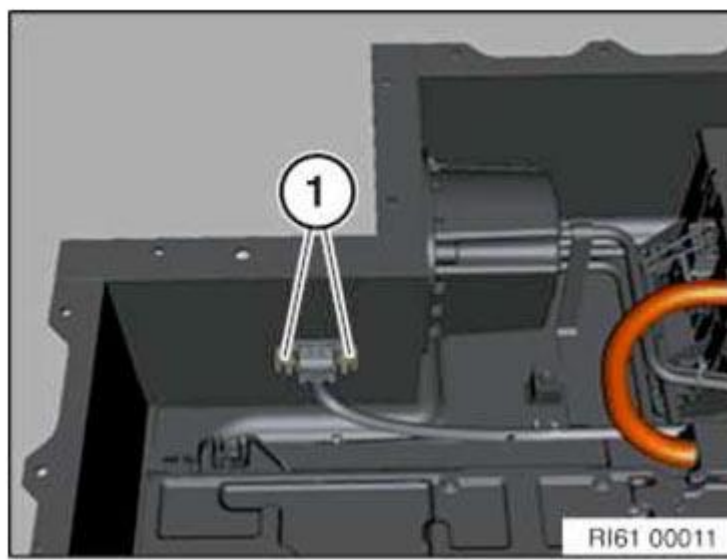
**Fig. 335: Installing Communication Wiring Harness Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten the screws (1).

**COMMUNICATION WIRING HARNESS CONNECTOR HOUSING TO HOUSING WELL SPECIFICATION**

Oval-head screw	2 Nm
-----------------	------

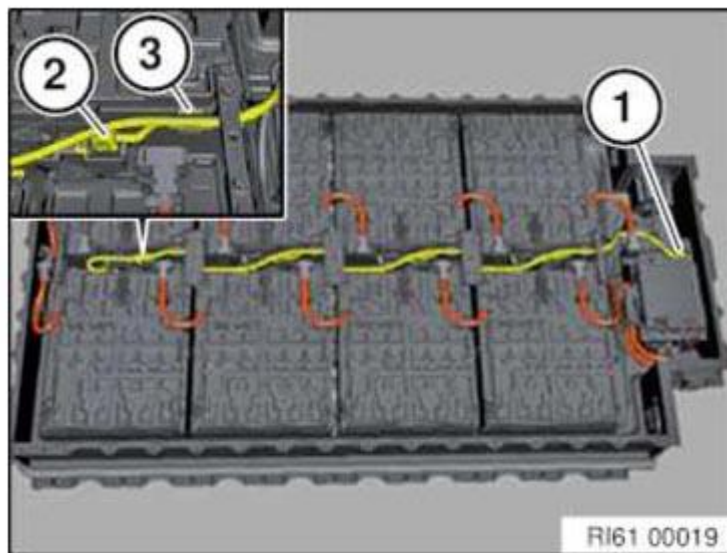




**Fig. 336: Identifying Communication Wiring Harness Connector Housing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**12. Installing wiring harness for cell supervision circuit:**

- Insert wiring harness for cell supervision circuit and clip in (3).
- Connect connector (2) at all cell supervision circuits.
- Connect connector (1) at battery management electronics (SME).



**Fig. 337: Identifying Cell Supervision Circuit Wiring Harness**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**13. Installing the safety box:**

Check packaging and component for integrity through visual inspection.

Do not use the components in case of damage.

The component must be clean and dry and hence may be taken out from the packaging in the workbay only shortly before the installation.

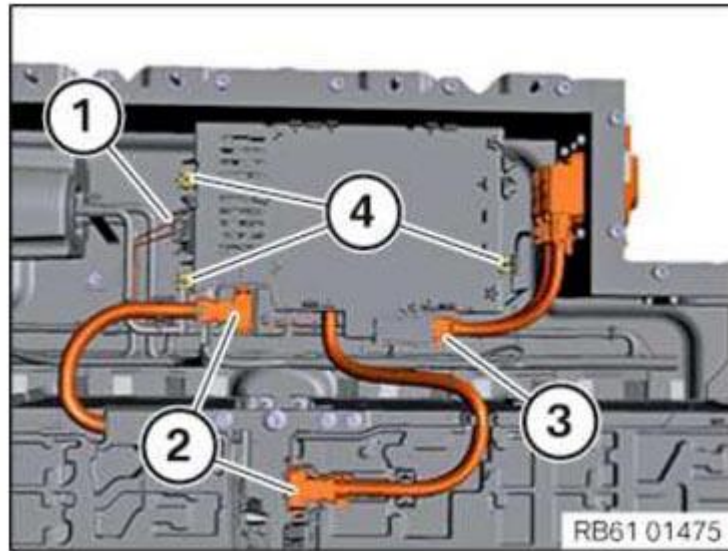
- Tighten down screws (4).

**SAFETY BOX TO HOUSING WELL SPECIFICATION**

M6	11.8 Nm
----	---------

- Connect high-voltage connector (2).
- Connect high-voltage connection lines (3).

- Connect the heating connector for the high-voltage battery unit (1).



**Fig. 338: Identifying Safety Box And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

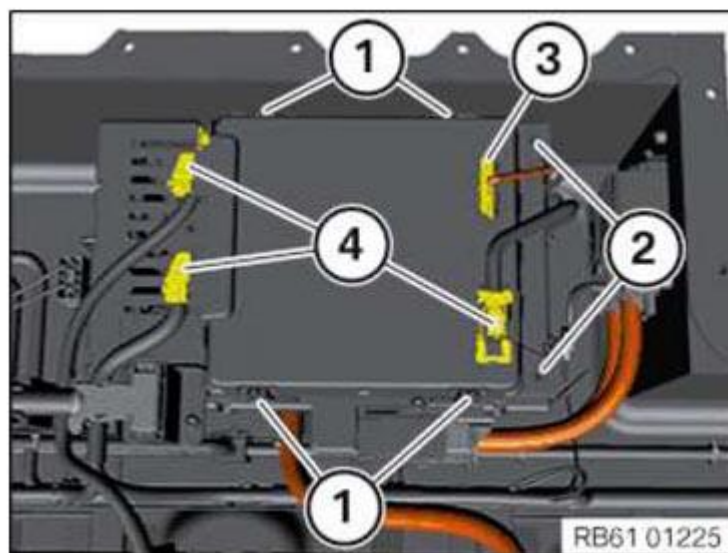
**14. Install battery management electronics (SME):**

- Clip in SME (1).
- Tighten down screws (2).

**HIGH-VOLTAGE BATTERY UNIT CONTROL UNIT TO SAFETY BOX SPECIFICATION**

Oval-head screw	If torque is not reached, safety box must be replaced.	1.1 Nm
-----------------	--	--------

- Connect connector (4).
- Connect connector for isolation monitor (3) and check that it engages correctly.

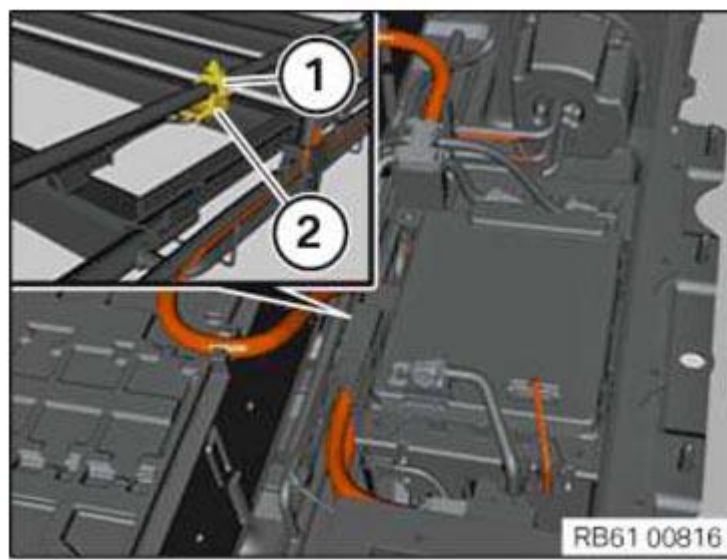


**Fig. 339: Identifying Battery Management Electronics (SME) And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**15. Install temperature sensor:**

- Insert temperature sensor (2).
- Close latch mechanism (1).

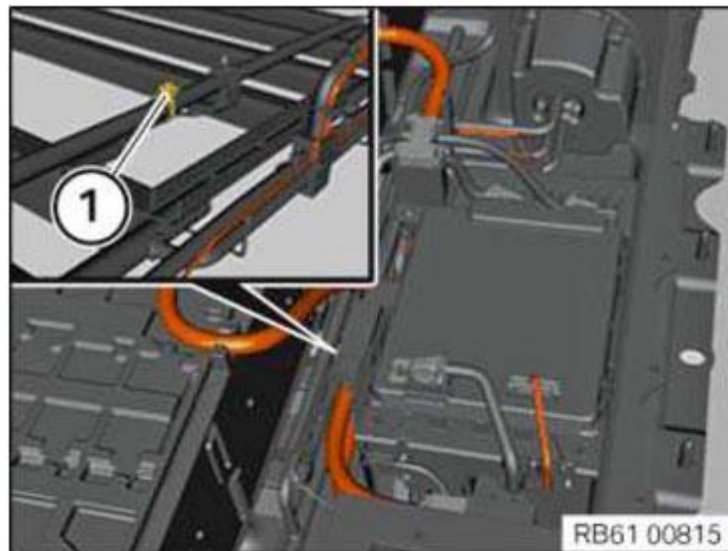




**Fig. 340: Identifying Latch Mechanism And Temperature Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

Observe the additional information on [OPENING AND CLOSING CABLE STRAPS.](#)

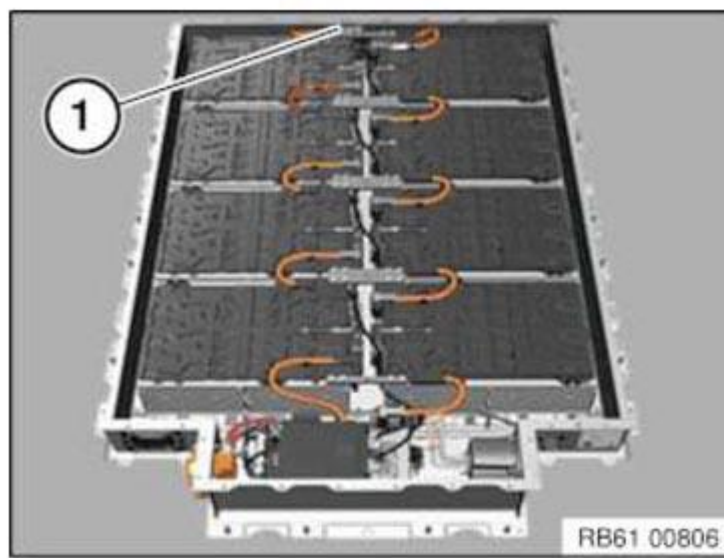
- Attach new cable strap (1) and close.



**Fig. 341: Identifying Cable Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

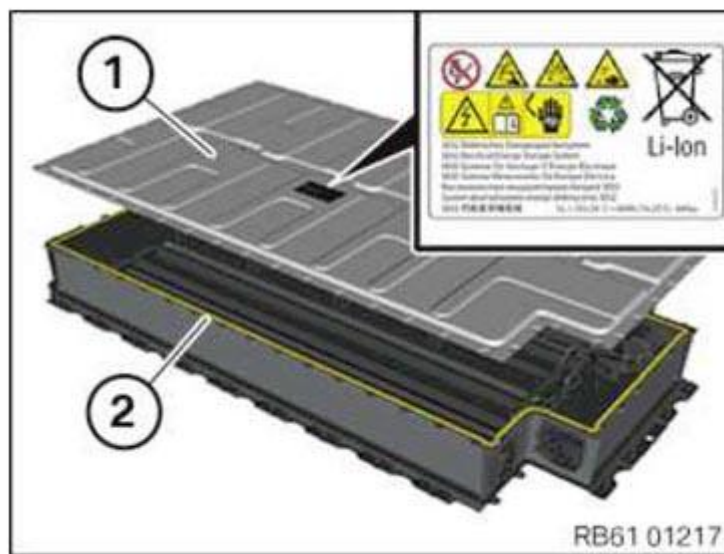
**16. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).



**Fig. 342: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

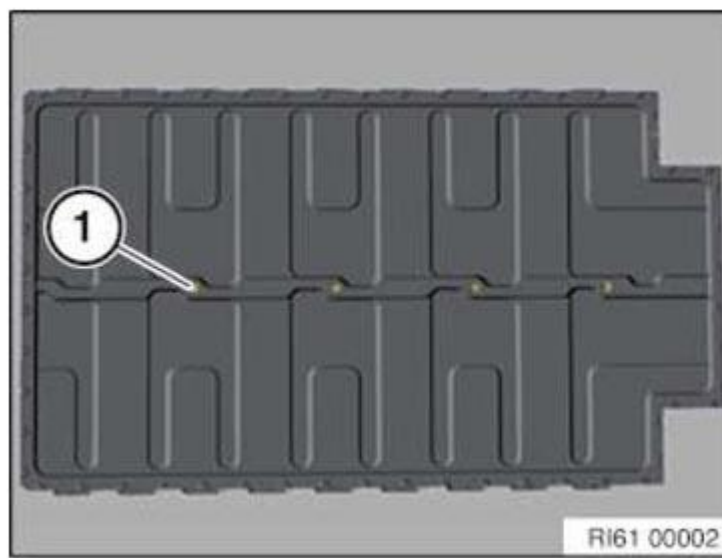


**Fig. 343: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

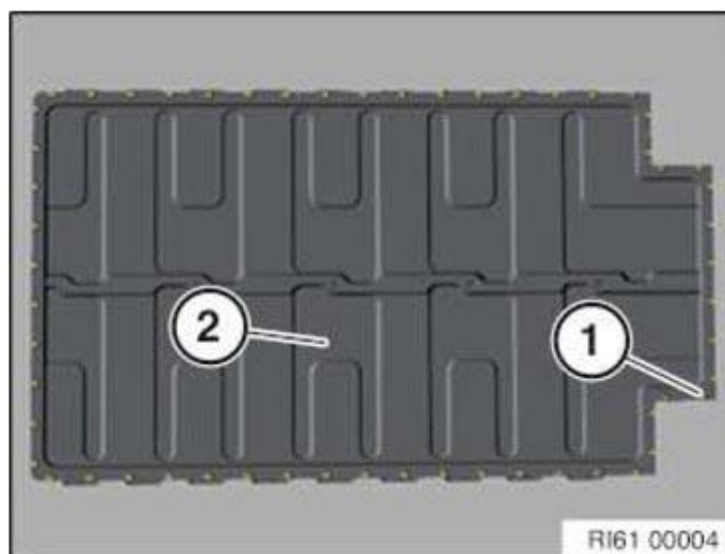


**Fig. 344: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 345: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

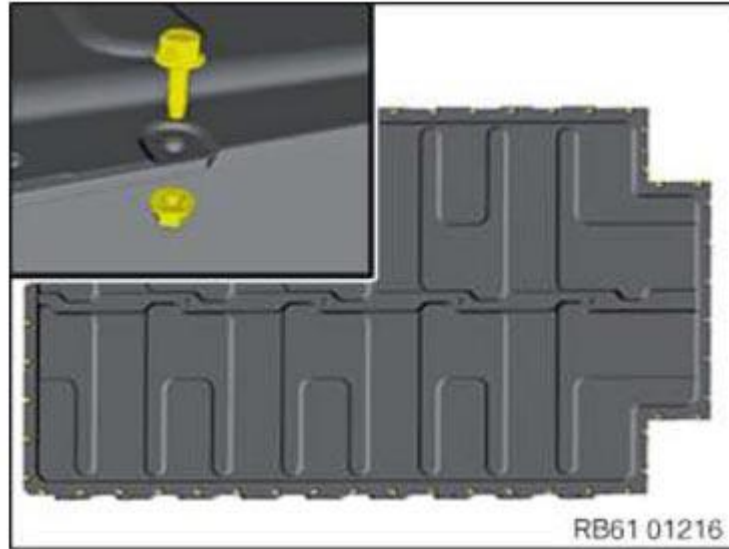
- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 346: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**17. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 347: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 565 REMOVE AND INSTALL THE COMMUNICATION WIRING HARNESS (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

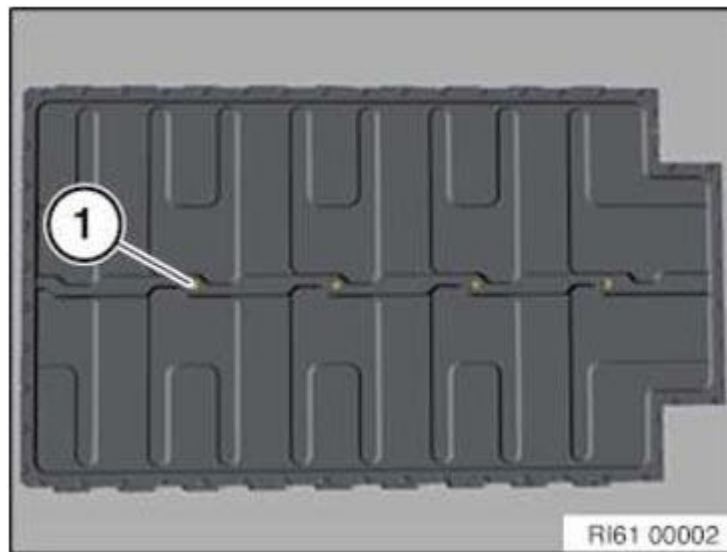
**WARNING:****High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.
1. Remove lid from high-voltage battery unit:
    - Undo sealing screws (1).

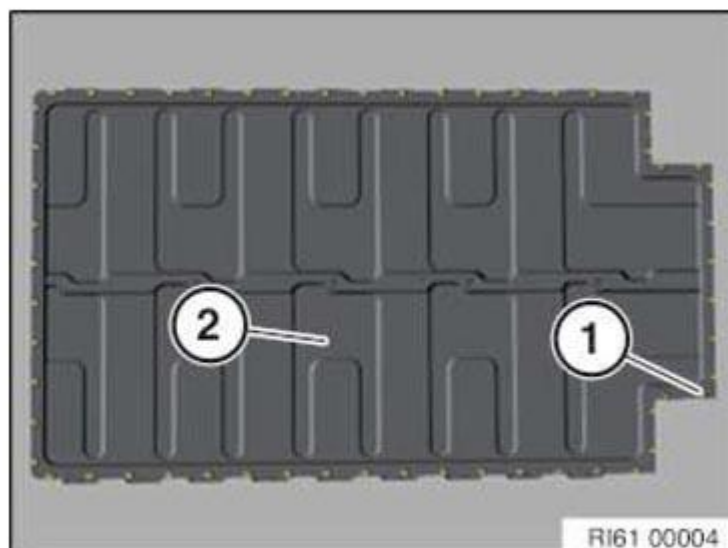


**Fig. 348: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

Remove lid (2) with help of a second person.

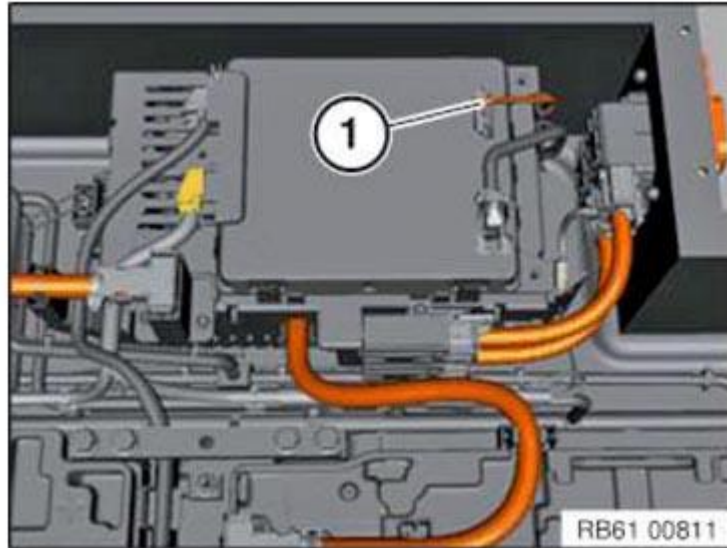


**Fig. 349: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



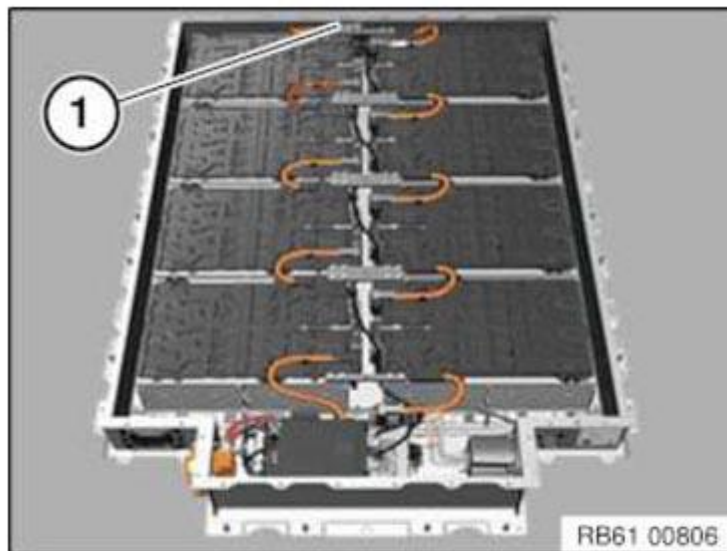
**Fig. 350: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.

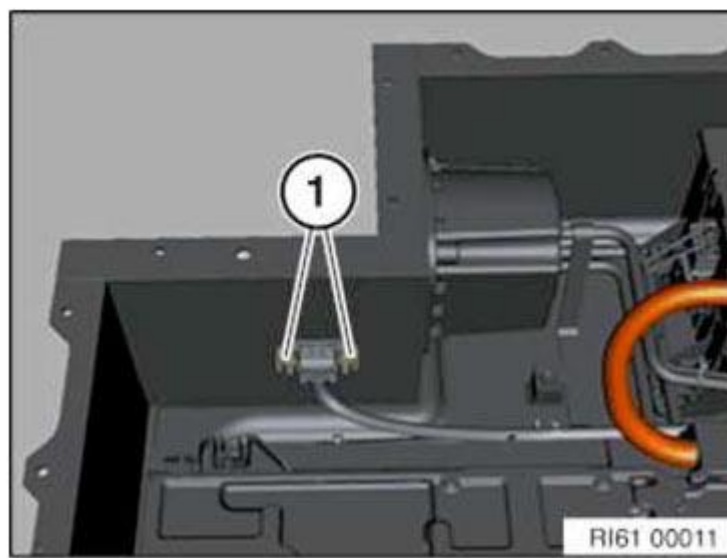


**Fig. 351: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Remove communication wiring harness connector:**

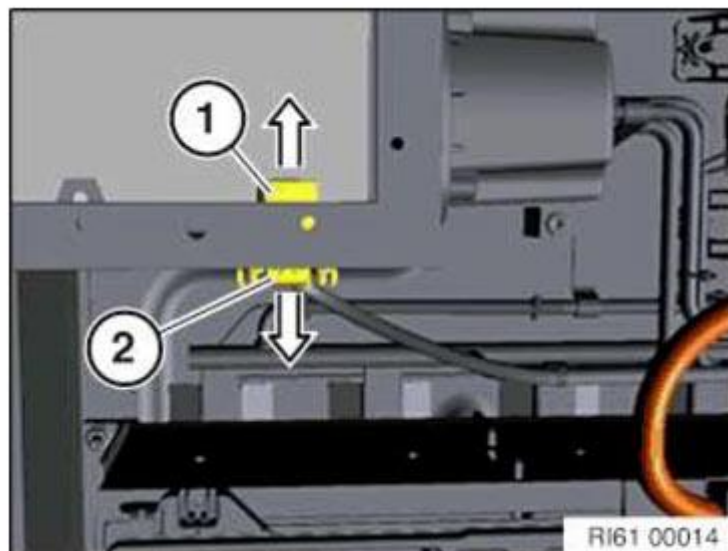
- Loosen screws (1).





**Fig. 352: Identifying Communication Wiring Harness Connector Housing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

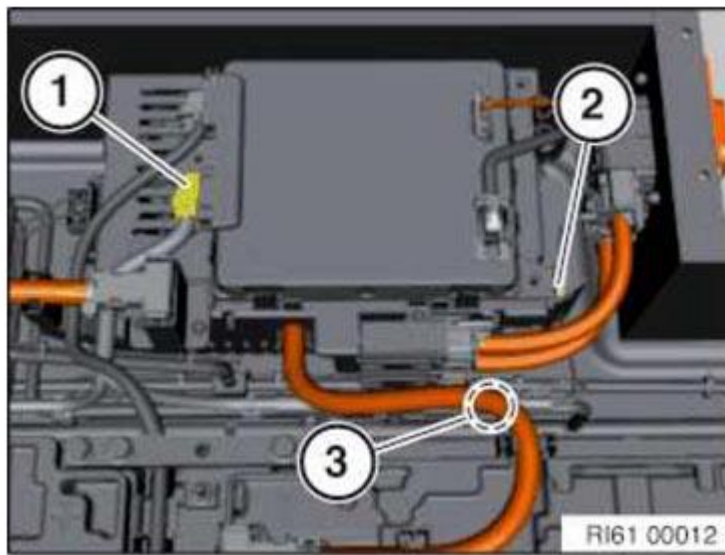
- Pull out connector housing front section (1) in direction of arrow.  
Pull out connector housing rear section (2) in direction of arrow.



**Fig. 353: Pulling Out Connector Housing Front Section**  
Courtesy of BMW OF NORTH AMERICA, INC.

**3. Remove communication wiring harness:**

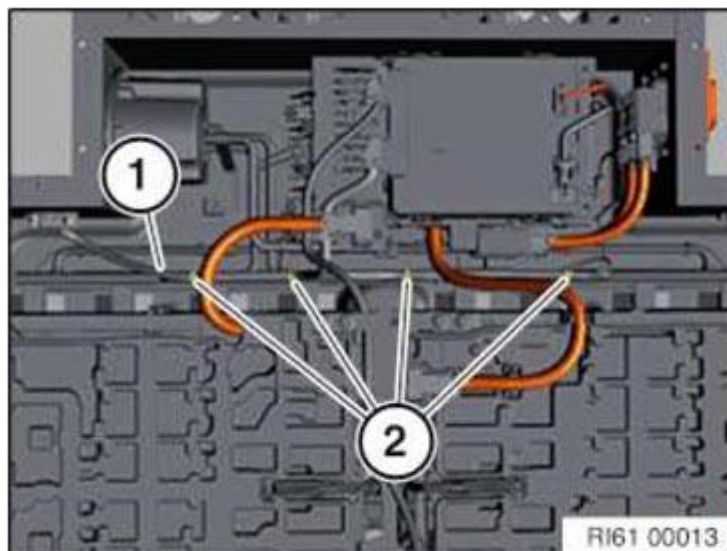
- Disconnect connector (1) at battery management electronics (SME).  
Disconnect connector (2) at high-voltage connection.  
Disconnect connector (3) at radiator.



**Fig. 354: Identifying Battery Management Electronics (SME) Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Unclip wiring harness (1) at marked points (2).

Remove wiring harness (1).



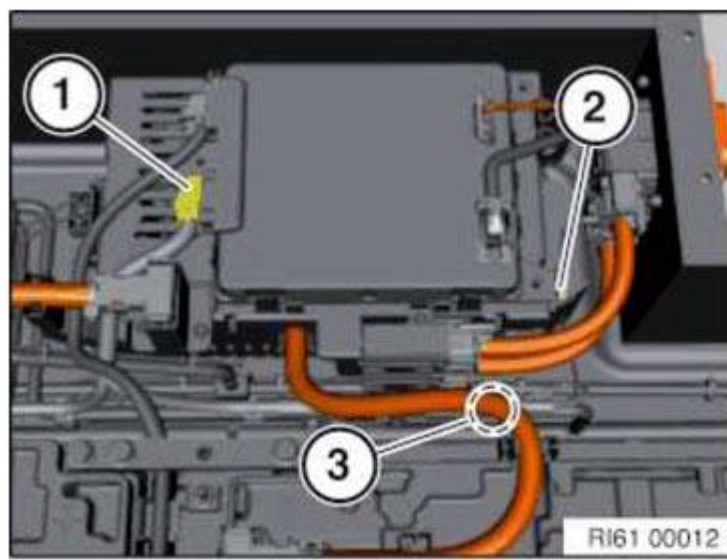
**Fig. 355: Identifying Wiring Harness Marked Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

**4. Installing communication wiring harness:**

- Connect connector (1) at battery management electronics (SME).

Connect connector (2) at high-voltage connection.

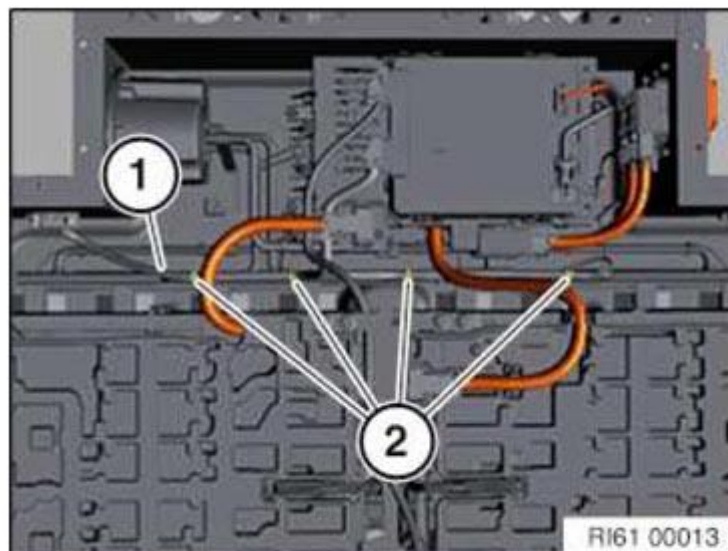
Connect connector (3) at radiator.



**Fig. 356: Identifying Battery Management Electronics (SME) Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Insert wiring harness (1).

Clip in wiring harness (1) at marked points (2).

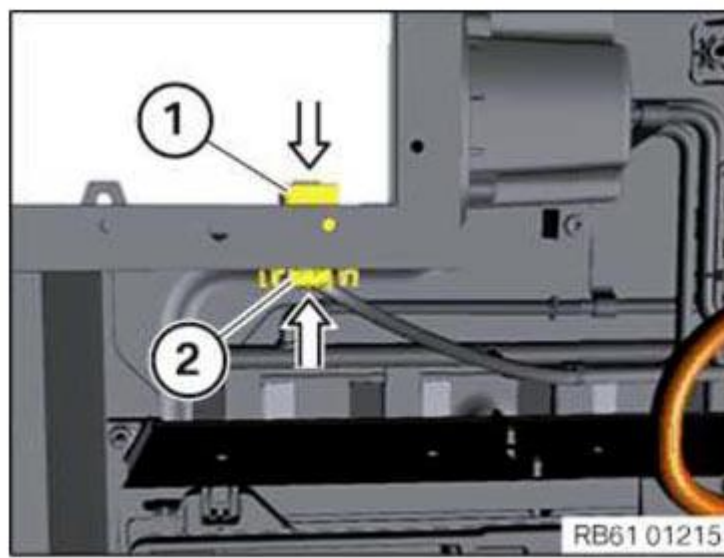


**Fig. 357: Identifying Wiring Harness Marked Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

**5. Install communication wiring harness connector:**

- Insert connector housing front section (1) in direction of arrow.

Insert connector housing rear section (2) in direction of arrow.

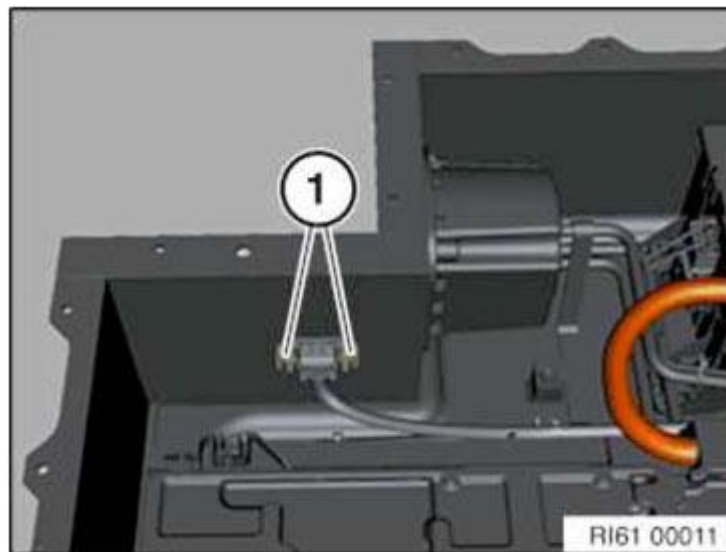


**Fig. 358: Installing Communication Wiring Harness Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten the screws (1).

**COMMUNICATION WIRING HARNESS CONNECTOR HOUSING TO HOUSING WELL SPECIFICATION**

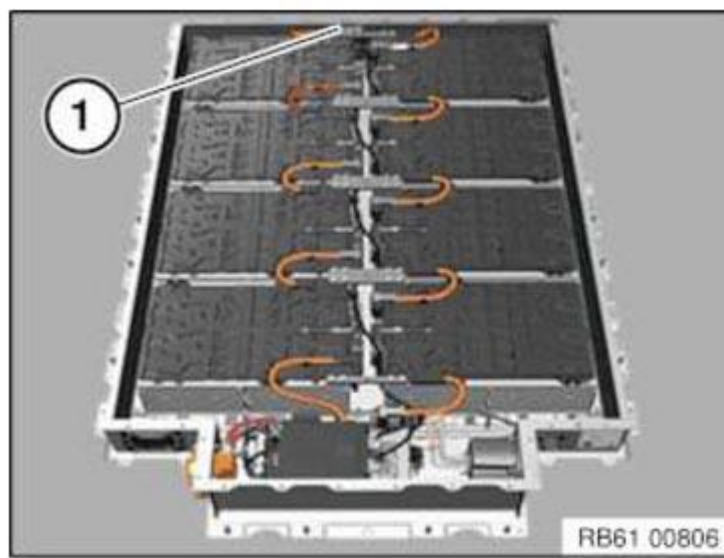
Oval-head screw	2 Nm
-----------------	------



**Fig. 359: Identifying Communication Wiring Harness Connector Housing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**6. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).



**Fig. 360: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.



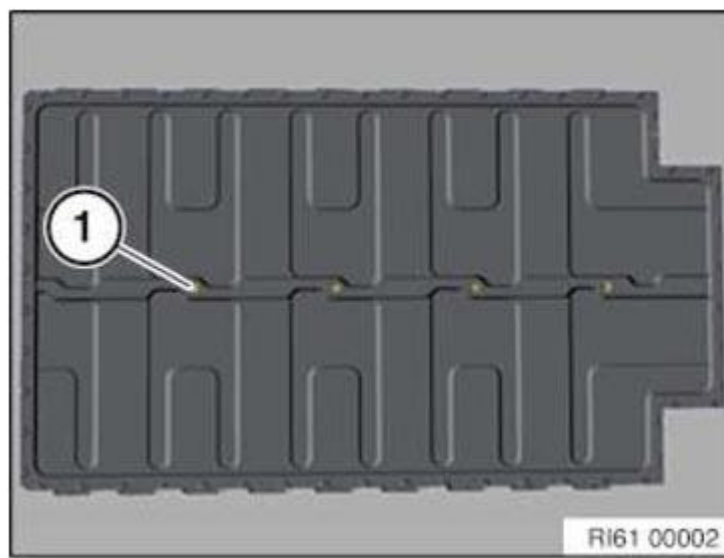
**Fig. 361: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°



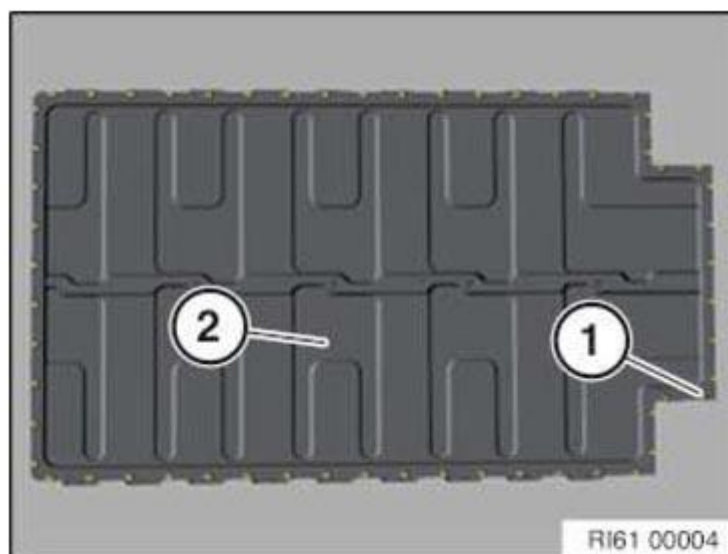


**Fig. 362: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
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**Fig. 363: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

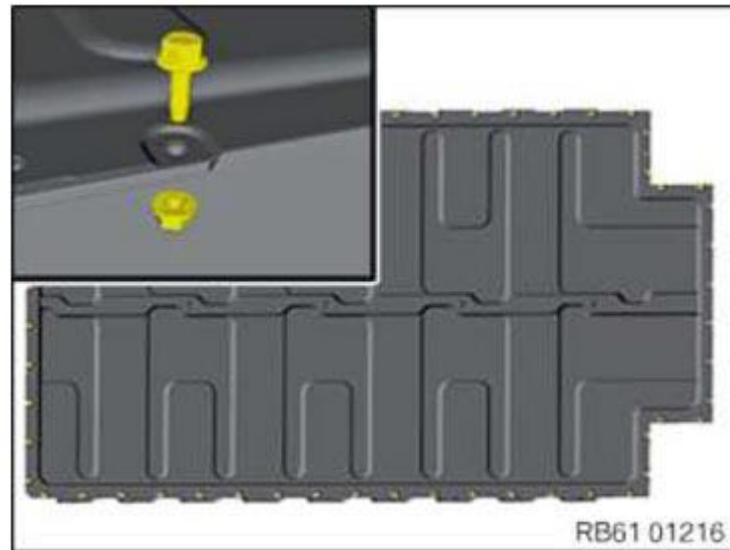
Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.



- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 364: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**7. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 365: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 501 REMOVING AND INSTALLING LID FOR HIGH-VOLTAGE BATTERY UNIT (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

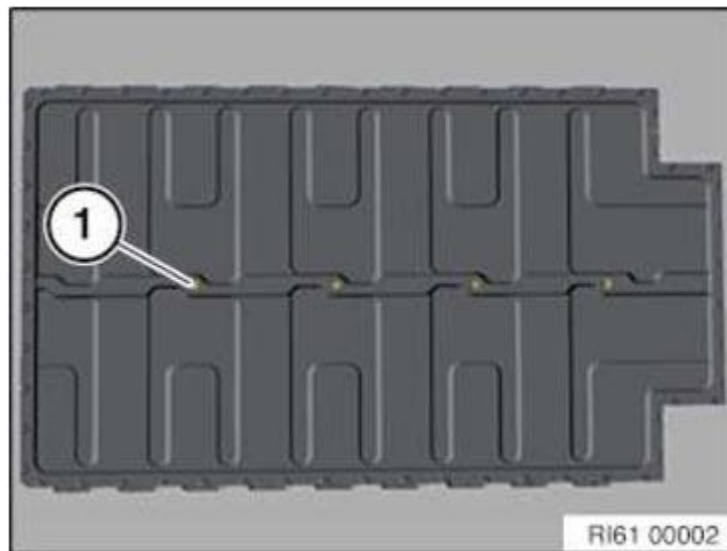
**WARNING:****High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

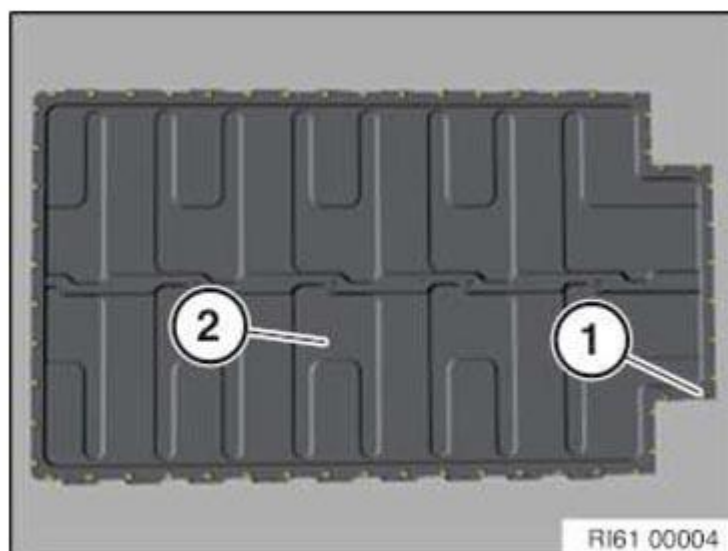
**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.
1. Remove lid from high-voltage battery unit:
    - Undo sealing screws (1).



**Fig. 366: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

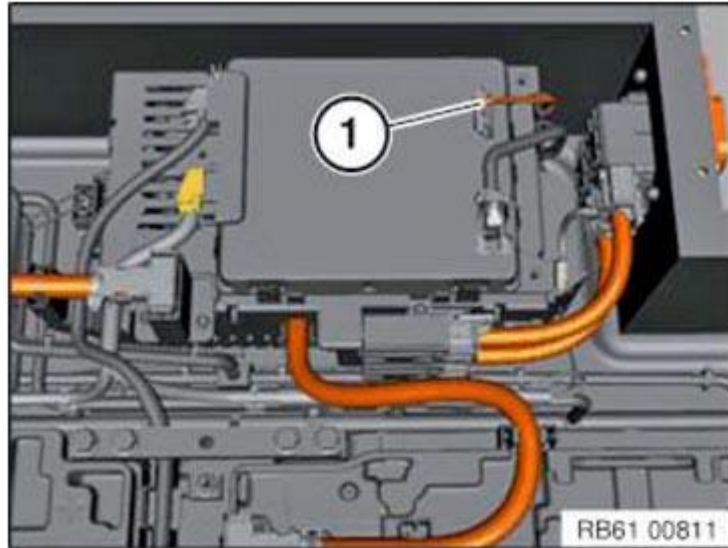
- Loosen screws (1).
- Remove debris from screw holes (1) using a vacuum cleaner.
- Remove lid (2) with help of a second person.



**Fig. 367: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



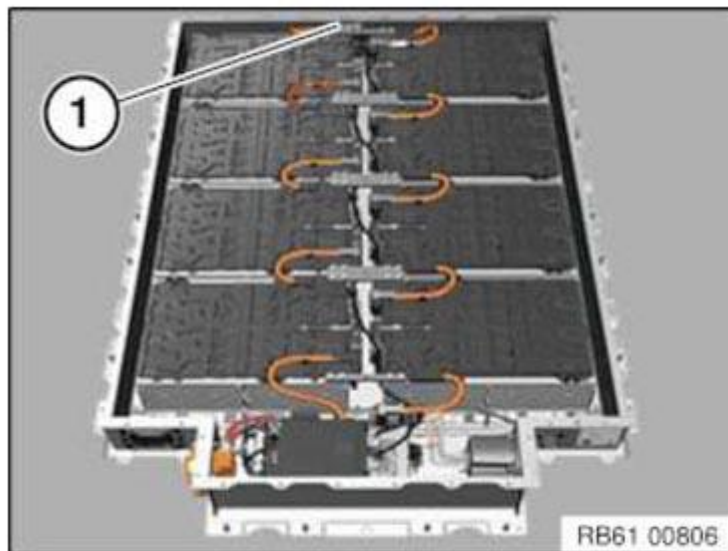
**Fig. 368: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

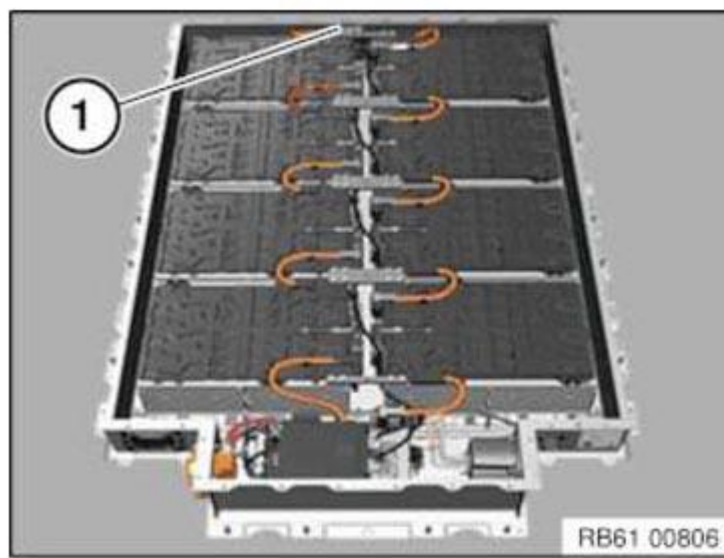
- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 369: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

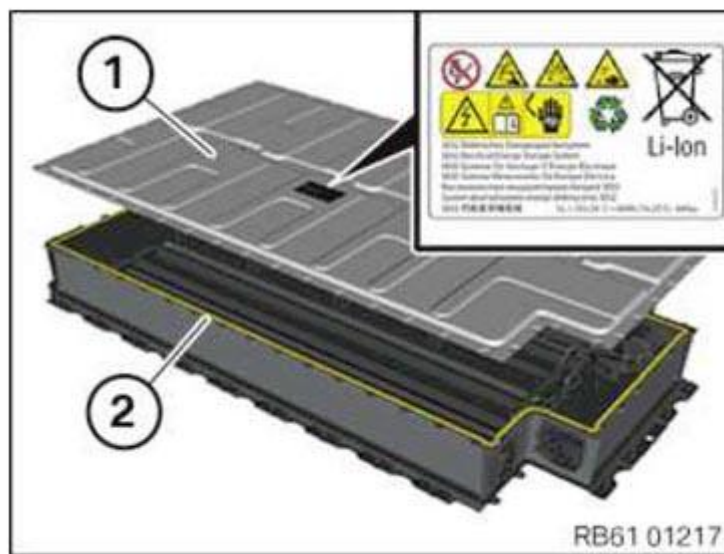
**2. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).



**Fig. 370: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

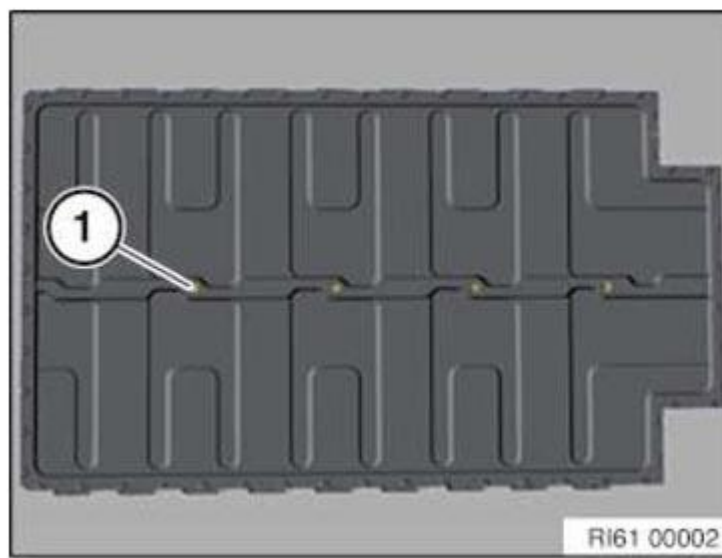


**Fig. 371: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

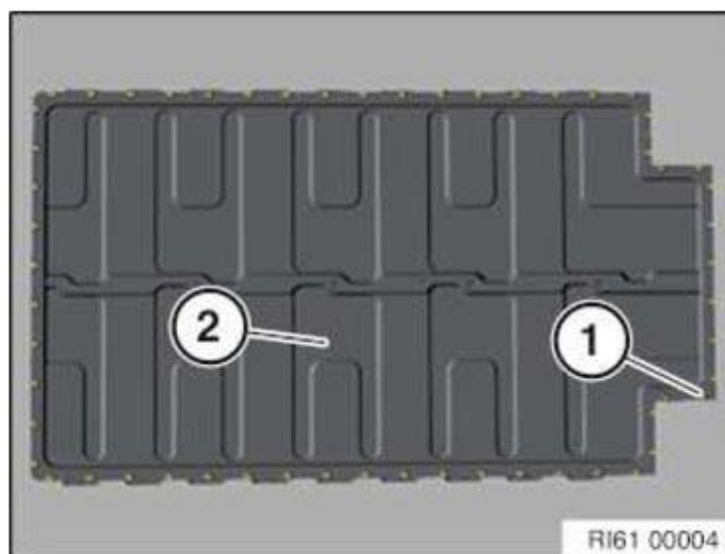


**Fig. 372: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 373: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

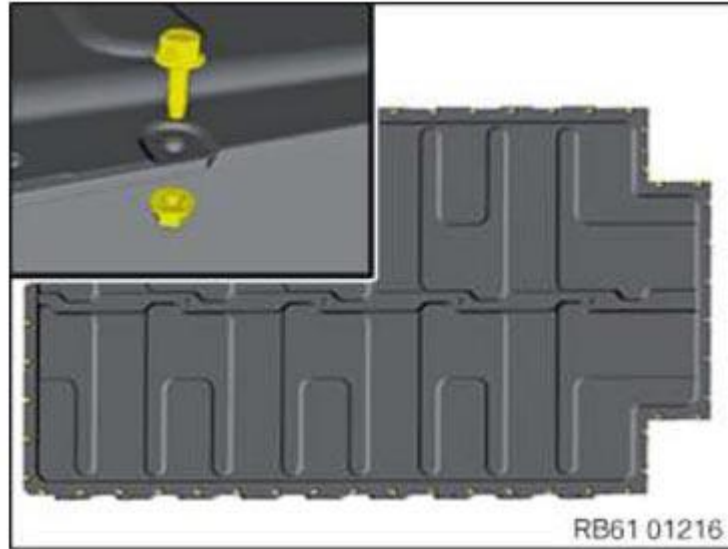
- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 374: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
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**3. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 375: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 551 REPLACING SAFETY BOX (HIGH-VOLTAGE BATTERY UNIT REMOVED)**



**WARNING:****High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

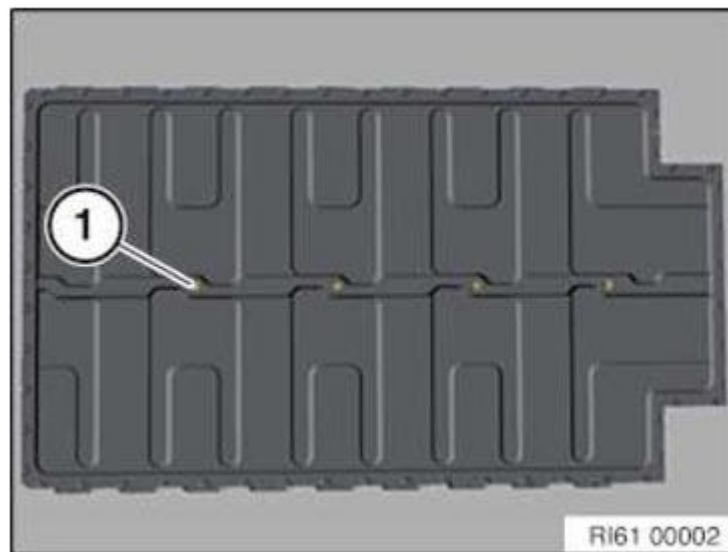
- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**1. Removing lid from high-voltage battery unit:**

- Undo sealing screws (1).

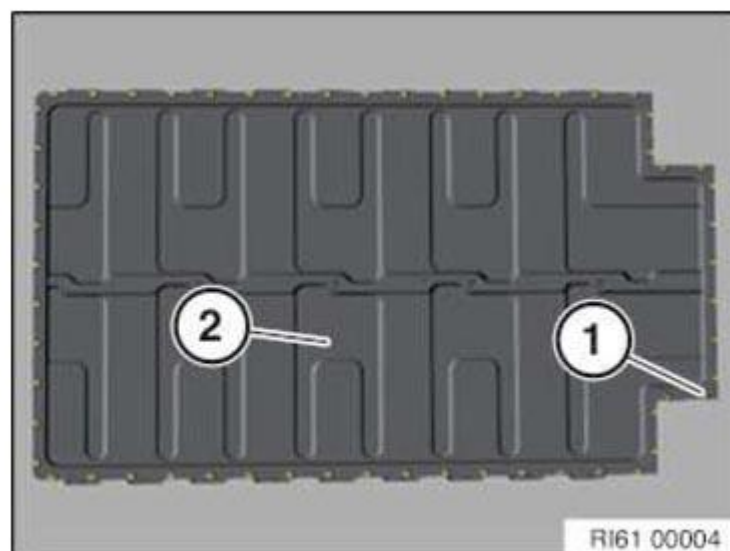


**Fig. 376: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

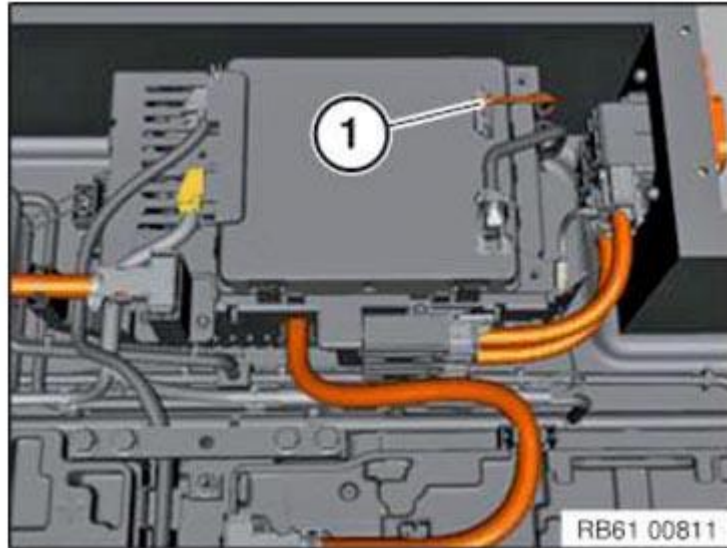
Remove lid (2) with help of a second person.



**Fig. 377: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



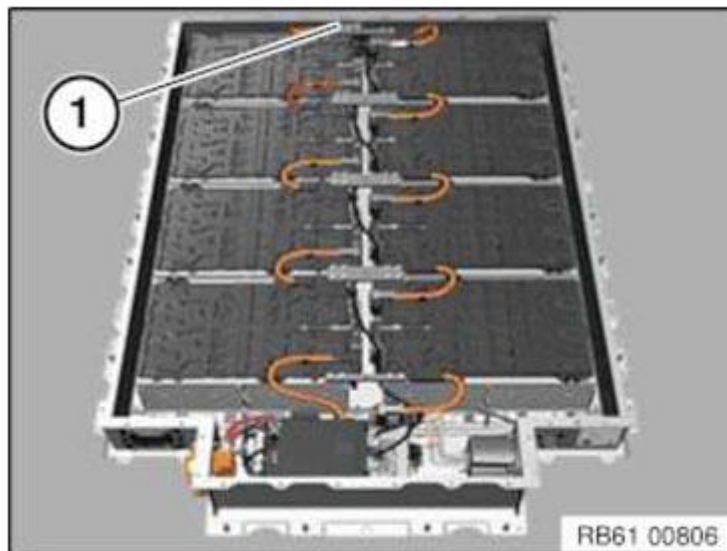
**Fig. 378: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

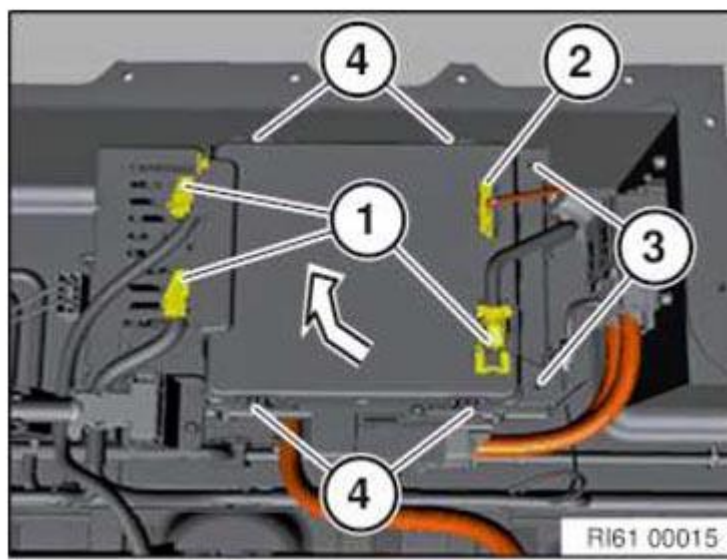
- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 379: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Remove battery management electronics (SME):**

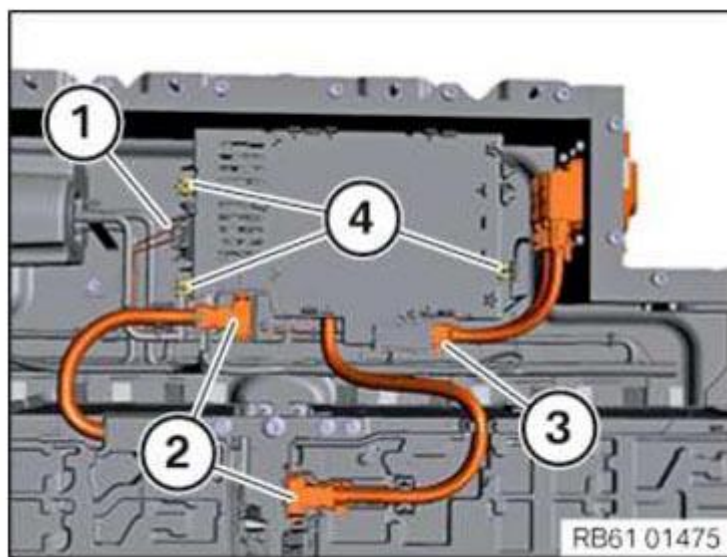
- Disconnect the connector (1).
- Disconnect connector for isolation monitor (2).
- Loosen screws (3).
- Unclip SME at side (4) and lift out upwards in direction of arrow.



**Fig. 380: Removing Battery Management Electronics (SME)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**3. Removing the safety box:**

- Disconnect the heating connector for the high-voltage battery unit (1).
- Disconnect high-voltage connector (2).
- Disconnect high-voltage connection lines (3).
- Loosen screws (4) and remove safety box.



**Fig. 381: Identifying Safety Box And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**4. Installing the safety box:**

Check packaging and component for integrity through visual inspection.

Do not use the components in case of damage.

The component must be clean and dry and hence may be taken out from the packaging in the workbay only shortly before the installation.

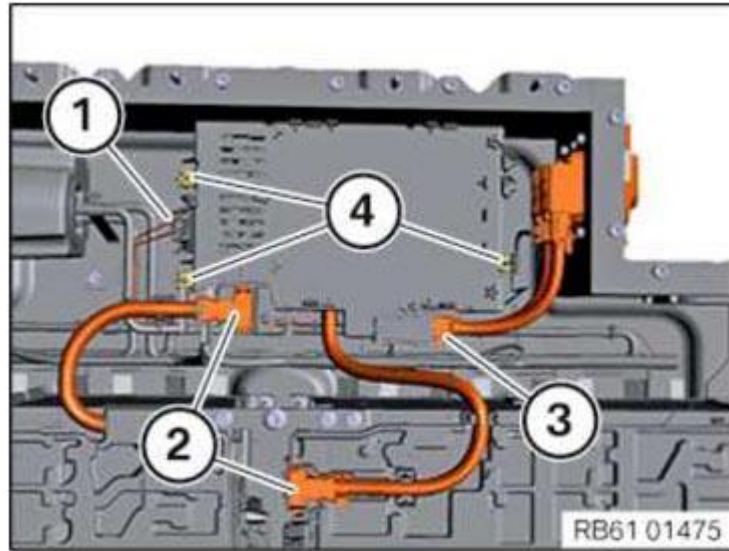
- Tighten down screws (4).

**SAFETY BOX TO HOUSING WELL SPECIFICATION**

M6	11.8 Nm
----	---------

- Connect high-voltage connector (2).

- Connect high-voltage connection lines (3).
- Connect the heating connector for the high-voltage battery unit (1).



**Fig. 382: Identifying Safety Box And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

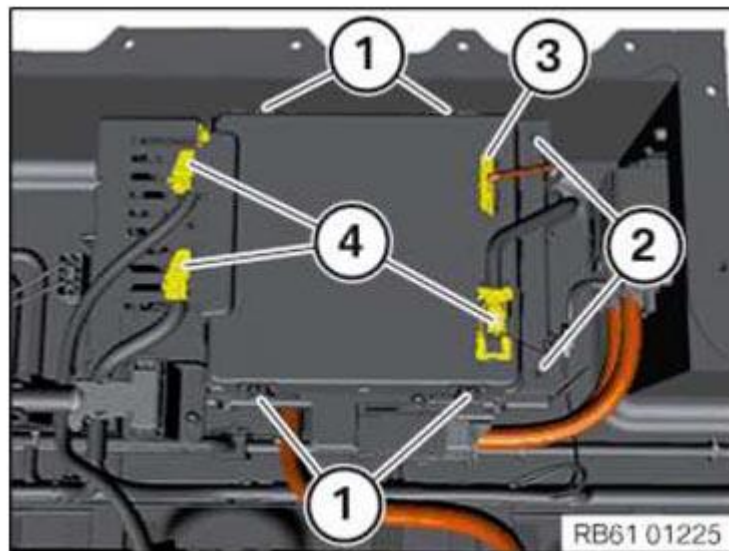
**5. Install battery management electronics (SME):**

- Clip in SME (1).
- Tighten down screws (2).

**HIGH-VOLTAGE BATTERY UNIT CONTROL UNIT TO SAFETY BOX SPECIFICATION**

Oval-head screw	If torque is not reached, safety box must be replaced.	1.1 Nm
-----------------	--	--------

- Connect connector (4).
- Connect connector for isolation monitor (3) and check that it engages correctly.

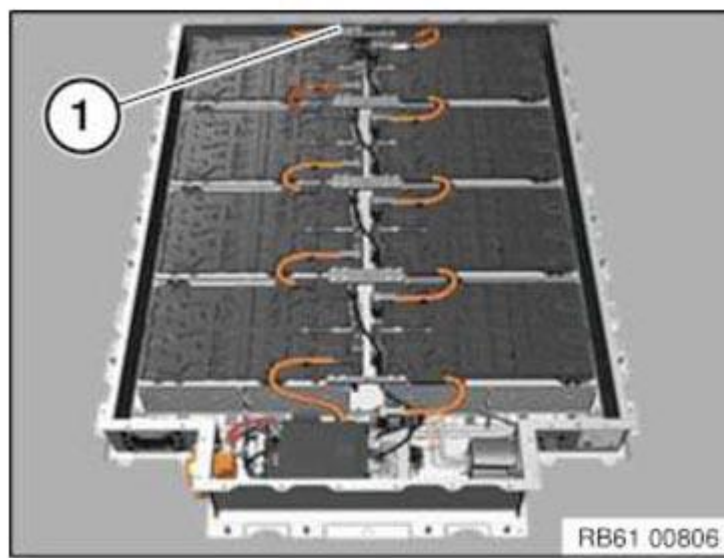


**Fig. 383: Identifying Battery Management Electronics (SME) And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**6. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).





**Fig. 384: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

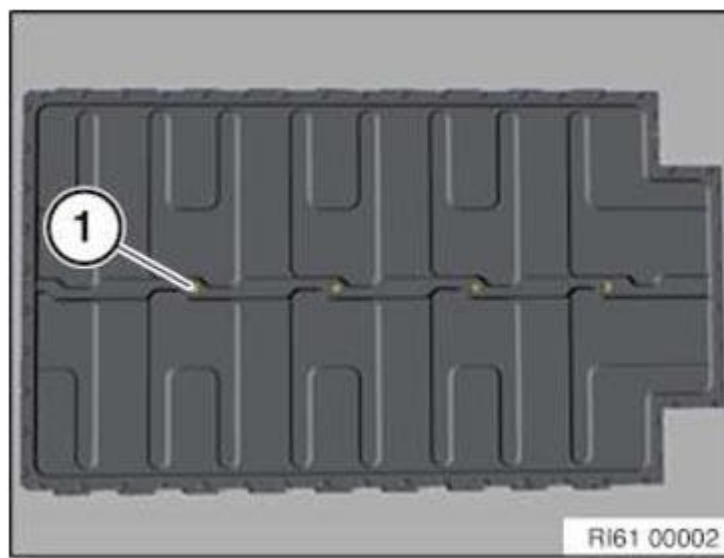


**Fig. 385: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

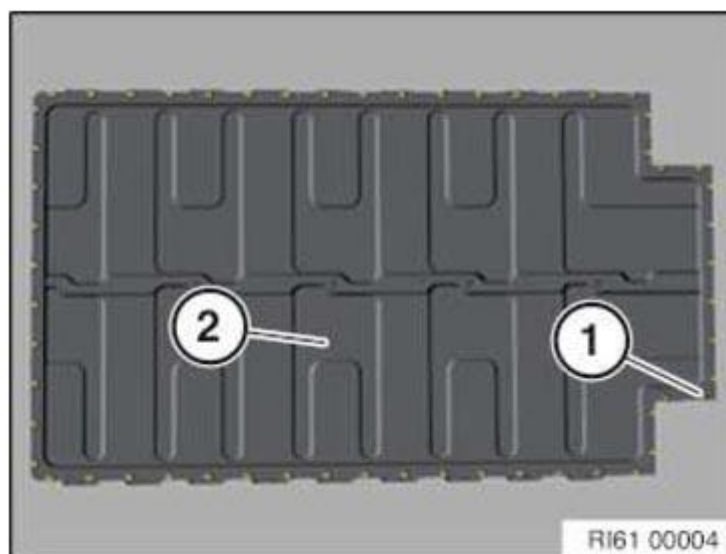


**Fig. 386: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 387: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

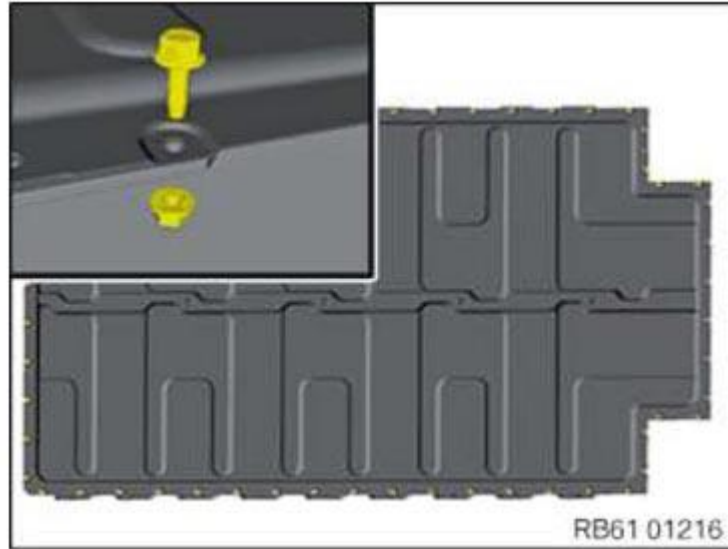
Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.



- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 388: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**7. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 389: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 541 REPLACE THE CELL SUPERVISION CIRCUIT (AFTER VEHICLE DIAGNOSIS) (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

**WARNING:****High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

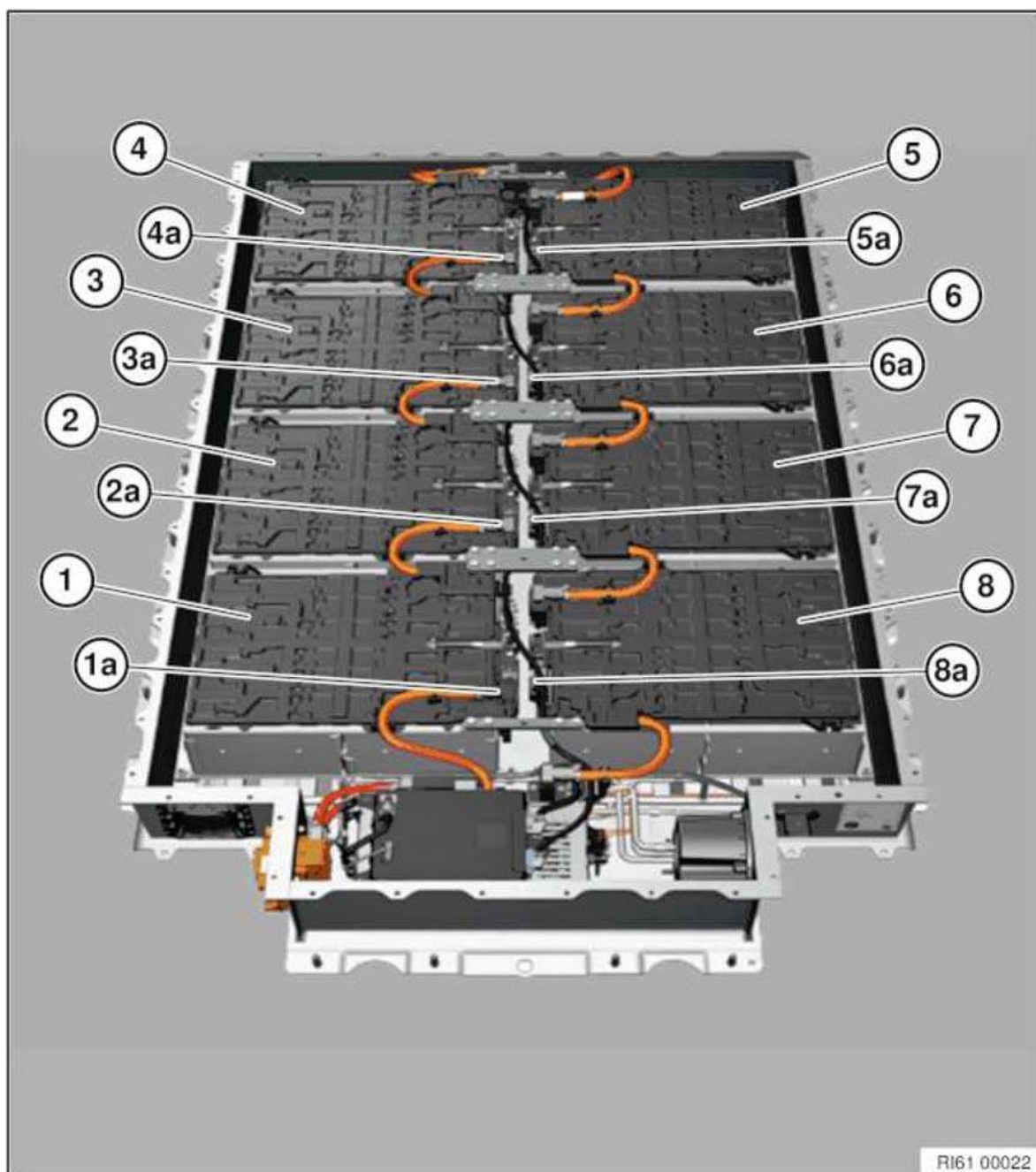
- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**1. Position plan:**

- Before removing cell modules: Print out position plan for cell modules and cell supervision circuits from diagnosis system.
- Mark installation position of all cell modules and cell supervision circuits and inscribe the installation position on the component.

**2. Preparing the position plan:**

Overview of high-voltage battery unit:



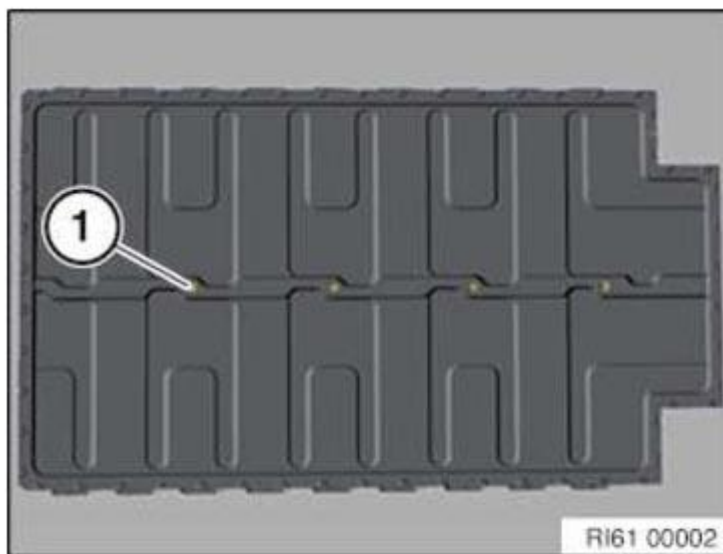
**Fig. 390: Overview Of High-Voltage Battery Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Enter the serial number of the cell module and cell supervision circuit here.

Å	Enter new serial numbers here:	Exchange part serial number:
Cell module 1	Å	Å
Cell supervision circuit 1a	Å	Å
Cell module 2	Å	Å
Cell supervision circuit 2a	Å	Å
Cell module 3	Å	Å
Cell supervision circuit 3a	Å	Å
Cell module 4	Å	Å
Cell supervision circuit 4a	Å	Å
Cell module 5	Å	Å
Cell supervision circuit 5a	Å	Å
Cell module 6	Å	Å
Cell supervision circuit 6a	Å	Å
Cell module 7	Å	Å
Cell supervision circuit 7a	Å	Å
Cell module 8	Å	Å
Cell supervision circuit 8a	Å	Å

**3. Removing lid from high-voltage battery unit:**

- Undo sealing screws (1).

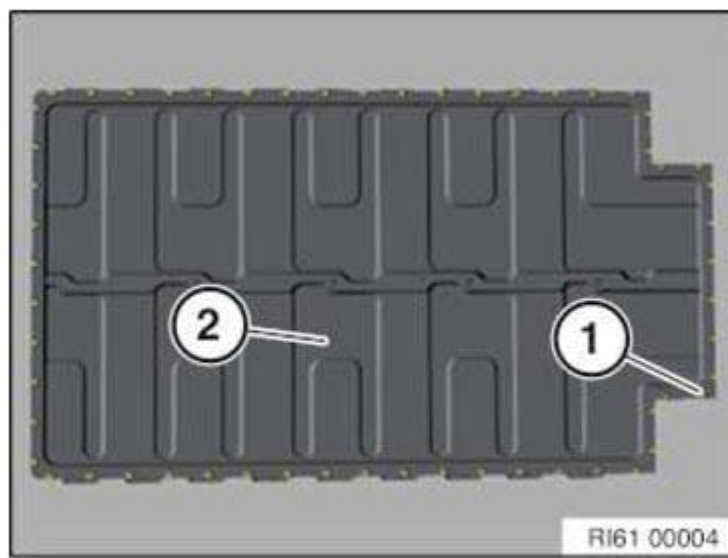


**Fig. 391: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

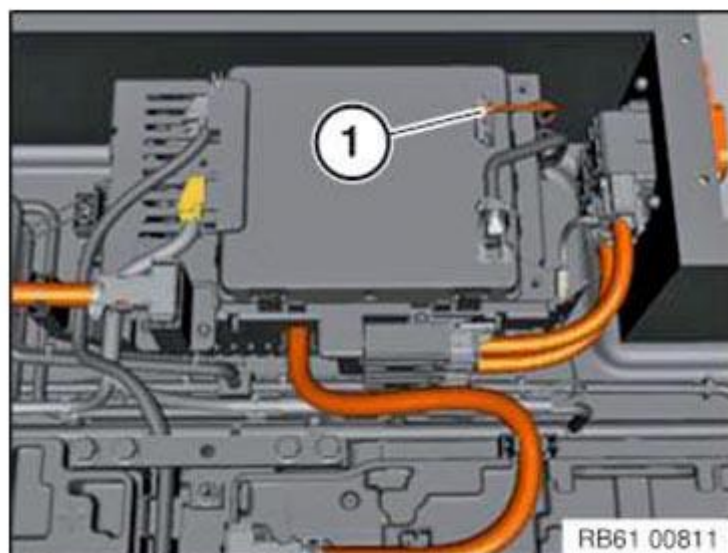
Remove lid (2) with help of a second person.



**Fig. 392: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



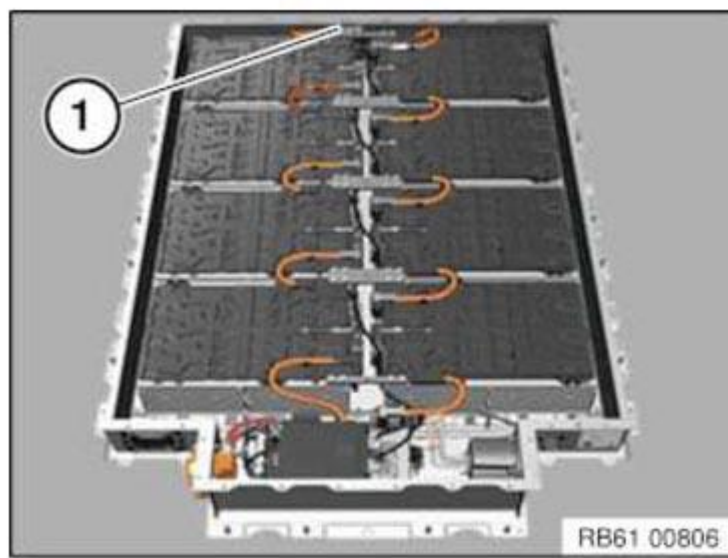
**Fig. 393: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



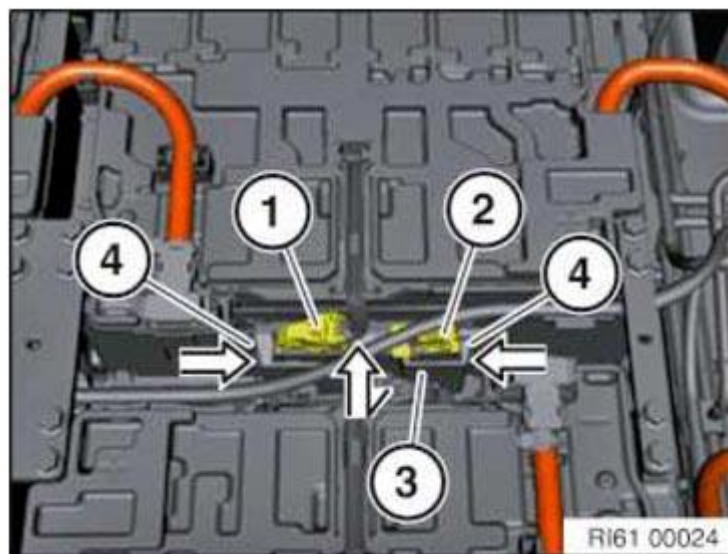
**Fig. 394: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**4. Removing cell supervision circuit:**

- Disconnect connector (1) at cell module.

When disconnecting, pull on connector (1) and not on line. Sheared wiring can cause a short circuit.

- Disconnect connector (2) at cell supervision circuit wiring harness.
- Unlock cell supervision circuit (3) at side latch mechanism (4) in direction of arrow and, at the same time, pull out upwards in direction of arrow.

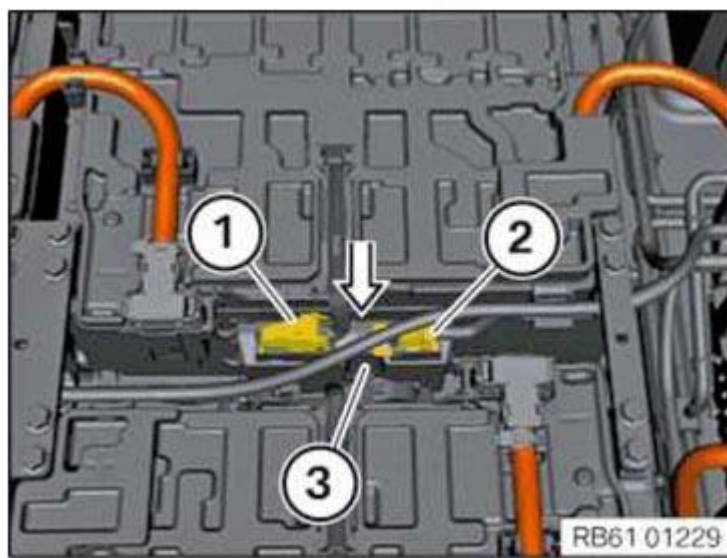


**Fig. 395: Removing Cell Supervision Circuit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**5. Installing cell supervision circuit:**

- Push in cell supervision circuit (3) downwards in direction of arrow until it engages.
- Connect connector (1) at cell module.
- Connect connector (2) at cell supervision circuit wiring harness.

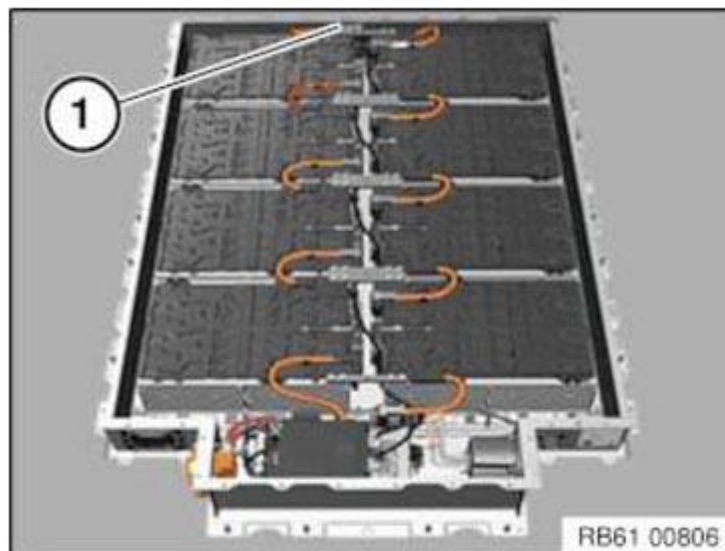




**Fig. 396: Installing Cell Supervision Circuit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**6. Installing high-voltage battery unit lid:**

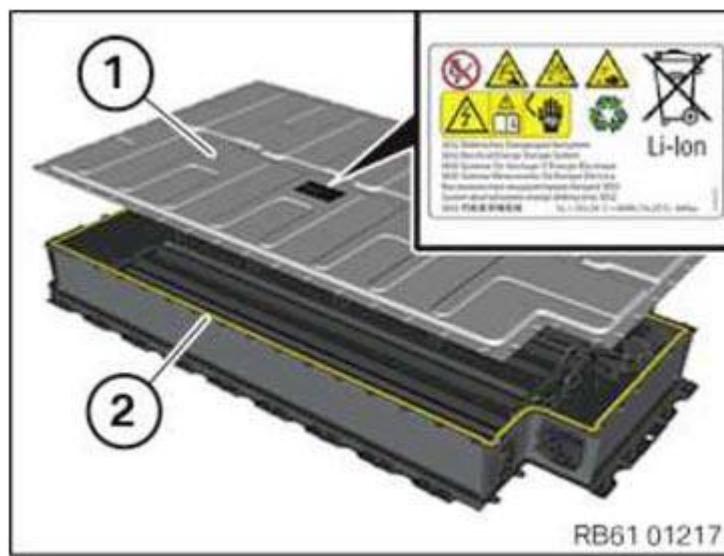
- Connect high-voltage connector (1).



**Fig. 397: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.



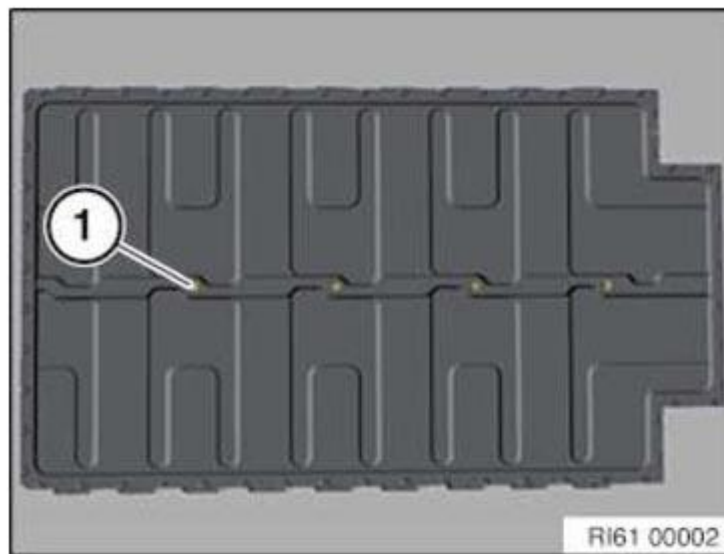


**Fig. 398: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

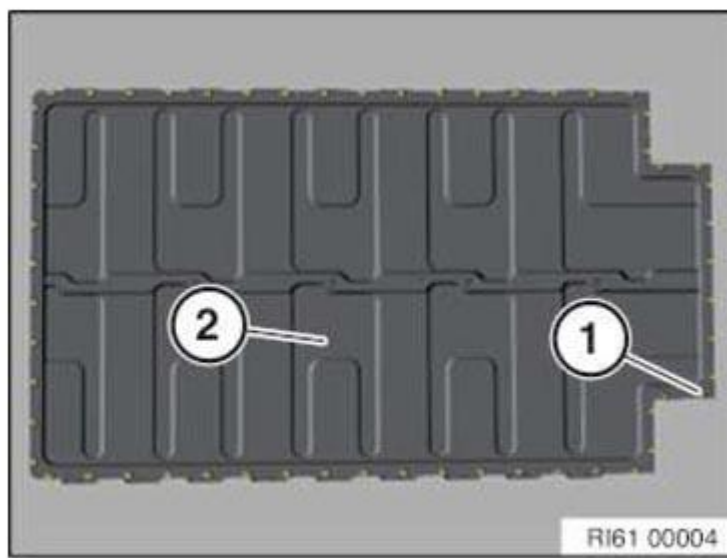


**Fig. 399: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
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**Fig. 400: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

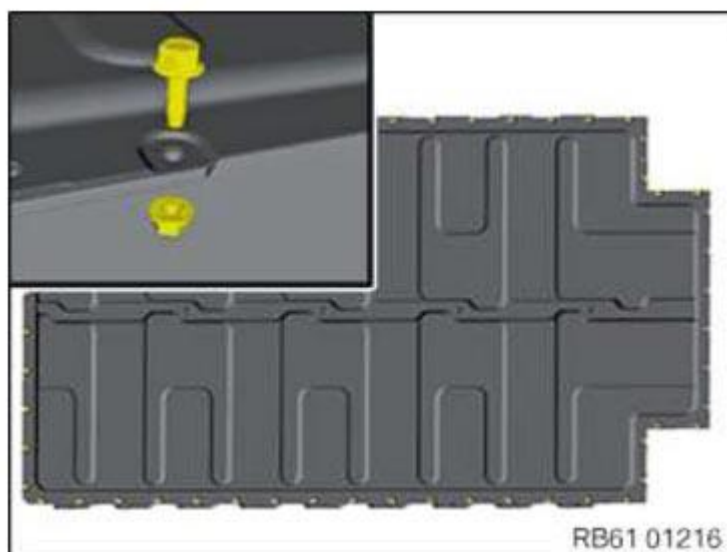
If all screw connections are damaged, the housing well must be replaced.

- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.
- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 401: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

## 7. Perform EoS test:

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 402: Identifying EoS Tester**

Courtesy of BMW OF NORTH AMERICA, INC.

## **61 27 596 REPLACE THE HIGH-VOLTAGE BATTERY UNIT FOR THE RADIATOR (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

### **WARNING:**

**High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

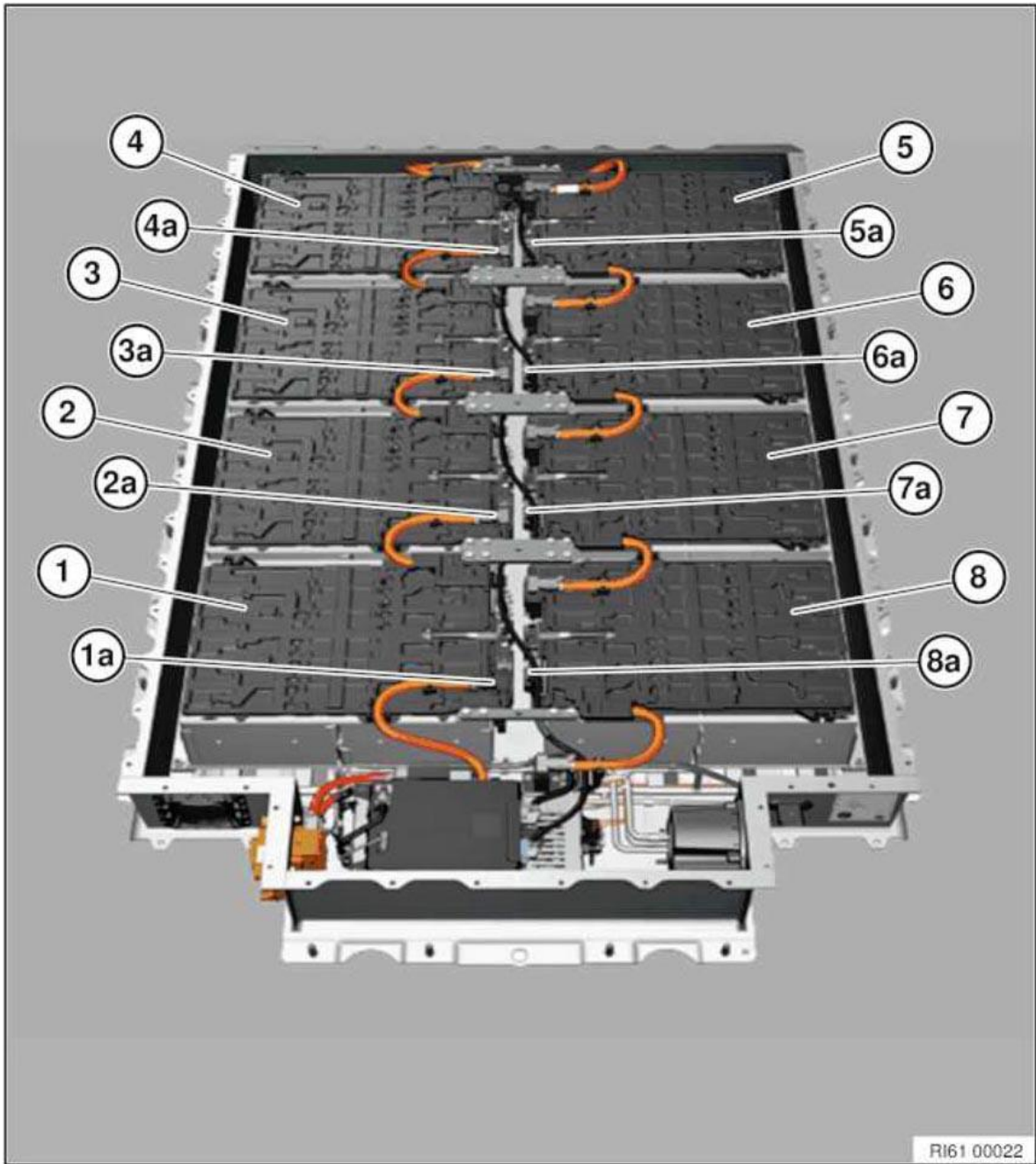
- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power
- Observe the safety requirements for the **EQUIPOTENTIAL BONDING** screw connection.
- Clean contact faces and have then checked by a second person.
- Tighten the screws for equipotential bonding to the specified torque; have a second person check the torque.
- Correct execution of these tasks must be documented in the vehicle records by both persons.

### **Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

#### **1. Preparing the position plan:**

Overview of high-voltage battery unit:



**Fig. 403: Overview Of High-Voltage Battery Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Enter the serial number of the cell module and cell supervision circuit here.

Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 1	Â	Â
Cell supervision circuit 1a	Â	Â
Cell module 2	Â	Â
Cell supervision circuit 2a	Â	Â
Cell module 3	Â	Â
Cell supervision circuit 3a	Â	Â
Cell module 4	Â	Â
Cell supervision circuit 4a	Â	Â
Cell module 5	Â	Â
Cell supervision circuit 5a	Â	Â
Cell module 6	Â	Â
Cell supervision circuit 6a	Â	Â
Cell module 7	Â	Â
Cell supervision circuit 7a	Â	Â

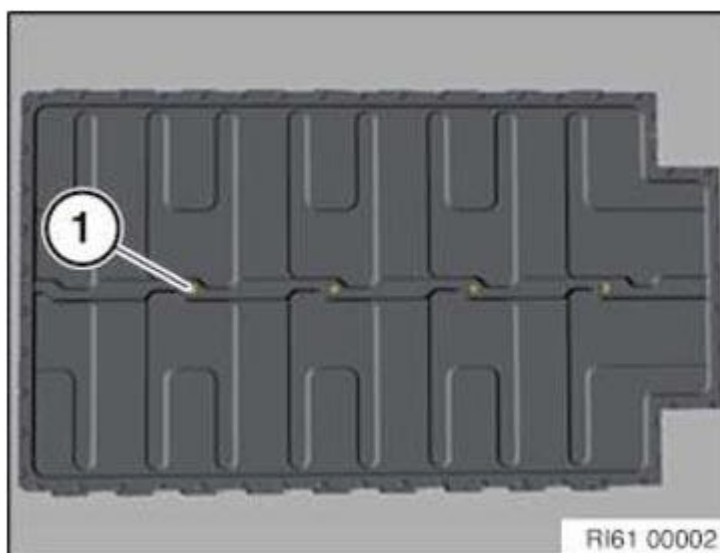
Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 8	Â	Â
Cell supervision circuit 8a	Â	Â

## 2. Position plan:

- Before removing cell modules: Print out position plan for cell modules and cell supervision circuits from diagnosis system.
- Mark installation position of all cell modules and cell supervision circuits and inscribe the installation position on the component.

## 3. Removing lid from high-voltage battery unit:

- Undo sealing screws (1).

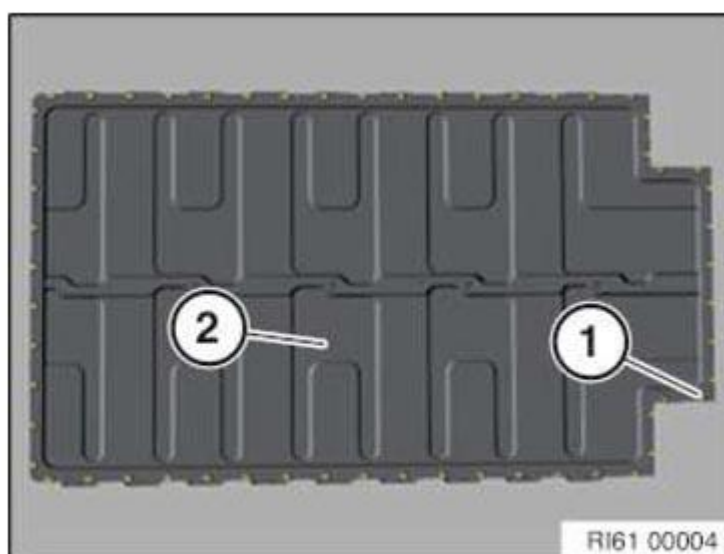


**Fig. 404: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

Remove lid (2) with help of a second person.

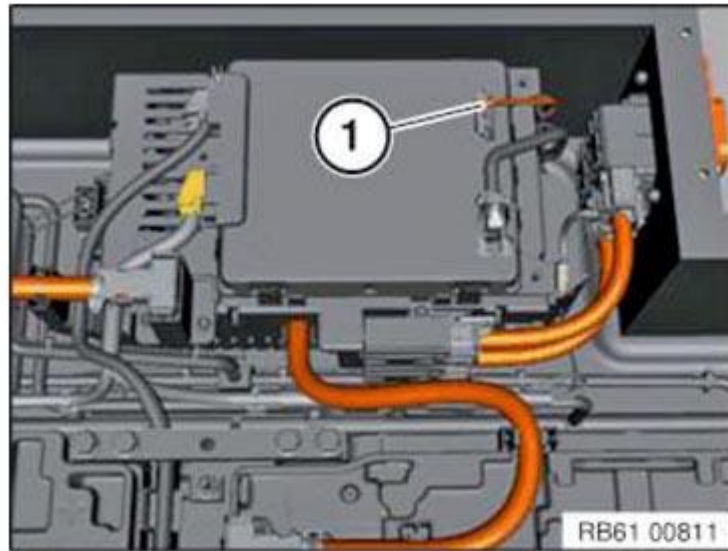


**Fig. 405: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**



- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



**Fig. 406: Identifying Isolation Monitoring Connector**

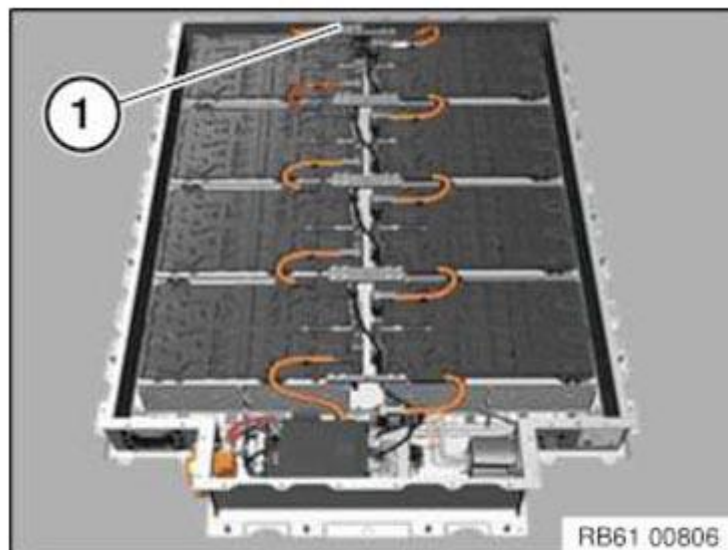
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



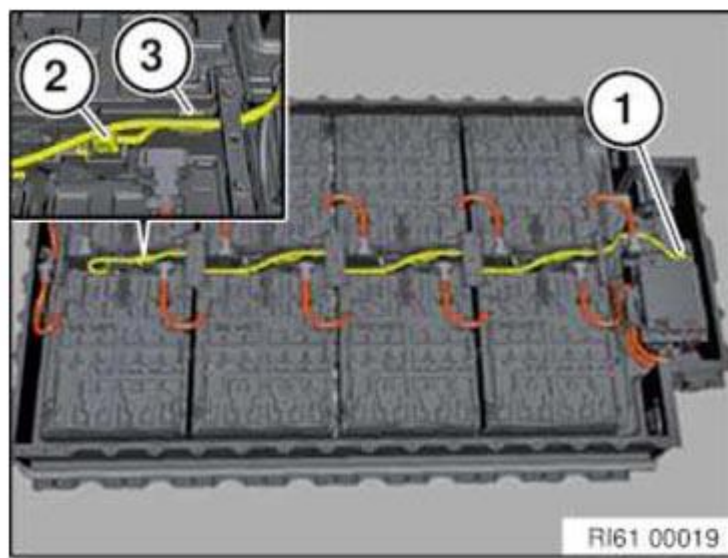
**Fig. 407: Identifying High-Voltage Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

**4. Removing cell supervision circuit wiring harness:**

- Disconnect connector (1) at battery management electronics (SME).
- Disconnect connector (2) at all cell supervision circuits.
- Release all clips (3) and remove wiring harness for cell supervision circuit.

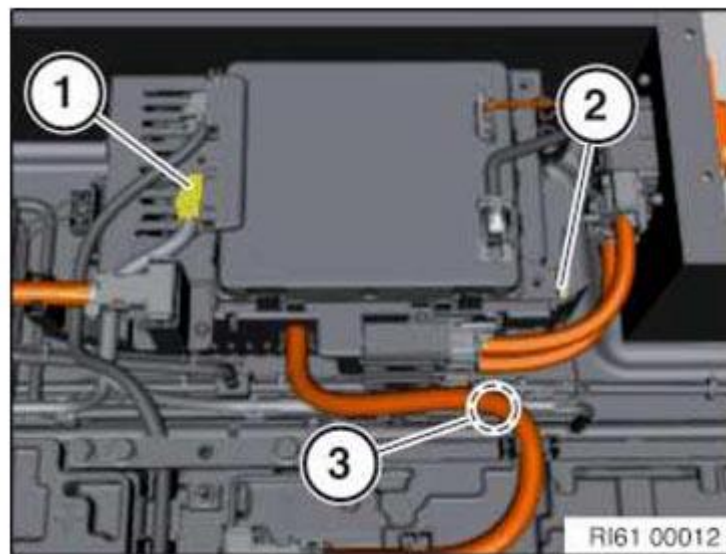




**Fig. 408: Identifying Cell Supervision Circuit Wiring Harness**  
Courtesy of BMW OF NORTH AMERICA, INC.

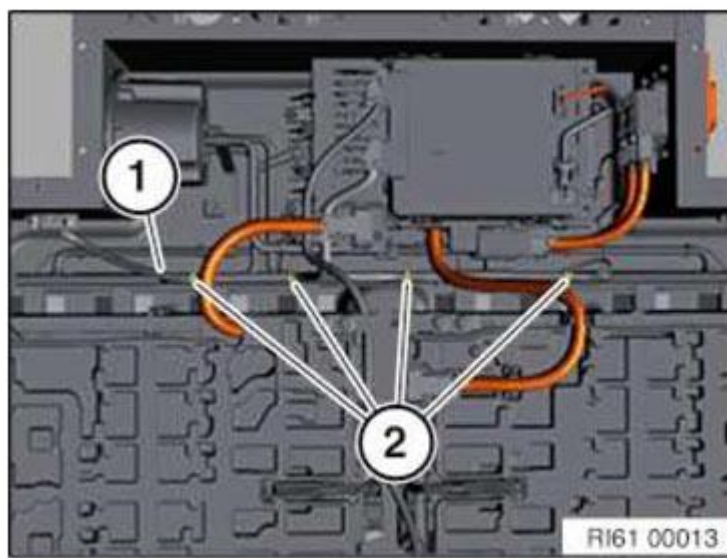
**5. Removing communication wiring harness:**

- Disconnect connector (1) at battery management electronics (SME).
- Disconnect connector (2) at high-voltage connection.
- Disconnect connector (3) at radiator.



**Fig. 409: Identifying Battery Management Electronics (SME) Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Unclip wiring harness (1) at marked points (2).
- Remove wiring harness (1).



**Fig. 410: Identifying Wiring Harness Marked Points**  
 Courtesy of BMW OF NORTH AMERICA, INC.

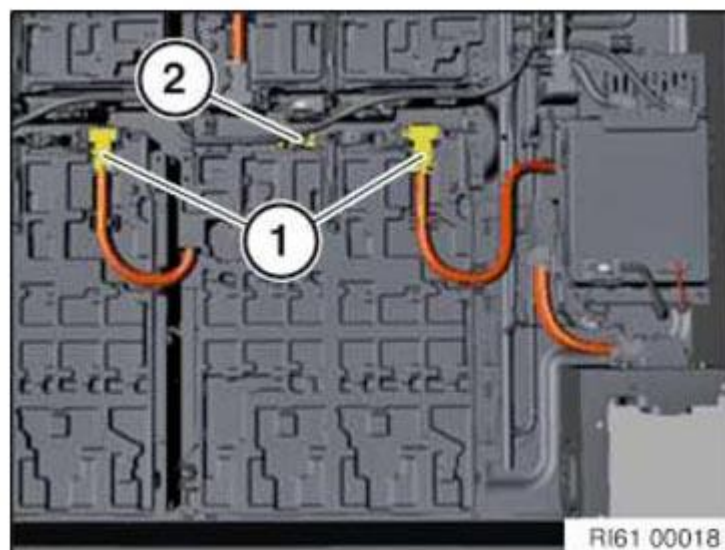
6. Removing all cell blocks:

**NOTE:** Description is for one component only. Procedure is identical for all further components.

**Remove cell module**

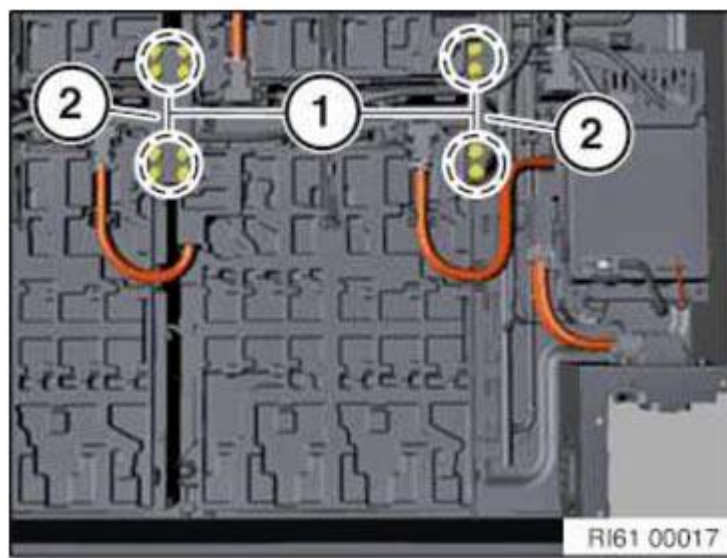
- Disconnect high-voltage connector (1).
- Disconnect connector (2) at communication wiring harness.
- Unclip the communication cable wiring harness in the area of the cell block.
- After disconnecting high-voltage connector (1), perform a visual inspection.

Technical support must be contacted if high-voltage connectors are damaged.



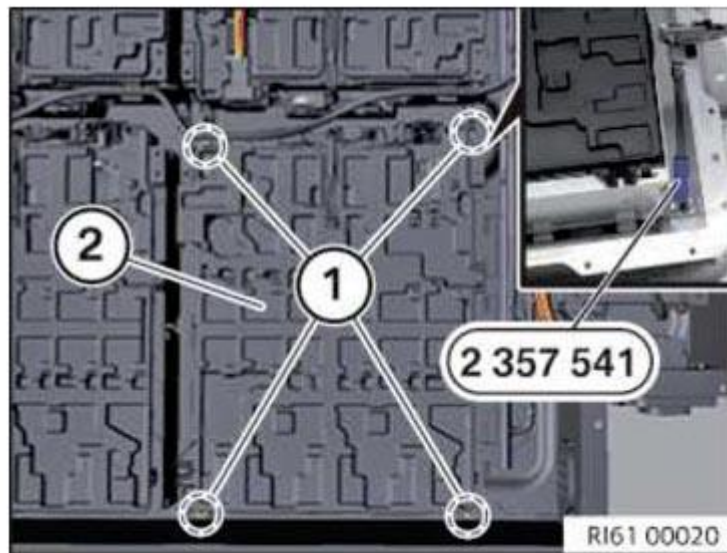
**Fig. 411: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Undo screws (1) and remove module struts (2).



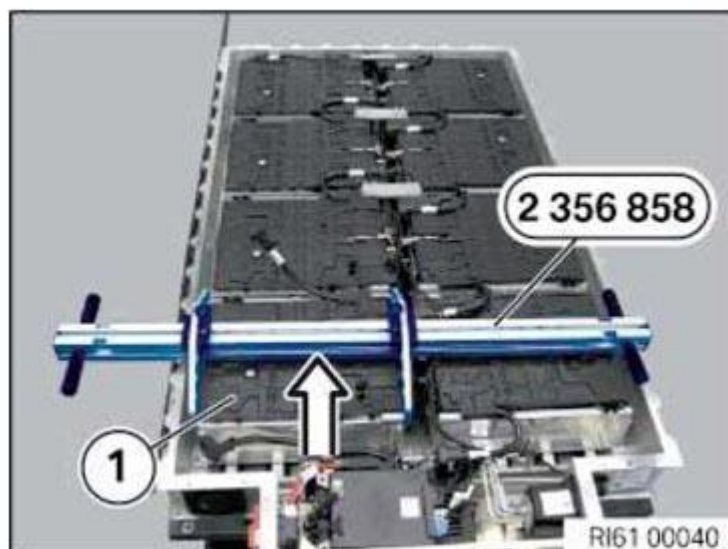
**Fig. 412: Identifying Cell Module Struts And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Undo nuts (1) at cell module (2) using special tool 2 357 541.



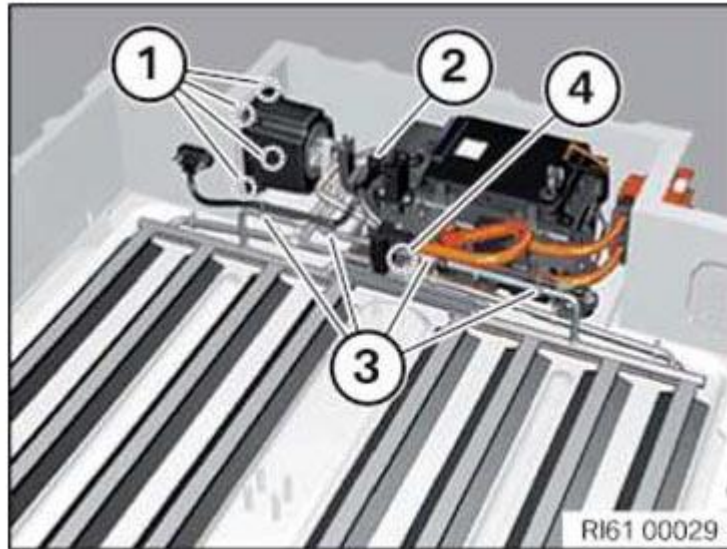
**Fig. 413: Identifying Cell Module And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lift out cell module (1) vertically using special tool 2 356 858 and with help of a second person.



**7. Remove high-voltage battery unit radiator:**

- Undo screws (1) from outside.
- Disconnect connector (2) for heating.
- Unclip communication wiring harness (3).
- Undo equipotential bonding screw (4).
- Lift out radiator with help of a second person.



**Fig. 415: Identifying Heating Connector And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**8. Install high-voltage battery unit radiator:**

The radiator must not be damaged.

If the radiator is damaged or has dents/kinks, it must be replaced.

Faulty radiator pins must be replaced.

Exchange the **venting unit** if the radiator is **leaking** .

The sealing rings on the radiator connection must be replaced if the radiator is only removed and installed.

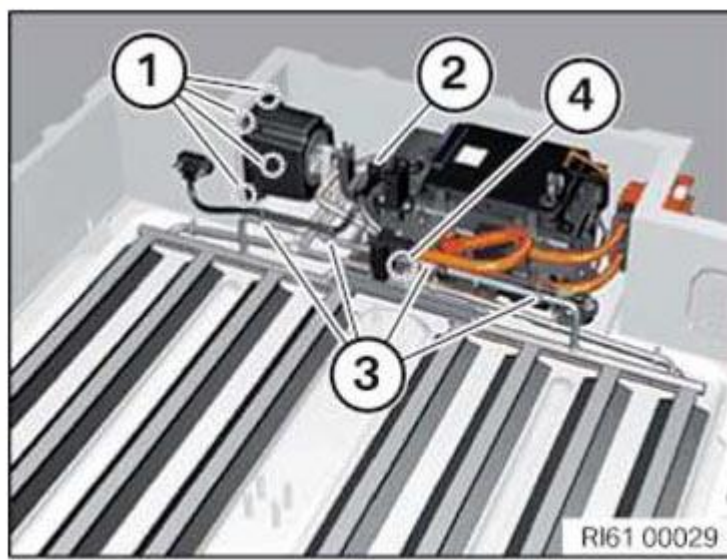
- Clean sealing surface of radiator screw connection.
- Insert radiator with help of a second person.
- Tighten screws (1) from outside.

**RADIATOR CONNECTION TO HOUSING WELL SPECIFICATION**

M5	5 Nm
----	------

- Connect connector (2) for heating.
- Clip in communication wiring harness (3).
- Tighten equipotential bonding screw (4).





**Fig. 416: Identifying Heating Connector And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**POTENTIAL COMPENSATION TO RADIATOR SPECIFICATION**

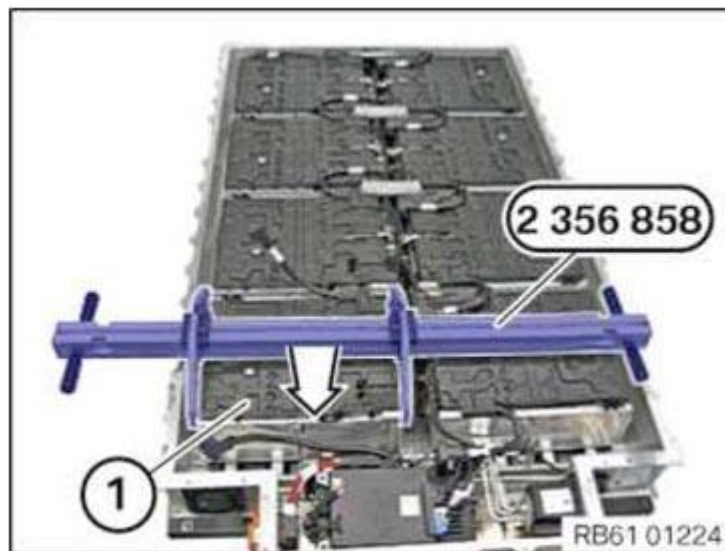
Observe instructions for potential compensation screw connections.	8.5 Nm
--	--------

**9. Install all cell modules:**

**NOTE:** Description is for one component only. Procedure is identical for all further components.

**Install cell module**

- Before installing the cell block (1), it must be ensured that the state of charge of the cell module matches the state of charge of the other cell blocks.
- Before installing the cell module(1), the high-voltage battery unit, radiator and cell module must be cleaned.
- Lower in cell module (1) vertically using special tool 2 356 858 and with help of a second person.



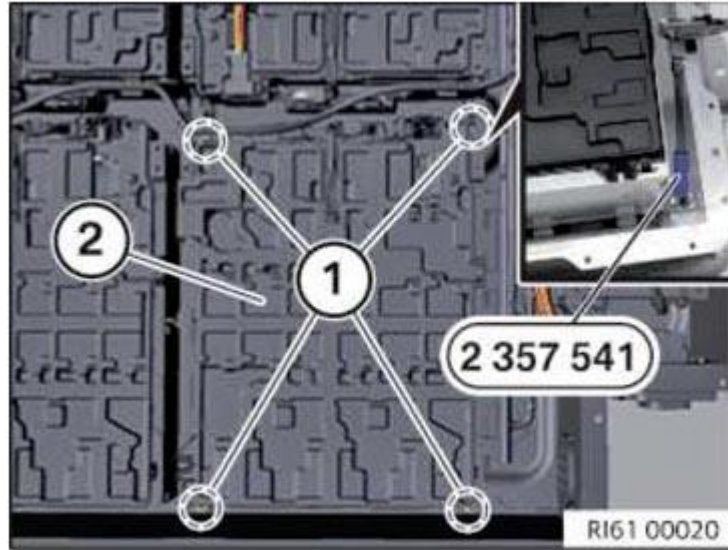
**Fig. 417: Installing Cell Module Using Special Tool (2 356 858)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten nuts (1) at cell module (2) using special tool 2 357 541.

**CELL MODULE TO HOUSING WELL SPECIFICATION**

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M6	Jointing torque	11.8 Nm
∧	Angle of rotation	45 ∧°

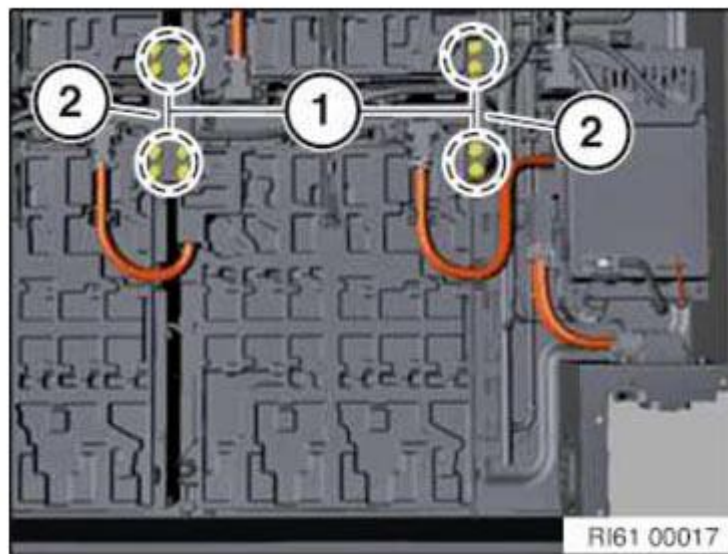


**Fig. 418: Identifying Cell Module And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten screws (1) at module struts (2).

**CELL MODULE STRUT TO CELL MODULE SPECIFICATION**

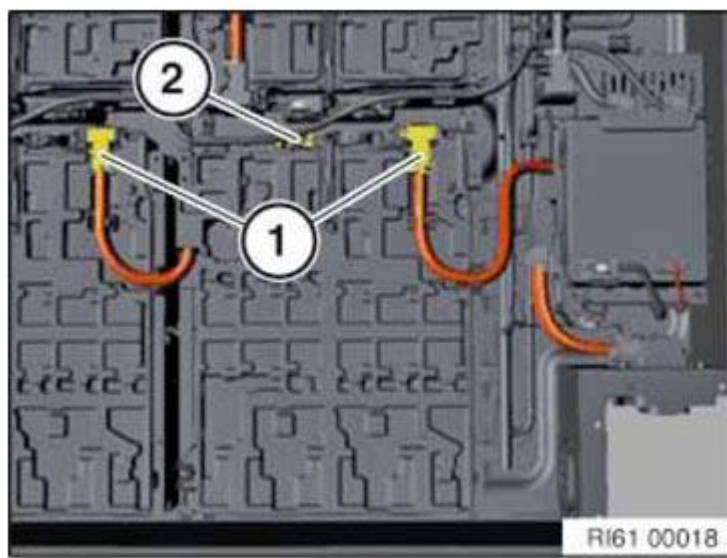
M6	Renew screws.	Jointing torque	11.8 Nm
∧	∧	Angle of rotation	45 ∧°



**Fig. 419: Identifying Cell Module Struts And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Connect connector (2) at communication wiring harness.
- Connect high-voltage connector (1).
- Clip in communication wiring harness in area of cell block.

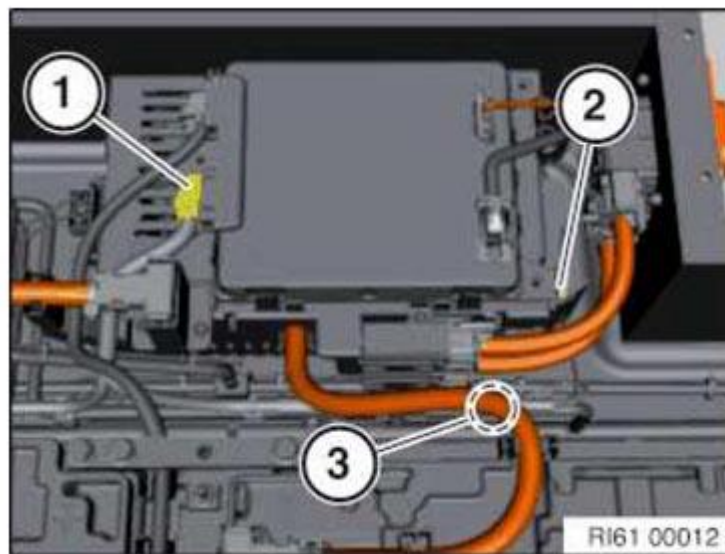




**Fig. 420: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

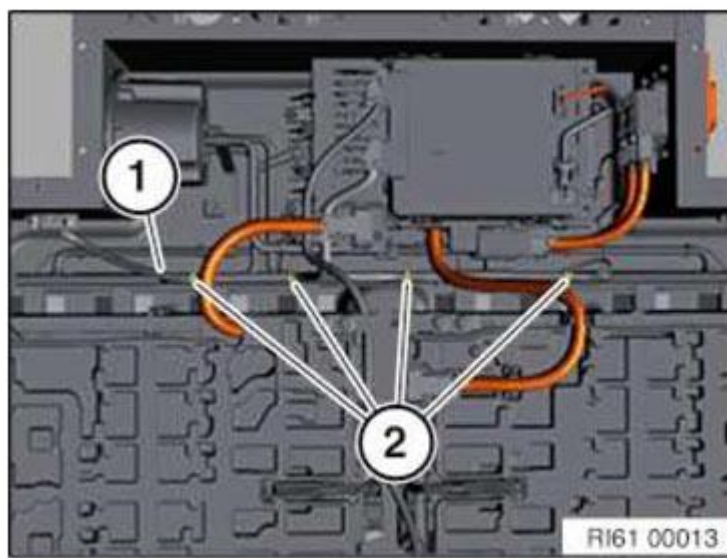
10. **Installing communication wiring harness:**

- Connect connector (1) at battery management electronics (SME).
- Connect connector (2) at high-voltage connection.
- Connect connector (3) at radiator.



**Fig. 421: Identifying Battery Management Electronics (SME) Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

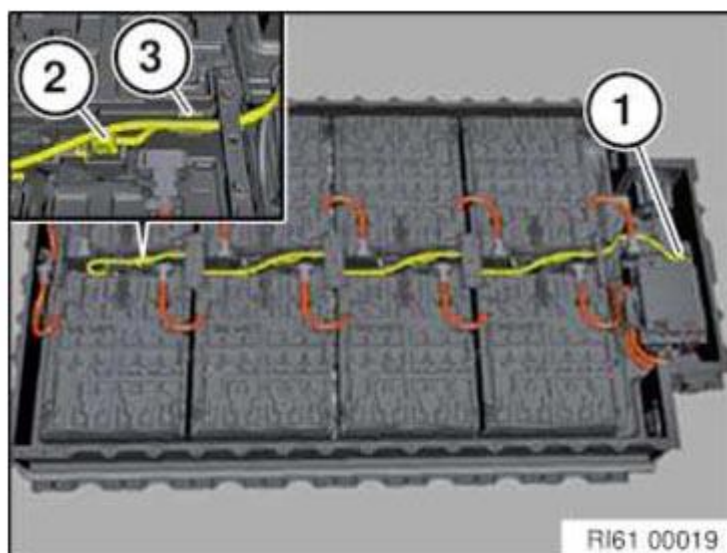
- Insert wiring harness (1).
- Clip in wiring harness (1) at marked points (2).



**Fig. 422: Identifying Wiring Harness Marked Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

**11. Installing wiring harness for cell supervision circuit**

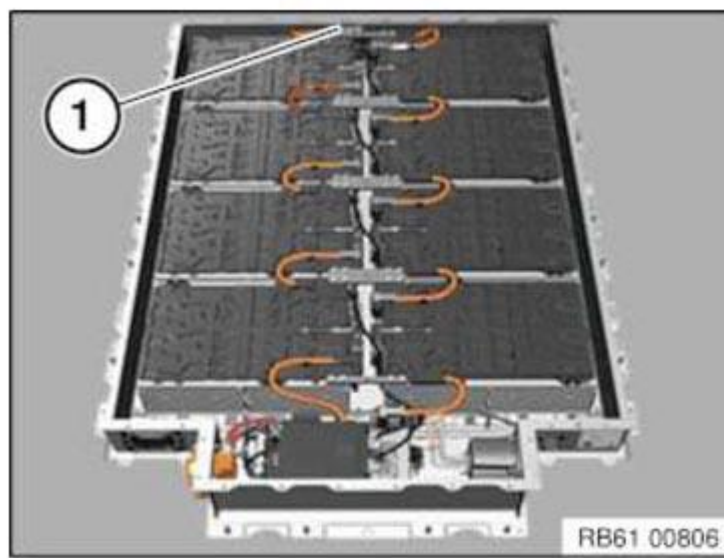
- Insert wiring harness for cell supervision circuit and clip in (3).
- Connect connector (2) at all cell supervision circuits.
- Connect connector (1) at battery management electronics (SME).



**Fig. 423: Identifying Cell Supervision Circuit Wiring Harness**  
Courtesy of BMW OF NORTH AMERICA, INC.

**12. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).



**Fig. 424: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

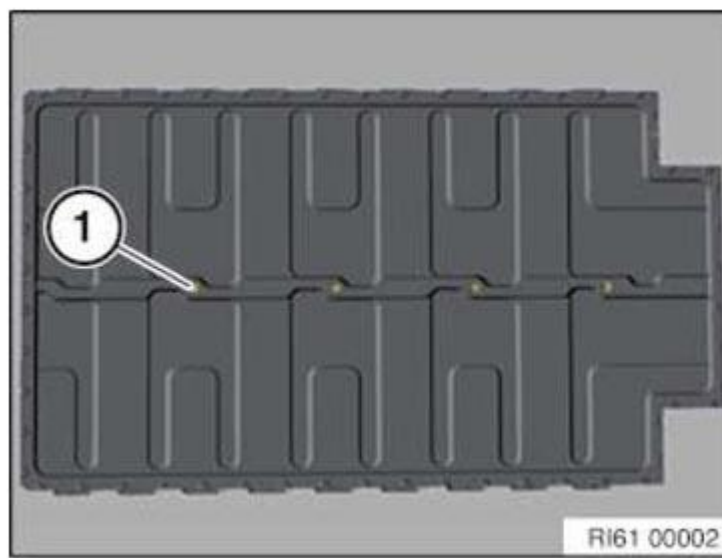


**Fig. 425: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

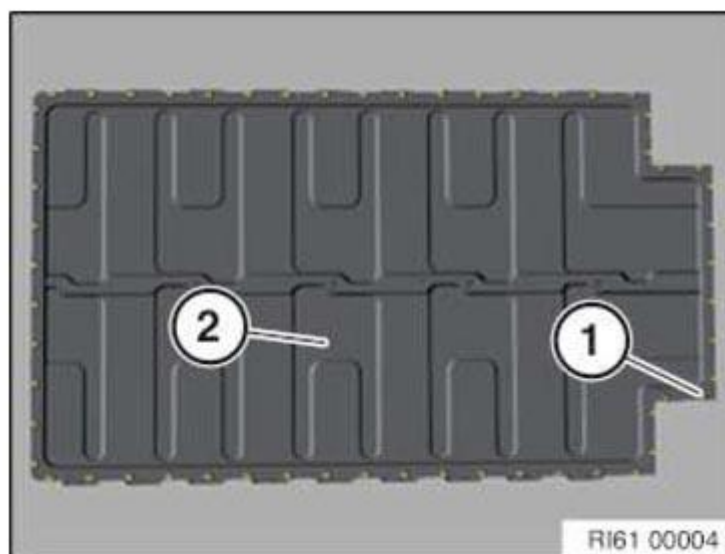


**Fig. 426: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 427: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

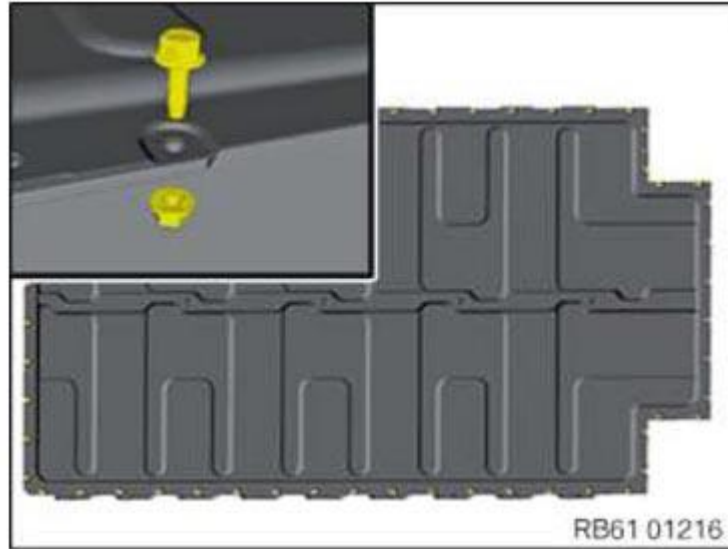
- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 428: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**13. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 429: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 581 REPLACE THE HOUSING PAN FOR THE HIGH-VOLTAGE BATTERY UNIT (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

**WARNING:**

**High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power
- Observe the safety requirements for the **EQUIPOTENTIAL BONDING** screw connection.
- Clean contact faces and have then checked by a second person.
- Tighten the screws for equipotential bonding to the specified torque; have a second person check the torque.
- Correct execution of these tasks must be documented in the vehicle records by both persons.

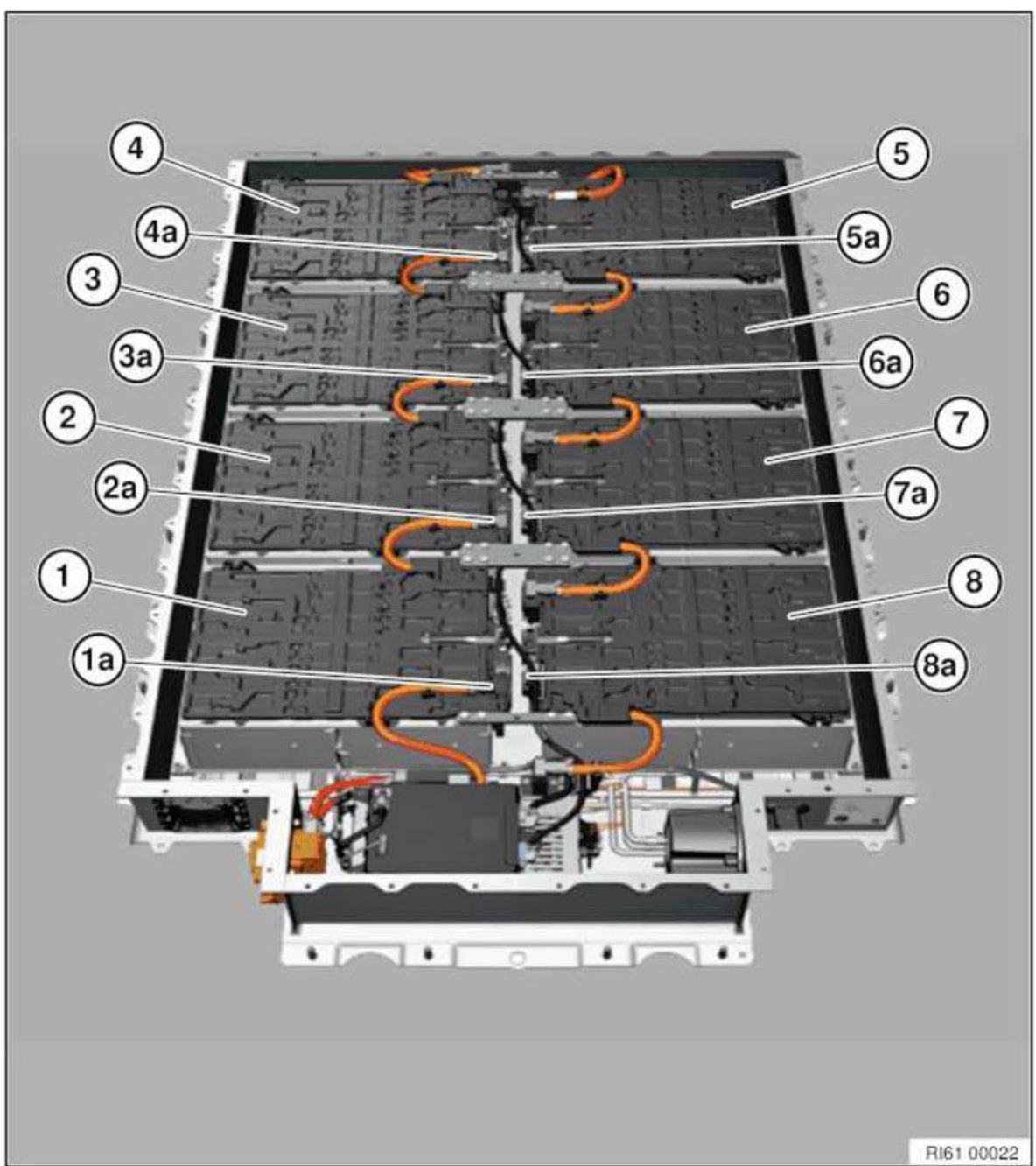
**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**1. Preparing the position plan:**

Overview of high-voltage battery unit:





**Fig. 430: Overview Of High-Voltage Battery Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Enter the serial number of the cell module and cell supervision circuit here.

Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 1	Â	Â
Cell supervision circuit 1a	Â	Â
Cell module 2	Â	Â
Cell supervision circuit 2a	Â	Â
Cell module 3	Â	Â
Cell supervision circuit 3a	Â	Â
Cell module 4	Â	Â
Cell supervision circuit 4a	Â	Â
Cell module 5	Â	Â
Cell supervision circuit 5a	Â	Â
Cell module 6	Â	Â
Cell supervision circuit 6a	Â	Â
Cell module 7	Â	Â
Cell supervision circuit 7a	Â	Â

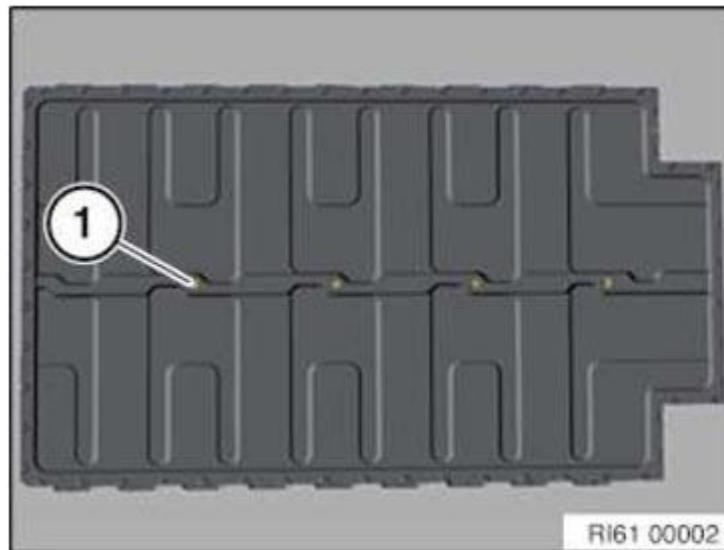
Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 8	Â	Â
Cell supervision circuit 8a	Â	Â

## 2. Position plan:

- Before removing cell modules: Print out position plan for cell modules and cell supervision circuits from diagnosis system.
- Mark installation position of all cell modules and cell supervision circuits and inscribe the installation position on the component.

## 3. Removing lid from high-voltage battery unit:

- Undo sealing screws (1).

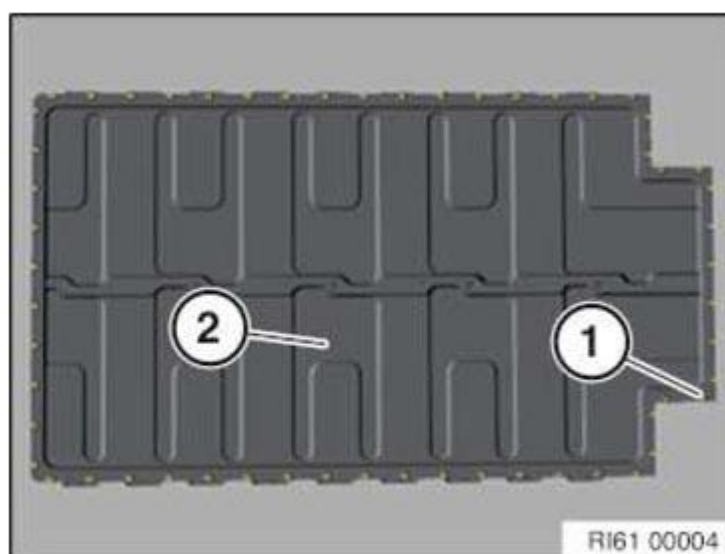


**Fig. 431: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

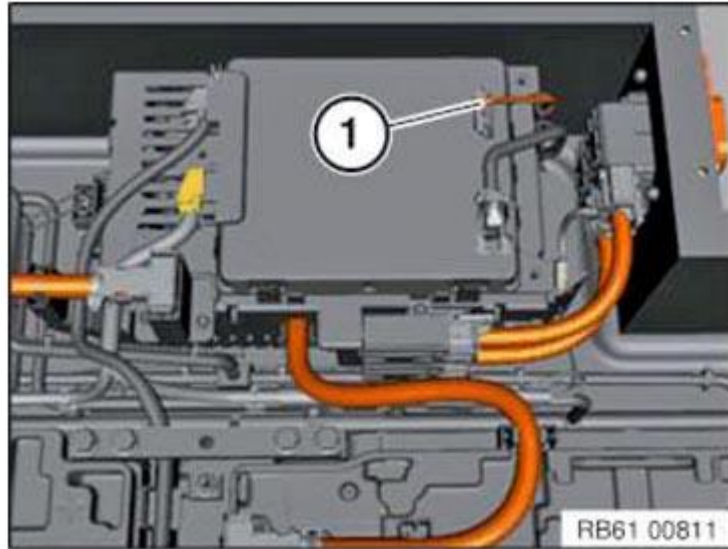
Remove lid (2) with help of a second person.



**Fig. 432: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



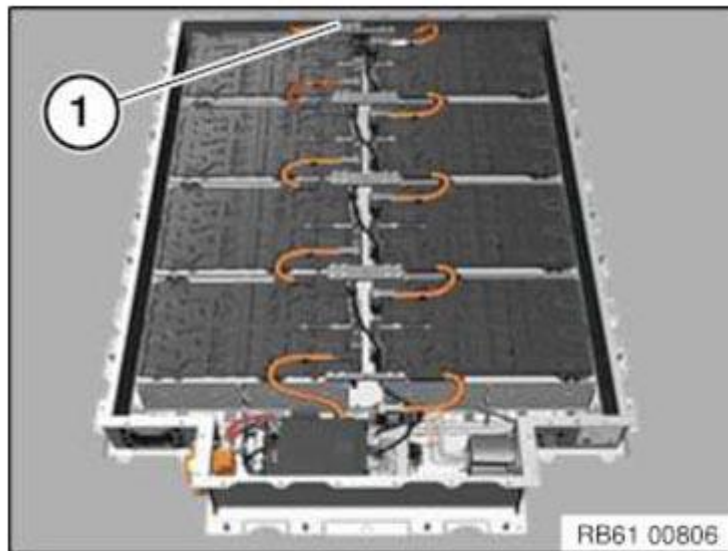
**Fig. 433: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

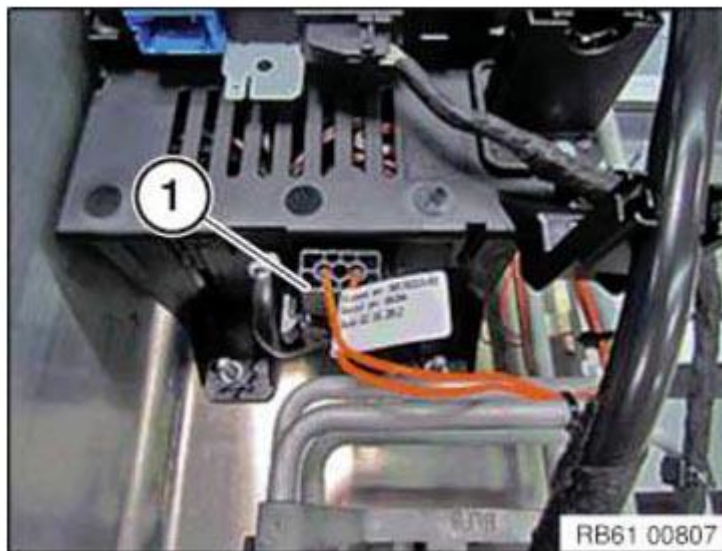
- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 434: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

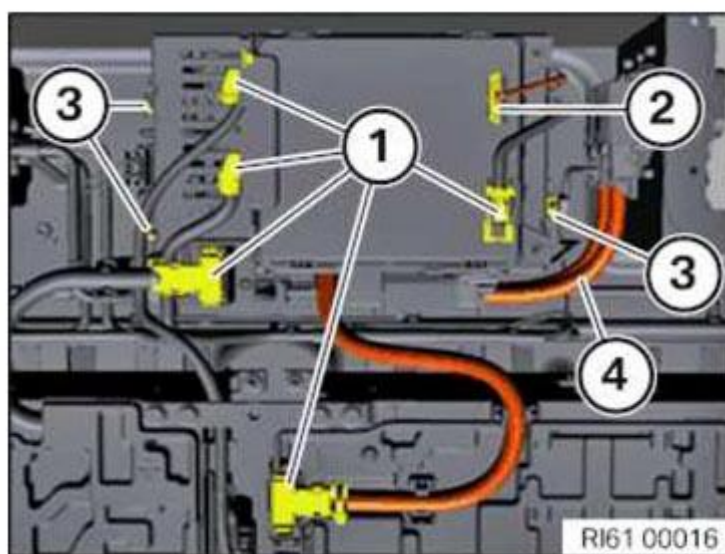
**4. Removing the safety box:**

- Disconnect the heating connector for the high-voltage battery unit (1).



**Fig. 435: Identifying High-Voltage Battery Unit Heating Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Disconnect the connector (1).
- Disconnect connector for isolation monitor (2).
- Disconnect high-voltage connector (4) at safety box.
- Unclip communication and cell supervision circuit wiring harness using special tool 2 298 505.
- Undo nuts (3) using special tool 2 357 541 and remove safety box.

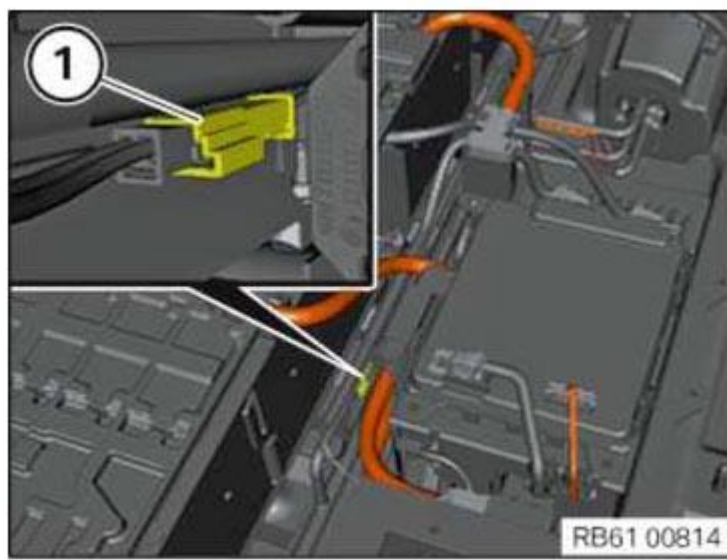


**Fig. 436: Identifying Safety Box Connector And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

**5. Disconnect temperature sensor connector:**

- Disconnect connector (1) at temperature sensor.

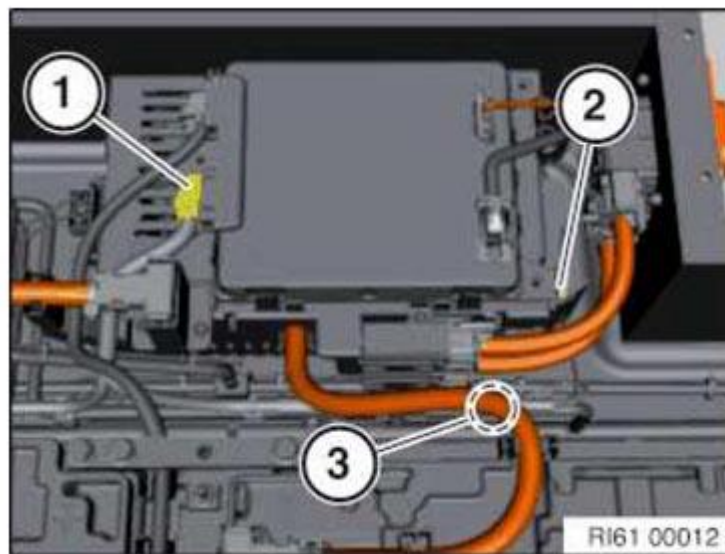




**Fig. 437: Identifying Temperature Sensor Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

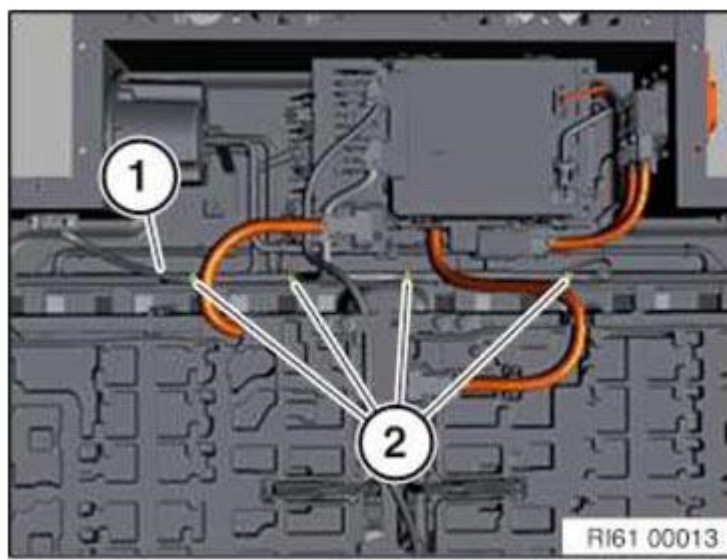
**6. Removing communication wiring harness:**

- Disconnect connector (1) at battery management electronics (SME).  
Disconnect connector (2) at high-voltage connection.  
Disconnect connector (3) at radiator.



**Fig. 438: Identifying Battery Management Electronics (SME) Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

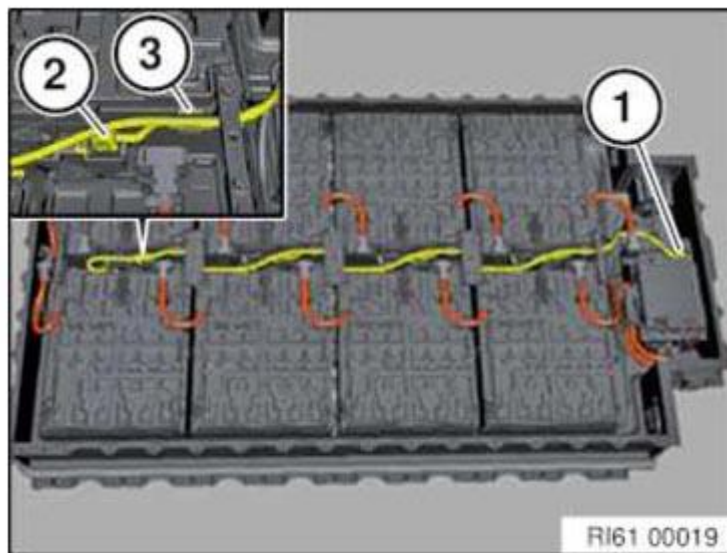
- Unclip wiring harness (1) at marked points (2).  
Remove wiring harness (1).



**Fig. 439: Identifying Wiring Harness Marked Points**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**7. Removing cell supervision circuit wiring harness:**

- Disconnect connector (1) at battery management electronics (SME).
- Disconnect connector (2) at all cell supervision circuits.
- Release all clips (3) and remove wiring harness for cell supervision circuit.

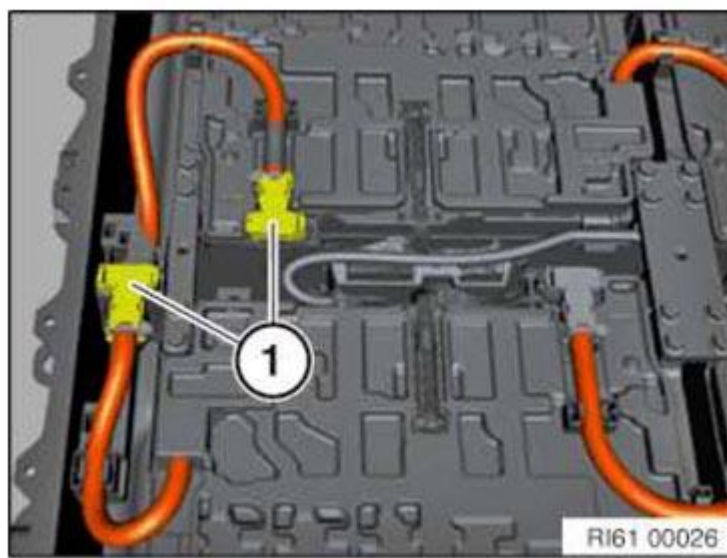


**Fig. 440: Identifying Cell Supervision Circuit Wiring Harness**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**8. Remove module connecting line:**

- Disconnect both high-voltage connectors (1).





**Fig. 441: Identifying High-Voltage Connectors**  
Courtesy of BMW OF NORTH AMERICA, INC.

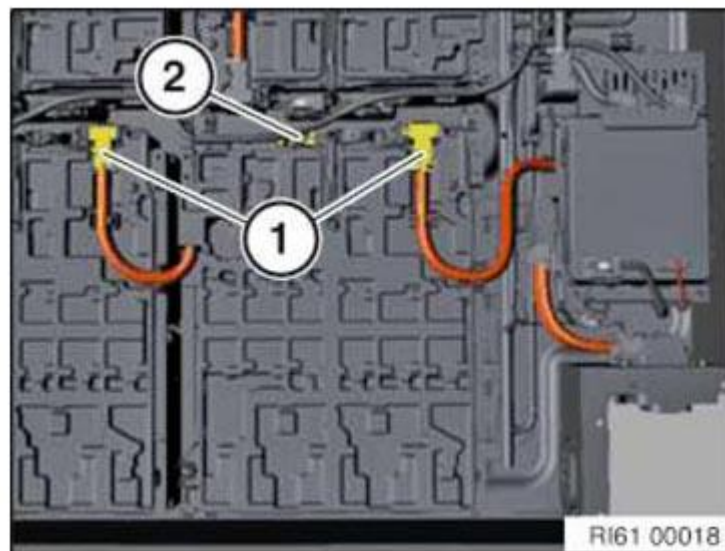
9. Removing all cell blocks:

**NOTE:** Description is for one component only. Procedure is identical for all further components.

**Remove cell module:**

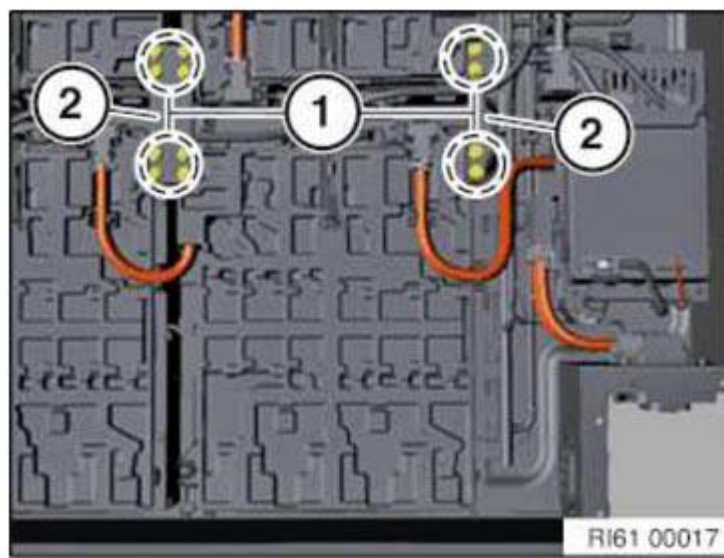
- Disconnect high-voltage connector (1).
- Disconnect connector (2) at communication wiring harness.
- Unclip the communication cable wiring harness in the area of the cell block.
- After disconnecting high-voltage connector (1), perform a visual inspection.

Technical support must be contacted if high-voltage connectors are damaged.



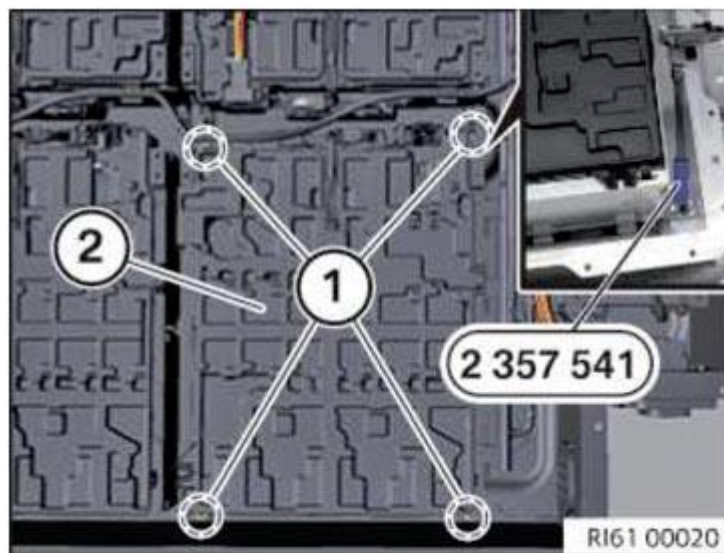
**Fig. 442: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Undo screws (1) and remove module struts (2).



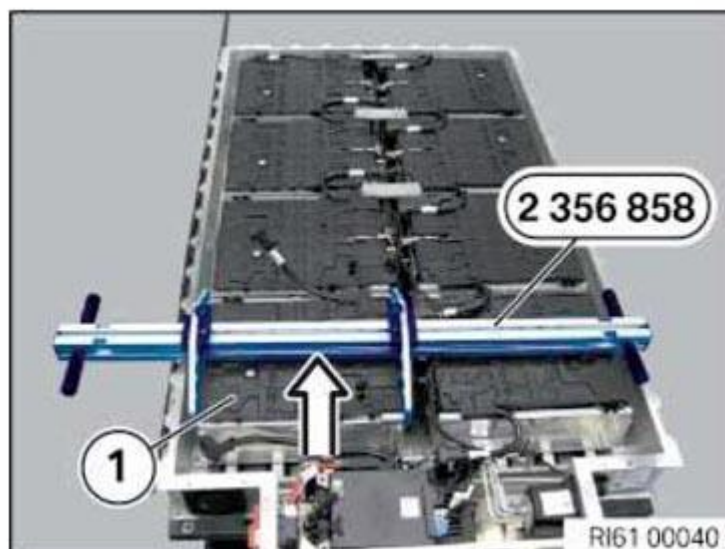
**Fig. 443: Identifying Cell Module Struts And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Undo nuts (1) at cell module (2) using special tool 2 357 541.



**Fig. 444: Identifying Cell Module And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lift out cell module (1) vertically using special tool 2 356 858 and with help of a second person.



**10. Removing degassing unit:**

- Undo screws (1) from inside.

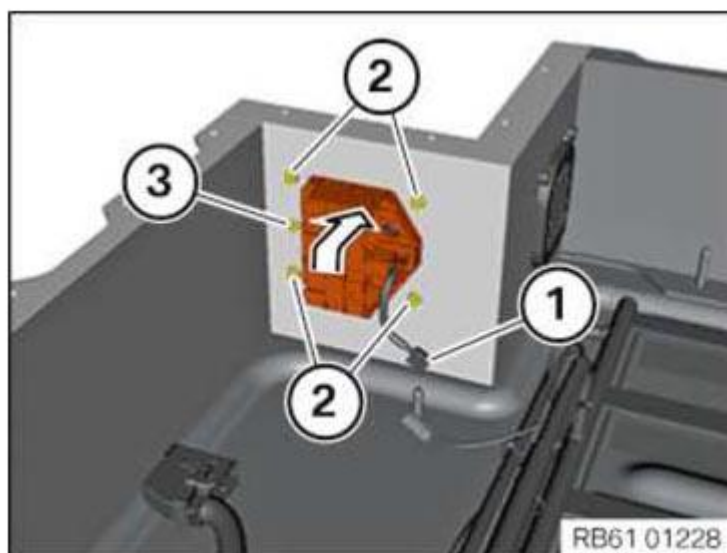
Remove degassing unit in direction of arrow.



**Fig. 446: Removing Degassing Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

**11. Removing high-voltage connection:**

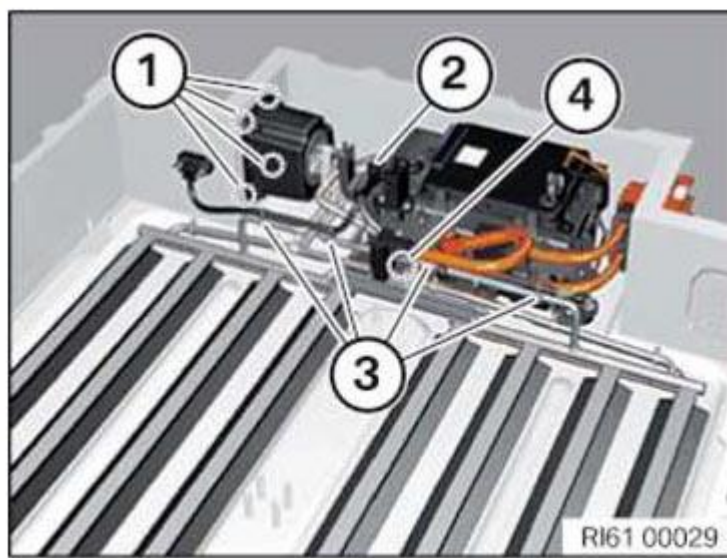
- Disconnect the connector (1).
- Loosen screw (2).
- Loosen screws (3).
- Press out high-voltage connection in direction of arrow.



**Fig. 447: Pressing Out High-Voltage Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**12. Remove high-voltage battery unit radiator:**

- Undo screws (1) from outside.
- Disconnect connector (2) for heating.
- Unclip communication wiring harness (3).
- Undo equipotential bonding screw (4).
- Lift out radiator with help of a second person.

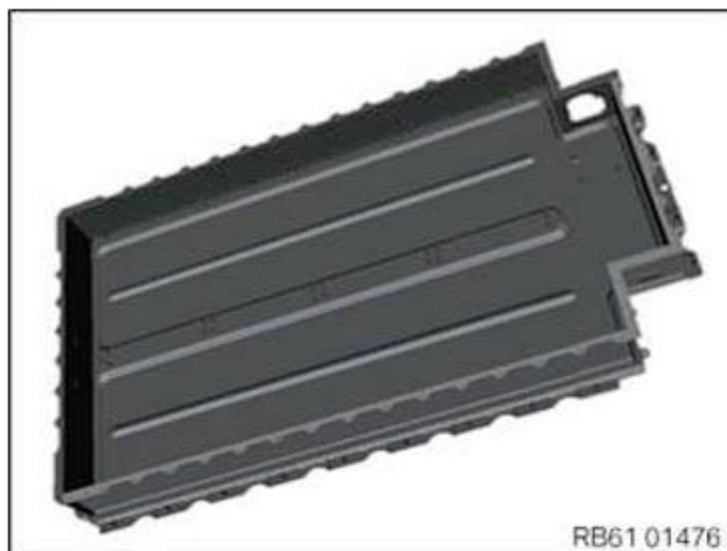


**Fig. 448: Identifying Heating Connector And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

13. **Checking the housing well for contamination and foreign bodies:**

**Check:**

- Check the housing well for contamination and foreign bodies.



**Fig. 449: Identifying Contamination Housing Well**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Housing well contaminated/foreign bodies in the housing well.

**Action:**

- Clean with approved cleaning agent/remove foreign bodies.

14. **Attaching the type plate:**

- When replacing or re-installing the housing well, a new type plate must be attached.





**Fig. 450: Identifying Electrical Energy Storage System Type Plate**  
 Courtesy of BMW OF NORTH AMERICA, INC.

15. Replacing the high-voltage battery unit radiator:

**NOTE:** If all cell modules are removed, the radiator of the high-voltage battery unit must always be replaced.

**Install high-voltage battery unit radiator:**

The radiator must not be damaged.

If the radiator is damaged or has dents/kinks, it must be replaced.

Faulty radiator pins must be replaced.

Exchange the **venting unit** if the radiator is **leaking** .

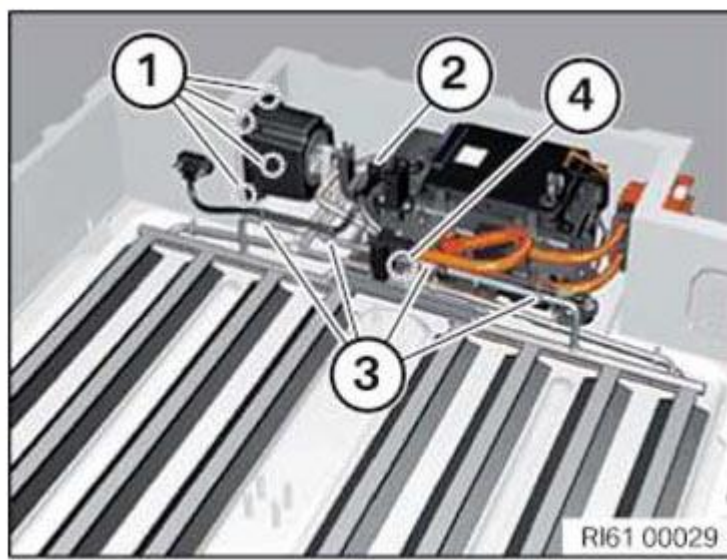
The sealing rings on the radiator connection must be replaced if the radiator is only removed and installed.

- Clean sealing surface of radiator screw connection.
- Insert radiator with help of a second person.
- Tighten screws (1) from outside.

**RADIATOR CONNECTION TO HOUSING WELL SPECIFICATION**

M5	5 Nm
----	------

- Connect connector (2) for heating.
- Clip in communication wiring harness (3).
- Tighten equipotential bonding screw (4).



**Fig. 451: Identifying Heating Connector And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**POTENTIAL COMPENSATION TO RADIATOR SPECIFICATION**

Observe instructions for potential compensation screw connections.	8.5 Nm
--	--------

**16. Install high-voltage connection:**

- Clean contact surface of high-voltage connection on housing well.
- Insert high-voltage connection in direction of arrow.
- Tighten down screw (2).

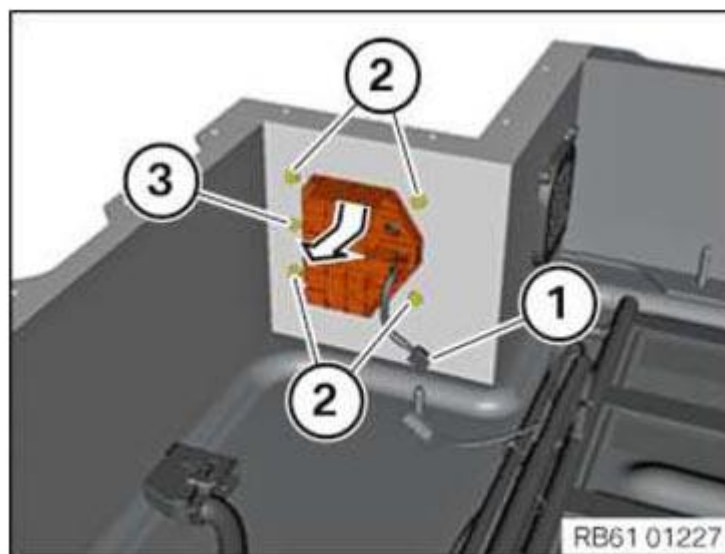
**HIGH-VOLTAGE CONNECTOR TO HOUSING WELL SPECIFICATION**

M5	5 Nm
----	------

- Tighten down screws (3).

**HIGH-VOLTAGE CONNECTOR TO HOUSING WELL SPECIFICATION**

M4	2.4 Nm
----	--------



**Fig. 452: Installing High-Voltage Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Connect connector (1).

**17. Install venting unit:**

- Clean sealing surface before installation.



Insert venting unit in direction of arrow.

Tighten screws (1) from inside.

### VENTING UNIT TO HOUSING WELL SPECIFICATION

M5	5 Nm
----	------



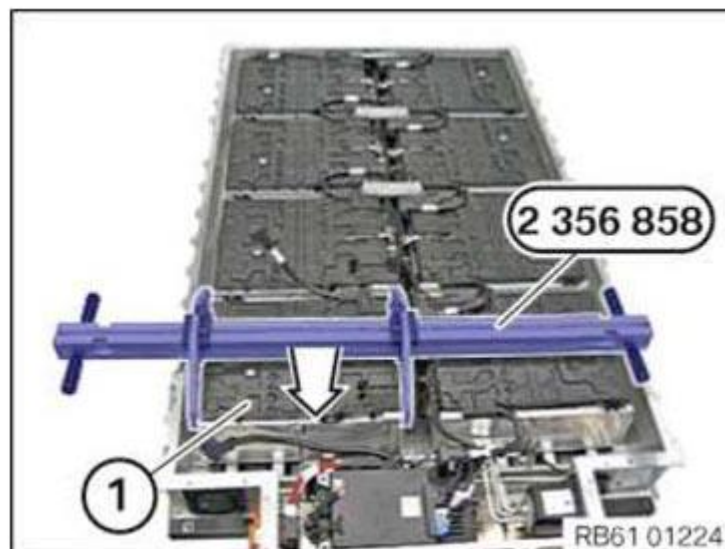
**Fig. 453: Installing Venting Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### 18. Install all cell modules:

**NOTE:** Description is for one component only. Procedure is identical for all further components.

#### Install cell module

- Before installing the cell block (1), it must be ensured that the state of charge of the cell module matches the state of charge of the other cell blocks.
- Before installing the cell module(1), the high-voltage battery unit, radiator and cell module must be cleaned.
- Lower in cell module (1) vertically using special tool 2 356 858 and with help of a second person.

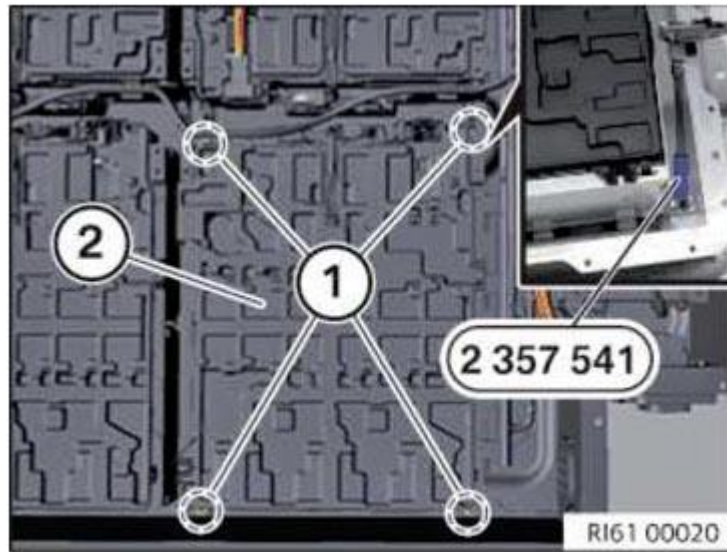


**Fig. 454: Installing Cell Module Using Special Tool (2 356 858)**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten nuts (1) at cell module (2) using special tool 2 357 541.

### CELL MODULE TO HOUSING WELL SPECIFICATION

M6	Jointing torque	11.8 Nm
∧	Angle of rotation	45 ∨°



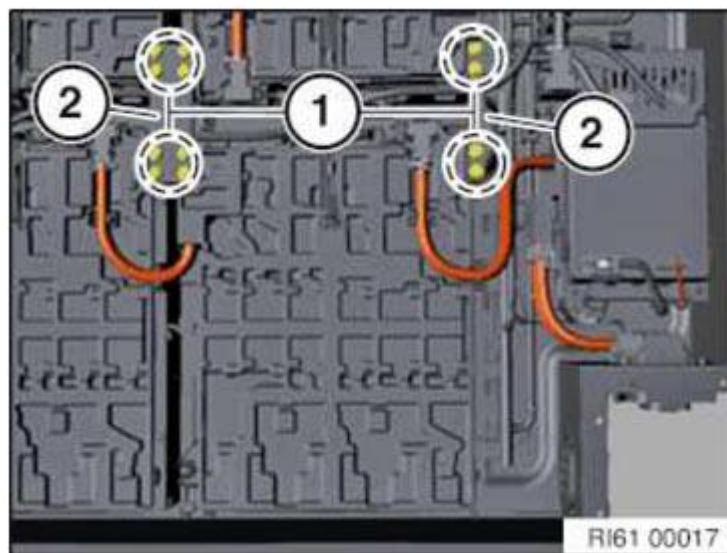
**Fig. 455: Identifying Cell Module And Nuts**

Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten screws (1) at module struts (2).

### CELL MODULE STRUT TO CELL MODULE SPECIFICATION

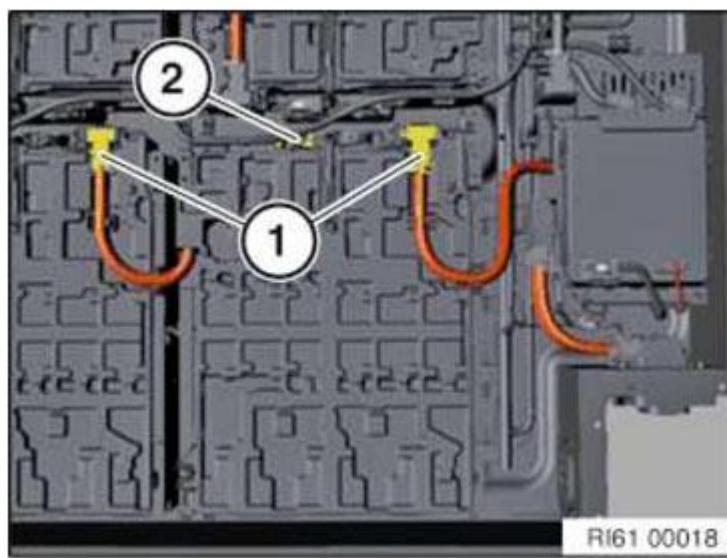
M6	Renew screws.	Jointing torque	11.8 Nm
∧	∧	Angle of rotation	45 ∨°



**Fig. 456: Identifying Cell Module Struts And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

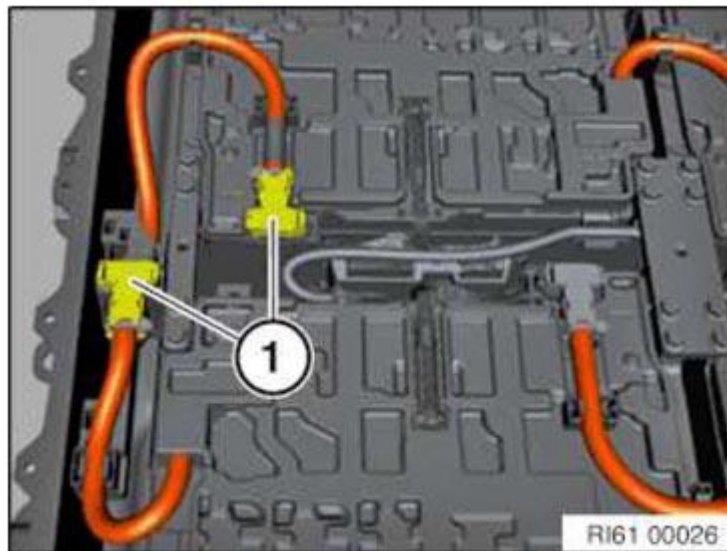
- Connect connector (2) at communication wiring harness.
- Connect high-voltage connector (1).
- Clip in communication wiring harness in area of cell block.



**Fig. 457: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**19. Install module connecting line:**

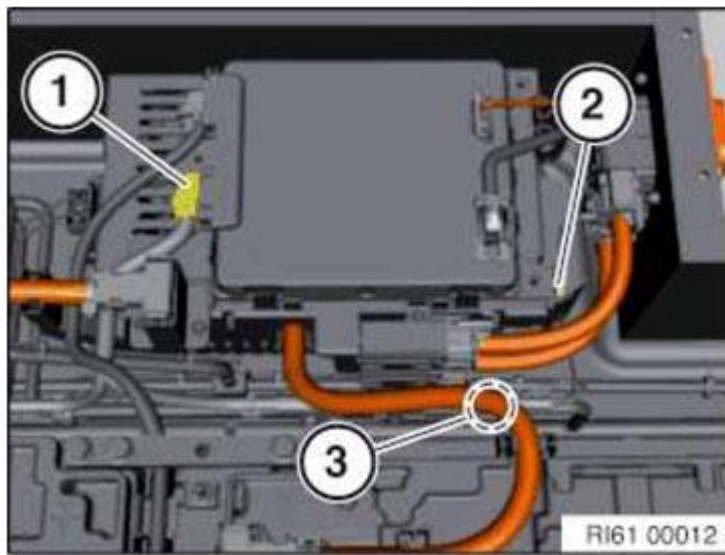
- Connect both high-voltage connectors (1).



**Fig. 458: Identifying High-Voltage Connectors**  
Courtesy of BMW OF NORTH AMERICA, INC.

**20. Installing communication wiring harness:**

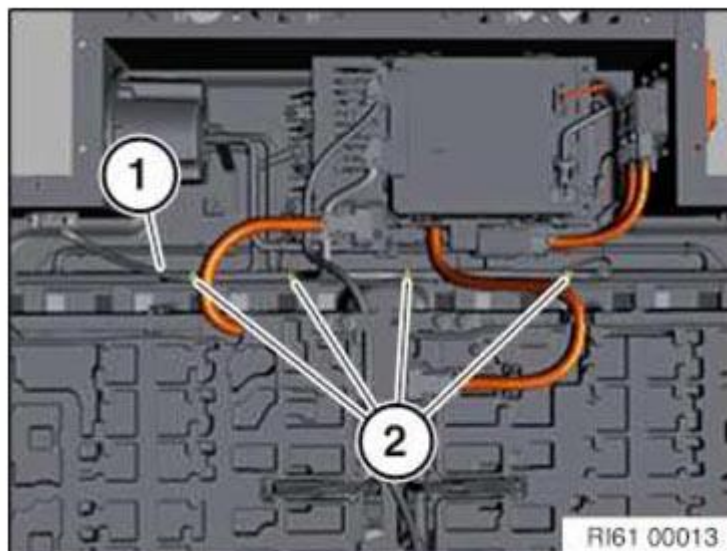
- Connect connector (1) at battery management electronics (SME).  
Connect connector (2) at high-voltage connection.  
Connect connector (3) at radiator.



**Fig. 459: Identifying Battery Management Electronics (SME) Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Insert wiring harness (1).

Clip in wiring harness (1) at marked points (2).

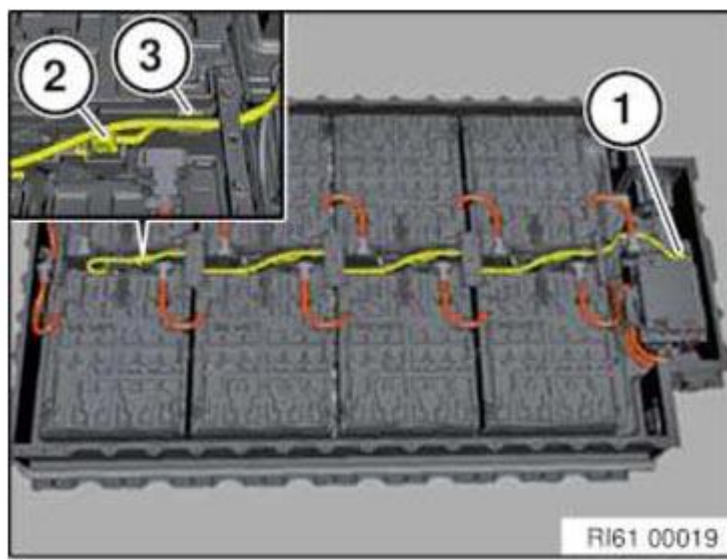


**Fig. 460: Identifying Wiring Harness Marked Points**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**21. Installing wiring harness for cell supervision circuit:**

- Insert wiring harness for cell supervision circuit and clip in (3).
- Connect connector (2) at all cell supervision circuits.
- Connect connector (1) at battery management electronics (SME).

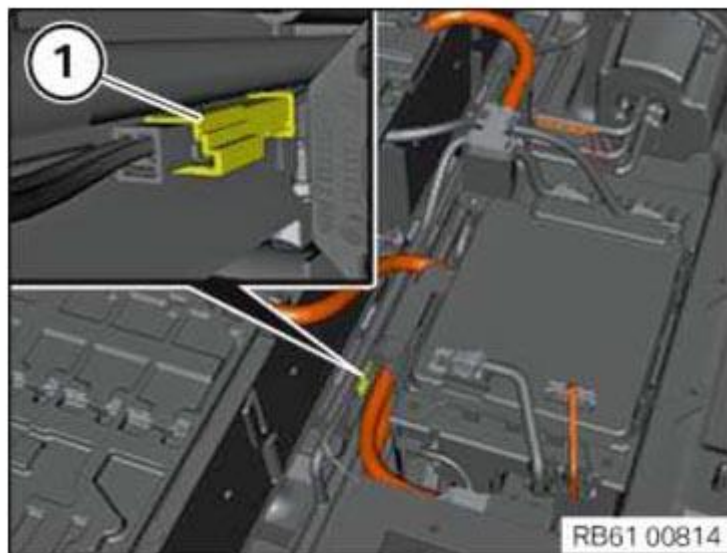




**Fig. 461: Identifying Cell Supervision Circuit Wiring Harness**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**22. Connect temperature sensor connector:**

- Connect connector (1) at temperature sensor.



**Fig. 462: Identifying Temperature Sensor Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

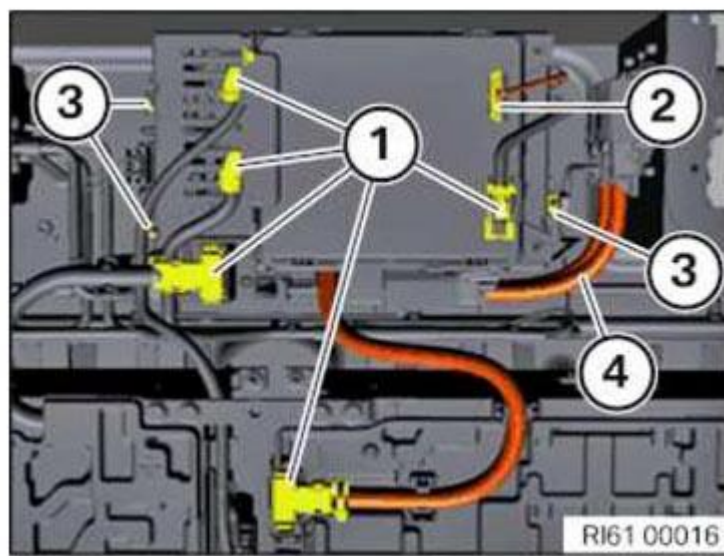
**23. Installing the safety box:**

- Insert safety box and tighten nuts (3) using special tool 2 357 541 .

**SAFETY BOX TO HOUSING WELL SPECIFICATION**

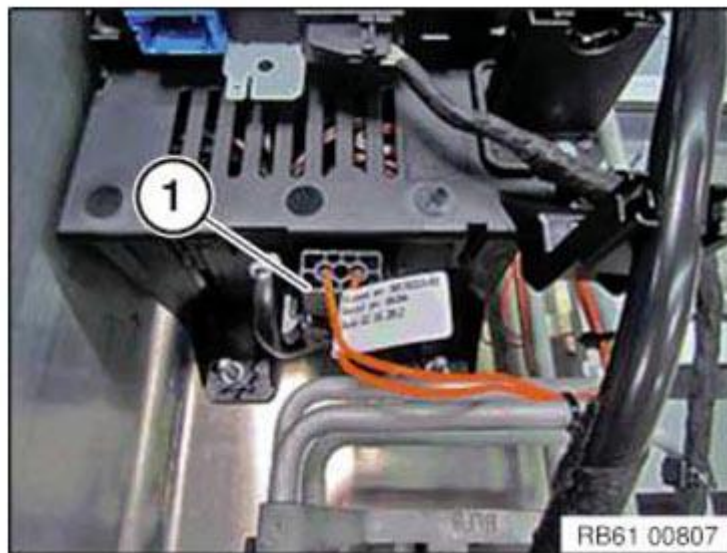
M6	11.8 Nm
----	---------

- Connect connector (1).
- Connect connector for isolation monitor (2).
- Connect high-voltage connector (4) at safety box.



**Fig. 463: Identifying Safety Box Connector And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

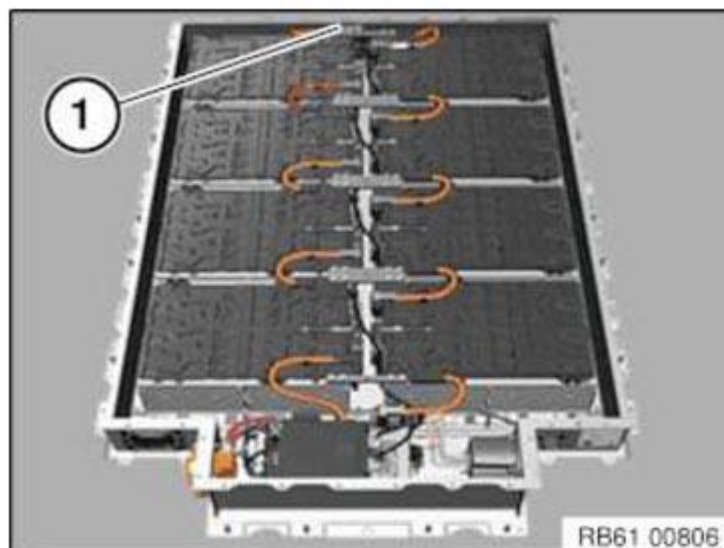
- Connect the heating connector for the high-voltage battery unit (1).



**Fig. 464: Identifying High-Voltage Battery Unit Heating Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**24. Installing high-voltage battery unit lid:**

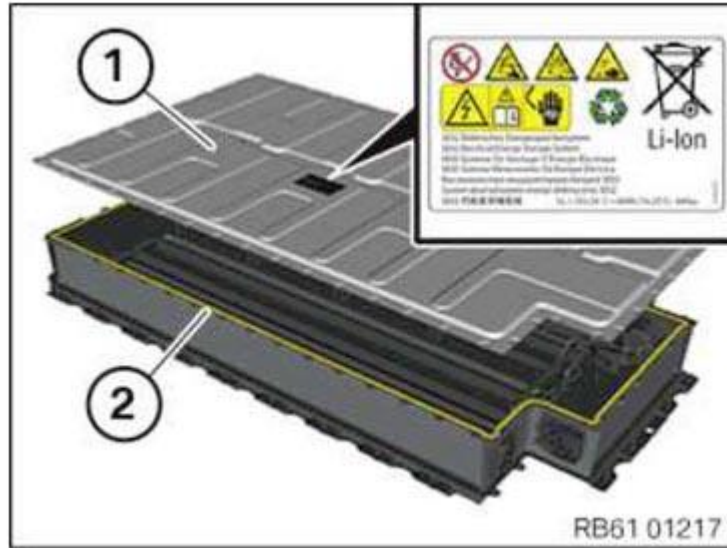
- Connect high-voltage connector (1).





**Fig. 465: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

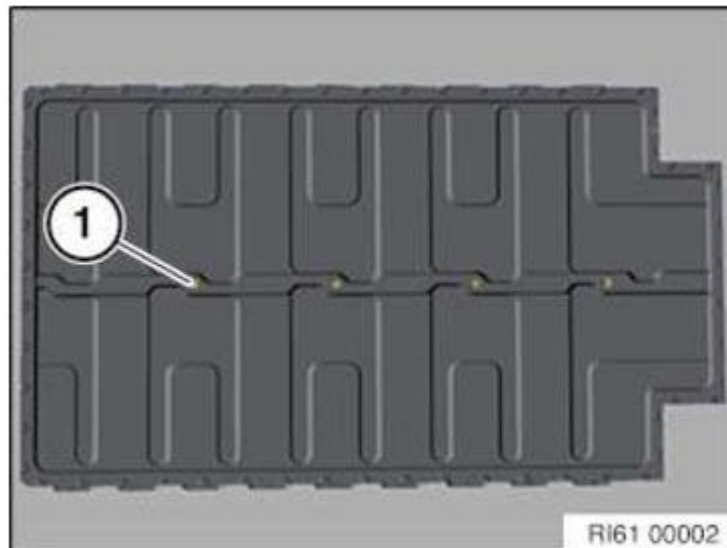


**Fig. 466: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
⌘	⌘	Angle of rotation	90 ⌘°

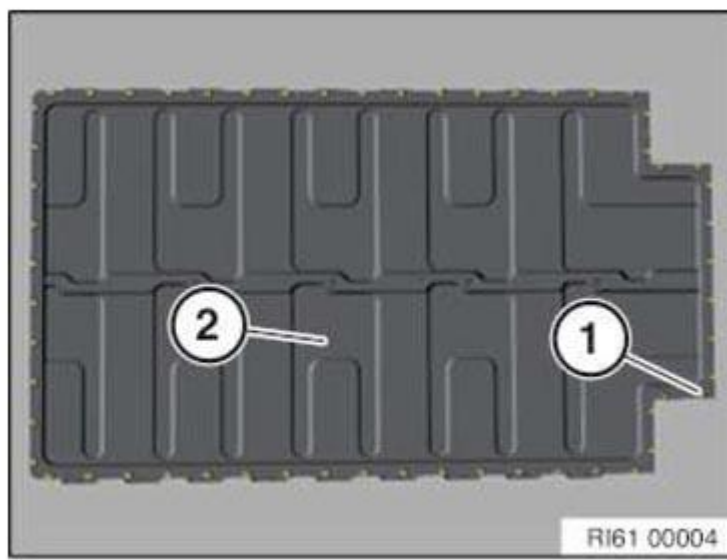


**Fig. 467: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 468: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

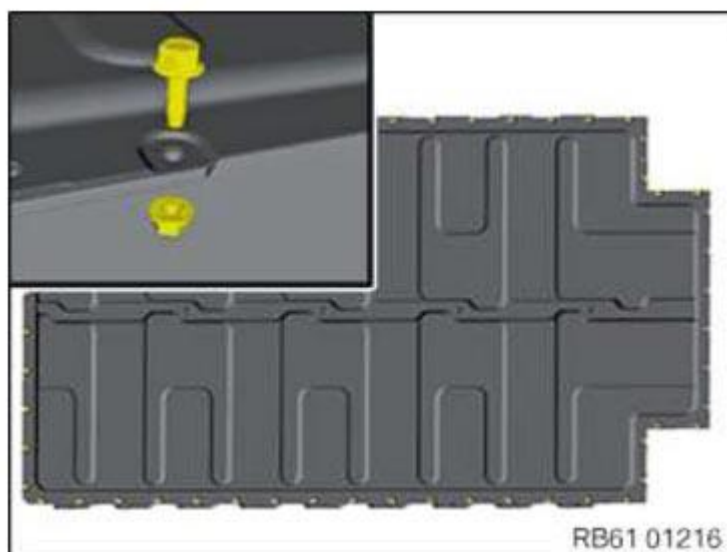
If all screw connections are damaged, the housing well must be replaced.

- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.
- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 469: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

## 25. Perform EoS test:

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 470: Identifying EoS Tester**

Courtesy of BMW OF NORTH AMERICA, INC.

## **61 27 601 REPLACE THE RADIATOR TEMPERATURE SENSOR (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

### **WARNING:**

**High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

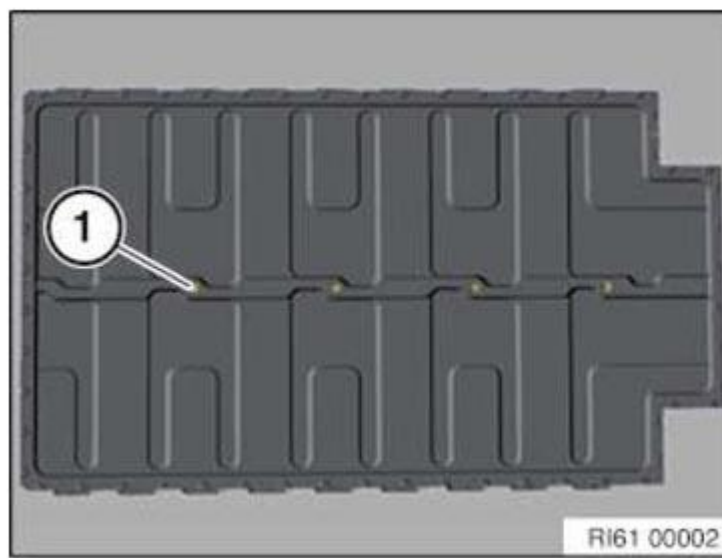
- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

### **Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

#### **1. Removing lid from high-voltage battery unit:**

- Undo sealing screws (1).

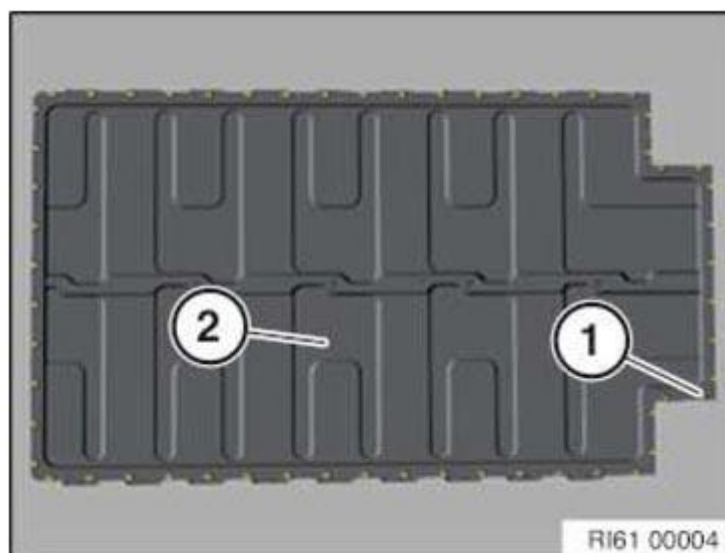


**Fig. 471: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

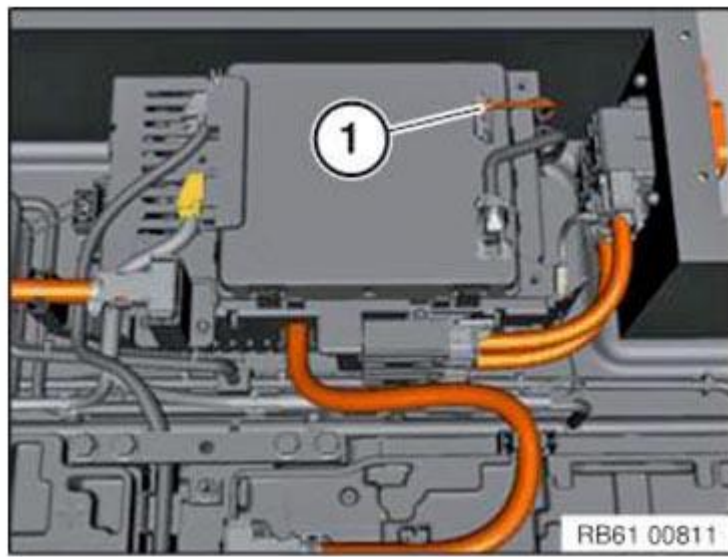
Remove lid (2) with help of a second person.



**Fig. 472: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



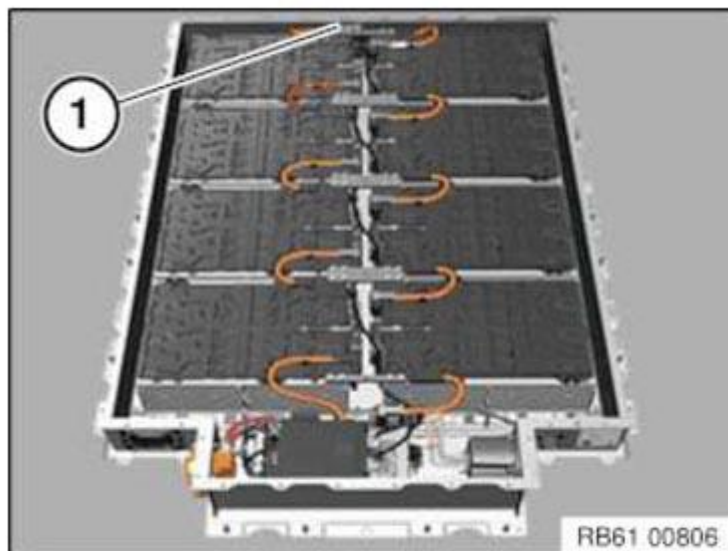
**Fig. 473: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

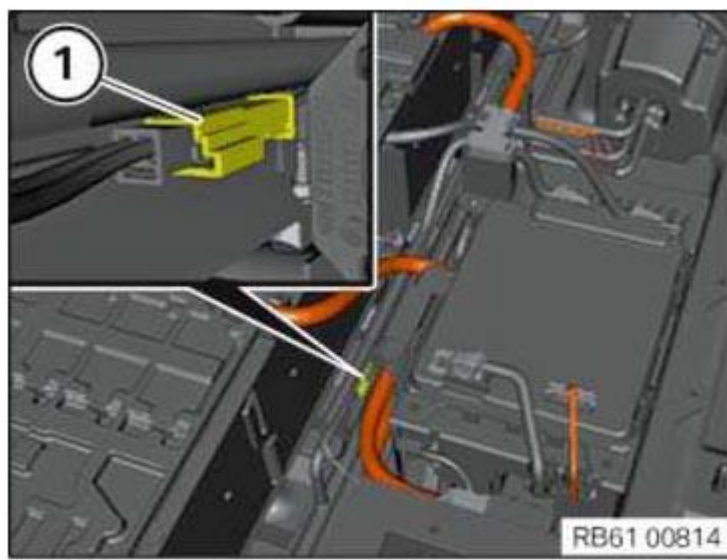
- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 474: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Disconnect temperature sensor connector:**

- Disconnect connector (1) at temperature sensor.

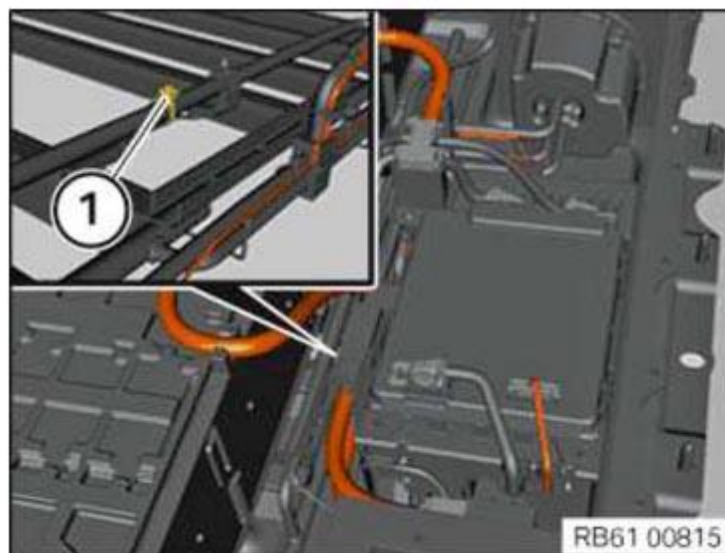


**Fig. 475: Identifying Temperature Sensor Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**3. Remove temperature sensor:**

Observe the additional information on [\*\*OPENING AND CLOSING CABLE STRAPS.\*\*](#)

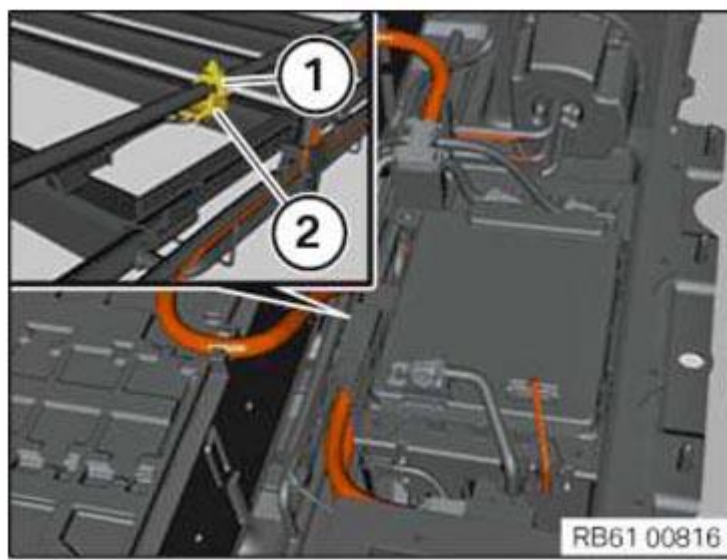
- Unfasten cable strap (1).



**Fig. 476: Identifying Cable Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Open latch mechanism (1).
- Unthread temperature sensor (2).

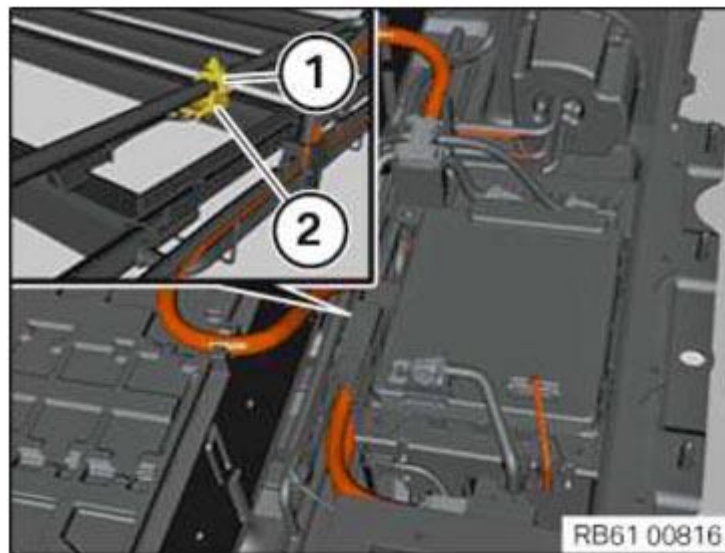




**Fig. 477: Identifying Latch Mechanism And Temperature Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

**4. Install temperature sensor:**

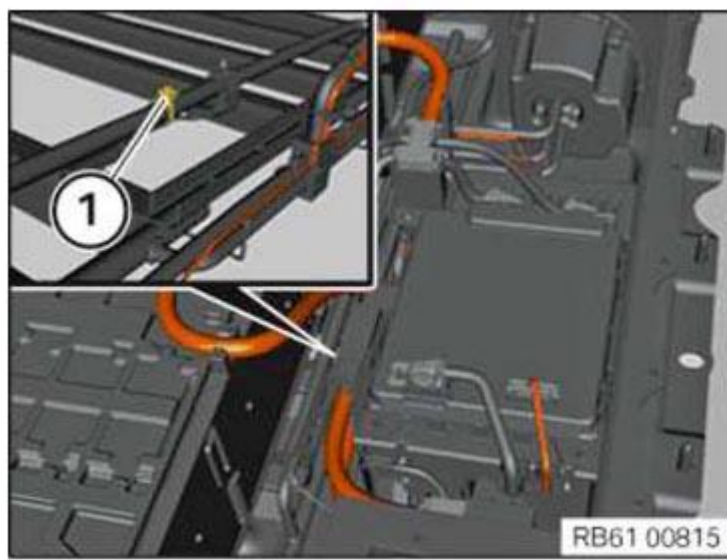
- Insert temperature sensor (2).
- Close latch mechanism (1).



**Fig. 478: Identifying Latch Mechanism And Temperature Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

Observe the additional information on **OPENING AND CLOSING CABLE STRAPS**.

- Attach new cable strap (1) and close.

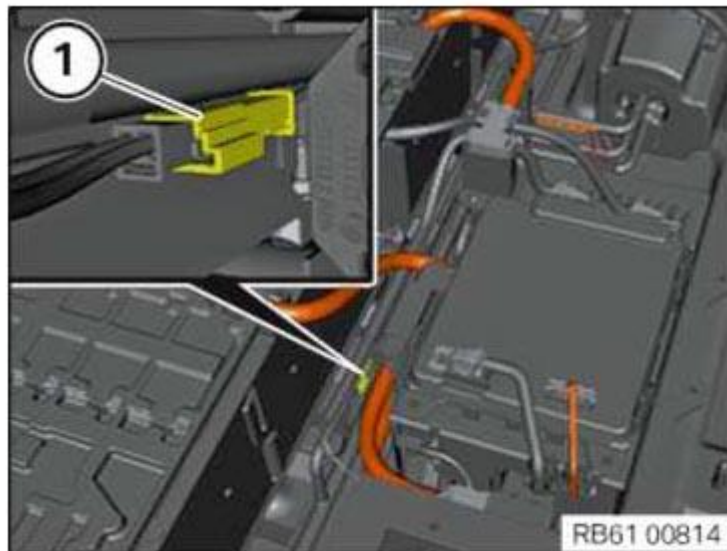


**Fig. 479: Identifying Cable Strap**

Courtesy of BMW OF NORTH AMERICA, INC.

**5. Connect temperature sensor connector:**

- Connect connector (1) at temperature sensor.

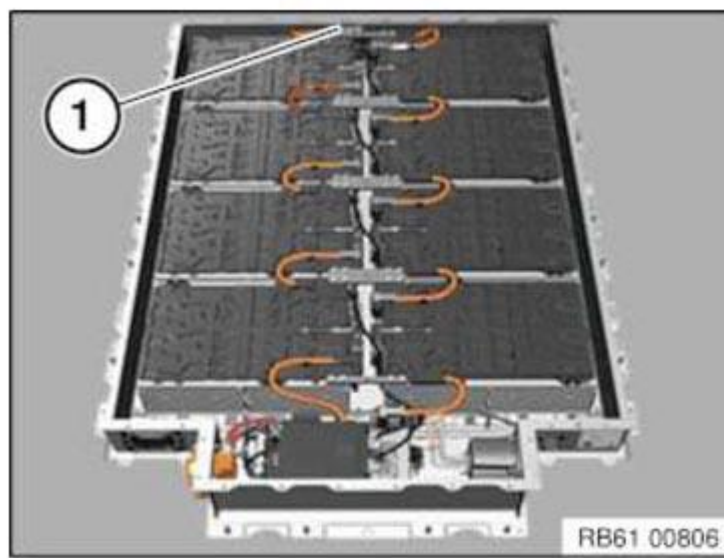


**Fig. 480: Identifying Temperature Sensor Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

**6. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).



**Fig. 481: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

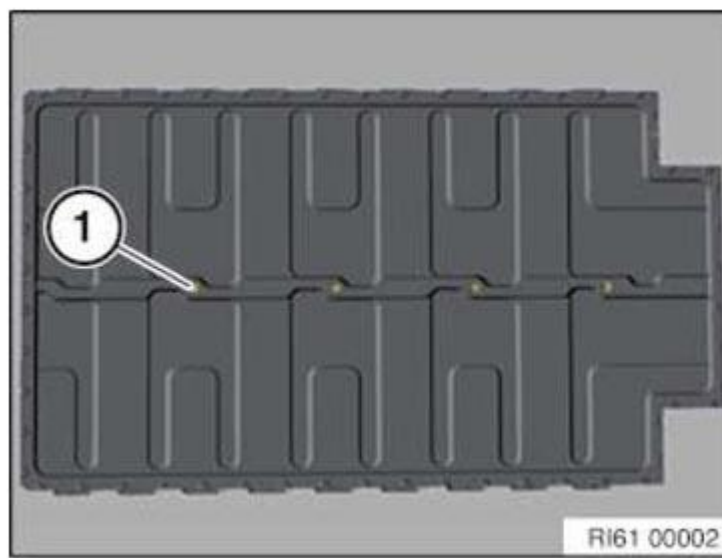


**Fig. 482: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

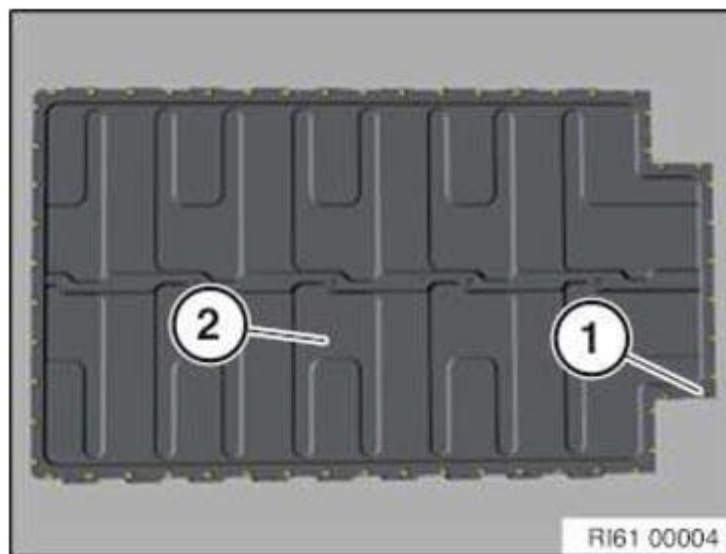


**Fig. 483: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 484: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

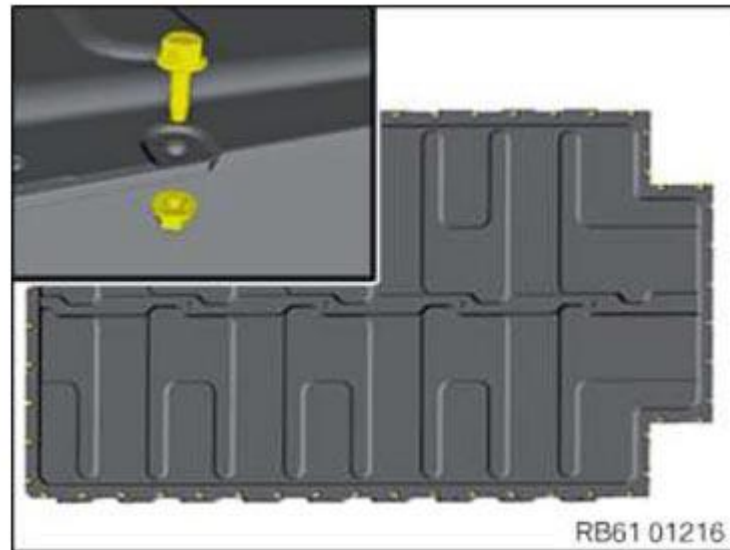
- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 485: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**7. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 486: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 521 REPLACE VENTING UNIT (HIGH-VOLTAGE BATTERY UNIT REMOVED)**



**WARNING:****High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

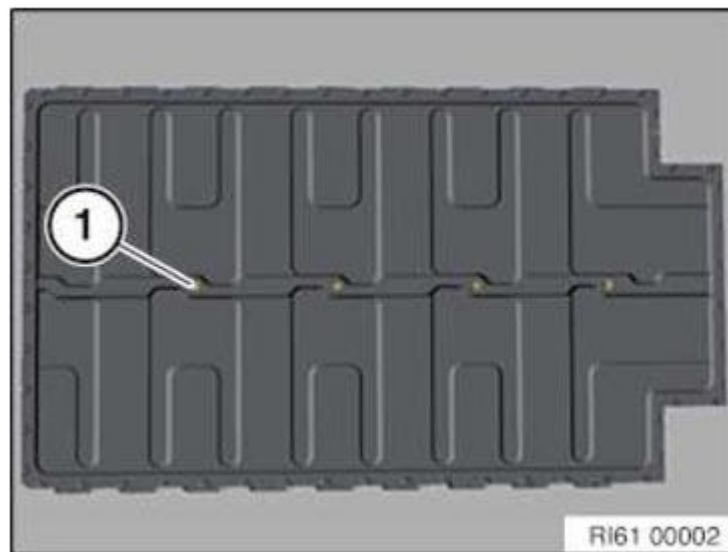
- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**1. Removing lid from high-voltage battery unit:**

- Undo sealing screws (1).

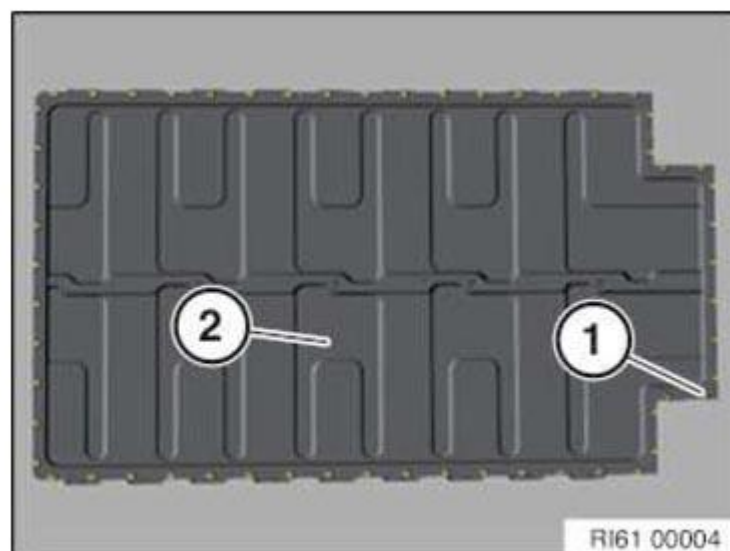


**Fig. 487: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

Remove lid (2) with help of a second person.

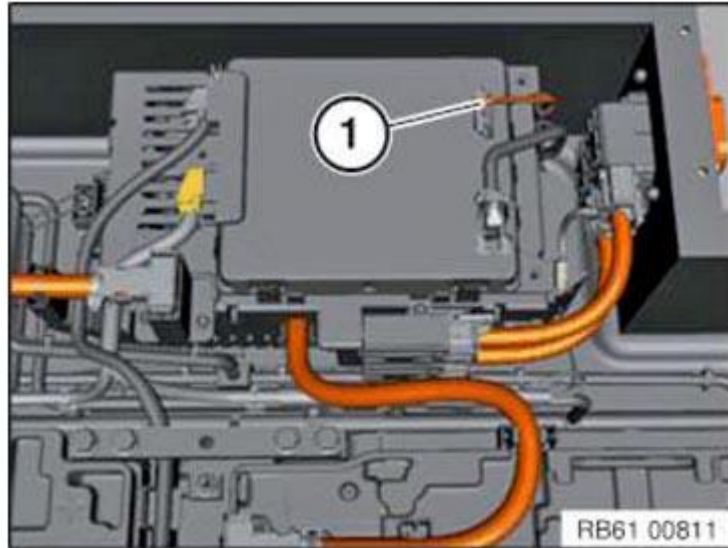


**Fig. 488: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



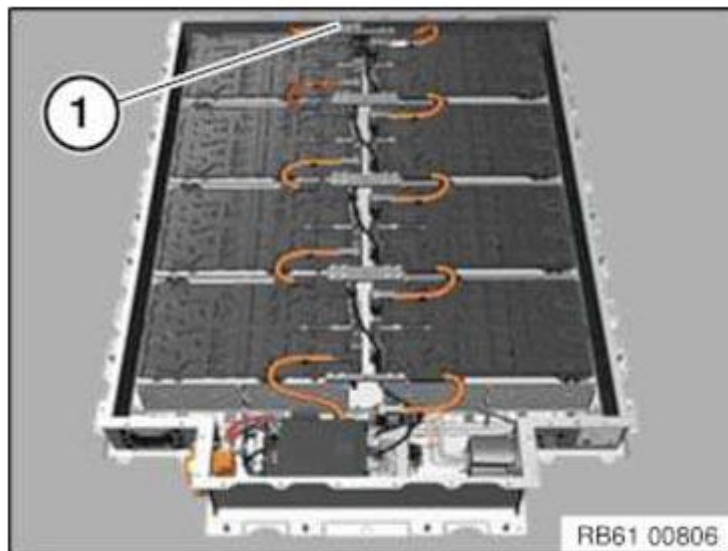
**Fig. 489: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 490: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Removing degassing unit:**

- Undo screws (1) from inside.

Remove degassing unit in direction of arrow.



**Fig. 491: Removing Degassing Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**3. Install venting unit:**

- Clean sealing surface before installation.
- Insert venting unit in direction of arrow.
- Tighten screws (1) from inside.

**VENTING UNIT TO HOUSING WELL SPECIFICATION**

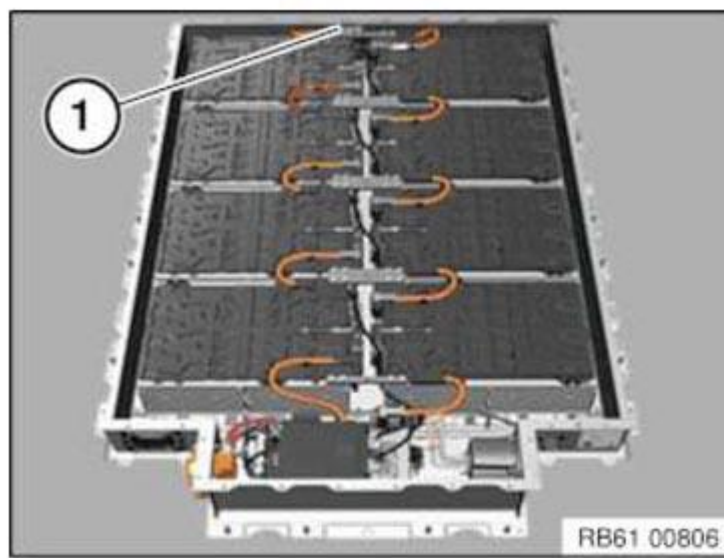
M5	5 Nm
----	------



**Fig. 492: Installing Venting Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**4. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).



**Fig. 493: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

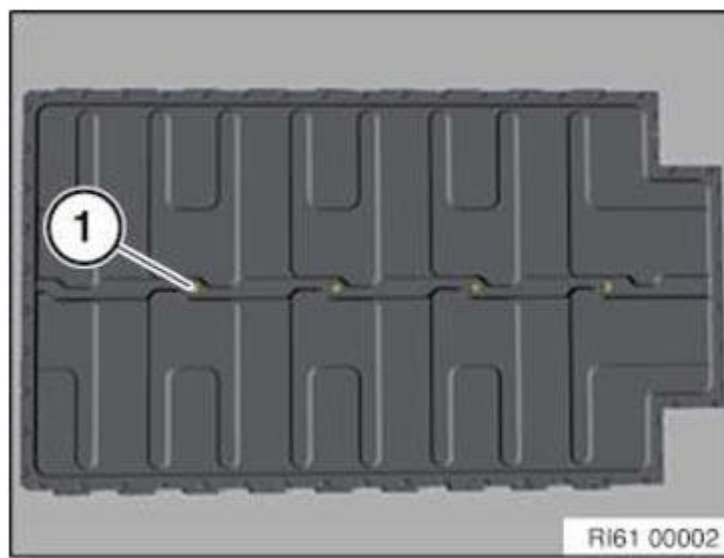


**Fig. 494: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

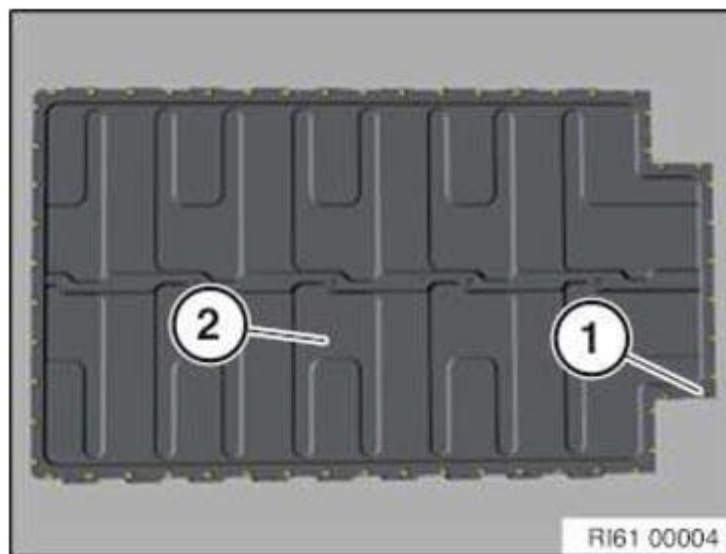


**Fig. 495: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 496: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

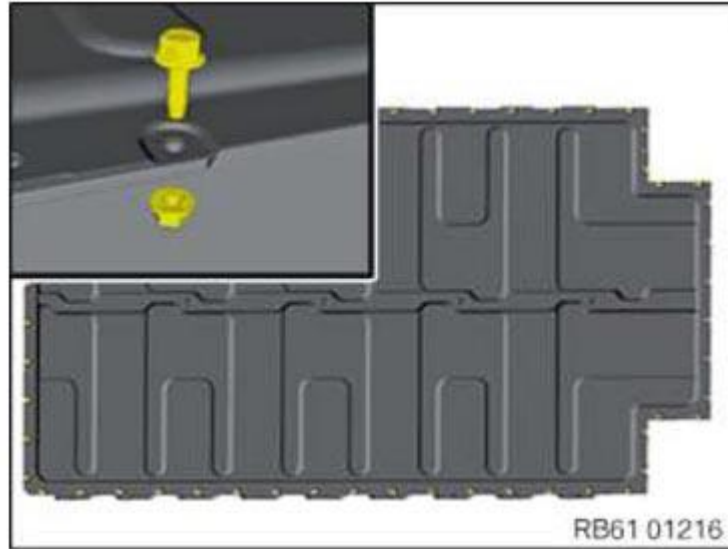
- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 497: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**5. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 498: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 621 REPLACING A CELL MODULE (HIGH-VOLTAGE BATTERY UNIT REMOVED)  
 (AFTER VEHICLE DIAGNOSIS)**

**WARNING:****High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**NOTE:** If cell modules are to be shipped, the form for assessing the cell modules' transport capability must be filled out.

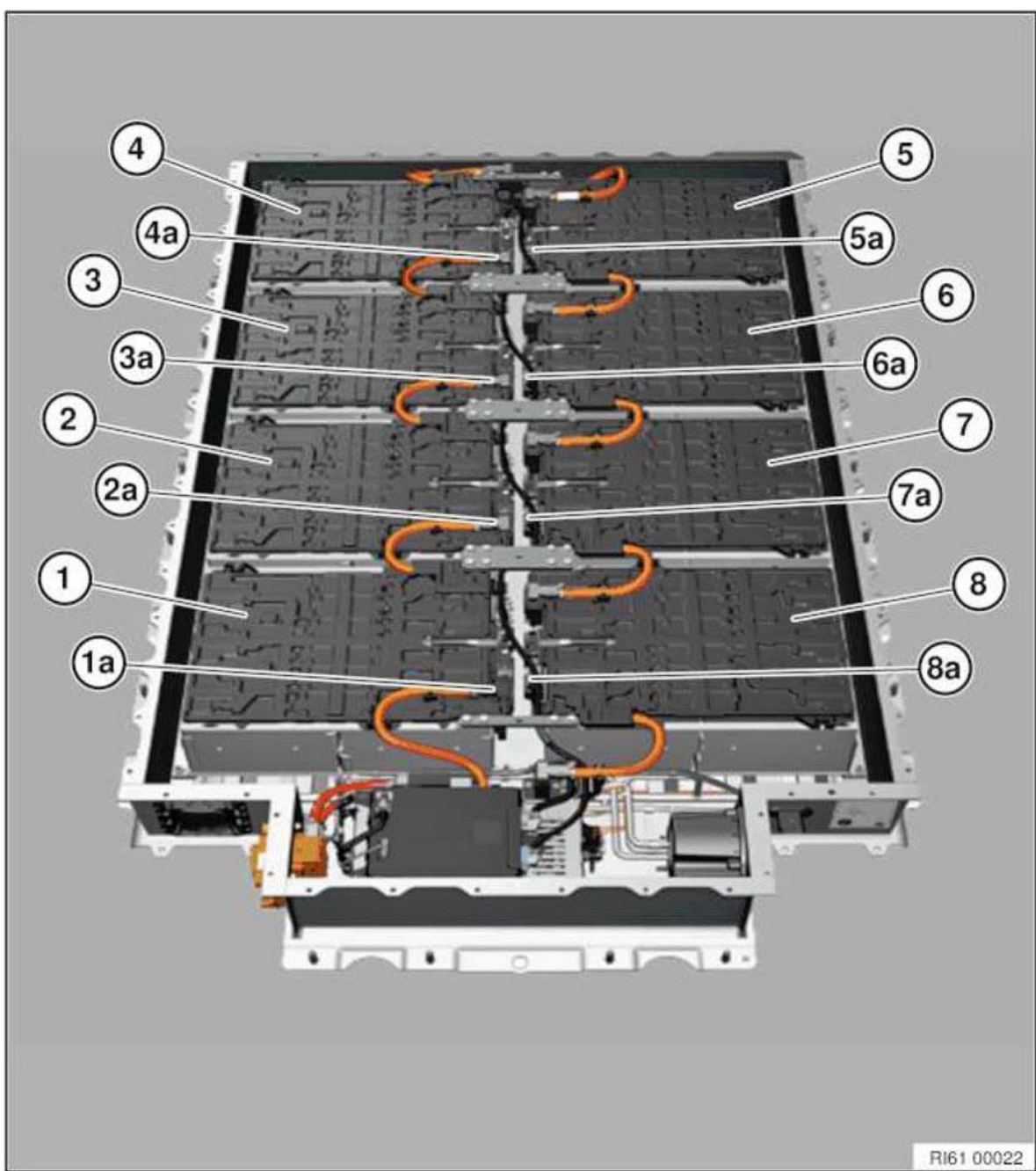
**1. Position plan:**

- Before removing cell modules: Print out position plan for cell modules and cell supervision circuits from diagnosis system.
- Mark installation position of all cell modules and cell supervision circuits and inscribe the installation position on the component.

**2. Preparing the position plan:**

Overview of high-voltage battery unit:





**Fig. 499: Overview Of High-Voltage Battery Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Enter the serial number of the cell module and cell supervision circuit here.

Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 1	Â	Â
Cell supervision circuit 1a	Â	Â
Cell module 2	Â	Â
Cell supervision circuit 2a	Â	Â
Cell module 3	Â	Â
Cell supervision circuit 3a	Â	Â
Cell module 4	Â	Â
Cell supervision circuit 4a	Â	Â
Cell module 5	Â	Â
Cell supervision circuit 5a	Â	Â
Cell module 6	Â	Â
Cell supervision circuit 6a	Â	Â
Cell module 7	Â	Â
Cell supervision circuit 7a	Â	Â

Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 8	Â	Â
Cell supervision circuit 8a	Â	Â

### 3. Adjust charging voltage:

- Before starting work, adjust the module voltage of the new cell module in the removed state using the module charger.

**Only one cell module may be charged.**

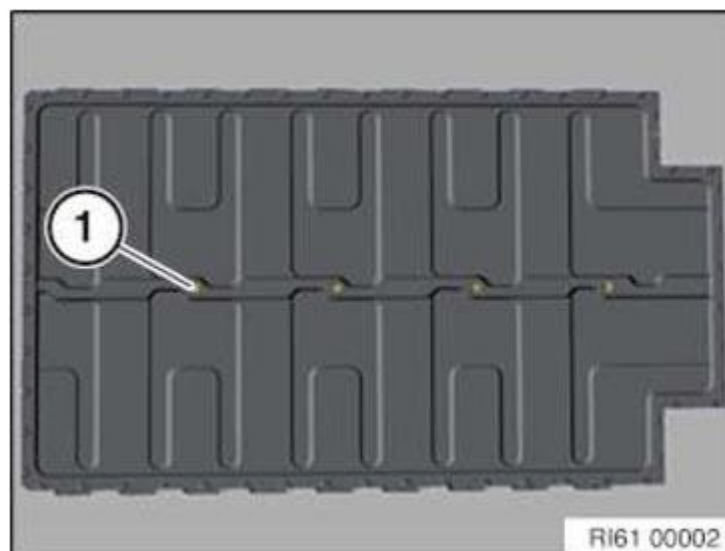


**Fig. 500: Identifying Cell Module**

Courtesy of BMW OF NORTH AMERICA, INC.

### 4. Removing lid from high-voltage battery unit:

- Undo sealing screws (1).



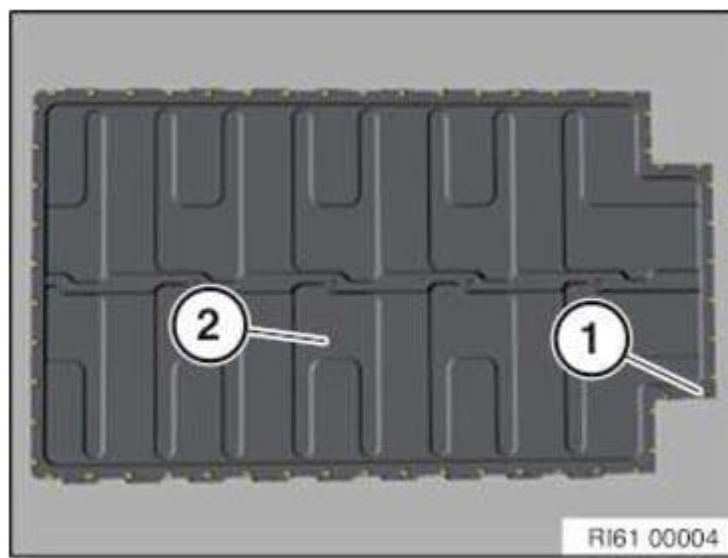
**Fig. 501: Identifying High-Voltage Battery Unit Lid Sealing Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

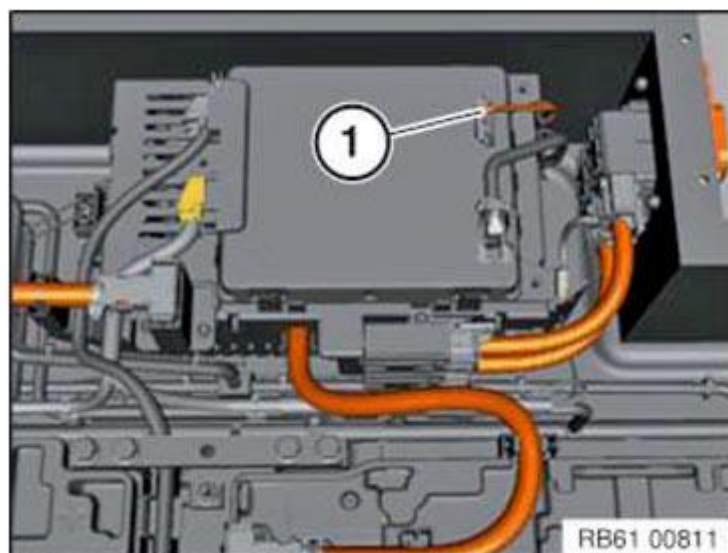
Remove lid (2) with help of a second person.



**Fig. 502: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



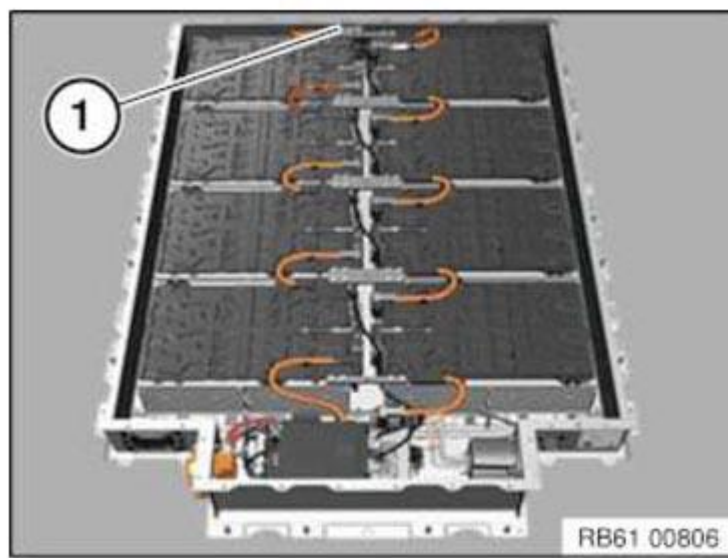
**Fig. 503: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.

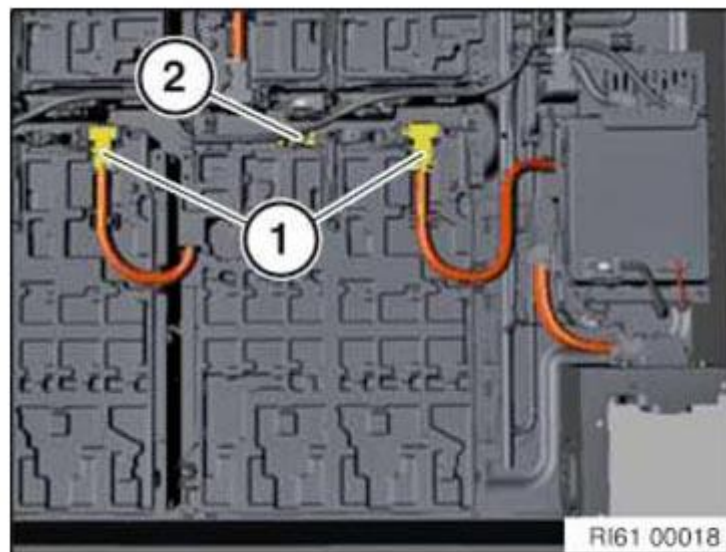


**Fig. 504: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**5. Remove cell module:**

- Disconnect high-voltage connector (1).
- Disconnect connector (2) at communication wiring harness.
- Unclip the communication cable wiring harness in the area of the cell block.
- After disconnecting high-voltage connector (1), perform a visual inspection.

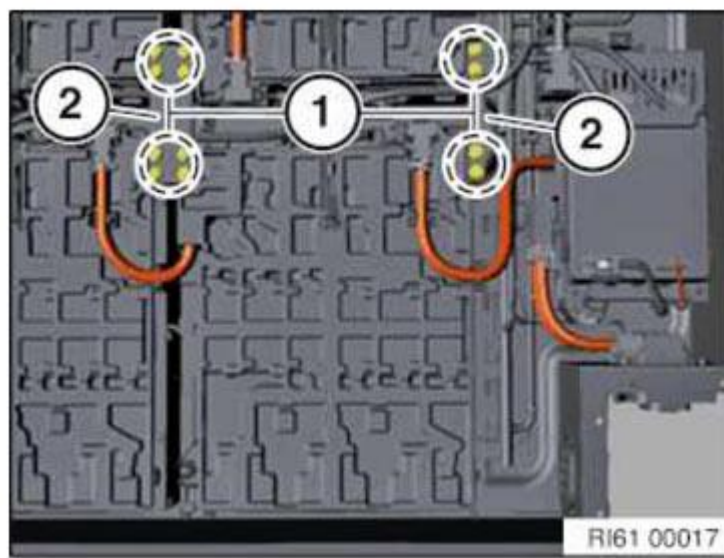
Technical support must be contacted if high-voltage connectors are damaged.



**Fig. 505: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

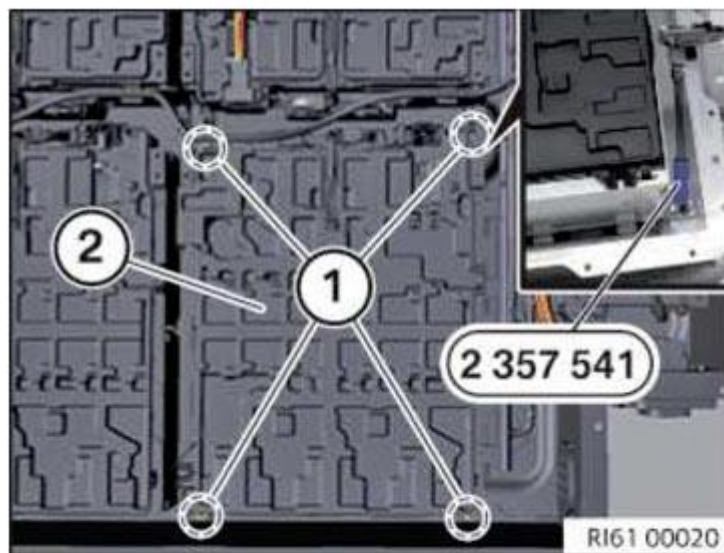
- Undo screws (1) and remove module struts (2).





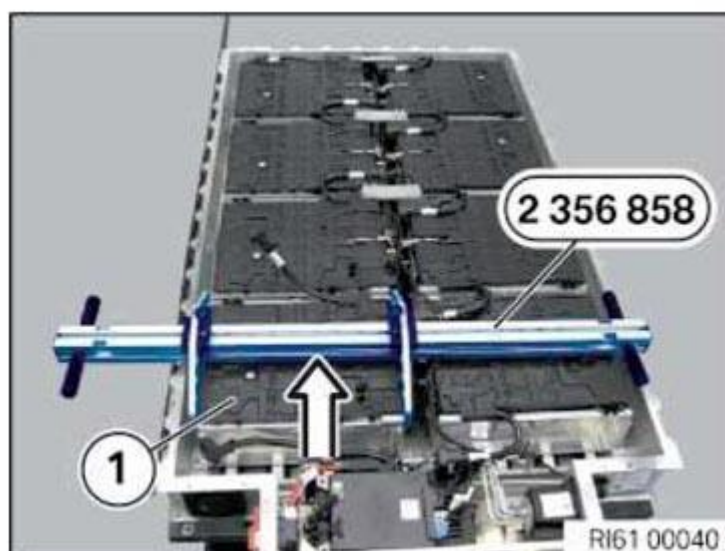
**Fig. 506: Identifying Cell Module Struts And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Undo nuts (1) at cell module (2) using special tool 2 357 541.



**Fig. 507: Identifying Cell Module And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lift out cell module (1) vertically using special tool 2 356 858 and with help of a second person.

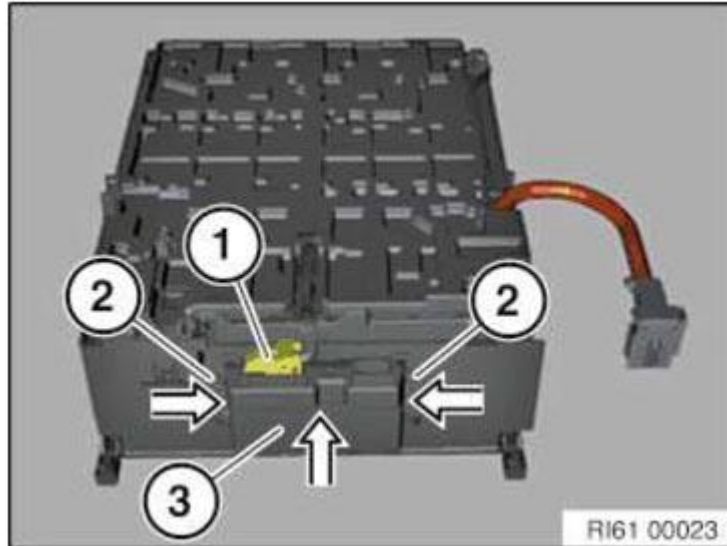


**6. Removing cell supervision circuit:**

- Disconnect connector (1) at cell supervision circuit (3).

When disconnecting, pull on connector (1) and not on line. Sheared wiring can cause a short circuit.

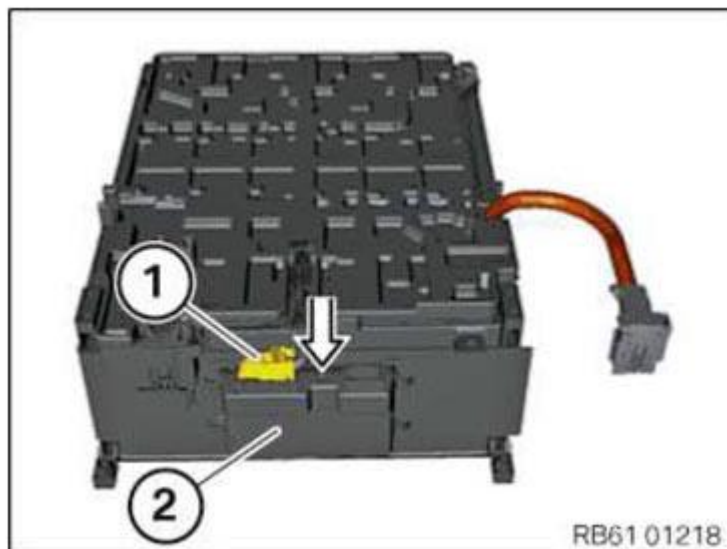
- Unlock cell supervision circuit (3) at side latch mechanism (2) in direction of arrow and, at the same time, pull out upwards in direction of arrow.



**Fig. 509: Removing Cell Supervision Circuit**  
Courtesy of BMW OF NORTH AMERICA, INC.

**7. Installing cell supervision circuit:**

- Push in cell supervision circuit (2) downwards in direction of arrow until it engages.
- Connect connector (1) at cell supervision circuit (2).



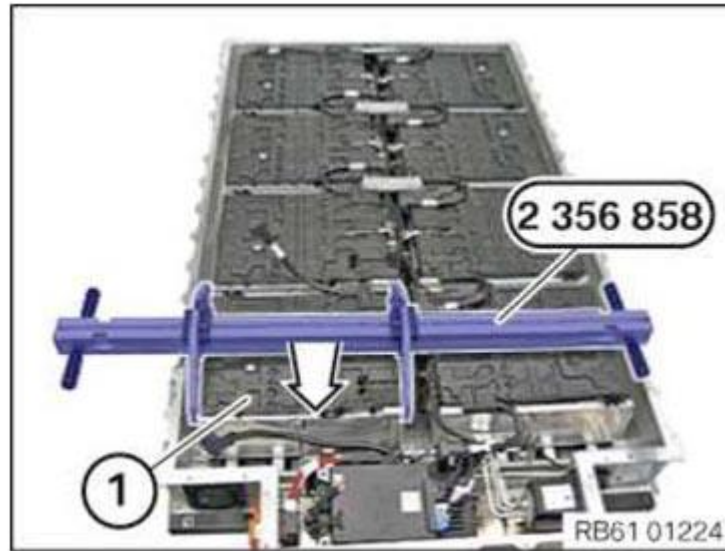
**Fig. 510: Installing Cell Supervision Circuit**  
Courtesy of BMW OF NORTH AMERICA, INC.

**8. Install cell module:**

- Before installing the cell block (1), it must be ensured that the state of charge of the cell module matches the state of charge of the other cell blocks.
- Before installing the cell module(1), the high-voltage battery unit, radiator and cell module must be cleaned.



- Lower in cell module (1) vertically using special tool 2 356 858 and with help of a second person.

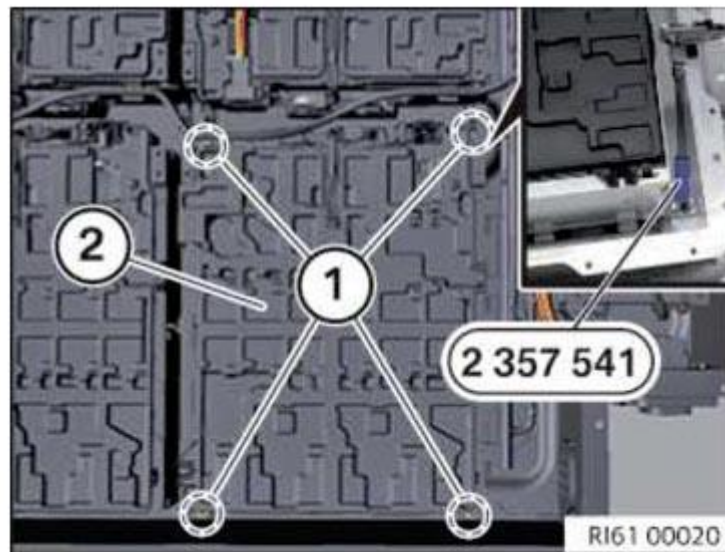


**Fig. 511: Installing Cell Module Using Special Tool (2 356 858)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten nuts (1) at cell module (2) using special tool 2 357 541.

**CELL MODULE TO HOUSING WELL SPECIFICATION**

M6	Jointing torque	11.8 Nm
∧	Angle of rotation	45 ∠°

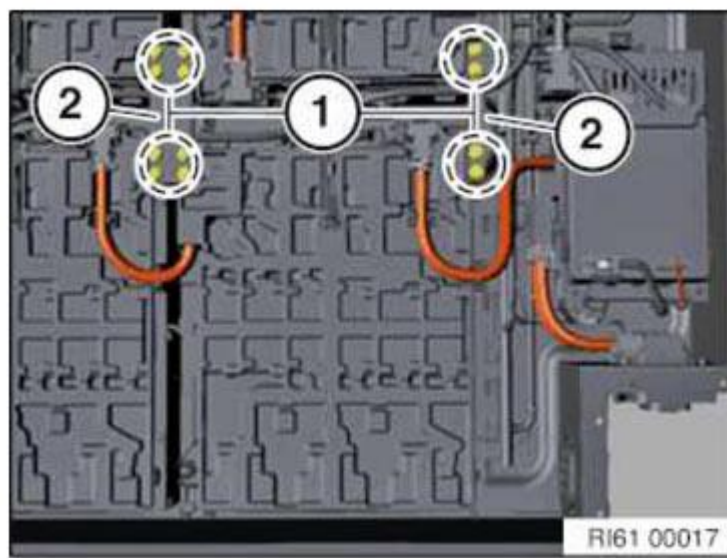


**Fig. 512: Identifying Cell Module And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten screws (1) at module struts (2).

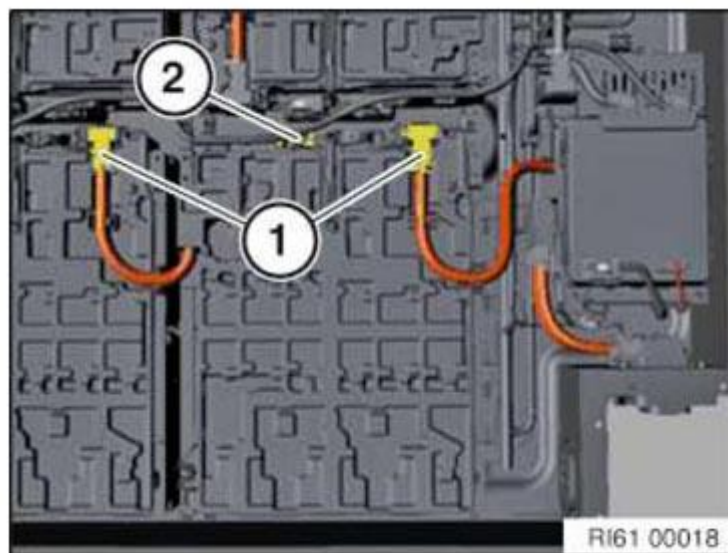
**CELL MODULE STRUT TO CELL MODULE SPECIFICATION**

M6	Renew screws.	Jointing torque	11.8 Nm
∧	∧	Angle of rotation	45 ∠°



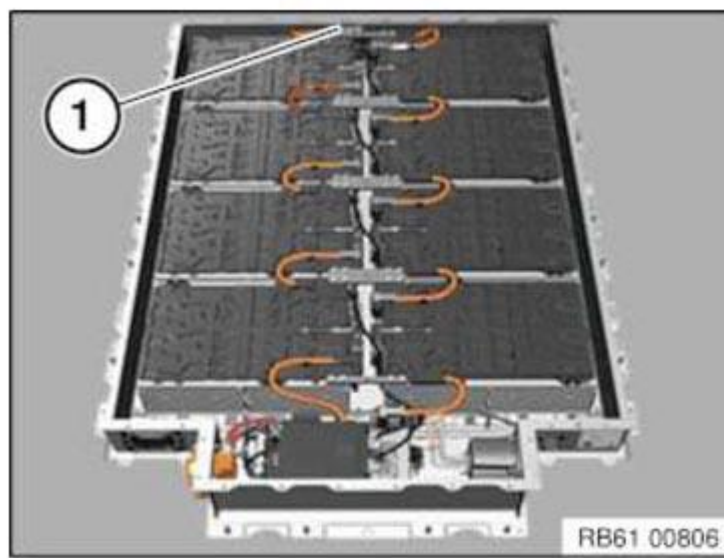
**Fig. 513: Identifying Cell Module Struts And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Connect connector (2) at communication wiring harness.
- Connect high-voltage connector (1).
- Clip in communication wiring harness in area of cell block.



**Fig. 514: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

9. **Installing high-voltage battery unit lid:**
- Connect high-voltage connector (1).



**Fig. 515: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

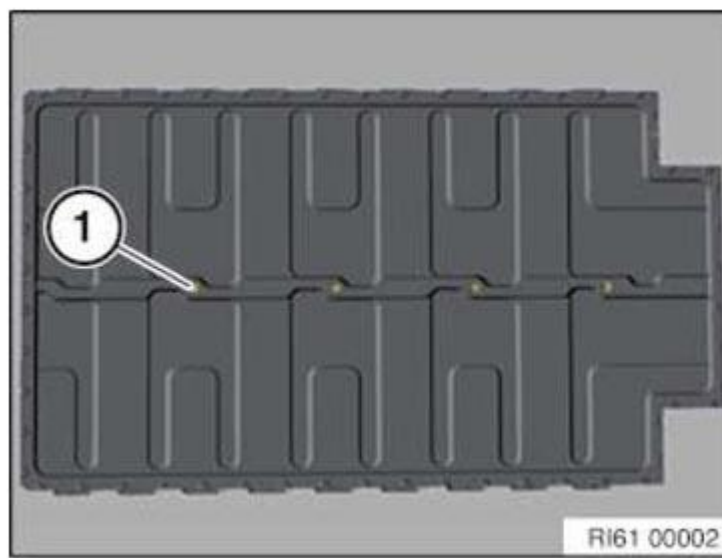


**Fig. 516: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

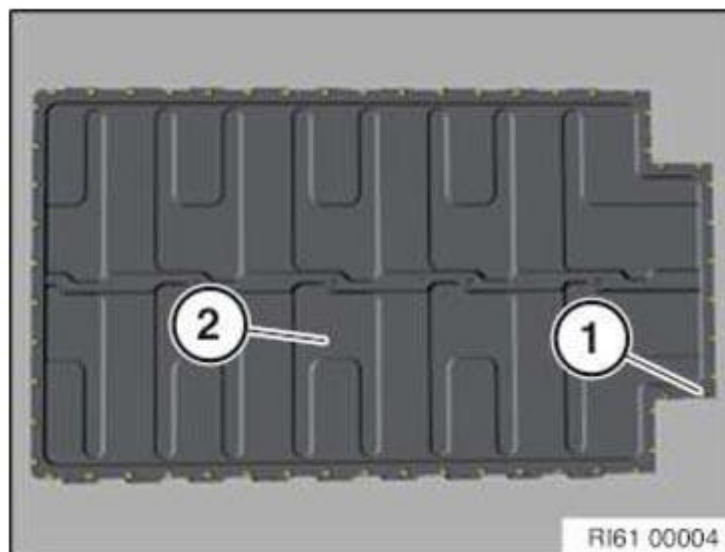


**Fig. 517: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 518: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

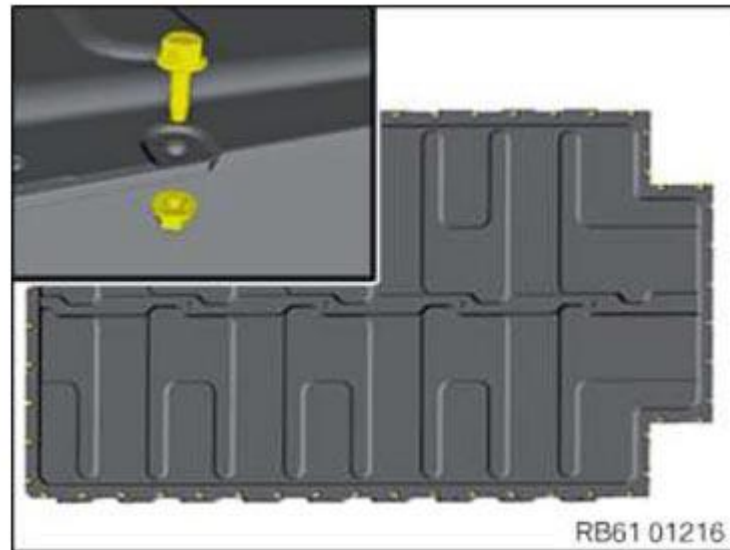
- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 519: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**10. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 520: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 571 REPLACING BATTERY MANAGEMENT ELECTRONICS (SME) (HIGH-VOLTAGE BATTERY UNIT REMOVED)**



**WARNING:****High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**NOTE:**

To ensure the operability of new control units it is necessary to set the control units in the vehicle to a compatible status (software, encoding and enabling if necessary). In addition, the data specific to the control units (e.g. individual data, etc.) must be read out of the control unit to be replaced and transferred to the new control unit.

The serial number of the high-voltage battery unit, the cell modules and of the cell supervision circuits (including location data) only needs to be written down if the control unit to be replaced cannot be read out by means of ISTA/P. After programming, the serial number must be transferred to the new SME.

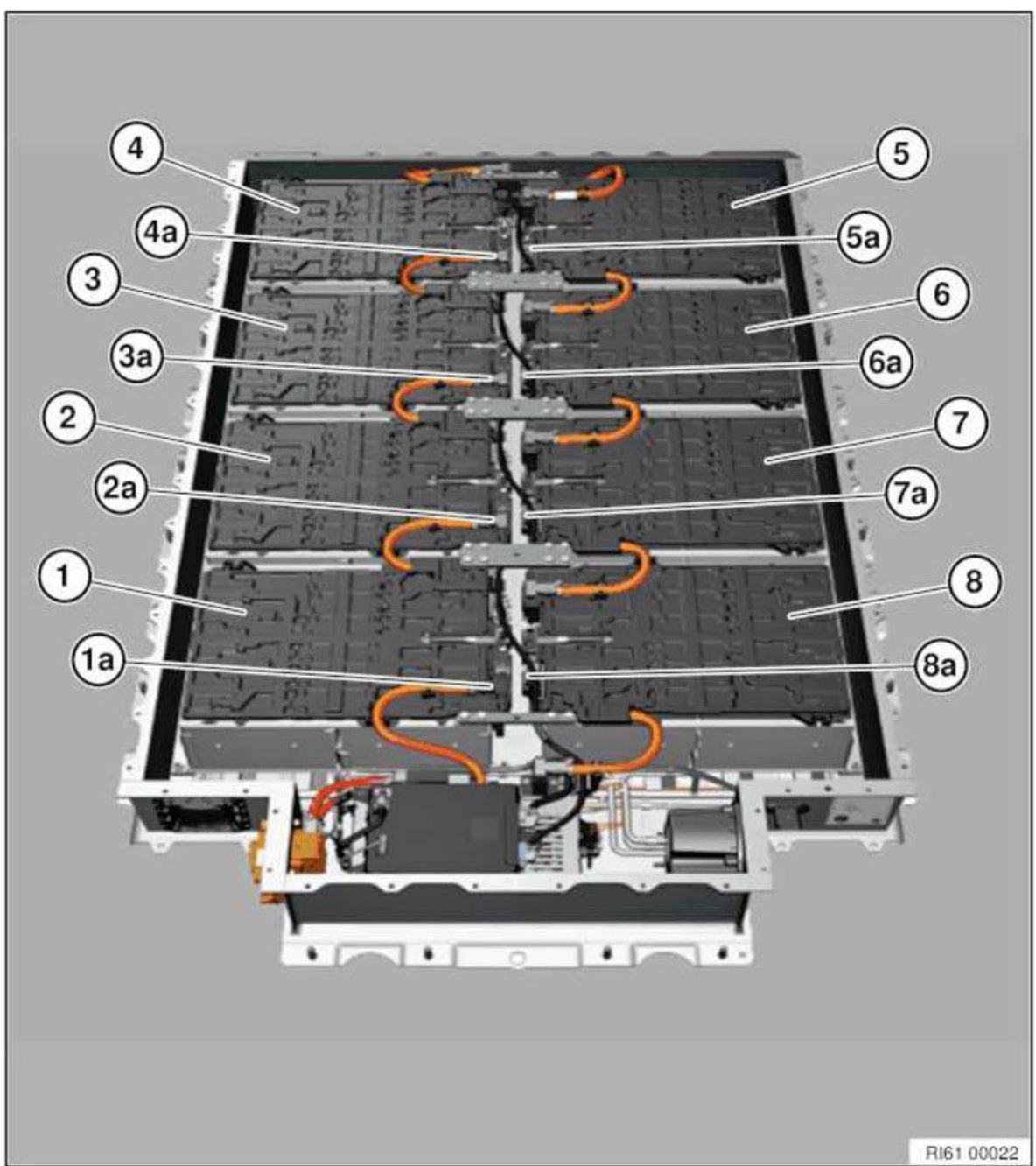
**1. Position plan**

- Before removing cell modules: Print out position plan for cell modules and cell supervision circuits from diagnosis system.
- Mark installation position of all cell modules and cell supervision circuits and inscribe the installation position on the component.

**2. Preparing the position plan:**

Overview of high-voltage battery unit:





**Fig. 521: Overview Of High-Voltage Battery Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

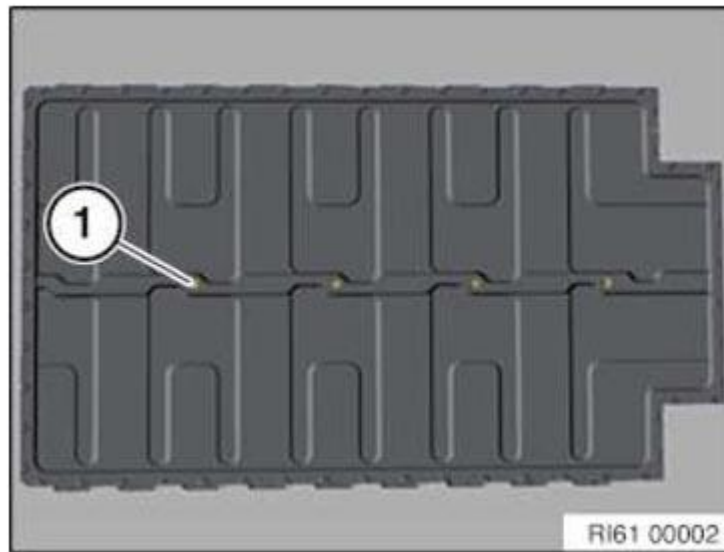
- Enter the serial number of the cell module and cell supervision circuit here.

Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 1	Â	Â
Cell supervision circuit 1a	Â	Â
Cell module 2	Â	Â
Cell supervision circuit 2a	Â	Â
Cell module 3	Â	Â
Cell supervision circuit 3a	Â	Â
Cell module 4	Â	Â
Cell supervision circuit 4a	Â	Â
Cell module 5	Â	Â
Cell supervision circuit 5a	Â	Â
Cell module 6	Â	Â
Cell supervision circuit 6a	Â	Â
Cell module 7	Â	Â
Cell supervision circuit 7a	Â	Â

Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 8	Â	Â
Cell supervision circuit 8a	Â	Â

### 3. Removing lid from high-voltage battery unit:

- Undo sealing screws (1).

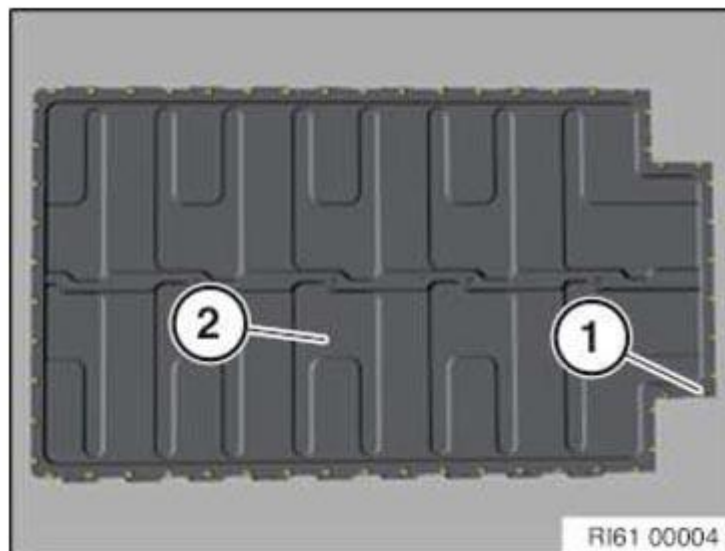


**Fig. 522: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

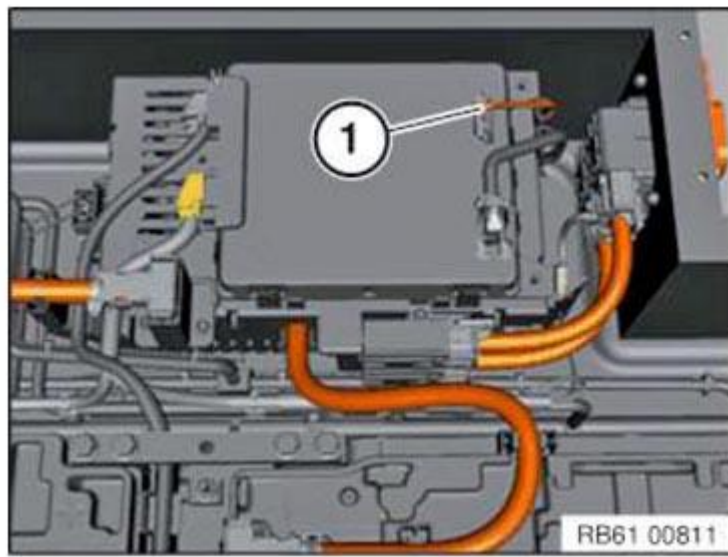
Remove lid (2) with help of a second person.



**Fig. 523: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

#### Check:

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



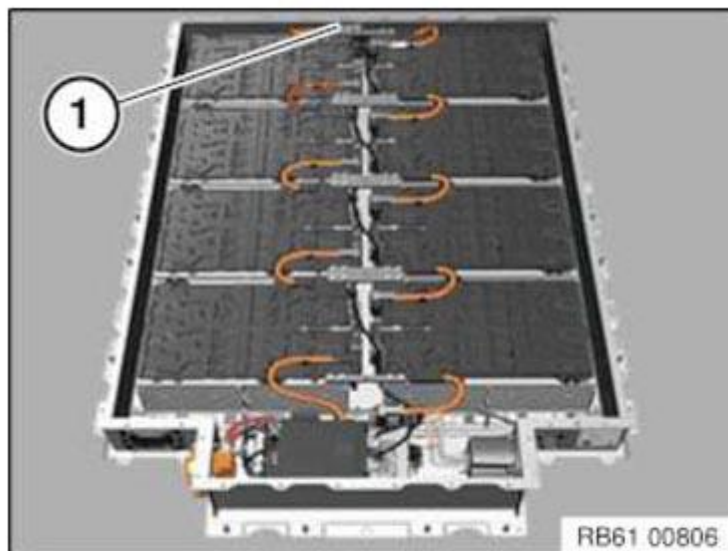
**Fig. 524: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

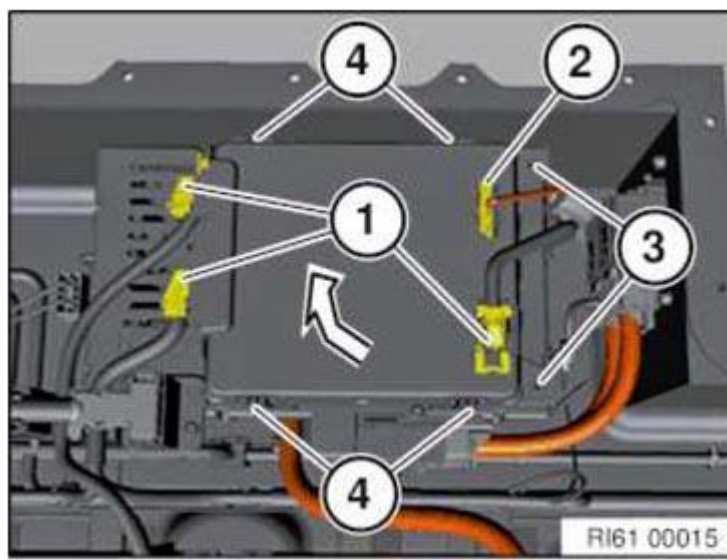
- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 525: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**4. Remove battery management electronics (SME):**

- Disconnect the connector (1).
- Disconnect connector for isolation monitor (2).
- Loosen screws (3).
- Unclip SME at side (4) and lift out upwards in direction of arrow.



**Fig. 526: Removing Battery Management Electronics (SME)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

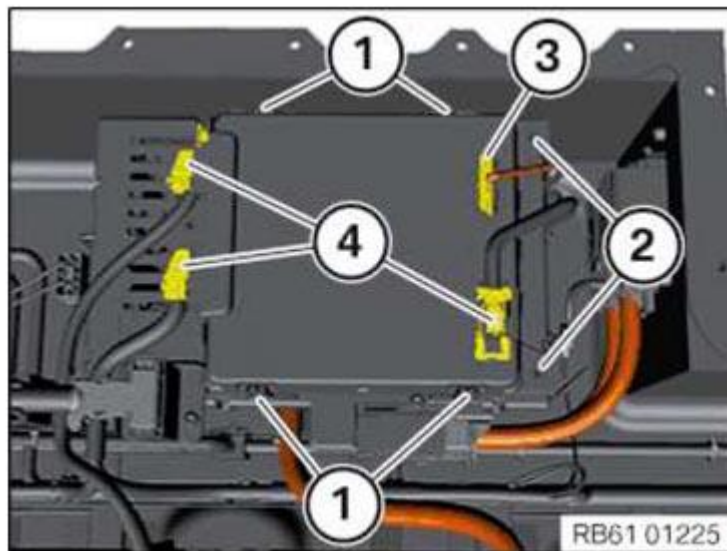
**5. Install battery management electronics (SME):**

- Clip in SME (1).
- Tighten down screws (2).

**HIGH-VOLTAGE BATTERY UNIT CONTROL UNIT TO SAFETY BOX SPECIFICATION**

Oval-head screw	If torque is not reached, safety box must be replaced.	1.1 Nm
-----------------	--	--------

- Connect connector (4).
- Connect connector for isolation monitor (3) and check that it engages correctly.

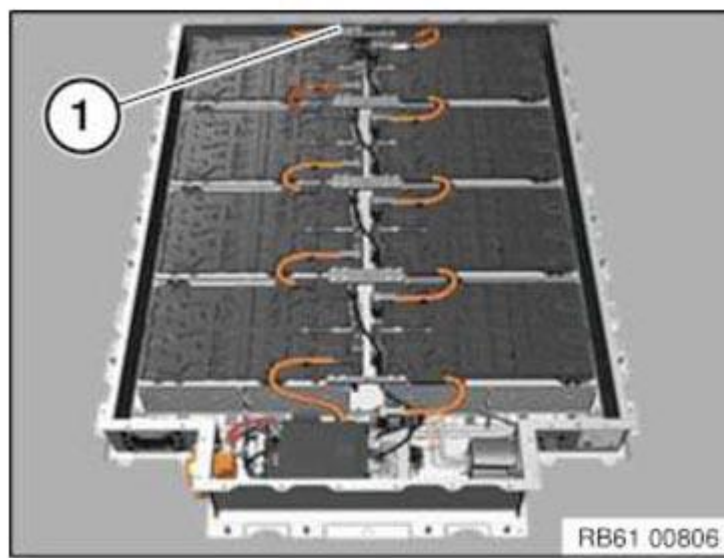


**Fig. 527: Identifying Battery Management Electronics (SME) And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**6. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).





**Fig. 528: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

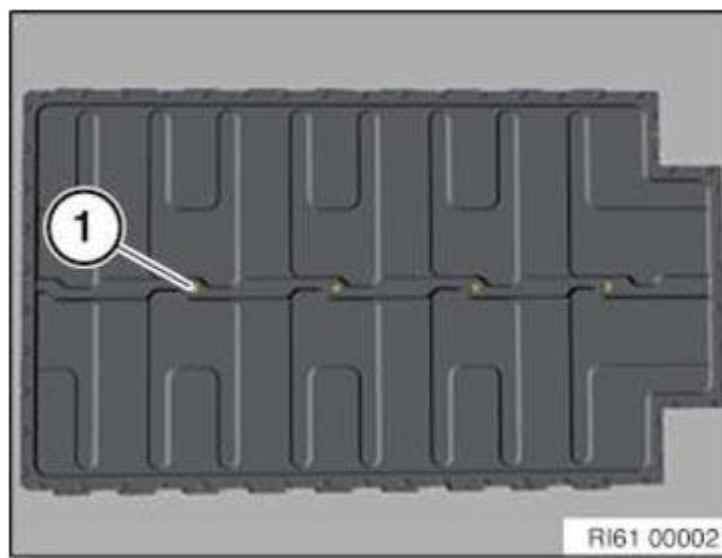


**Fig. 529: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

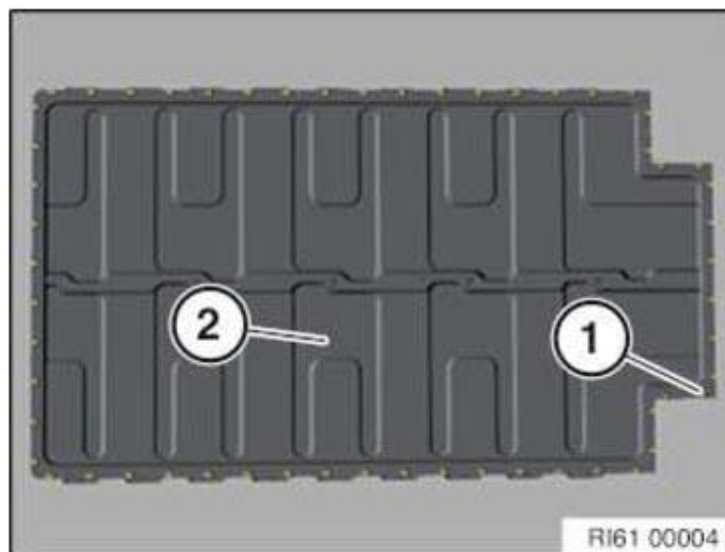


**Fig. 530: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 531: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

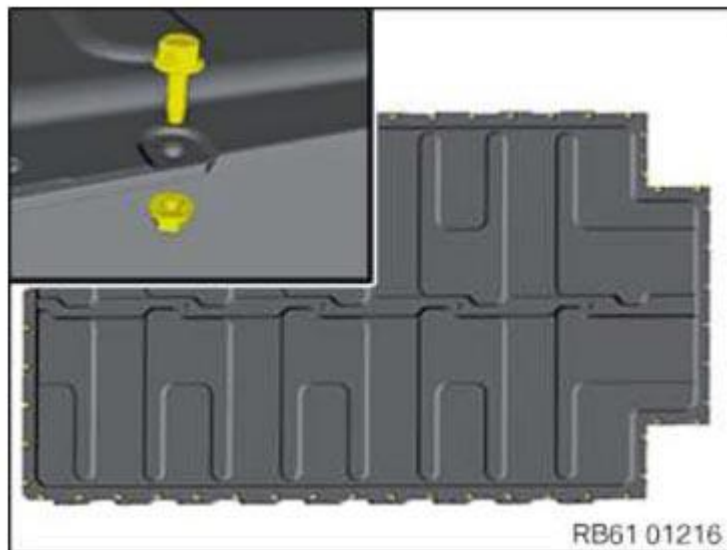
Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.



- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 532: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**7. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 533: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 561 REPLACING CELL SUPERVISION CIRCUIT WIRING HARNESS (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

**WARNING:****High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

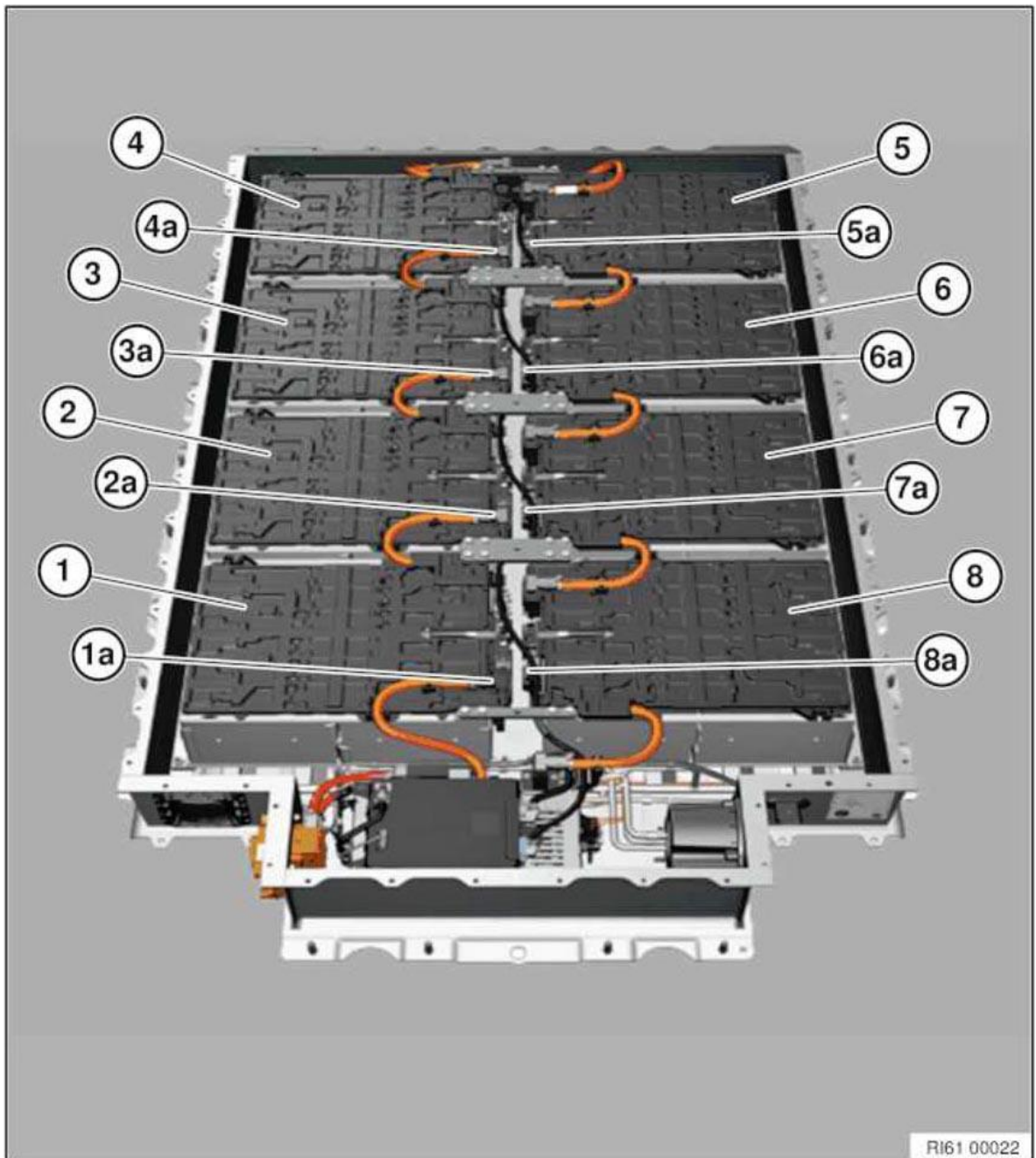
- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**1. Preparing the position plan:**

Overview of high-voltage battery unit:



**Fig. 534: Overview Of High-Voltage Battery Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Enter the serial number of the cell module and cell supervision circuit here.

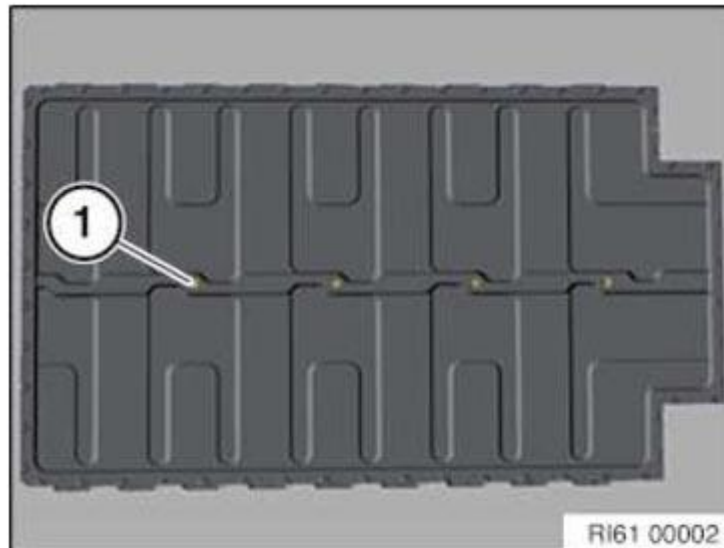
Â	Enter new serial numbers here:	Exchange part serial number:
Cell module 1	Â	Â
Cell supervision circuit 1a	Â	Â
Cell module 2	Â	Â
Cell supervision circuit 2a	Â	Â
Cell module 3	Â	Â
Cell supervision circuit 3a	Â	Â
Cell module 4	Â	Â
Cell supervision circuit 4a	Â	Â
Cell module 5	Â	Â
Cell supervision circuit 5a	Â	Â
Cell module 6	Â	Â
Cell supervision circuit 6a	Â	Â
Cell module 7	Â	Â
Cell supervision circuit 7a	Â	Â
Cell module 8	Â	Â
Cell supervision circuit 8a	Â	Â

## 2. Position plan:

- Before removing cell modules: Print out position plan for cell modules and cell supervision circuits from diagnosis system.
- Mark installation position of all cell modules and cell supervision circuits and inscribe the installation position on the component.

## 3. Removing lid from high-voltage battery unit:

- Undo sealing screws (1).

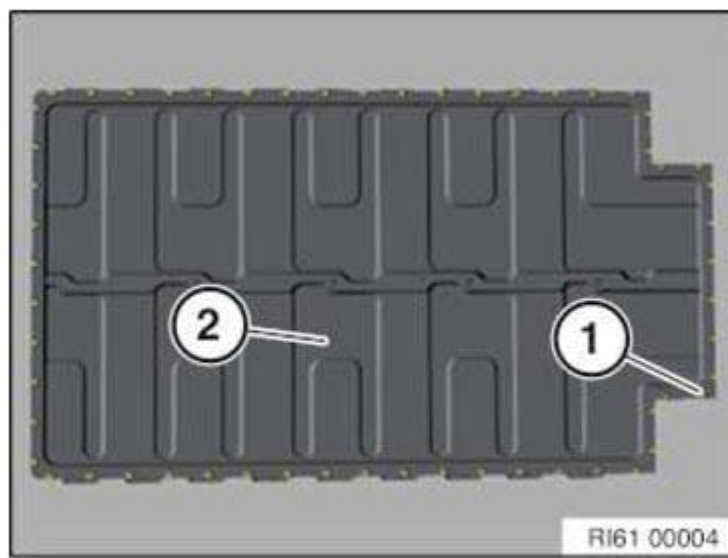


**Fig. 535: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

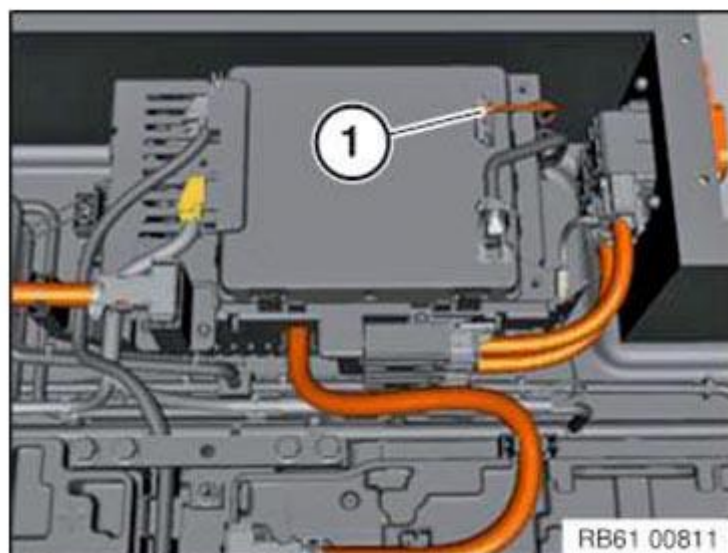
Remove lid (2) with help of a second person.



**Fig. 536: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



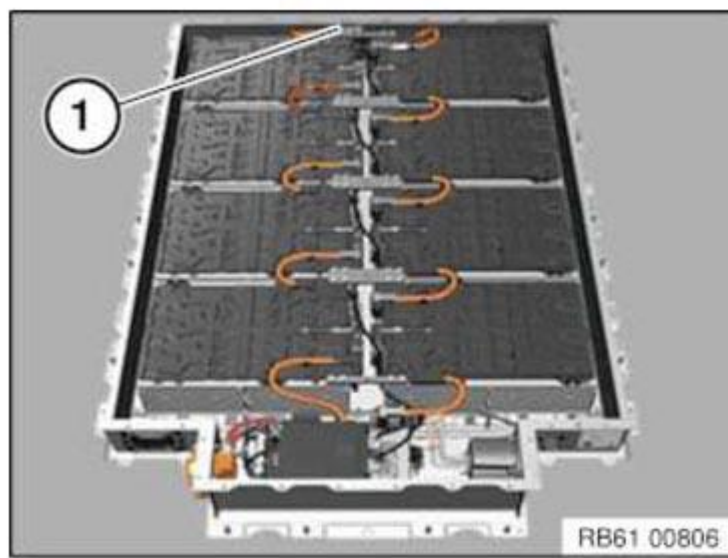
**Fig. 537: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

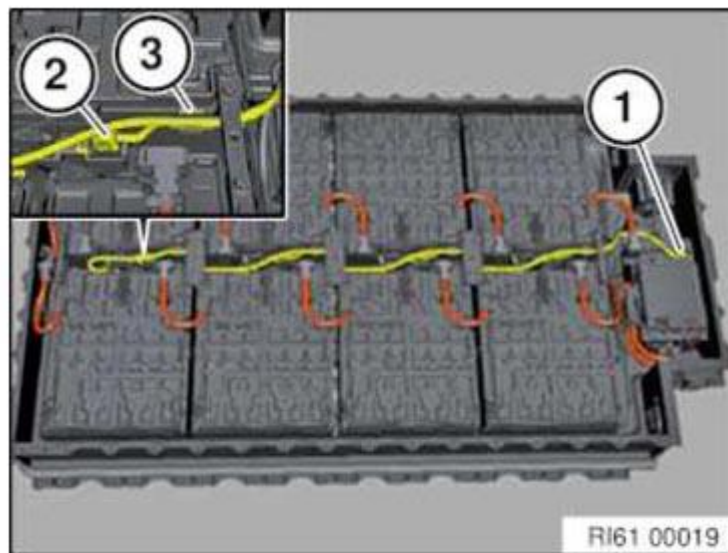
- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 538: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**4. Removing cell supervision circuit wiring harness:**

- Disconnect connector (1) at battery management electronics (SME).
- Disconnect connector (2) at all cell supervision circuits.
- Release all clips (3) and remove wiring harness for cell supervision circuit.

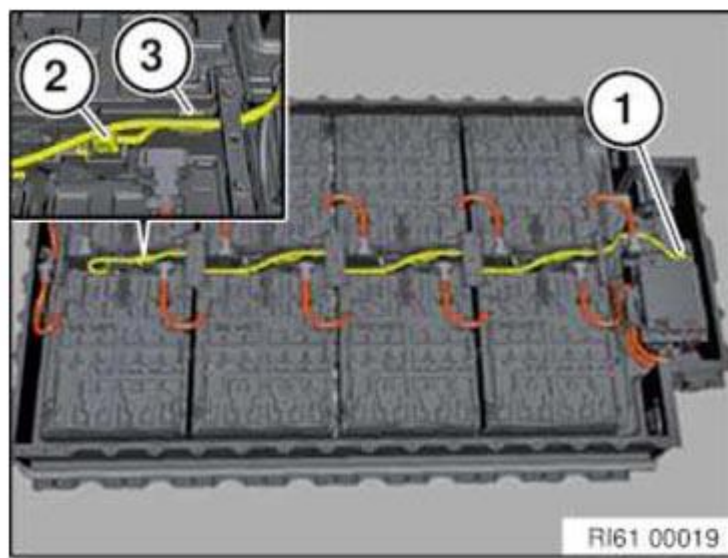


**Fig. 539: Identifying Cell Supervision Circuit Wiring Harness**  
Courtesy of BMW OF NORTH AMERICA, INC.

**5. Installing wiring harness for cell supervision circuit:**

- Insert wiring harness for cell supervision circuit and clip in (3).
- Connect connector (2) at all cell supervision circuits.
- Connect connector (1) at battery management electronics (SME).

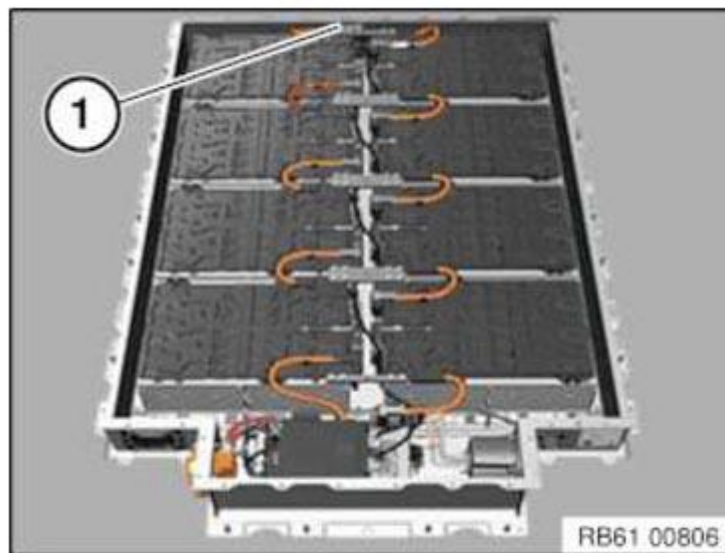




**Fig. 540: Identifying Cell Supervision Circuit Wiring Harness**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**6. Installing high-voltage battery unit lid:**

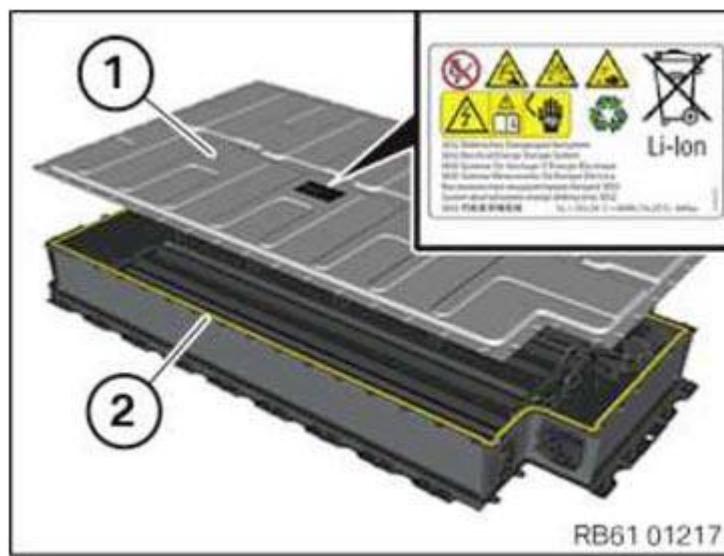
- Connect high-voltage connector (1).



**Fig. 541: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.



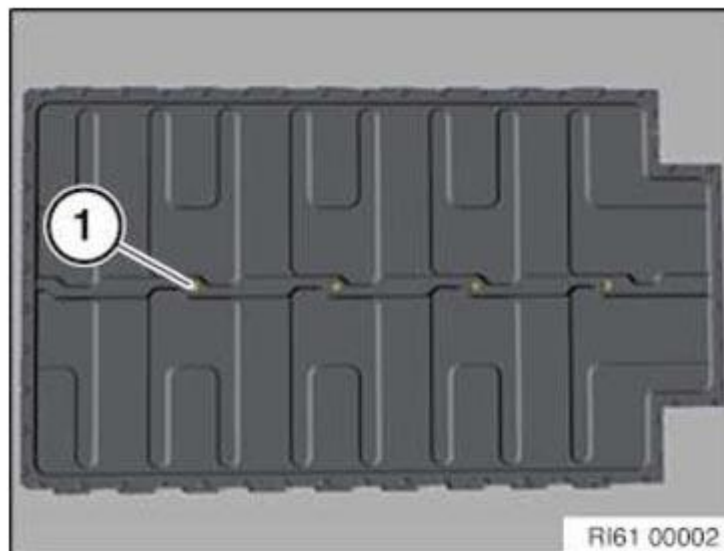


**Fig. 542: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

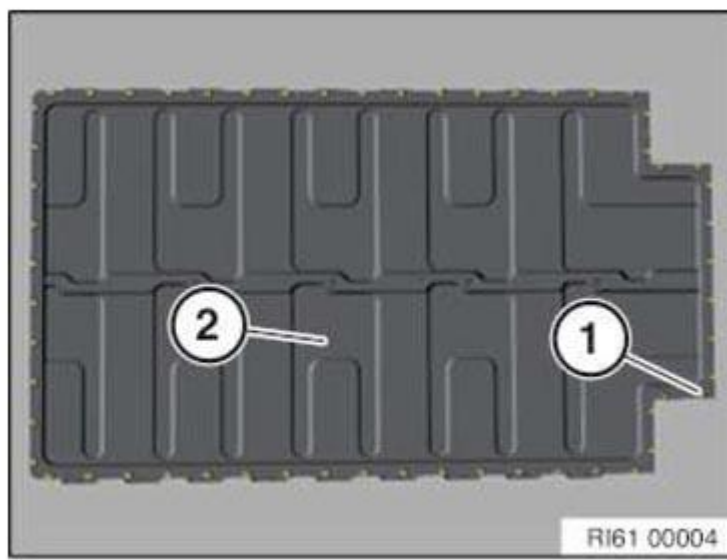


**Fig. 543: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 544: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

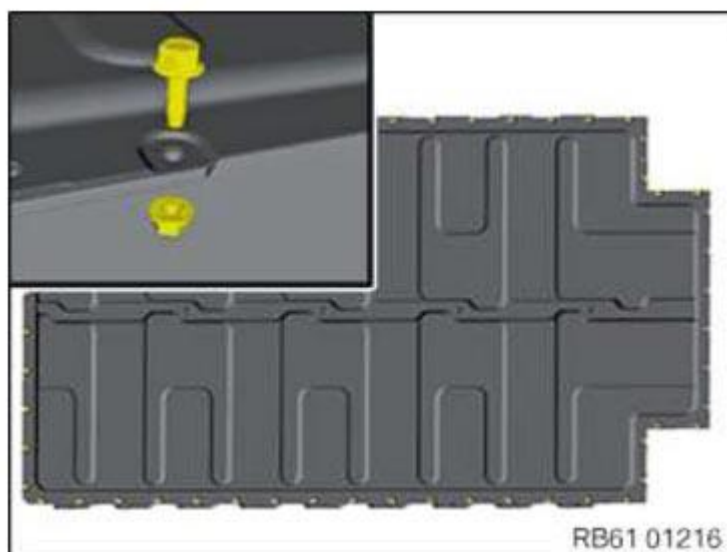
If all screw connections are damaged, the housing well must be replaced.

- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.
- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 545: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

## 7. Perform EoS test:

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 546: Identifying EoS Tester**

Courtesy of BMW OF NORTH AMERICA, INC.

## **61 27 591 REPLACING HIGH-VOLTAGE CONNECTING LINE (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

### **WARNING:**

**High-voltage system.**

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

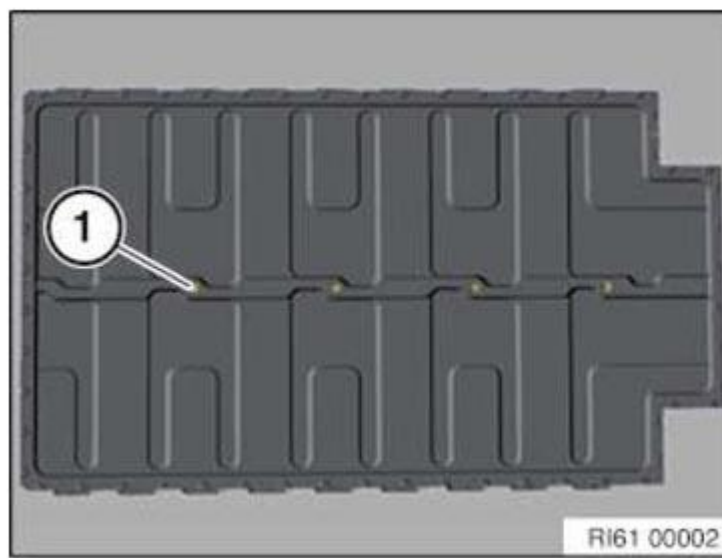
- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

### **Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

#### **1. Removing lid from high-voltage battery unit:**

- Undo sealing screws (1).

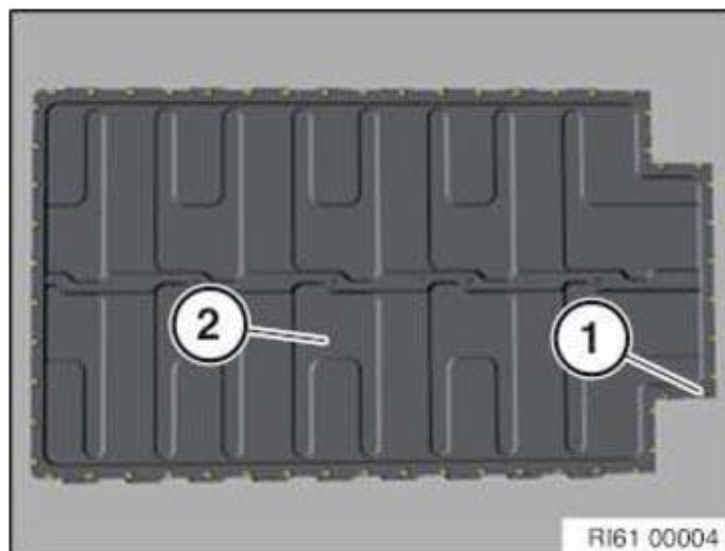


**Fig. 547: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

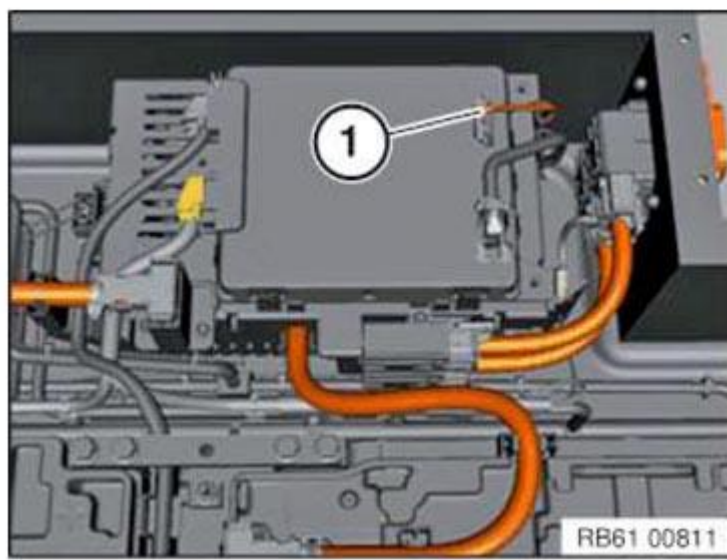
Remove lid (2) with help of a second person.



**Fig. 548: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



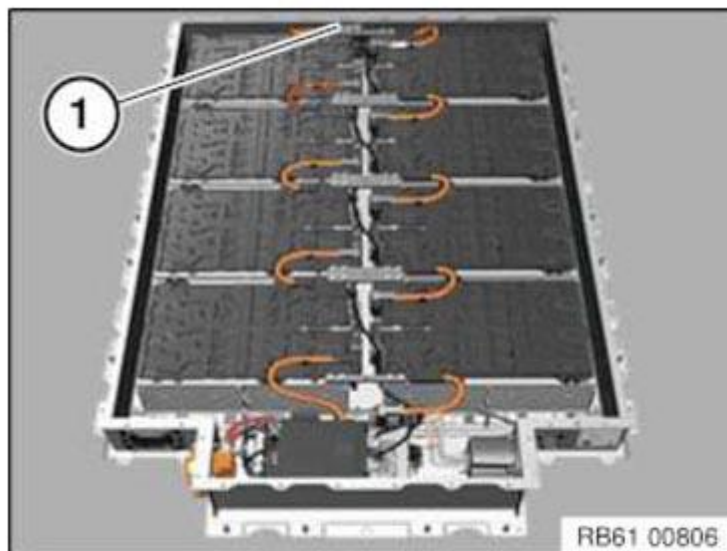
**Fig. 549: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

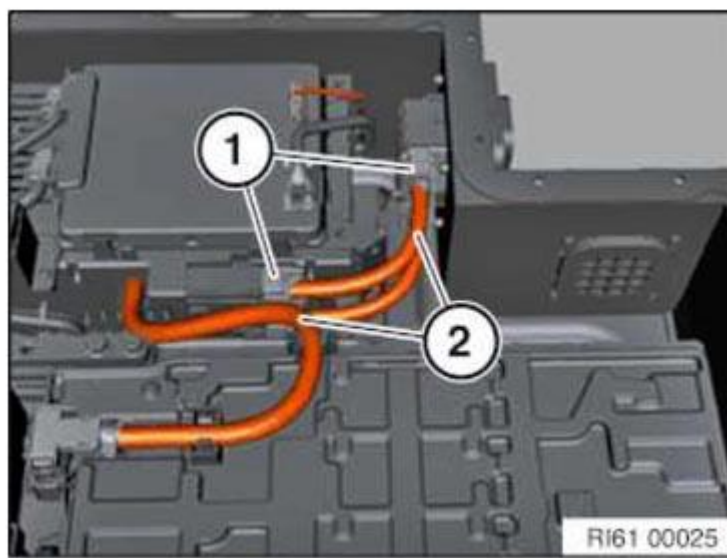
- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 550: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Remove high-voltage connecting line:**

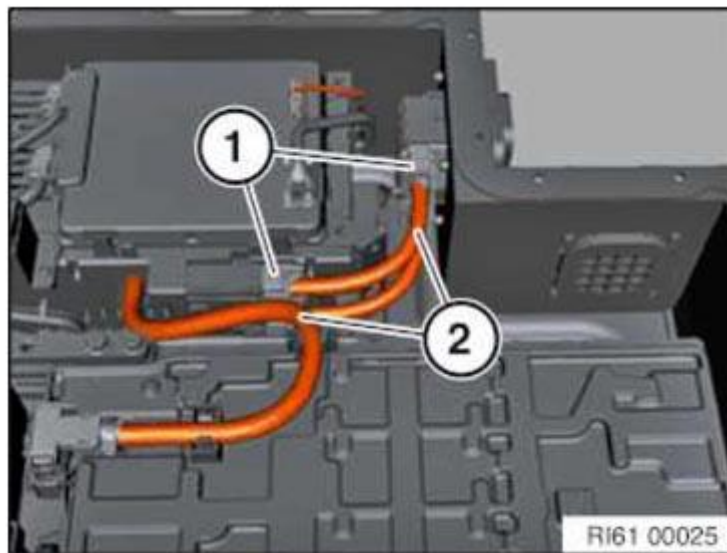
- Disconnect connector (1) for high-voltage positive terminal.
- Disconnect connector (2) for high-voltage negative terminal.



**Fig. 551: Identifying High-Voltage Positive Terminal Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**3. Install high-voltage connecting line:**

- Connect connector (2) for high-voltage negative terminal.
- Connect connector (1) for high-voltage positive terminal.

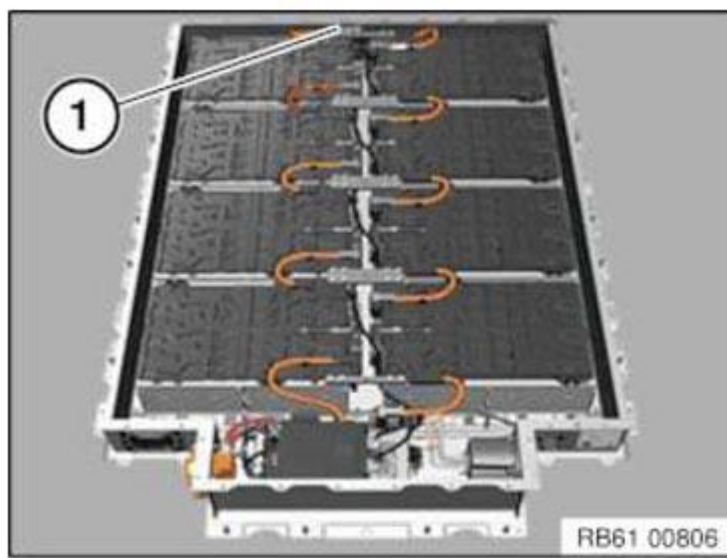


**Fig. 552: Identifying High-Voltage Positive Terminal Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**4. Installing high-voltage battery unit lid:**

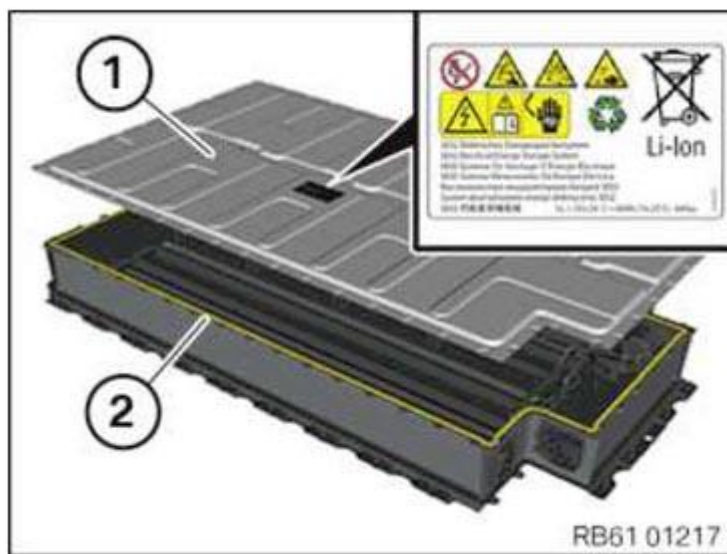
- Connect high-voltage connector (1).





**Fig. 553: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

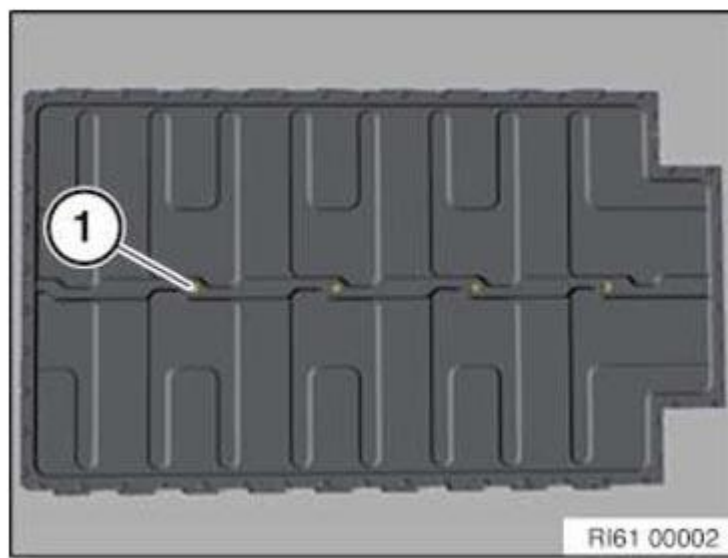


**Fig. 554: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

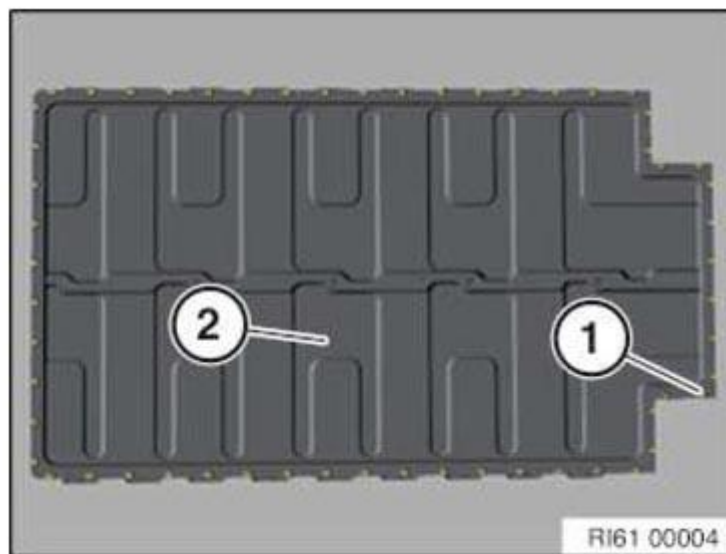


**Fig. 555: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
----	---	--------



**Fig. 556: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

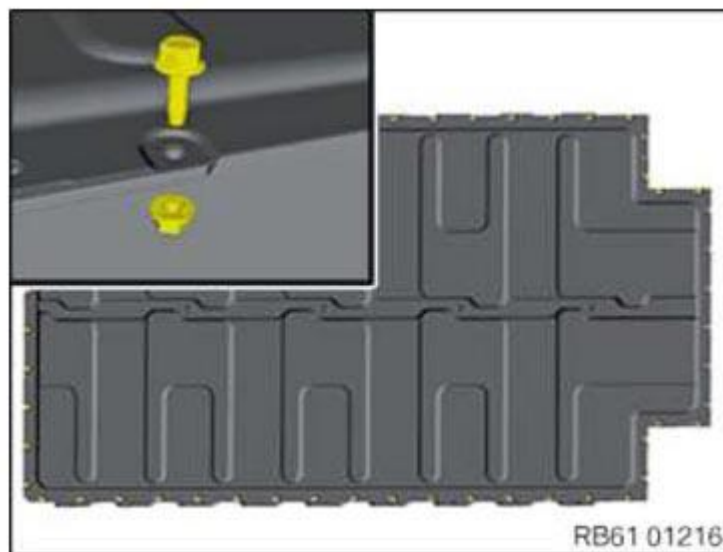
At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.
  - Remove debris using a vacuum cleaner.
- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 557: Securing Lid Using Bolt And Nut**

Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
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**61 27 531 REPLACING HIGH-VOLTAGE CONNECTION (HIGH-VOLTAGE BATTERY UNIT REMOVED)**

**WARNING:**

High-voltage system.

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

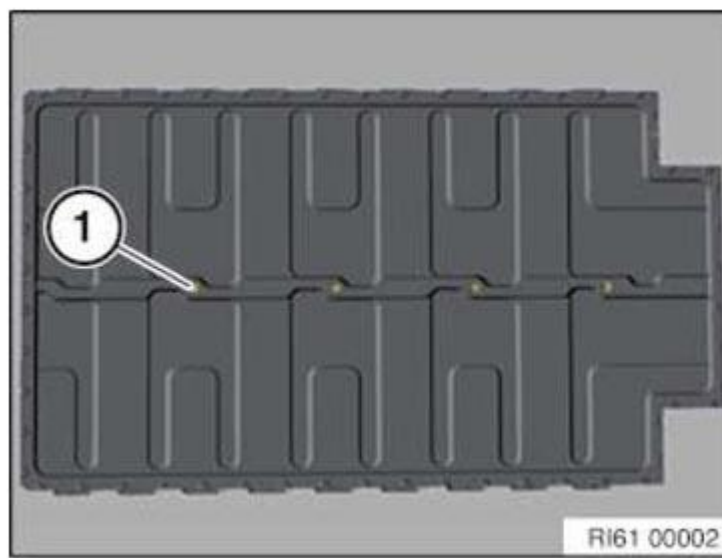
- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**1. Removing lid from high-voltage battery unit:**

- Undo sealing screws (1).

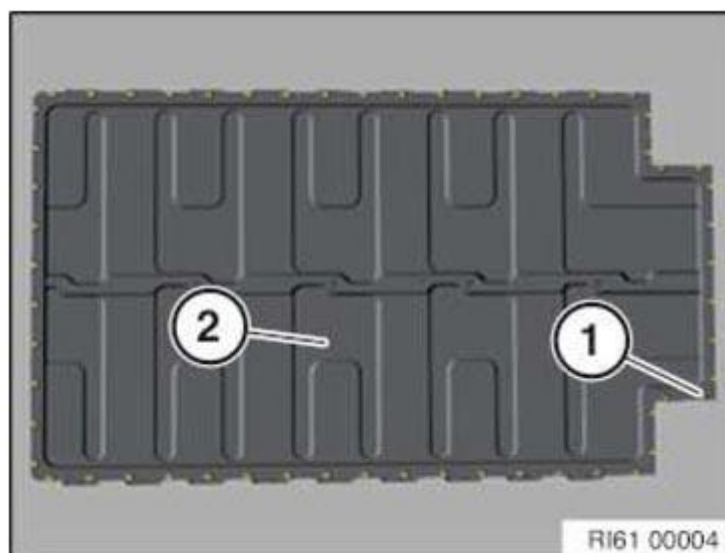


**Fig. 558: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

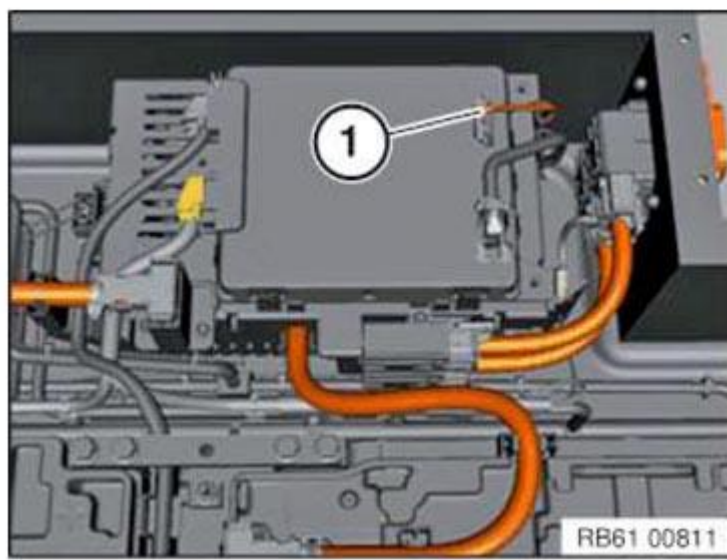
Remove lid (2) with help of a second person.



**Fig. 559: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



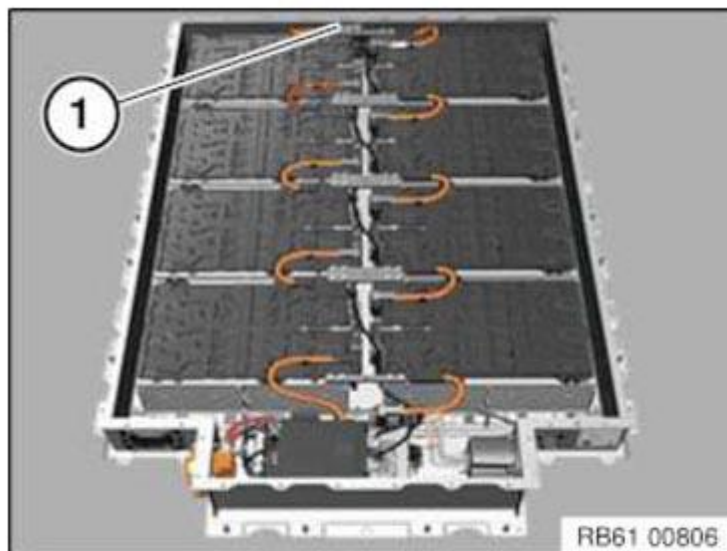
**Fig. 560: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.

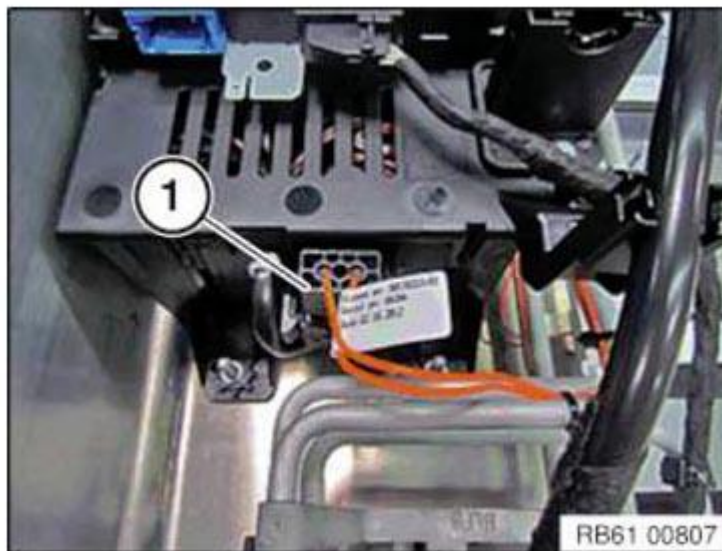


**Fig. 561: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Removing the safety box:**

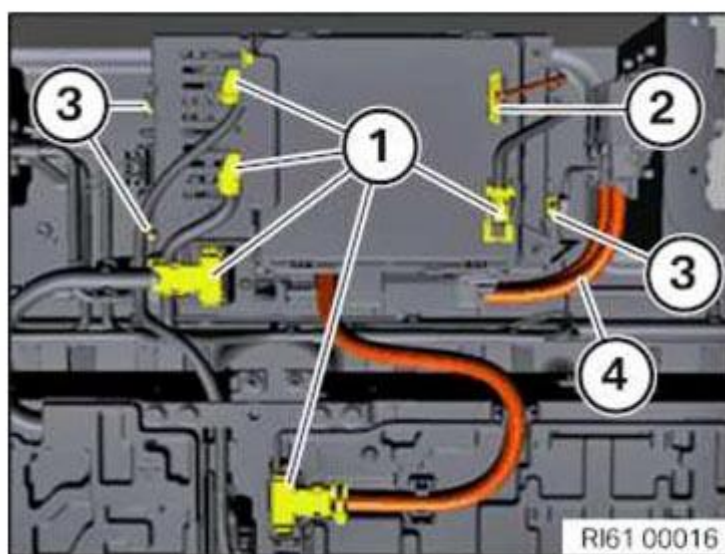
- Disconnect the heating connector for the high-voltage battery unit (1).





**Fig. 562: Identifying High-Voltage Battery Unit Heating Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Disconnect the connector (1).
- Disconnect connector for isolation monitor (2). 588 of 822
- Disconnect high-voltage connector (4) at safety box.
- Unclip communication and cell supervision circuit wiring harness using special tool 2 298 505.
- Undo nuts (3) using special tool 2 357 541 and remove safety box.

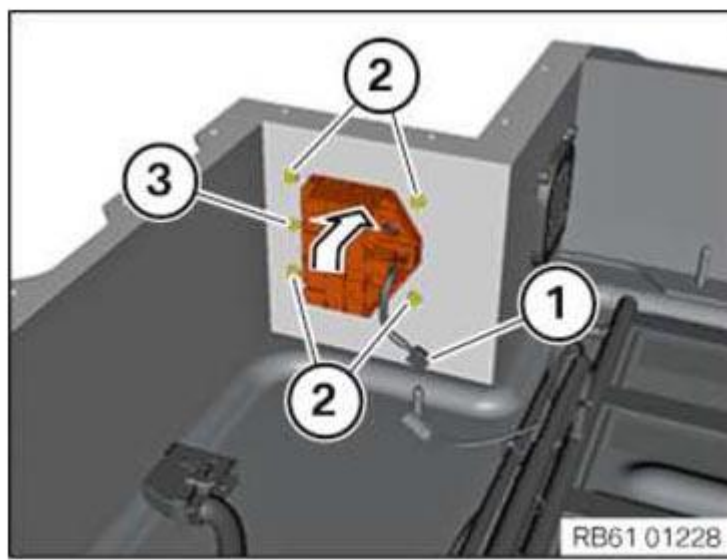


**Fig. 563: Identifying Safety Box Connector And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**3. Removing high-voltage connection:**

- Disconnect the connector (1).
- Loosen screw (2).
- Loosen screws (3).
- Press out high-voltage connection in direction of arrow.





**Fig. 564: Pressing Out High-Voltage Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**4. Install high-voltage connection:**

- Clean contact surface of high-voltage connection on housing well.
- Insert high-voltage connection in direction of arrow.
- Tighten down screw (2).

**HIGH-VOLTAGE CONNECTOR TO HOUSING WELL SPECIFICATION**

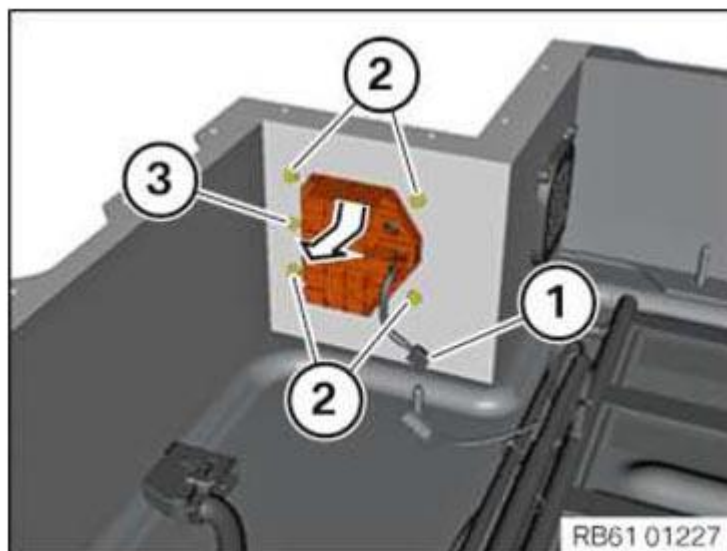
M5	5 Nm
----	------

- Tighten down screws (3).

**HIGH-VOLTAGE CONNECTOR TO HOUSING WELL SPECIFICATION**

M4	2.4 Nm
----	--------

- Connect connector (1).



**Fig. 565: Installing High-Voltage Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

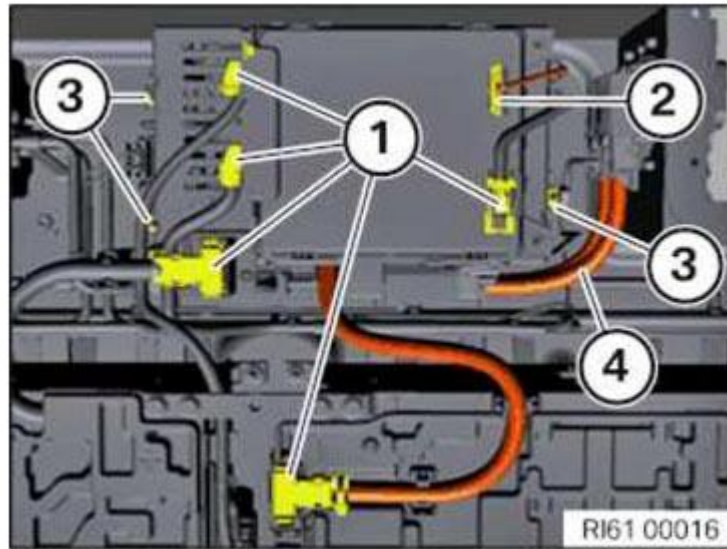
**5. Installing the safety box:**

- Insert safety box and tighten nuts (3) using special tool 2 357 541 .

**SAFETY BOX TO HOUSING WELL SPECIFICATION**

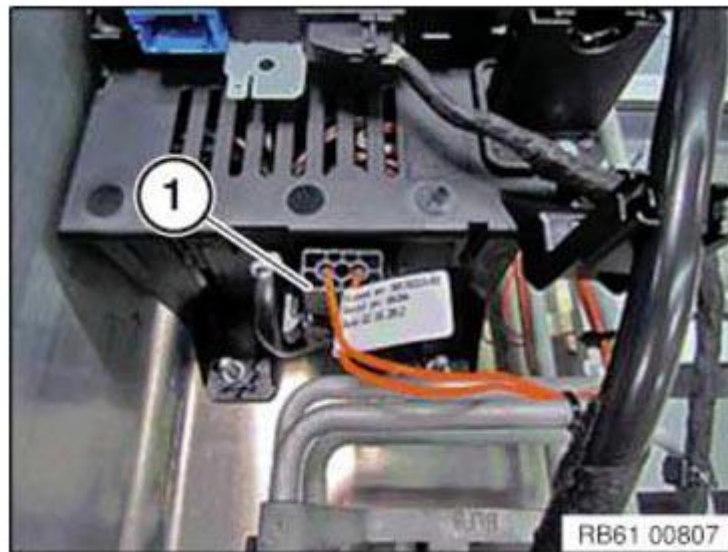
M6	11.8 Nm
----	---------

- Connect connector (1).
- Connect connector for isolation monitor (2).
- Connect high-voltage connector (4) at safety box.



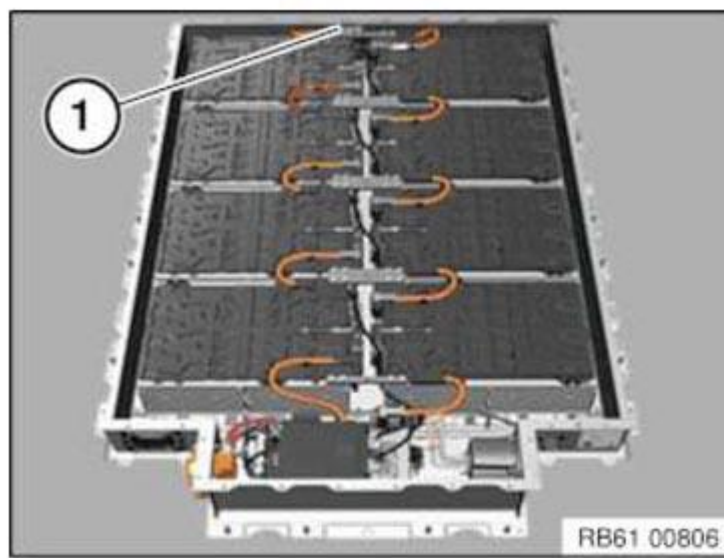
**Fig. 566: Identifying Safety Box Connector And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Connect the heating connector for the high-voltage battery unit (1).



**Fig. 567: Identifying High-Voltage Battery Unit Heating Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

6. **Installing high-voltage battery unit lid:**
- Connect high-voltage connector (1).



**Fig. 568: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

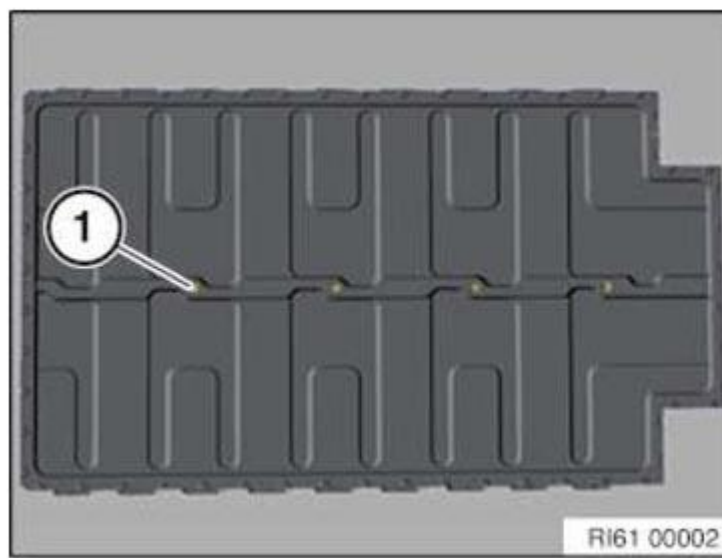


**Fig. 569: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

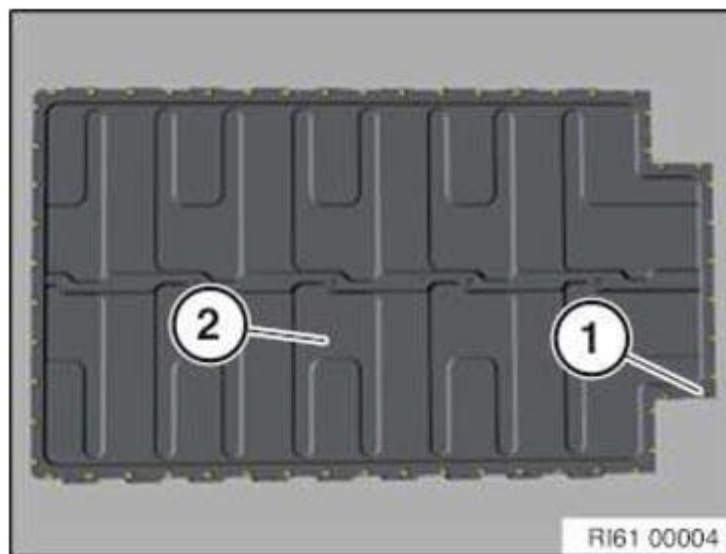


**Fig. 570: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
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**Fig. 571: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

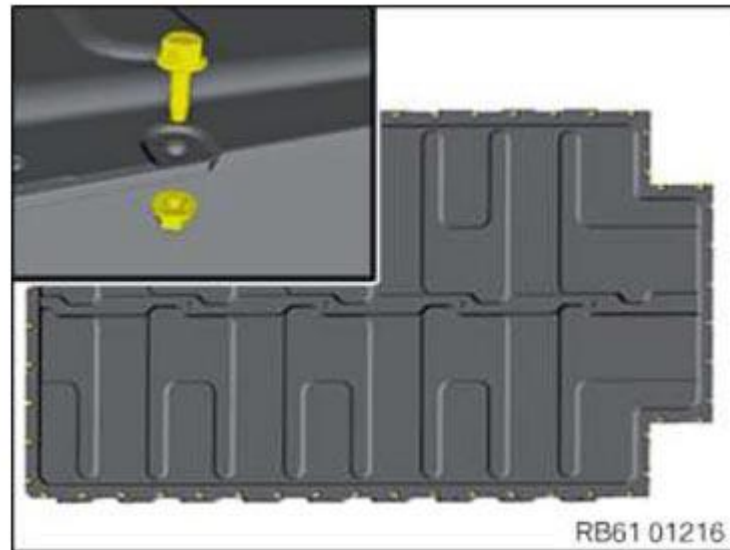
- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 572: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**7. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 573: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 27 611 REPLACING HIGH-VOLTAGE MODULE CONNECTING LINE (HIGH-VOLTAGE BATTERY UNIT REMOVED) (AFTER VEHICLE DIAGNOSIS)**



**WARNING:**

High-voltage system.

The high-voltage system operates on the basis of hazardous, electrical voltage and high currents. Danger to life through electric shock.

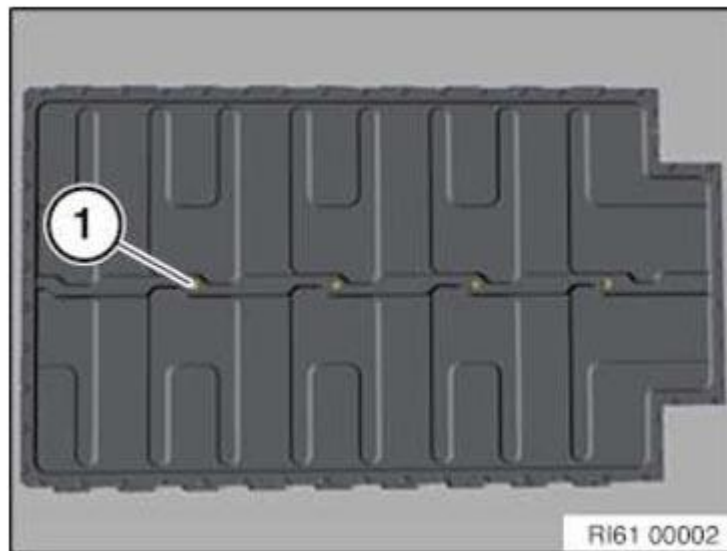
- All work on the high-voltage system may only be carried out by specially trained and technically experienced personnel.
- Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.
- Disconnect **HIGH-VOLTAGE SYSTEM** from power

**Preliminary work:**

- Remove **HIGH-VOLTAGE BATTERY UNIT**.

**1. Removing lid from high-voltage battery unit:**

- Undo sealing screws (1).

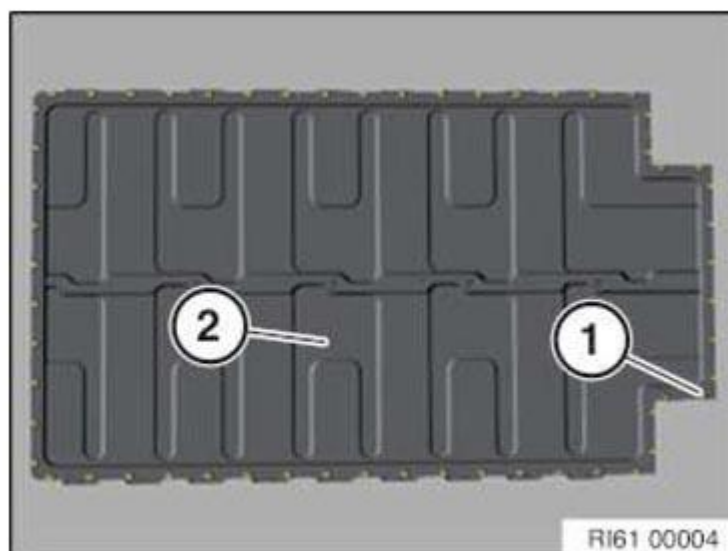


**Fig. 574: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen screws (1).

Remove debris from screw holes (1) using a vacuum cleaner.

Remove lid (2) with help of a second person.

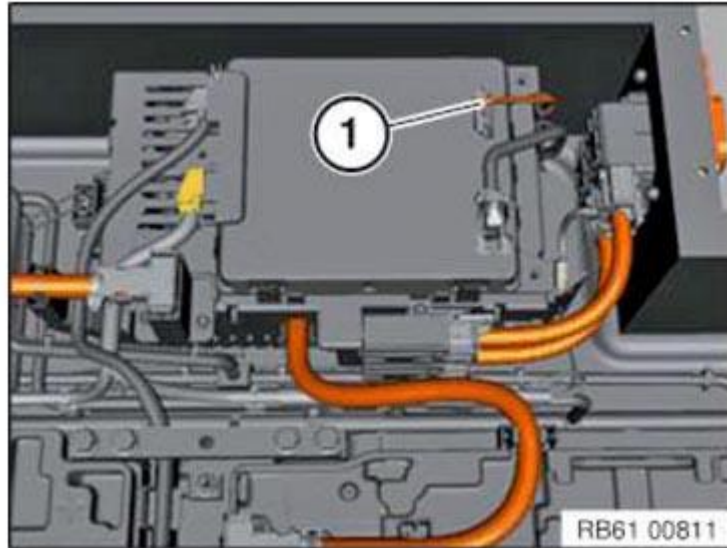


**Fig. 575: Identifying High-Voltage Battery Unit Lid Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Check:**

- In order to rule out unnoticed isolation faults, a visual inspection to ensure that the connector for isolation monitoring (1) has been locked correctly must be performed after opening the lid.



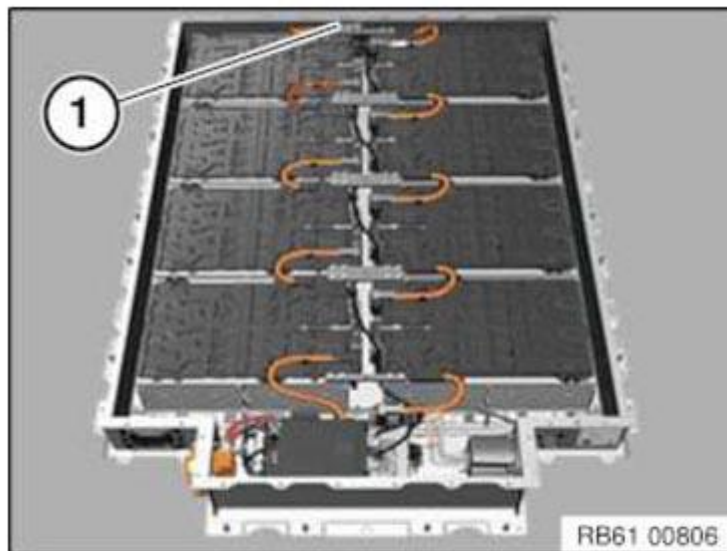
**Fig. 576: Identifying Isolation Monitoring Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Result:**

Connector (1) is not locked correctly or is damaged.

**Action:**

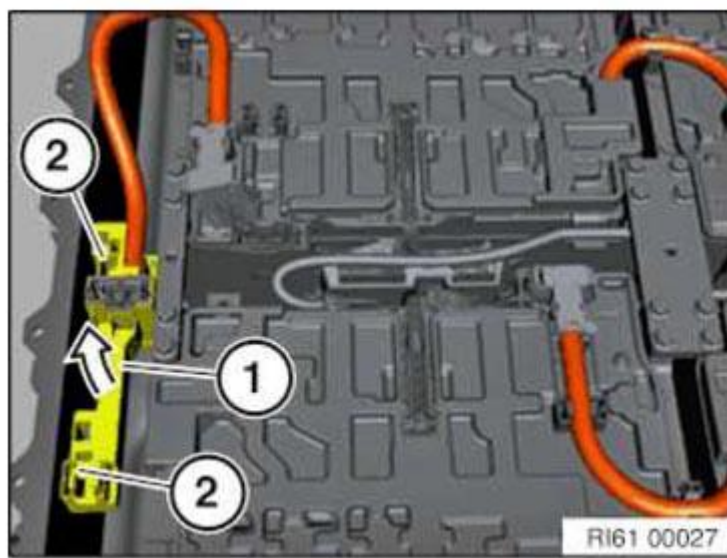
- Stop work immediately. Contact BMW technical support.
- For safety reasons, disconnect the high-voltage connector (1) before performing further work.



**Fig. 577: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Remove module connecting line holder:**

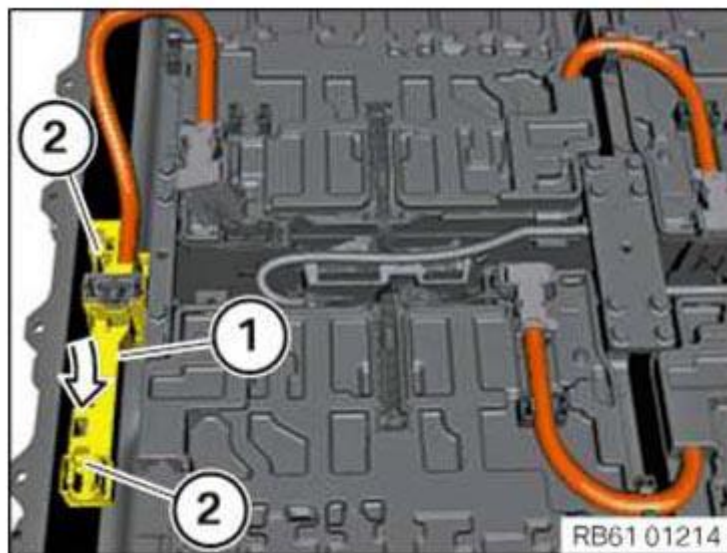
- Unlock holder with high-voltage module connecting line (1) at position (2) and pull out in direction of arrow.



**Fig. 578: Removing Module Connecting Line Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

**3. Install module connecting line holder:**

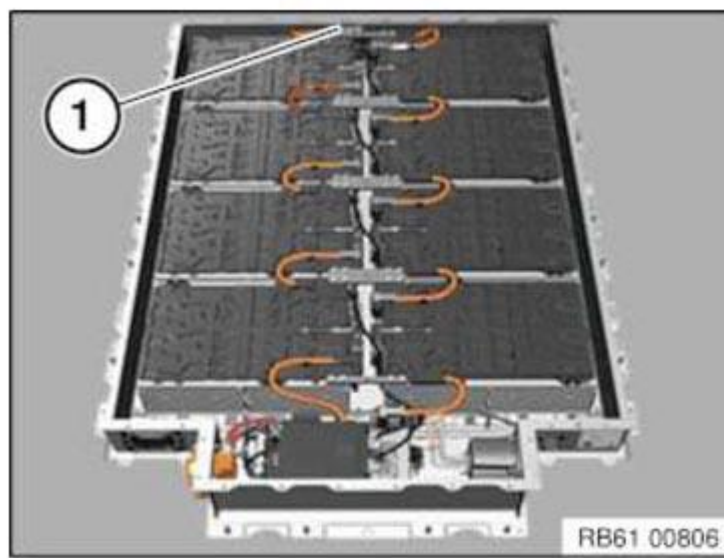
- Insert holder with high-voltage module connecting line (1) at position (2) in direction of arrow.



**Fig. 579: Installing Module Connecting Line Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

**4. Installing high-voltage battery unit lid:**

- Connect high-voltage connector (1).



**Fig. 580: Identifying High-Voltage Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Lid (1) must be renewed each time it is removed.
- Attach warning sticker to new lid (1).
- Clean contact surface (2) of lid seal on housing well.
- Remove moisture, foreign objects and contamination.
- Put on lid (1) with help of a second person.

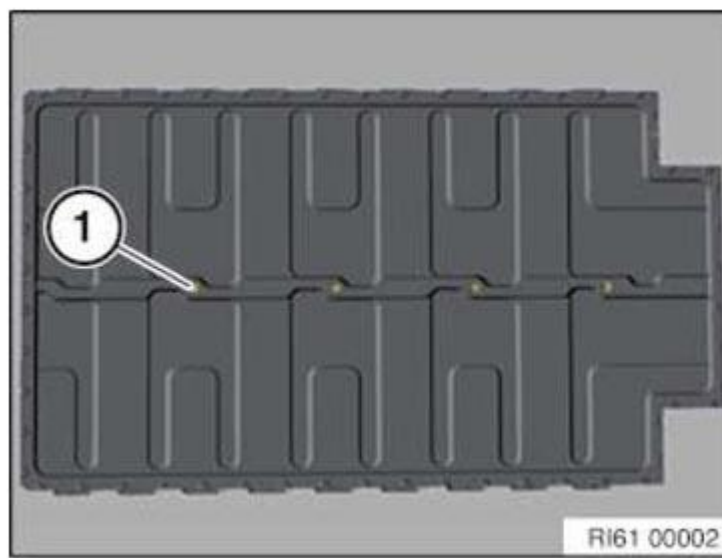


**Fig. 581: Attaching Warning Sticker To Lid**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Tighten sealing screws (1).

**SEALING SCREWS TO HIGH-VOLTAGE BATTERY UNIT LID SPECIFICATION**

M6	Renew screws.	Torque	4 Nm
∧	∧	Angle of rotation	90 ∧°

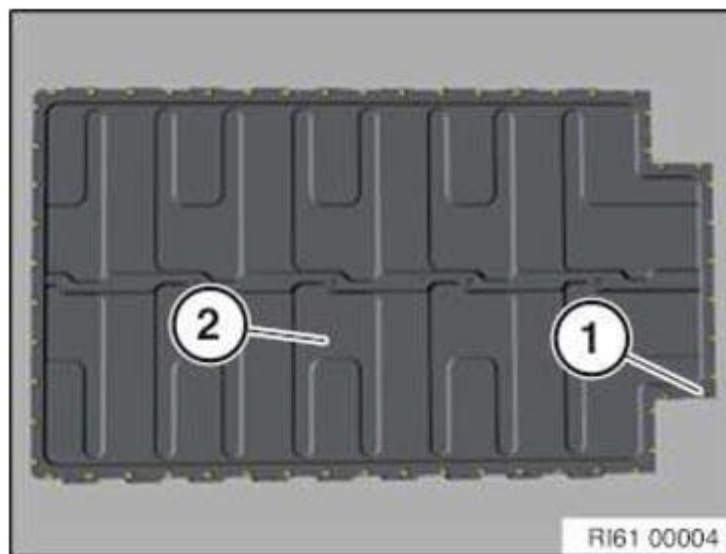


**Fig. 582: Identifying High-Voltage Battery Unit Lid Sealing Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Screw down lid (2) securely using screws (1).

**LID TO HIGH-VOLTAGE BATTERY UNIT SPECIFICATION**

M6	If the torque is not reached, refer to the repair solution.	8.5 Nm
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**Fig. 583: Identifying High-Voltage Battery Unit Lid Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Repair solution in the case of faulty thread:**

If a screw fails to achieve the specified torque during tightening, or if the thread is damaged, this screw connection must be replaced.

At least two screw connections must not be damaged and may not be repaired.

If all screw connections are damaged, the housing well must be replaced.

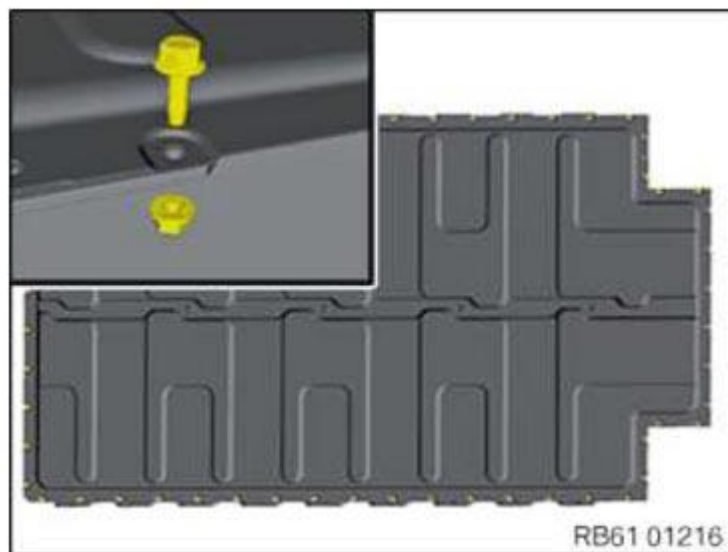
- To prevent debris from entering the inside of the housing, the drilling out may be carried out only when the lid is closed.

Remove debris using a vacuum cleaner.

- Drill out hole to 6.5 mm.
- Remove coating of lid under screw head.

- Secure lid using bolt and nut.

Screw	1 025 735
Nut	9 907 467



**Fig. 584: Securing Lid Using Bolt And Nut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**REPAIR SCREW WITH NUT TO LID SPECIFICATION**

M6	11.8 Nm
----	---------

**5. Perform EoS test:**

- Connect EoS tester.
  - Pressure connection
  - High-voltage connector
  - 12 V connector
- Perform final test.
- Note down the test result in ISTA or scan into the data matrix code.
- Perform vehicle diagnosis.



**Fig. 585: Identifying EoS Tester**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**SWITCH**



## 61 31 401 REMOVING AND INSTALLING (REPLACING) ENGINE COMPARTMENT UNLOCKING SWITCH

### Special tools required:

- [64 1 020](#)

Remove engine compartment unlocking switch (1) from trim panel (2) by means of special tool [64 1 020](#) .

Unlock associated plug connection and disconnect.

### Installation note:

Latching clamps on engine compartment unlocking switch (1) must not be damaged or missing.



**Fig. 586: Removing Engine Compartment Unlocking Switch From Trim Panel Using Special Tool (64 1 020)**

Courtesy of BMW OF NORTH AMERICA, INC.

## 61 31 195 REMOVING AND INSTALLING (REPLACING) FRONT CONTROLLER

**IMPORTANT:** Risk of damage.  
The button for the controller must not be removed.

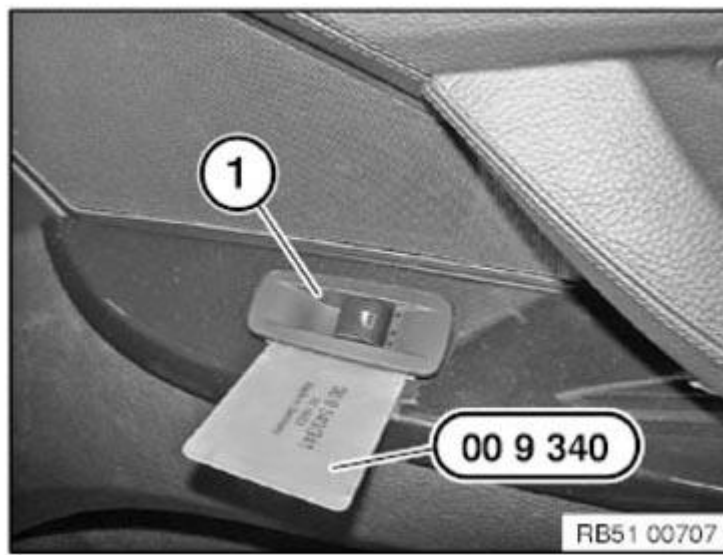
### Necessary preliminary tasks:

- Remove [DECORATIVE TRIM ON CENTER CONSOLE](#)

Release screws (1).

Remove controller (2) from center console cover (3).





**Fig. 587: Identifying Controller, Center Console Cover And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/ENCODING**.

**61 31 075 REMOVING AND INSTALLING (REPLACING) FUEL FILLER DOOR RELEASE SWITCH**

**Special tools required:**

- **64 1 020**

Pry fuel filler door release switch (1) out of trim panel (2) with special tool **64 1 020**.

Unlock associated plug connection and disconnect.

*Installation note:*

Latch clamps on fuel filler door release switch (1) must not be damaged or missing.



**Fig. 588: Prying Fuel Filler Door Release Switch Out Of Trim Panel**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 31 008 REMOVING AND INSTALLING (REPLACING) STEERING COLUMN SWITCH CLUSTER**

**IMPORTANT:** Move wheels into straight-ahead position and do not alter this position during the repair

work.

Do not under any circumstances turn the steering column switch cluster when the steering wheel is removed.

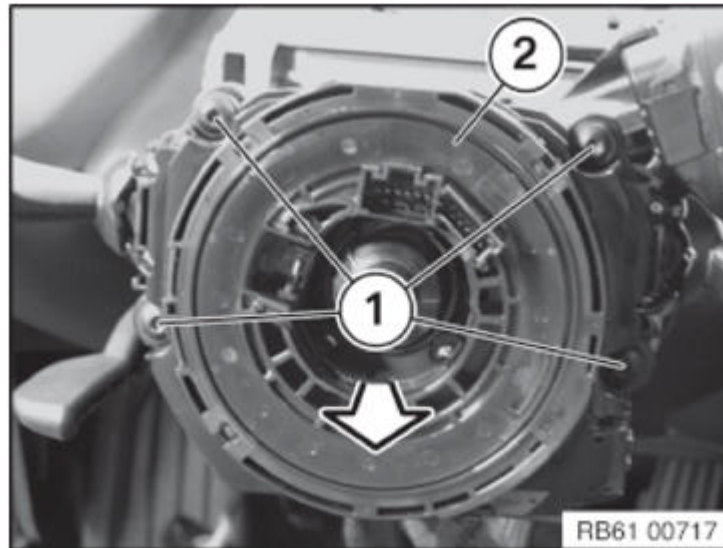
**Necessary preliminary tasks:**

- Remove **STEERING COLUMN SHROUD LOWER SECTION**
- Remove **STEERING WHEEL**

Release screws (1).

Tightening torque **61 31 3AZ** .

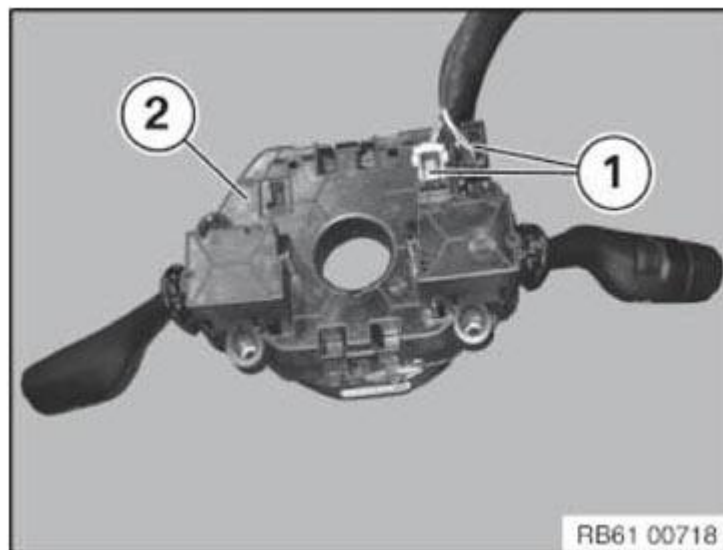
Remove steering column switch cluster (2) in direction of arrow.



**Fig. 589: Removing Steering Column Switch Cluster**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1).

Remove steering column switch cluster (2).

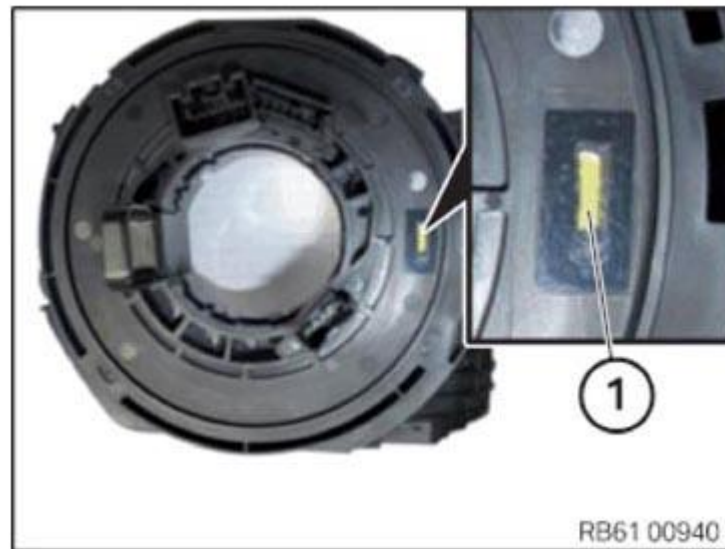


**Fig. 590: Identifying Steering Column Switch Cluster And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Check zero position of clock spring on steering column switch cluster.

Zero position is correct only when yellow mark (1) is clearly visible.



**Fig. 591: Identifying Coil Spring Cassette Yellow Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 31 083 REMOVING AND INSTALLING (REPLACING) TAILGATE RELEASE SWITCH**

**Special tools required:**

- [64 1 020](#)

Remove tailgate release switch (1) from trim panel (2) by means of special tool [64 1 020](#) .

Unlock associated plug connection and disconnect.

*Installation note:*

Latching clamps on tailgate release switch (1) must not be damaged or missing.



**Fig. 592: Removing Tailgate Release Switch From Trim Panel Using Special Tool (64 1 020)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 31 362 REMOVING AND INSTALLING (REPLACING) THE RECEIVER OF THE RADIO REMOTE CONTROL**

**IMPORTANT:** Read and comply with notes on [PROTECTION AGAINST ELECTROSTATIC DAMAGE \(ESD PROTECTION\)](#).

**Necessary preliminary tasks:**

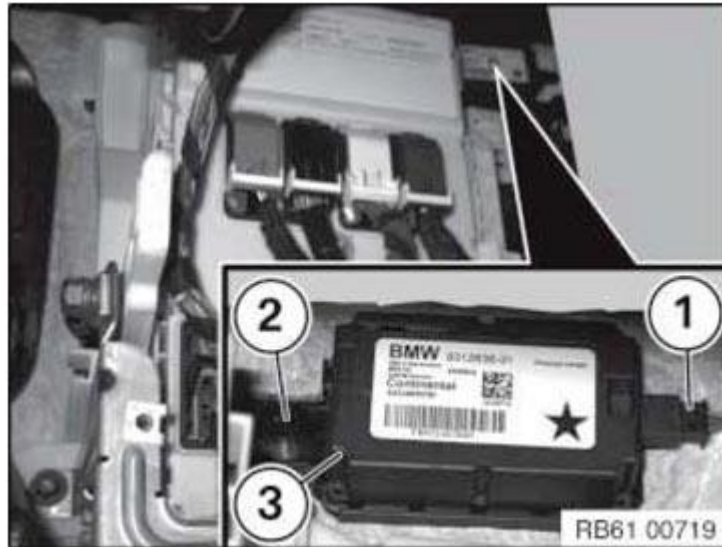
- Remove **BOTTOM RIGHT INSTRUMENT PANEL TRIM**
- Release fuse box

Unfasten plug connection (1) and disconnect.

Release expanding rivet (2) and remove control unit (3).

*Installation note:*

Position the receiver (3) in a way that the positioning pin on the rear engages in the matching bore hole.



**Fig. 593: Identifying Radio Remote Control Receiver And Plug Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **61 31 321 REMOVING AND INSTALLING RADIO AND A/C CONTROL PANEL**

IMPORTANT: Risk of damage.

A hard disk is installed in the Car Information Computer (CIC).

Carry out mechanical work on the CIC and adjacent components with care.

Avoid subjecting the CIC to vibration/shocks.

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

IMPORTANT: Carry out installation in a dust-free workshop area only.  
 To avoid damage, do not touch or dirty the display field.

If necessary, unclip trim (1) in direction of arrow.

Unlock associated plug connections and disconnect.



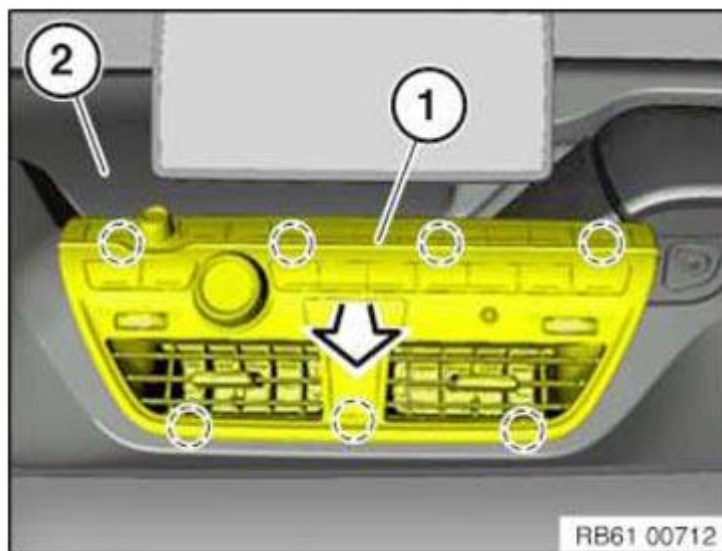
**Fig. 594: Removing Trim**

Courtesy of BMW OF NORTH AMERICA, INC.

Carefully unclip radio and A/C control panel (1) at marked points.

Pull radio and A/C control panel (1) out of instrument panel trim (2).

Disconnect corresponding plug connections and remove radio and A/C control panel (1).



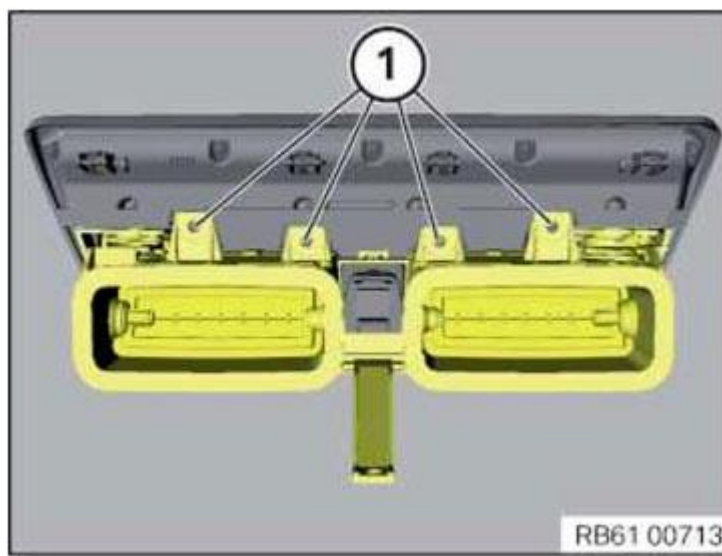
**Fig. 595: Pulling Radio And A/C Control Panel Out Of Instrument Panel Trim**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Release screws (1).



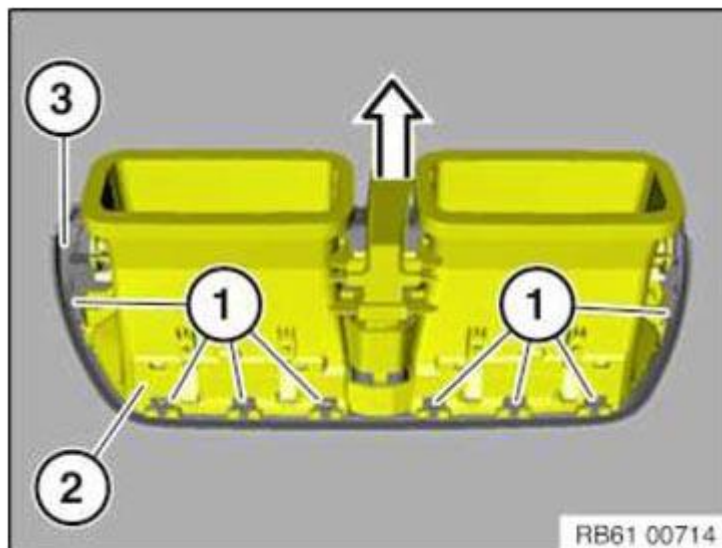


**Fig. 596: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Release latch mechanisms (1), remove fresh air grille (2) from radio and A/C control panel (3).



**Fig. 597: Removing Fresh Air Grille From Radio And A/C Control Panel**

Courtesy of BMW OF NORTH AMERICA, INC.

**61 31 043 REMOVING AND INSTALLING ROOF SWITCH CENTER**

**Special tools required:**

- [00 9 325](#)

IMPORTANT: Follow notes for [HANDLING LIGHT BULBS \(INTERIOR LIGHTING\)](#).

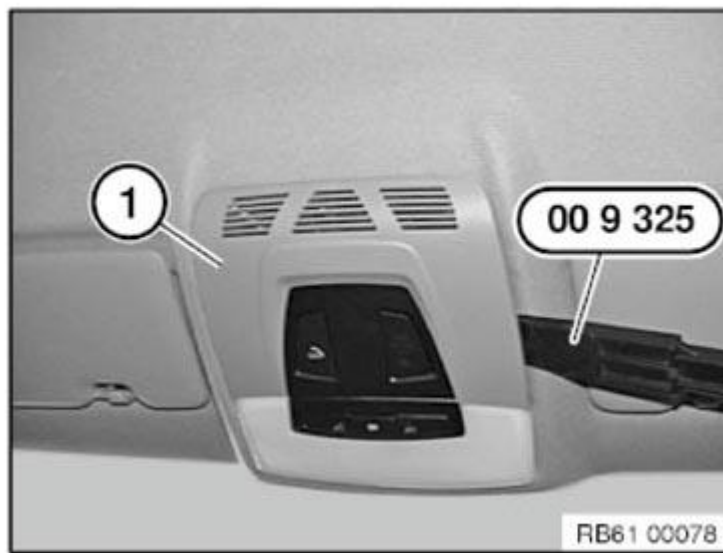
IMPORTANT: Read and comply with notes on [PROTECTION AGAINST ELECTROSTATIC DAMAGE \(ESD PROTECTION\)](#).

Carefully unclip and remove the trim (1) using special tool [00 9 325](#).

*Installation note:*

Ensure cover (1) is correctly seated.





**Fig. 598: Removing Roof Switch Cluster Cover Using Special Tool (00 9 325)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock left/right retaining lugs (1) with screwdriver (2) in direction of arrow.

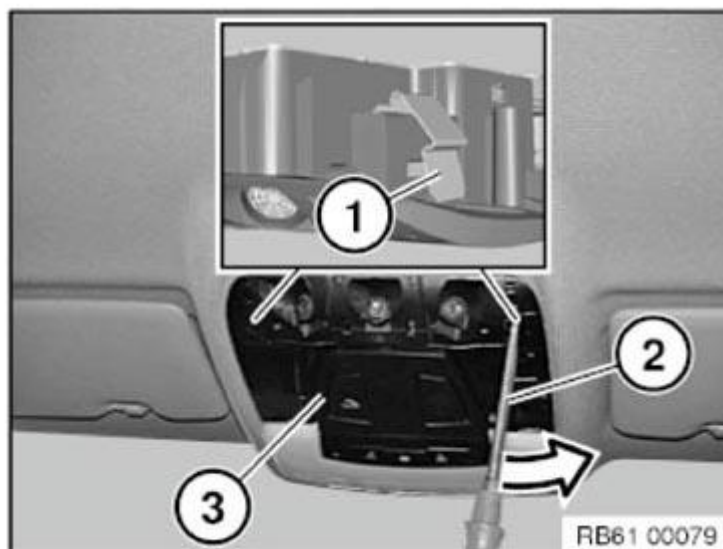
Remove roof switch cluster (3).

Unlock plug connections underneath and disconnect.

*Installation note:*

Retaining lugs (1) must not be damaged.

Make sure roof switch cluster (3) is correctly fitted.



**Fig. 599: Removing Roof Switch Cluster Retaining Lugs Using Screwdriver (Left/Right)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Disconnecting the plug connection for the SOS emergency call button results in fault entries  
 IMPORTANT: in the telephone control unit (restriction in the emergency call system).

After installation, read out fault memory and if necessary delete fault code entry.

If necessary, **INITIALIZE** slide/tilt sunroof.

## **61 31 197 REMOVING AND INSTALLING/RENEWING CENTER CONSOLE OPERATING FACILITY**

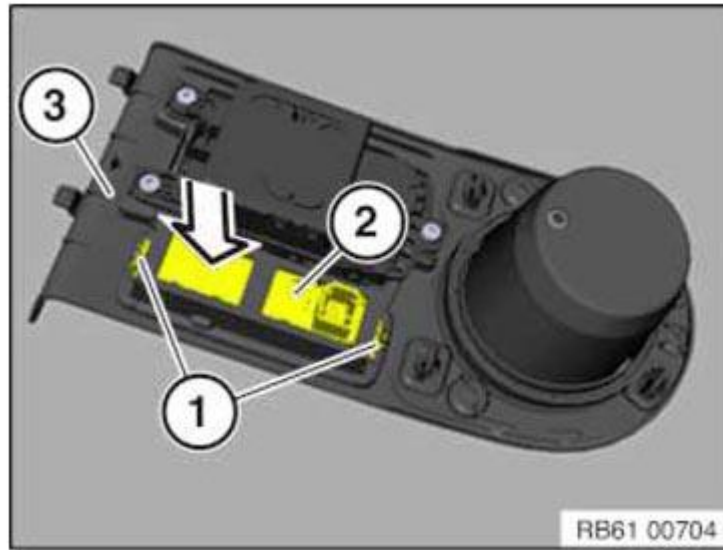
**Necessary preliminary tasks:**

- Remove **DECORATIVE TRIM ON CENTER CONSOLE**

**IMPORTANT:** **Risk of damage.**

Center console operating facility must not be pried out from the outside.

Release latch mechanisms (1) and press operating facility (2) out of trim (3).



**Fig. 600: Pressing Operating Facility Out Of Trim**

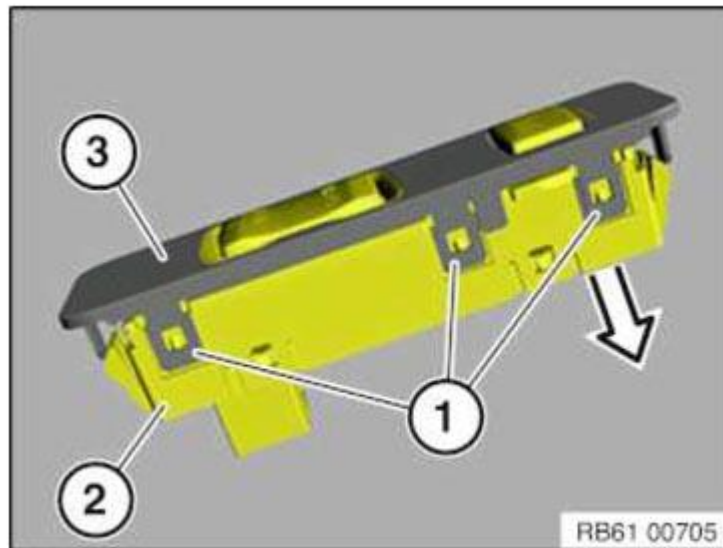
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Release catches (1) on both sides.

Remove operating unit (2) in direction of arrow from cover (3).

Remount trim (3).

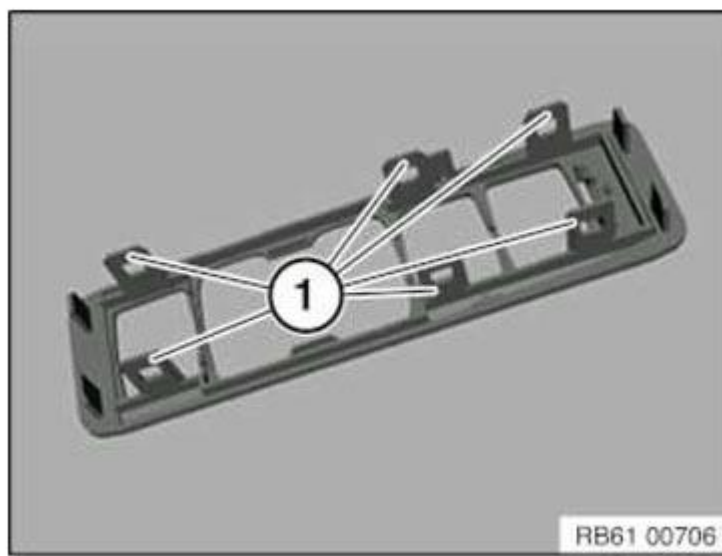


**Fig. 601: Removing Operating Unit From Cover**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Latch mechanisms (1) must not be damaged or missing.



**Fig. 602: Identifying Latch Mechanisms**  
Courtesy of BMW OF NORTH AMERICA, INC.

### 61 31 342 REMOVING AND INSTALLING/RENEWING GEAR SELECTOR SWITCH

**WARNING:** High-voltage system - risk of serious injury or death.  
The following points must be strictly observed prior to starting work :  
Disconnect **HIGH-VOLTAGE SYSTEM** from power  
Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

Necessary preliminary tasks:

- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Remove **STEERING COLUMN CONTROL PANEL**

Release screws (1).

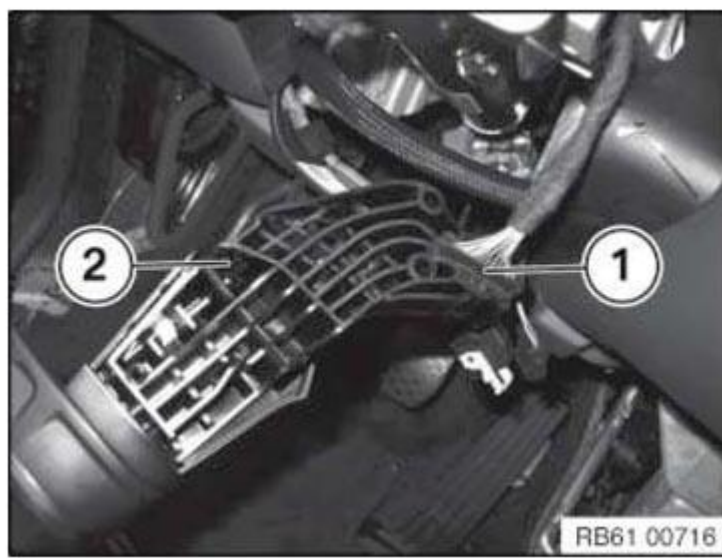
Tightening torque **61 31 1AZ** .

Remove gear selector switch (2) in direction of arrow.



**Fig. 603: Removing Gear Selector Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect plug connection (1) at gear selector switch (2).



**Fig. 604: Identifying Plug Connection And Gear Selector Switch**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING**.

**61 31 133 REMOVING AND INSTALLING/REPLACING A/V CONNECTING SOCKET**

**NOTE:** Operation is described in:  
 Remove **USB AUDIO INTERFACE CONNECTING SOCKET**.

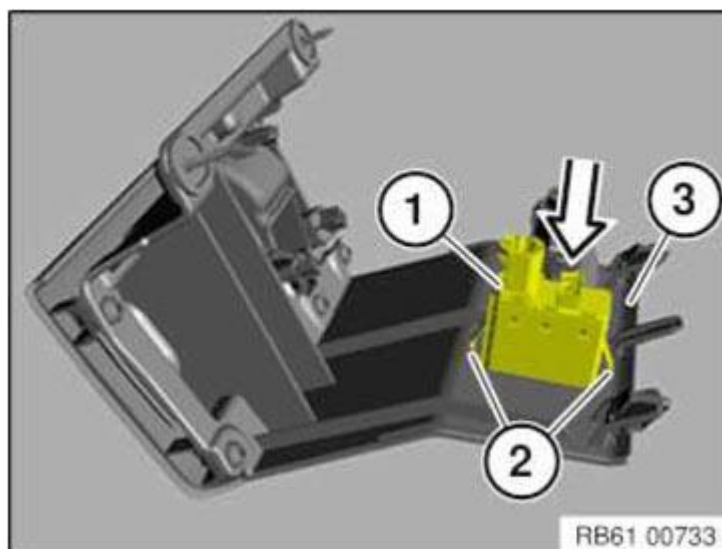
**61 31 134 REMOVING AND INSTALLING/REPLACING USB AUDIO INTERFACE CONNECTING SOCKET**

**Necessary preliminary tasks:**

- Remove **COVER FOR STORAGE COMPARTMENT**

Release connecting socket (1) on both sides of latch mechanism (2).

Press connecting socket (1) out of storage compartment (3) in direction of arrow.

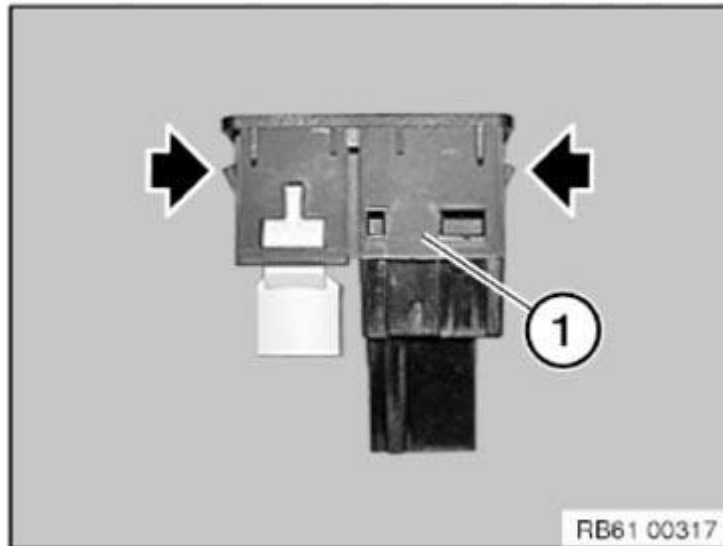


**Fig. 605: Pressing Connecting Socket Out Of Storage Compartment**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Connecting socket latch mechanisms (1) must not be damaged or missing

- Make sure connecting socket (1) is correctly fitted in storage compartment



**Fig. 606: Locating Connecting Socket Latch Mechanisms**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 31 241 REMOVING AND INSTALLING/REPLACING BONNET/HOOD CONTACT SWITCH**

Operation is described in:

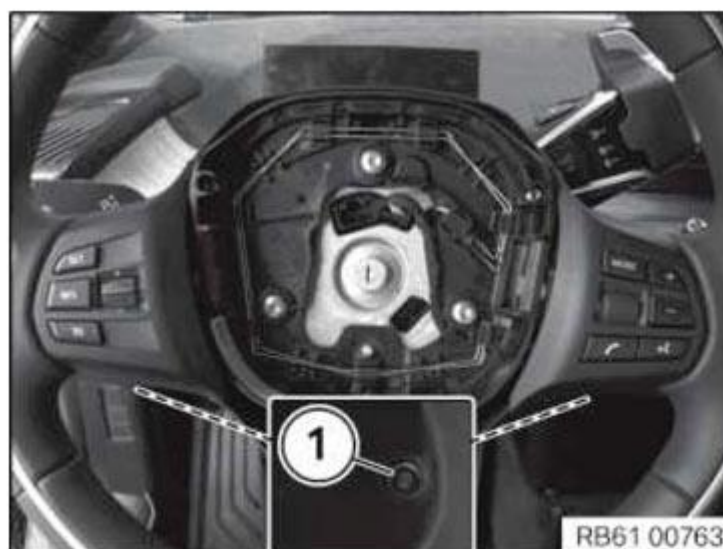
Removing and installing/replacing engine compartment lock

**61 31 221 REMOVING AND INSTALLING/REPLACING BOTH MULTIFUNCTION STEERING WHEEL SWITCHES**

Necessary preliminary tasks:

- Remove **AIRBAG UNIT**

Release screws (1) on left/right on back of steering wheel.



**Fig. 607: Identifying Screws On Steering Wheel**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull off both multifunction steering wheel switches (1) from steering wheel slightly.

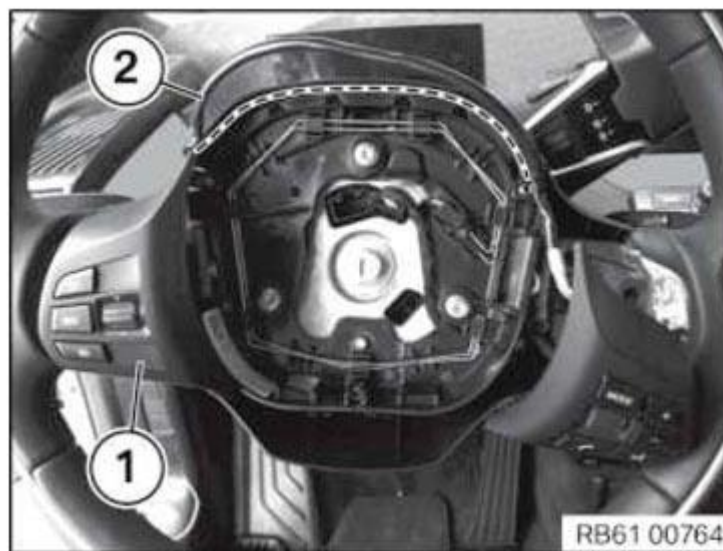
Feed cable (2) out of steering wheel trim.

*Installation note:*



Make sure multifunction steering wheel switch (1) is fitted correctly.

Make sure cable (2) correctly laid.



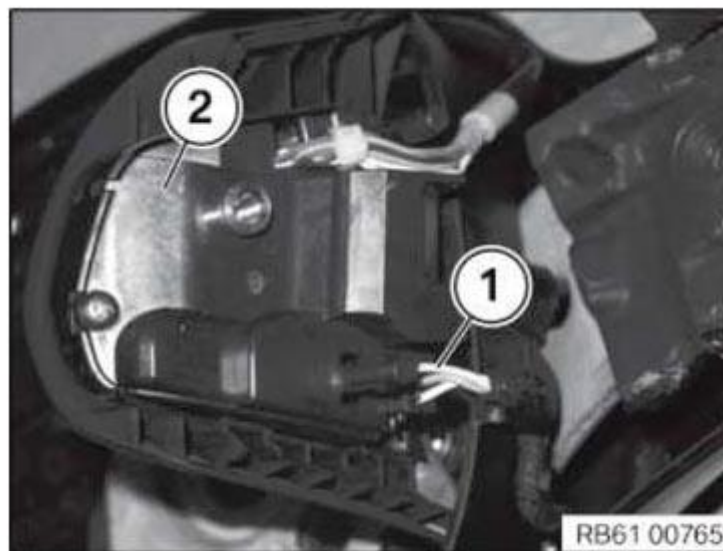
**Fig. 608: Identifying Multifunction Steering Wheel Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

Remove both multifunction steering wheel switches (2).

*Installation note:*

Make sure electrical wiring is correctly routed.



**Fig. 609: Identifying Plug Connection And Multifunction Steering Wheel Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **61 31 021 REMOVING AND INSTALLING/REPLACING EMERGENCY STARTING COIL**

**Necessary preliminary tasks:**

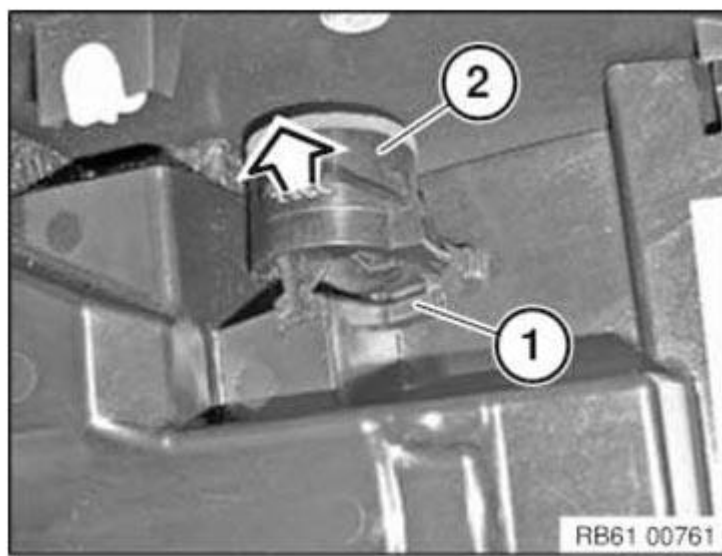
- Remove **STEERING COLUMN SHROUD LOWER SECTION**

Unlock latch mechanism (1) and pull ring aerial (2) out of steering column shroud in direction of arrow.

*Installation note:*

Make sure emergency starting coil (2) is correctly seated.





**Fig. 610: Pulling Ring Aerial Out Of Steering Column Shroud**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 31 037 REMOVING AND INSTALLING/REPLACING LIGHT OPERATING FACILITY**

**NOTE:** When working on trim panel components, make sure that the sensitive surfaces are not scratched or damaged.

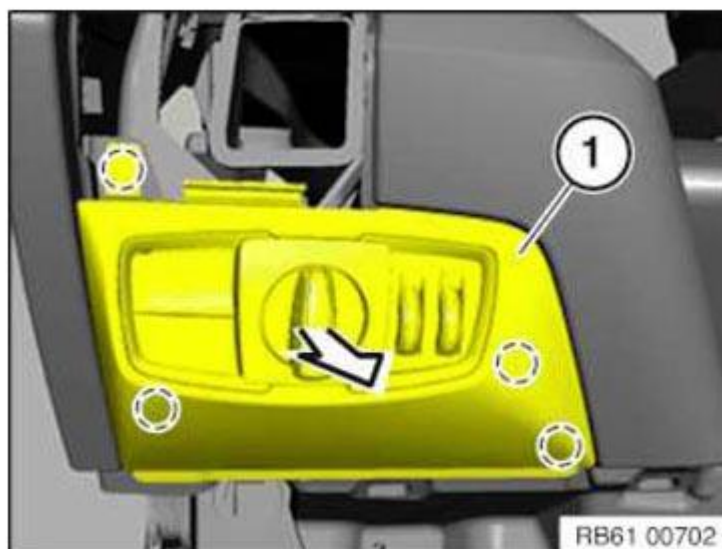
Necessary preliminary tasks:

- Remove left fresh air grille
- Partially release bottom center dashboard trim panel

Unclip trim with light operating facility (1).

Unlock associated plug connection and disconnect.

Remove cover with lighting operating facility (1).



**Fig. 611: Removing Cover With Lighting Operating Facility**  
Courtesy of BMW OF NORTH AMERICA, INC.

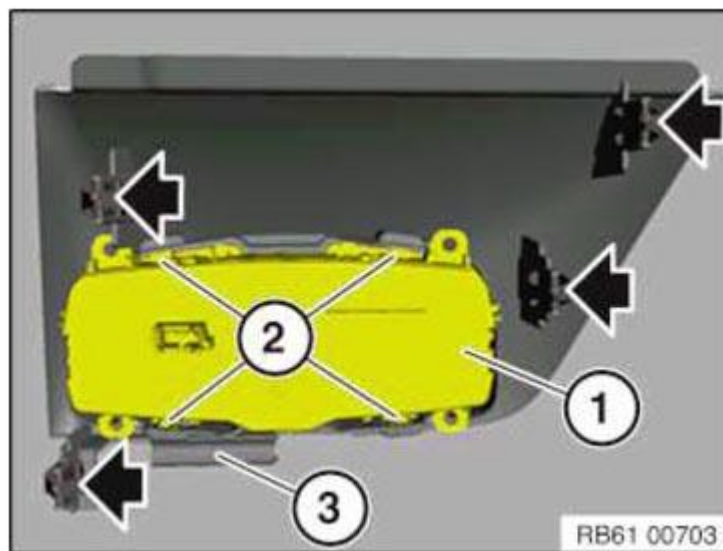
**Replacement:**

Release light operating facility (1) at latch mechanisms (2) and remove from trim (3).

*Installation note:*

Ensure correct latch mechanism of light operating facility (1) in trim (3).

Clamps on trim (3) must not be damaged or missing.



**Fig. 612: Locating Clamps On Trim**

Courtesy of BMW OF NORTH AMERICA, INC.

### **61 31 041 REMOVING AND INSTALLING/REPLACING OPERATING ELEMENT FOR ASSIST SYSTEM**

Special tools required:

- [00 9 340](#)

Lever out switch for hazard warning lights system/assist system (1) using special tool [00 9 340](#) as shown.



**Fig. 613: Removing Hazard Warning Lights System Switch Using Special Tool (00 9 340)**

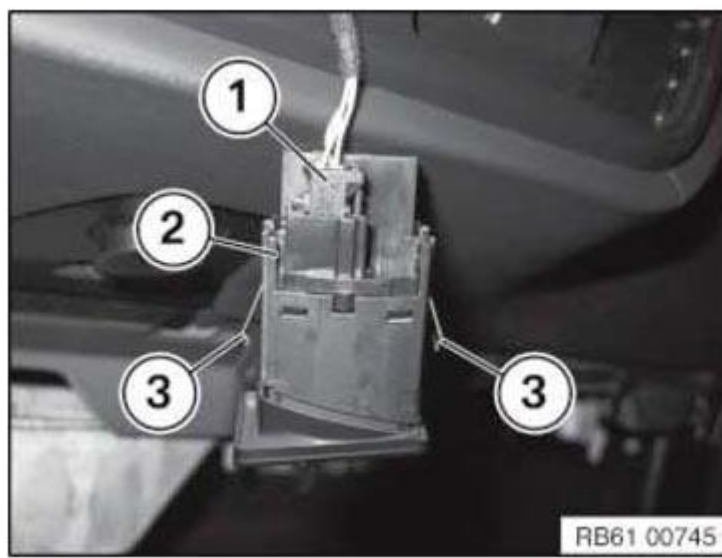
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

Remove switch for hazard warning lights system/assist system (2).

*Installation note:*

Clamps (3) on switch for hazard warning lights system/assist system (2) must not be damaged or missing.



**Fig. 614: Identifying Clamps On Hazard Warning Lights System/Assist System Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 31 117 REMOVING AND INSTALLING/REPLACING POWER WINDOW SWITCH (DRIVER'S SIDE)**

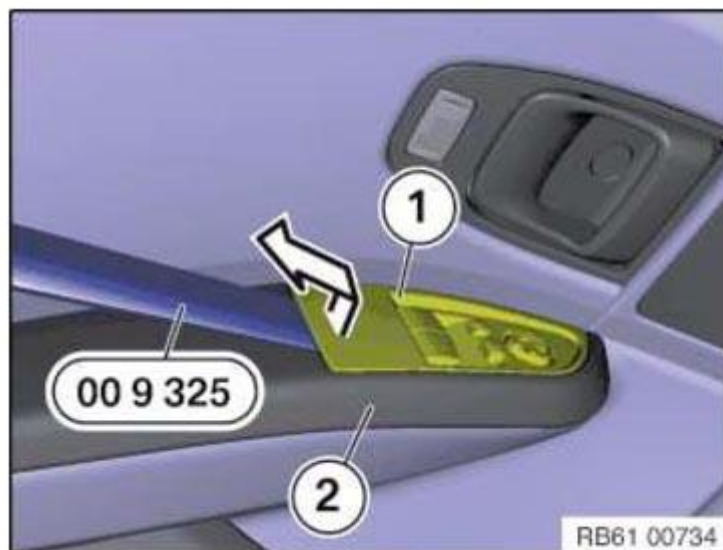
**Special tools required:**

- [00 9 325](#)

Carry out the following operation carefully so as to avoid damaging the door trim panel and  
IMPORTANT: switch.  
If necessary, tape off working area.

Lever power window switch (1) out of armrest (2) in direction of arrow using special tool [00 9 325](#).

Disconnect associated plug connection and remove power window switch (1).

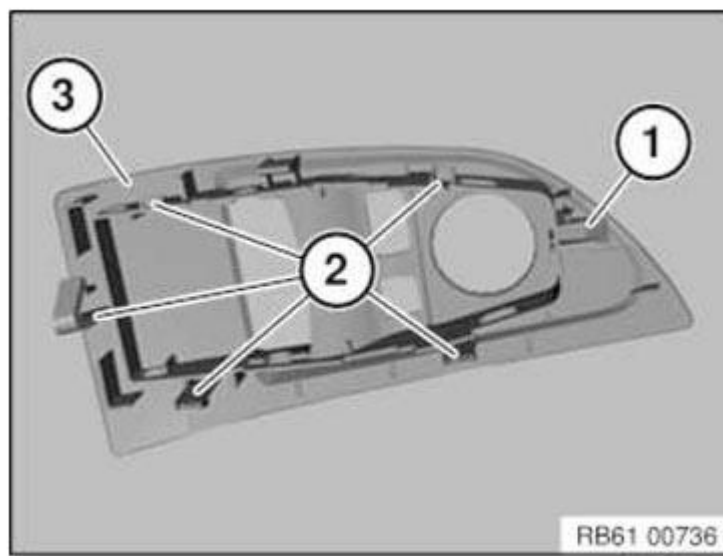


**Fig. 615: Removing Power Window Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

The guide (1) and latch mechanisms (2) on the trim (3) must not be damaged or missing.

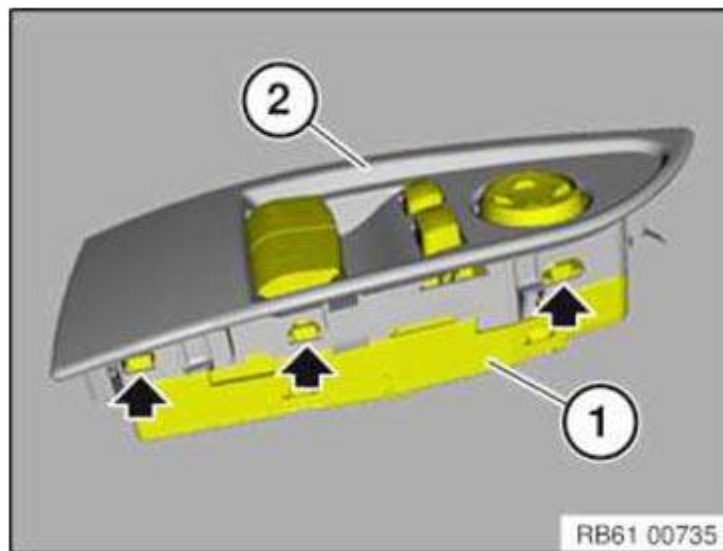
Make sure that the power window switch is correctly seated in the armrest.



**Fig. 616: Identifying Guide And Latch Mechanisms On Trim**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Release latch mechanisms on both sides and feed power window switch (1) out of trim (2).



**Fig. 617: Locating Power Window Switch Latch Mechanisms**  
 Courtesy of BMW OF NORTH AMERICA, INC.

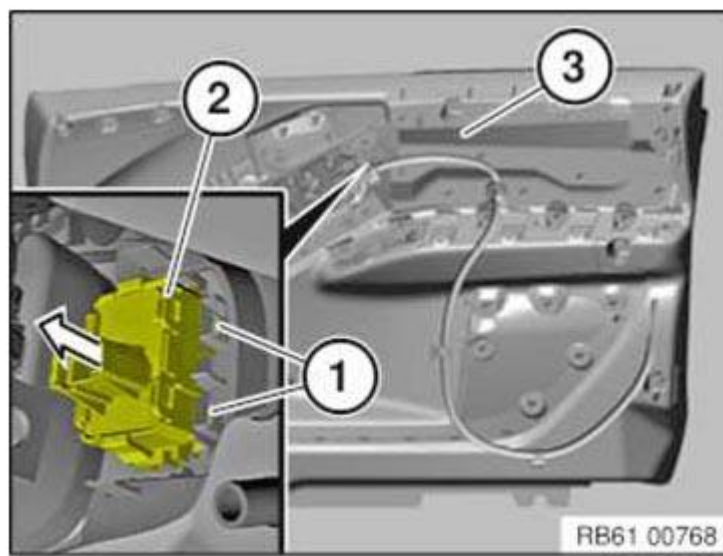
**61 31 082 REMOVING AND INSTALLING/REPLACING SWITCH FOR (LEFT OR RIGHT) CENTRAL LOCKING SYSTEM**

**Necessary preliminary tasks:**

- Remove **DOOR TRIM PANEL**

Unlock latch mechanisms (1) on both sides.

Remove switch for central locking system (2) from door trim panel (3) in direction of arrow.



**Fig. 618: Removing Switch For Central Locking System From Door Trim Panel**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 31 172 REMOVING AND INSTALLING/REPLACING SWITCH FOR ELECTROMECHANICAL PARKING BRAKE**

**WARNING:** High-voltage system - risk of serious injury or death.  
 The following points must be strictly observed prior to starting work :  
 Disconnect **HIGH-VOLTAGE SYSTEM** from power  
 Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

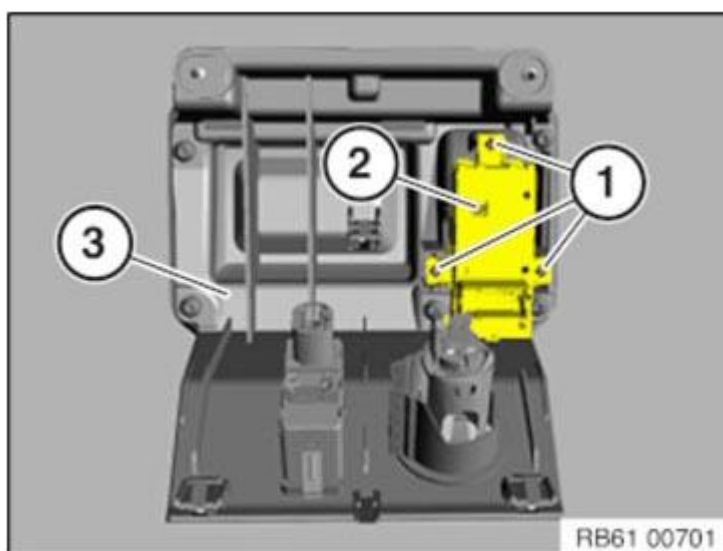
Necessary preliminary tasks:

- Disconnect **NEGATIVE BATTERY CABLE** (to avoid fault memory entries)
- Remove **COVER FOR STORAGE COMPARTMENT**

Release screws (1).

Tightening torque **61 31 2AZ** .

Remove switch for electromechanical parking brake (2) from cover for gear selector switch (3).



**Fig. 619: Identifying Electromechanical Parking Brake Switch And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

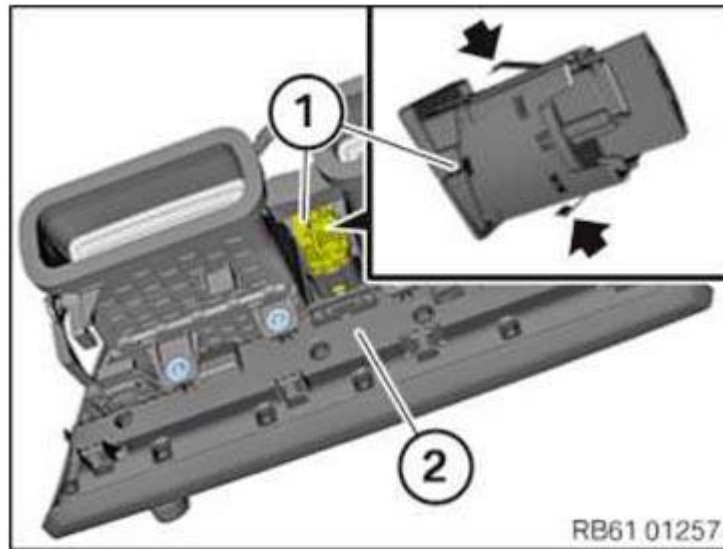
**61 31 080 REMOVING AND INSTALLING/REPLACING SWITCH FOR HAZARD WARNING FLASHERS**



**Necessary preliminary tasks:**

- Remove **RADIO AND IHKA CONTROLS**

Release switch for hazard warning lights system (1) on clamps and press from the radio-and IHKA controls (2).

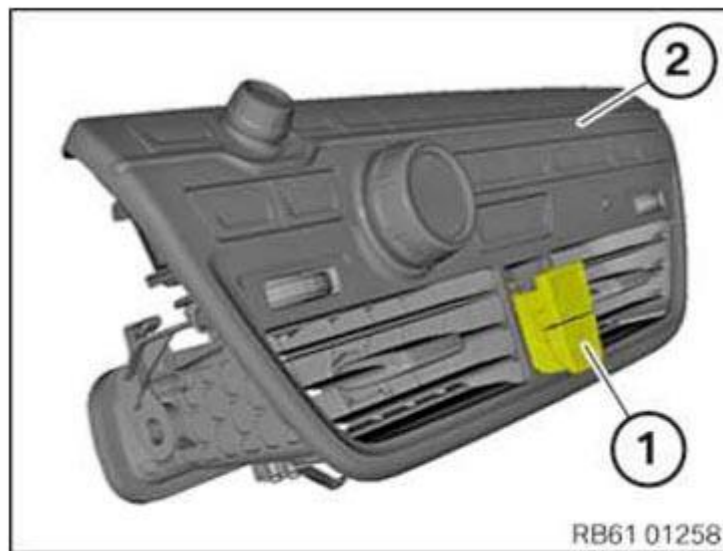


**Fig. 620: Locating Hazard Warning Lights System Switch On Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Clamps to switch for hazard warning lights system (1) may not be damaged or missing.

Connect switch for hazard warning lights system (1) to the radio- and IHKA controls (2).



**Fig. 621: Identifying Hazard Warning Lights System Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Install **RADIO AND IHKA CONTROLS**

**61 31 499 REMOVING AND INSTALLING/REPLACING THE MICROSWITCH ON THE TAILGATE (OPEN)**

**Necessary preliminary work:**

- Lower the **HEADLINING** at the rear left

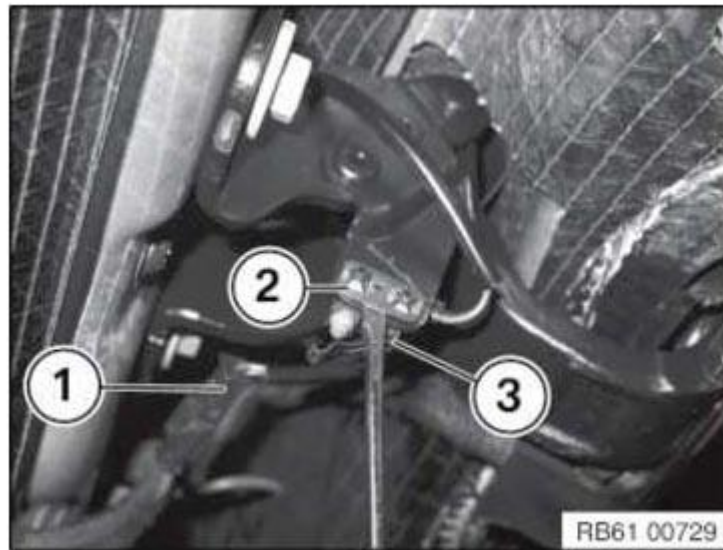


Unfasten plug connection (1) and disconnect.

Work out retaining clip (2).

Unfasten cable strap.

**NOTE:** Watch out for any falling plastic washers when removing the tailgate microswitch (3).

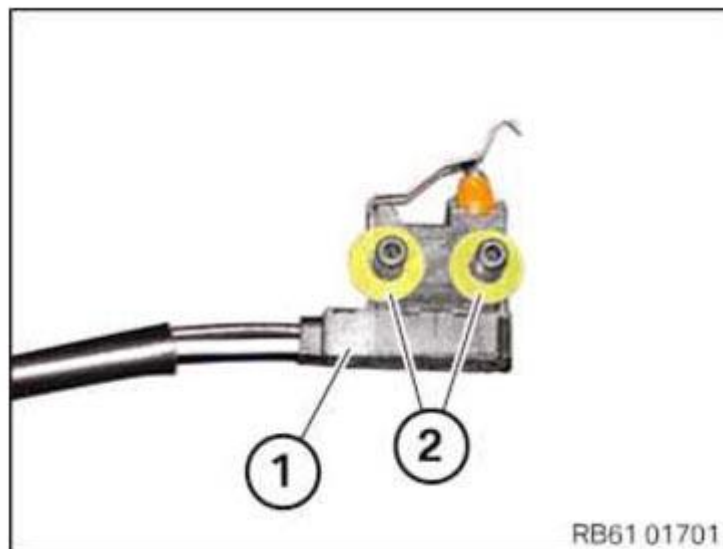


**Fig. 622: Removing Tailgate Microswitch**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove the tailgate microswitch (3).

*Installation note:*

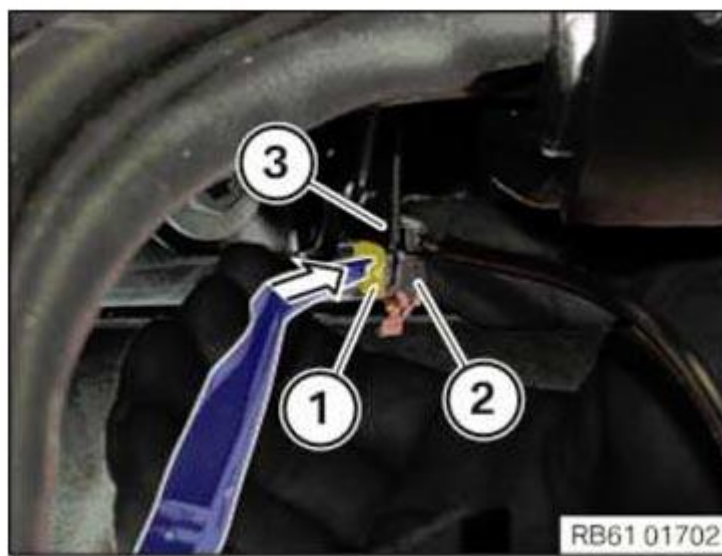
Tailgate microswitch (1) must be installed using the associated plastic washers (2) only.



**Fig. 623: Identifying Tailgate Microswitch And Associated Plastic Washers**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Press on the locking plate (1) of the tailgate microswitch (2) using a suitable tool to ensure that the tailgate microswitch (2) is positioned on the hinge (3) without clearance.



**Fig. 624: Pressing Locking Plate Of Tailgate Microswitch**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage.  
 Do not jam/squash the tailgate microswitch (2).

**61 31 492 REPLACING LEVEL SWITCH FOR WINDSCREEN WASHER SYSTEM**

Necessary preliminary tasks:

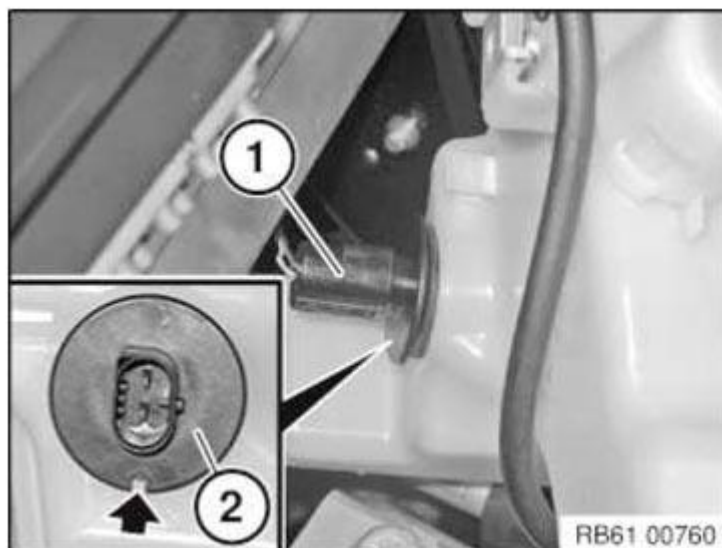
- Release **WASHER FLUID RESERVOIR FOR WINDOW WASHER SYSTEM**

Unfasten plug connection (1) and disconnect.

Pull level switch (2) out of washer fluid reservoir.

*Installation note:*

Make sure level switch is in the correct position (anti-twist lock) in the washer fluid reservoir.



**Fig. 625: Locating Washer Fluid Level Switch**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 31 544 REPLACING ROOF SWITCH CLUSTER**

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

**Necessary preliminary tasks:**

- Remove **ROOF SWITCH CLUSTER**

Release interior roof light (1) at clamps (2) and feed out of roof switch cluster (3).

*Installation note:*

Clips (2) must not be missing or damaged.

Make sure interior roof light (1) is correctly seated in roof switch cluster (3).



**Fig. 626: Identifying Interior Roof Light, Clamps And Roof Switch Cluster**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carry out **VEHICLE PROGRAMMING/ENCODING**.

**61 31 118 REPLACING THE POWER WINDOWS REGULATOR ON THE PASSENGER'S SIDE**

**Special tools required:**

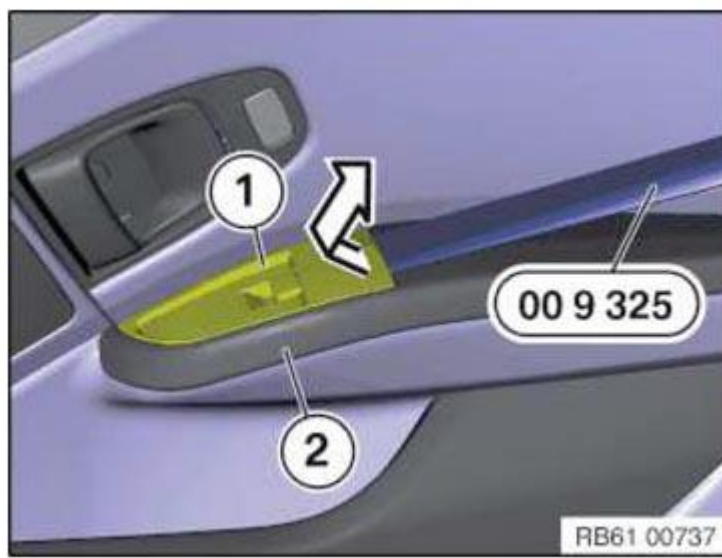
- **00 9 325**

Carry out the following operation carefully so as to avoid damaging the door trim panel and  
IMPORTANT: switch.

If necessary, tape off working area.

Lever power window switch (1) in direction of arrow out of armrest (2) using special tool **00 9 325** .

Disconnect associated plug connection and remove power window switch (1).

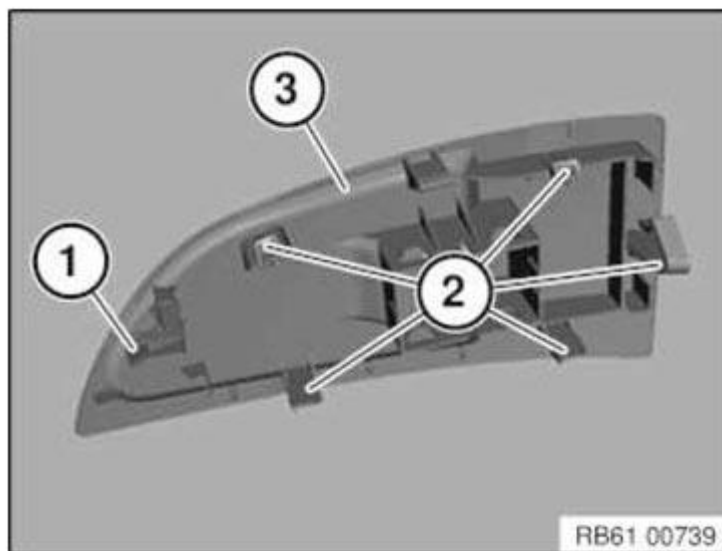


**Fig. 627: Removing Power Window Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

The guide (1) and latch mechanisms (2) on the trim (3) must not be damaged or missing.

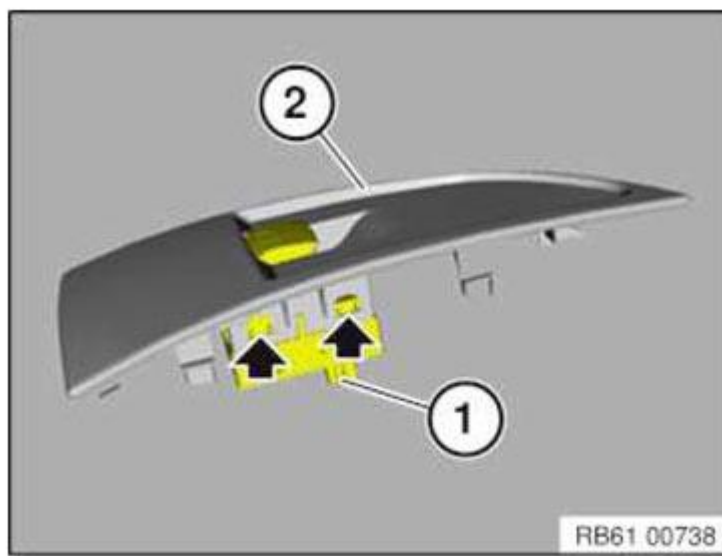
Make sure that the power window switch is correctly seated in the armrest.



**Fig. 628: Identifying Guide And Latch Mechanisms On Trim**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Release latch mechanisms on both sides and feed power window switch (1) out of trim (2).

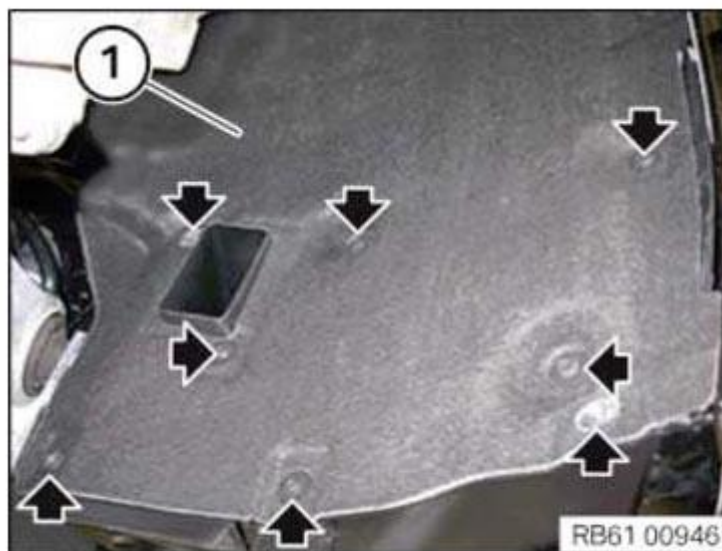


**Fig. 629: Locating Power Window Switch Latch Mechanisms**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 31 492 REPLACING WASHER FLUID LEVEL SWITCH FOR WINDOW WASHER SYSTEM**

**Removal:**

Loosen all screws and fold the wheel arch cover (1) out of the way.

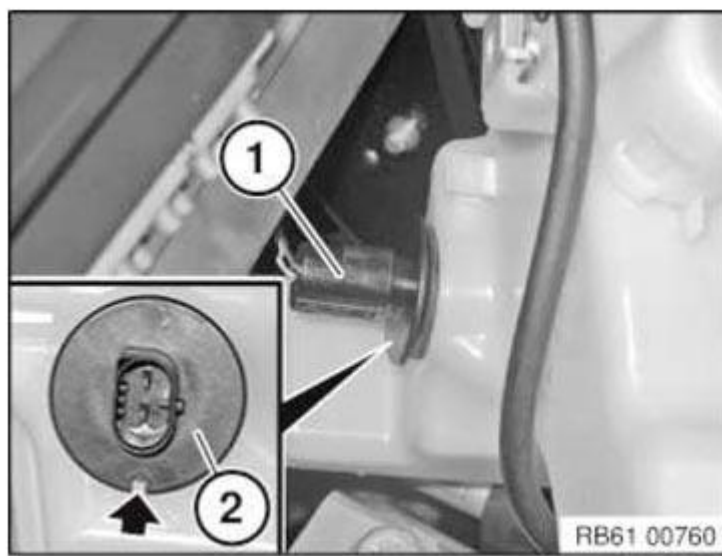


**Fig. 630: Locating Wheel Arch Cover Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Catch any escaping washer fluid if necessary.

Unlock and disconnect the connector (1).

Pull the washer fluid level switch (2) out of the washer fluid reservoir.



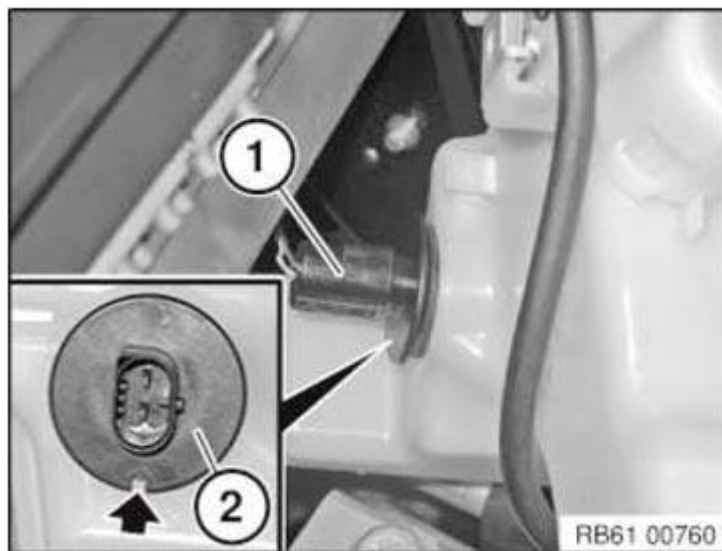
**Fig. 631: Locating Washer Fluid Level Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Insert the washer fluid level switch (2) into the washer fluid reservoir.

Connect the connector (1).

**NOTE:** Make sure the washer fluid level switch (2) is installed in the correct position in the washer fluid reservoir (anti-twist lock).

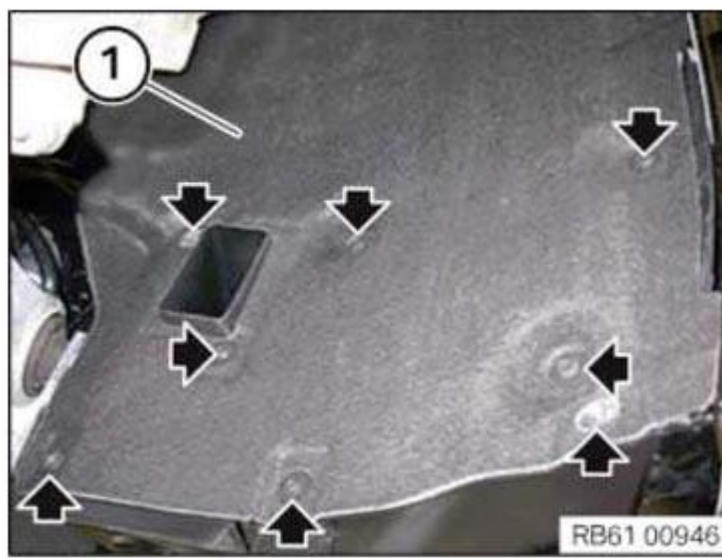


**Fig. 632: Locating Washer Fluid Level Switch**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attach the wheel arch cover (1) and tighten with the screws.

If necessary, top up washer fluid reservoir.





**Fig. 633: Locating Wheel Arch Cover Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **FANFARE, HORN**

### **61 33 050 REMOVING AND INSTALLING/REPLACING RIGHT FANFARE HORN**

#### **Necessary preliminary tasks:**

- Release **FRONT WHEEL ARCH COVER** at front area

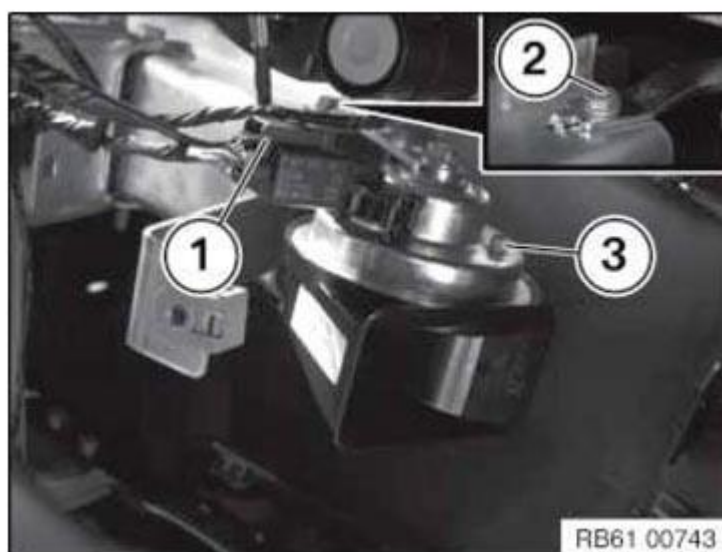
Unfasten plug connection (1) and disconnect.

Release screw (2).

Remove fanfare horn (3).

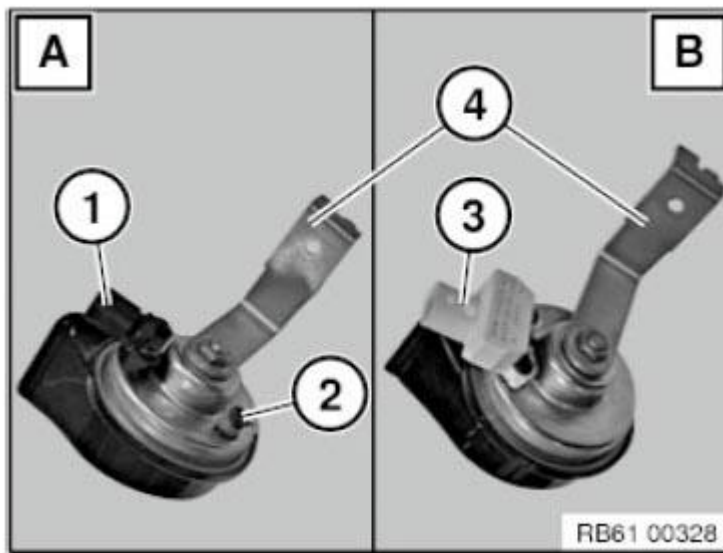
*Installation note:*

Insert guide pin on holder into corresponding bore hole on support for bumper panel.



**Fig. 634: Identifying Fanfare Horn, Plug Connection And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Electromechanical fanfare is installed as standard.  
 The electronic fanfare is only installed in China, India, Russia, South Africa and Gulf states as of 01/2011.



**Fig. 635: Identifying Electromechanical And Electronic Fanfare**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- A. A: Electromechanical fanfare
- B. B: Electronic fanfare

Distinguishing features:

- Electromechanical fanfare has a black connector (1)
- Electronic fanfare has a white connector (3)
- Only the electromechanical fanfare has no adjusting screw (2)
- Holder (4) is vehicle-specific and may deviate from the graphic.

## **12V POWER SOCKET, CIGARETTE LIGHTER**

### **61 34... REMOVING AND INSTALLING/REPLACING 12V POWER SOCKET**

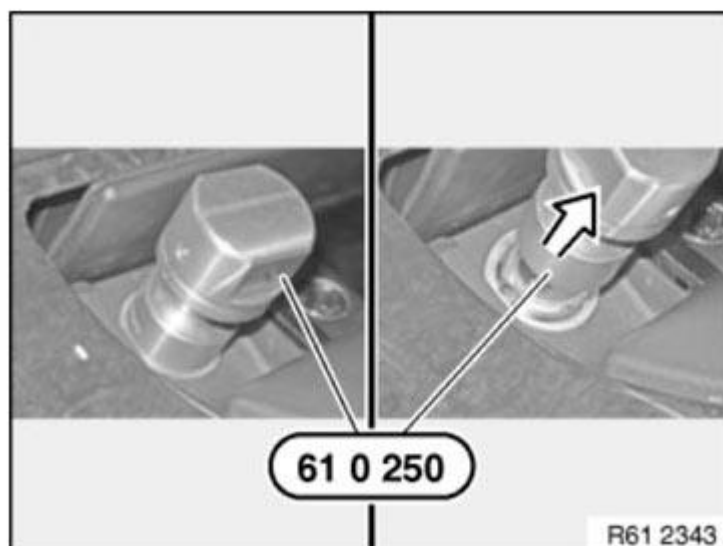
**Special tools required:**

- 61 0 250

**Depending on equipment, the following power sockets may be fitted:**

- Power socket in **FRONT CENTER CONSOLE**
- Power socket in **LUGGAGE COMPARTMENT**

Pull out 12-V power socket from housing with special tool 61 0 250 until connector is at bottom of light ring.



## **CONTROL UNITS, MODULES, SENSORS, AERIALS**

### **61 00... ENCODE/PROGRAM CONTROL UNIT(S)**

**NOTE:** Depending on the vehicle and the equipment, the following flat rate unit items are available for programming/encoding:

- 61 00 710
- 61 00 720
- 61 00 730

**NOTE:**

- In order to avoid incorrect programming procedures and Check Control message, it is essential to always use the most recent version when working with the ISTA/P programming system.
- Battery voltage must not drop below 13.0 V during programming. Connect battery charger prior to programming.

**Only use battery chargers recommended by BMW for low voltage vehicle electrical system.**

**No high-voltage switch off is required in electric vehicles or hybrid vehicles for programming/encoding.**

**IMPORTANT:** The high-voltage system will be automatically switched off by the programming system.

**Exception:**

BMW I01.

#### **programming routine via ISTA/P:**

- Connect the battery charger to the vehicle.
- Connect the programming system with the vehicle.
- Determine the action plan.
- Accept action plan with the control units to be programmed/encoded and enabled, if necessary or work through.
- Observe the reworking list.
- If applicable, connect the workshop system to the vehicle, depending on the reworking list. Perform brief test and delete fault memory.

**NOTE:** A switch to the workshop system may not necessarily be required with the integration of the service functions and the "Delete fault memory" function in ISTA/P. Check the rework list accordingly.

### **61 35... NOTES ON ESD PROTECTION (ELECTRO STATIC DISCHARGE)**

#### **Special tools required:**

- 12 7 060

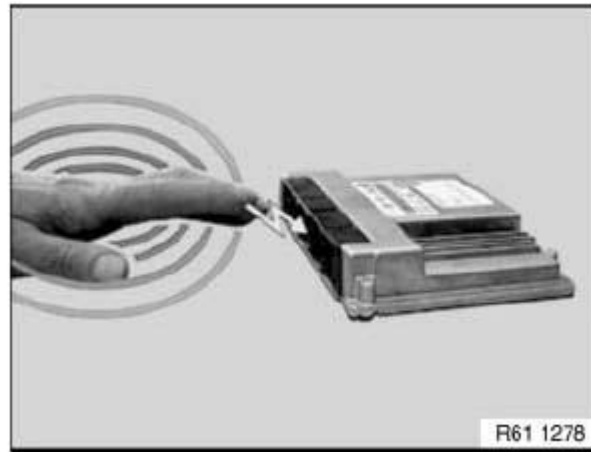
**NOTE:** Electrical components which are particularly sensitive to electrostatic discharge (electronic control units, sensors, etc.) are marked with the ESD warning symbol.  
**E-Electro**

**S-Static  
D-Discharge**

IMPORTANT: See [7060 ANTISTATIC MAT](#)

Statically charged persons can discharge themselves when they touch electrical components.

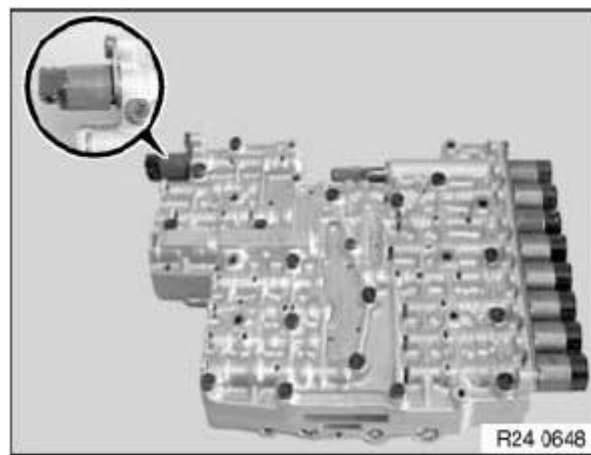
**NOTE:** Humans can only detect a discharge starting from a level of approx. 3000 V. The danger threshold for electrical components already starts from a level of approx. 100 V.



**Fig. 637: Caution - Electro Static Discharge Touch Electrical Components**  
Courtesy of BMW OF NORTH AMERICA, INC.

Example:

Mechatronic control unit.



**Fig. 638: Identifying Mechatronic Control Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 639: Caution - Do Not Touch Pins And Multi-Pin Connectors Directly**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Do not touch pins and multi-pin connectors directly.

Touch electrical components by their housings only.

To avoid damaging or destroying electrical components as a result of electrostatic discharge, it is absolutely essential to observe the following instructions:

- IMPORTANT:
- When replacing electrical components, leave the replacement components in their original packaging until immediately before they are to be installed
  - If necessary, always return a removed component in its original packaging (always pack the component away immediately)
  - Read and comply with user information on using the associated special tool 12 7 060

**Personal protective equipment:**

Electrically conducting clothing (high wool content, antistatic shoes required).

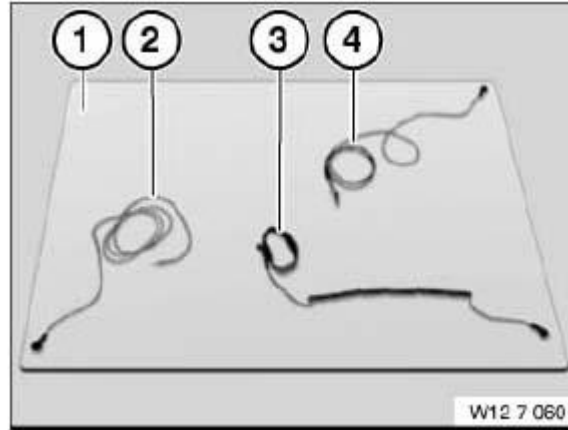
These can primarily be identified by the logo on the side.



**7060 Antistatic mat**

0495054 127060 Antistatic mat MW

**NOTE:** (Antistatic mat) ESD (Electronic Static Discharge) = electrostatic discharge  
 For protection against ESD during repairs to electronic components.  
 (Replaces the sub-number 12 7 192 from EPROM tool kit 12 7 190) [Released]



**Fig. 641: Identifying Antistatic Mat (0495054)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 35... OVERVIEW, RAIN SENSOR (ADDITIONAL WORK WHEN REPLACING THE WINDSCREEN/SENSOR REPLACEMENT)**

Sensor type/ Sensor shape	With windscreen replacement replacement sensor required	When replacing the sensor Programming/encoding necessary	When replacing the sensor Initialization required	Connecting the diagnosis system required
all types approximately $\tilde{A}$ , 35 mm	No	No	No	No

**61 35... REMOVING AND INSTALLING (REPLACING) CHARGING INTERFACE MODULE CONTROL UNIT**

**WARNING:** High-voltage system - risk of serious injury or death.  
 The following points must be strictly observed prior to starting work :  
 Disconnect **HIGH-VOLTAGE SYSTEM** from power  
 Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

**WARNING:** Observe **SAFETY INFORMATION** for handling vehicle battery.  
 Follow instructions for **DISCONNECTING AND CONNECTING BATTERY** .  
 Follow instructions on **INTELLIGENT BATTERY SENSOR (IBS)**.

**IMPORTANT:** Before disconnecting the negative lead, it must be ensured that the vehicle goes to sleep.  
 Observe a waiting period of at least 2 minutes.

**Necessary preliminary tasks:**

- Disconnect **BATTERY EARTH LEAD**
- Remove **REAR RIGHT WHEEL ARCH COVER**

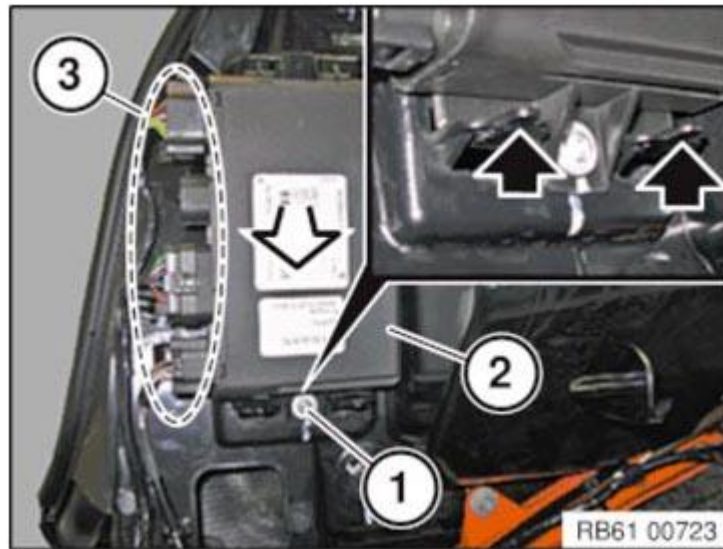
**NOTE:** Shown with side wall removed for purposes of clarity.



Release screw (1).

Unlock latch mechanisms and remove charging interface module control unit (2) from bracket.

Unlock plug connections (3) and disconnect.



**Fig. 642: Removing Charging Interface Module Control Unit From Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING**.

**61 35 980 REMOVING AND INSTALLING/REPLACING AERIAL FOR COMFORT ACCESS ON LEFT (OR RIGHT)**

**Necessary preliminary tasks:**

- Remove **REAR DOOR TRIM PANEL**

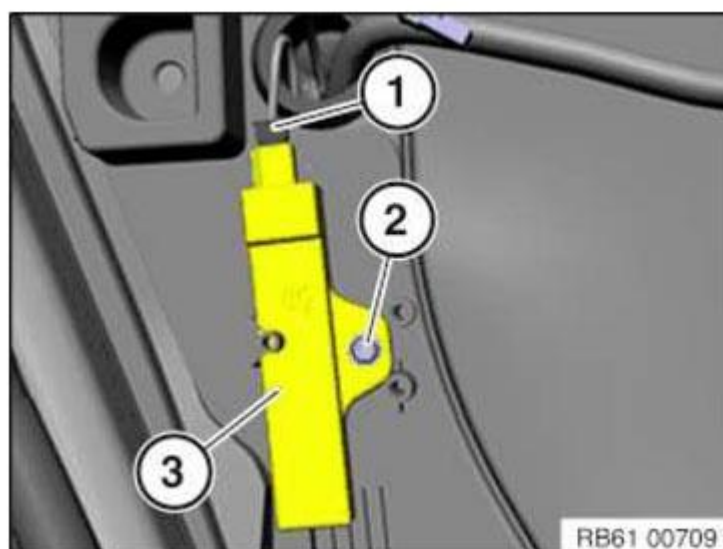
Disconnect plug connection (1).

Release screw (2).

Remove aerial for Comfort Access (3).

*Installation note:*

Ensure that aerial for Comfort Access (3) is correctly seated.



## **61 35 975 REMOVING AND INSTALLING/REPLACING BUMPER AERIAL FOR COMFORT ACCESS**

### **Necessary preliminary tasks:**

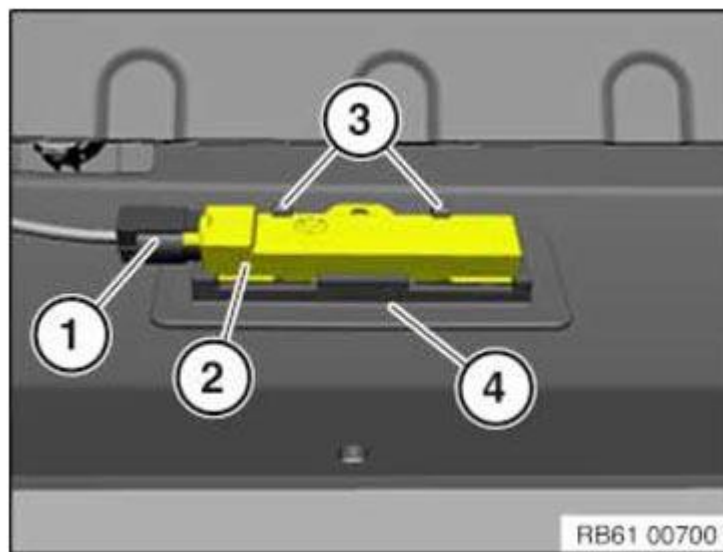
- Remove **REAR UNDERBODY PANELLING**

Disconnect plug connection (1).

Release bumper aerial for Comfort Access (2) on latch mechanism (3) and remove from holder (4).

### *Installation note:*

Ensure that bumper aerial for Comfort Access (2) is correctly seated in holder (4).



**Fig. 644: Identifying Comfort Access Bumper Aerial On Latch Mechanism And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **61 35 360 REMOVING AND INSTALLING/REPLACING CONTROL UNIT FOR CAMERA-BASED DRIVER SUPPORT SYSTEMS (KAFAS)**

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

### **Necessary preliminary tasks:**

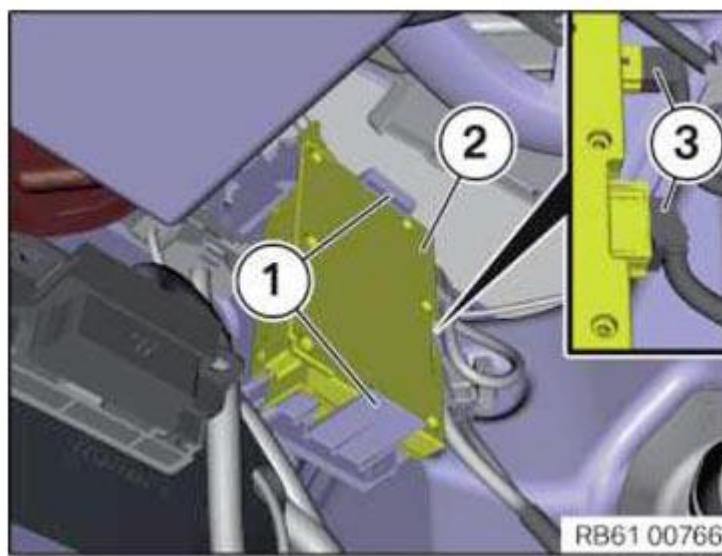
- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Remove **TRIM PANEL FOR PEDAL MECHANISM**

**NOTE:** For purposes of clarity, schematic diagram shows footwell side trim panel removed.

Release latch mechanisms on equipment holder (1) in direction of arrow.

Feed out control unit (2) from equipment holder towards top.

Disconnect plug connections (3) and remove control unit (2).



**Fig. 645: Releasing Latch Mechanisms On Equipment Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Make sure control unit (2) is correctly installed in equipment holder.

**Replacement:**

Carry out **PROGRAMMING/CODING**.

**Carry out calibration:**

- Service function
- Body
- Display and information functions
- Camera-based driver support systems
- Calibration of lane departure warning

**61 35 095 REMOVING AND INSTALLING/REPLACING CONTROL UNIT/MODULE FOR SEAT HEATING**

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

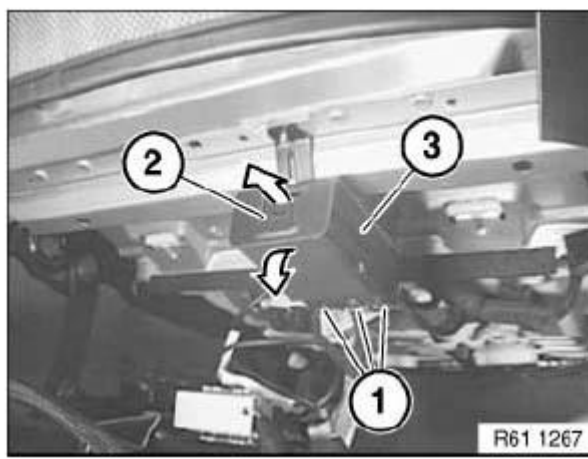
**NOTE:** To facilitate installation/removal of control unit, move seat upwards and to the rear fully.

Disconnect plug connection (1).

Open lock (2) in direction of arrow and remove control unit/module for seat heating (3) towards bottom.

*Installation note:*

Make sure control unit/module for seat heating (3) is correctly engaged.



**Fig. 646: Opening Lock**

Courtesy of BMW OF NORTH AMERICA, INC.

**61 35 953 REMOVING AND INSTALLING/REPLACING INTERIOR AERIAL FOR COMFORT ACCESS (FRONT STORAGE COMPARTMENT)**

**Necessary preliminary tasks:**

- Remove **DECORATIVE TRIM ON CENTER CONSOLE**

Disconnect plug connection (1).

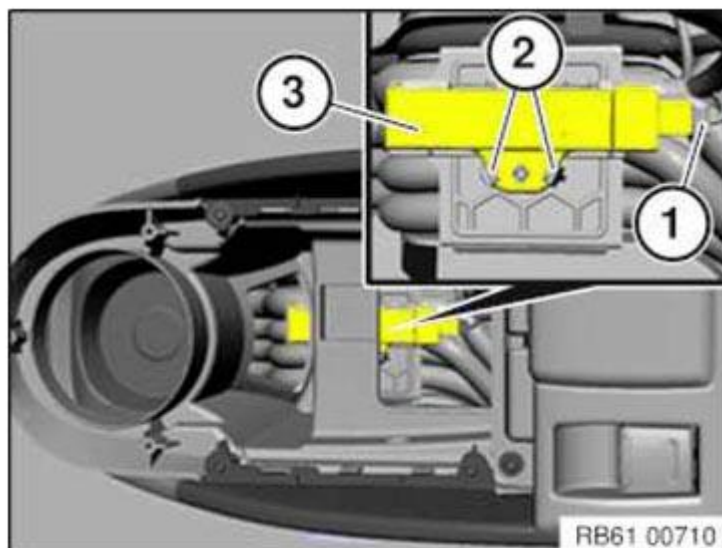
Release catches (2).

Remove interior aerial (3) from holder (4).

*Installation note:*

Make sure interior aerial (3) is correctly fitted.

Make sure plug connection (1) is correctly seated.



**Fig. 647: Identifying Catches, Interior Aerial And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

**61 35 954 REMOVING AND INSTALLING/REPLACING INTERIOR AERIAL FOR COMFORT ACCESS SYSTEM (REAR CENTER CONSOLE)**

**Necessary preliminary tasks:**

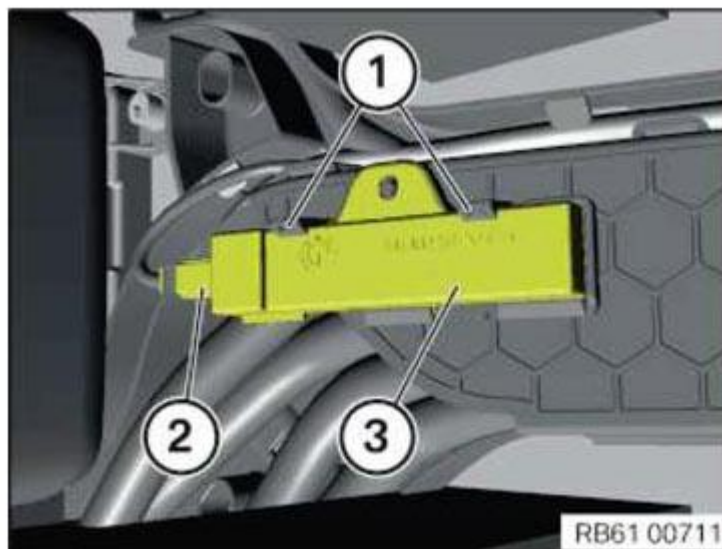
- Remove **REAR CENTER CONSOLE TRIM**

Unfasten plug connection (2) and disconnect.

Release latch mechanisms (1) and remove interior aerial (3).

*Installation note:*

Make sure plug connection (2) and interior aerial (3) are correctly seated.



**Fig. 648: Identifying Latch Mechanisms, Plug Connection And Interior Aerial**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **61 35... REMOVING AND INSTALLING/REPLACING THE CAR SHARING MODULE**

**Special tools required:**

- [2 354 571](#)

**NOTE:** Use the ignition key for service-relevant journeys or activities with a car sharing vehicle. Do not book journeys. The Car Sharing Module is located in the center armrest.

Open lid of center armrest (1). Insert special tool [2 354 571](#) in Car Sharing Module (3) as shown and press down.

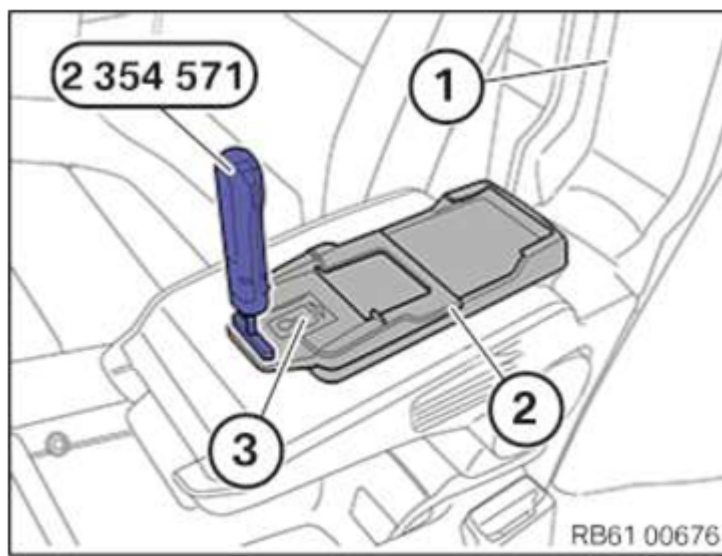
Remove Car Sharing Module (3) from base plate (2).

**Replacement:**

**After installing a new Car Sharing Module, proceed as follows:**

1. Lock vehicle with ignition key.
2. Wait until the green LED on the external reader lights up.

(The external reader is located on the windscreen in the bottom left corner in the direction of travel.)



**Fig. 649: Removing Car Sharing Module From Base Plate**  
Courtesy of BMW OF NORTH AMERICA, INC.

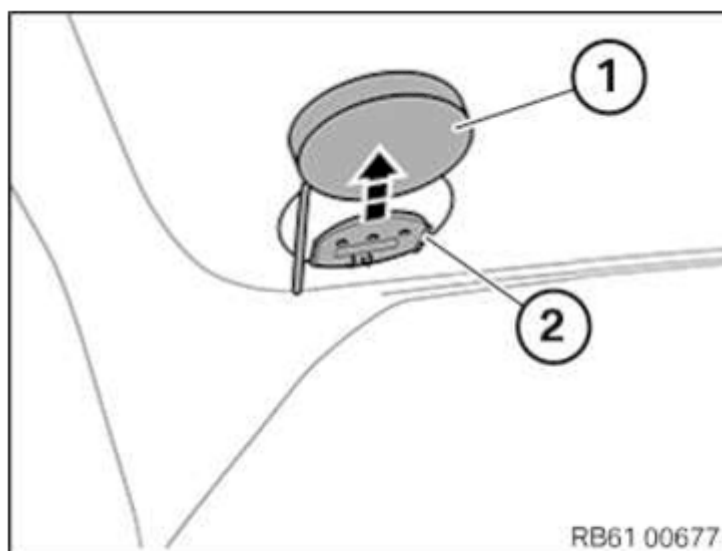
### **61 35... REMOVING AND INSTALLING/REPLACING THE EXTERNAL READER (CAR SHARING MODULE)**

**NOTE:** Use the ignition key for service-relevant journeys with a car sharing vehicle. Do not book journeys. The external reader is located on the windscreen in the bottom left corner in the direction of travel.

**Removing the external reader:**

Pull off external reader (1) from base (2) in upward direction.

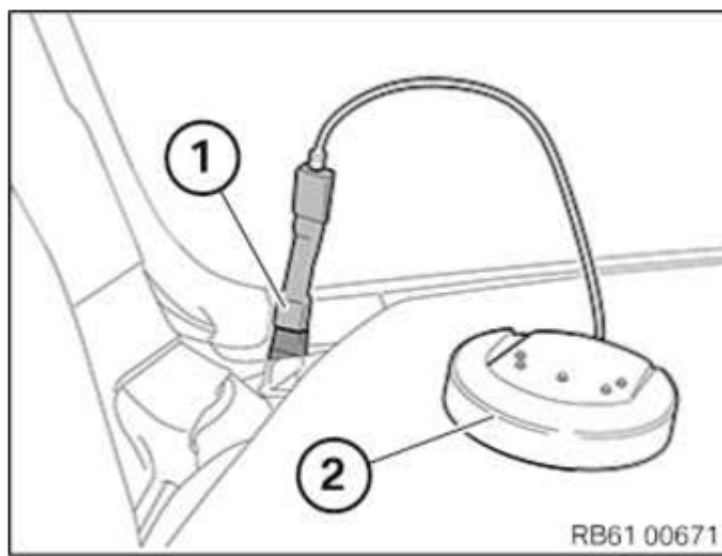
### **REMOVING A-PILLAR TRIM PANEL ON DRIVER'S SIDE**



**Fig. 650: Pulling External Reader From Base**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1). Remove external reader (2).

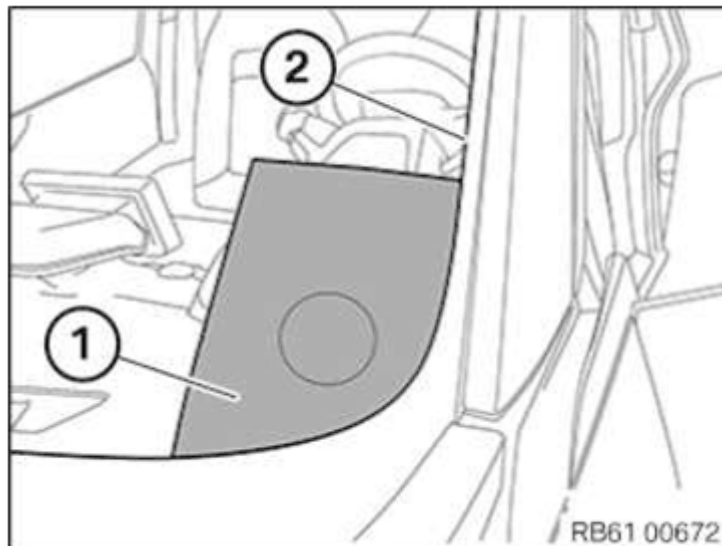




**Fig. 651: Identifying External Reader And Plug Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Installing external reader after windscreen replacement:**

*Installation note:*



**Fig. 652: Identifying External Reader, Template And Base**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**The following parts are required in the case of windscreen replacement:**

1. Template for printing out
2. Base (can be obtained through BMW Parts Department)
3. Label without operator logo (can be obtained through BMW Parts Department) or label with operator logo (source: operator or contact the phone number on the label or Technical Support)

**If a label with operator logo was installed, the new label must also have the operator logo.**

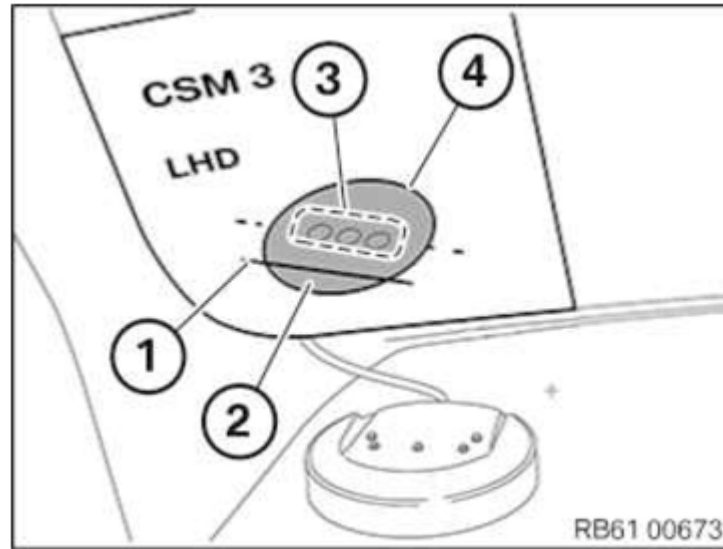
Cut out template (1) and place from outside on the driver's side at the black edge of the new windscreen (2) as shown (do not position at the cowl panel.).

Secure template (1) on windscreen, e.g. with adhesive tape.

*Installation note:*

The adhesive area on the inside of the new windscreen must be free of dust and grease.

The label (grey circle in the graphic) must be stuck onto the new windscreen so that the small circles (3) are level with the dashed line of the template.



**Fig. 653: Placing Longitudinal Edge Of Upper Protective Film At Continuous Line**  
Courtesy of BMW OF NORTH AMERICA, INC.

Place longitudinal edge of the upper protective film (4) at the continuous line (1).

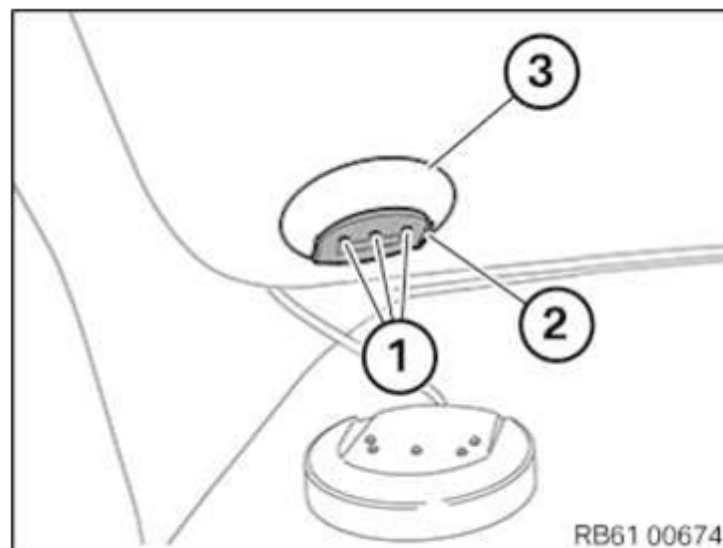
Pull off lower protective film (2). Stick bottom part of the label from inside onto the new windscreen so that there are no bubbles.

Pull off upper protective film (4) and stick on label without bubbles.

*Installation note:*

Pay attention to direction of installation of the base (2).

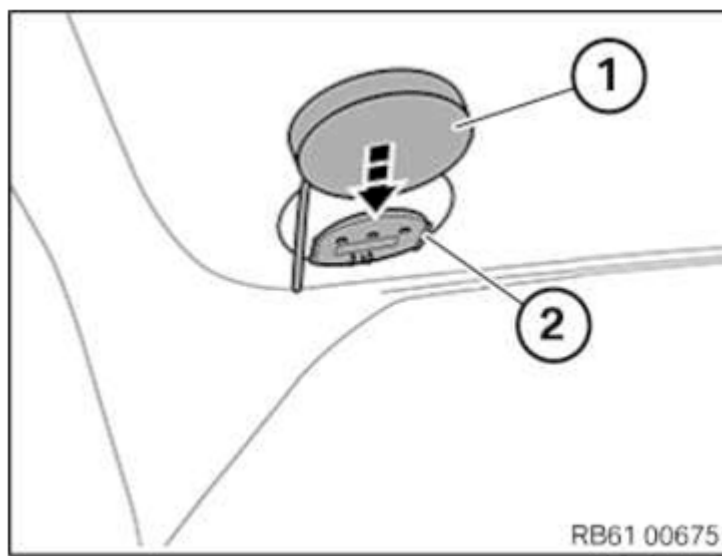
Stick base (2) onto the label (3) so that the small openings (1) match those on the label (3).



**Fig. 654: Identifying Stick Base Onto Label**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Slide external reader (1) onto the base (2) from above.



**Fig. 655: Sliding External Reader Onto Base**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**61 35 278 REMOVING AND REFITTING (REPLACING) BODY DOMAIN CONTROLLER (BDC)**

**WARNING:** High-voltage system - risk of serious injury or death.  
 The following points must be strictly observed prior to starting work :  
 Disconnect **HIGH-VOLTAGE SYSTEM** from power  
 Observe **SAFETY INFORMATION** for handling electric/hybrid vehicles.

Necessary preliminary tasks:

- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Remove **BOTTOM RIGHT INSTRUMENT PANEL TRIM**
- Release **POWER DISTRIBUTION BOX** and set to one side

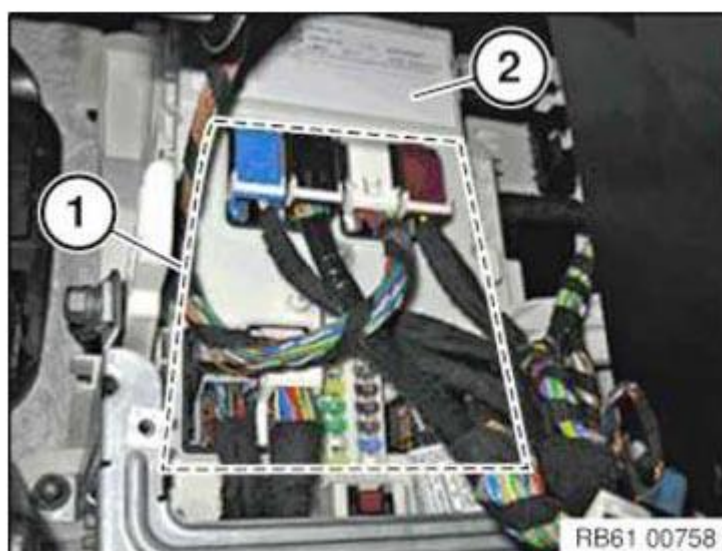
Unlock plug connections.(1) and disconnect.

Release screw (2) and slide BDC control unit (3) upward slightly.

Tightening torque **61 35 1AZ** .

*Installation note:*

Make sure all plug connections are correctly latched.

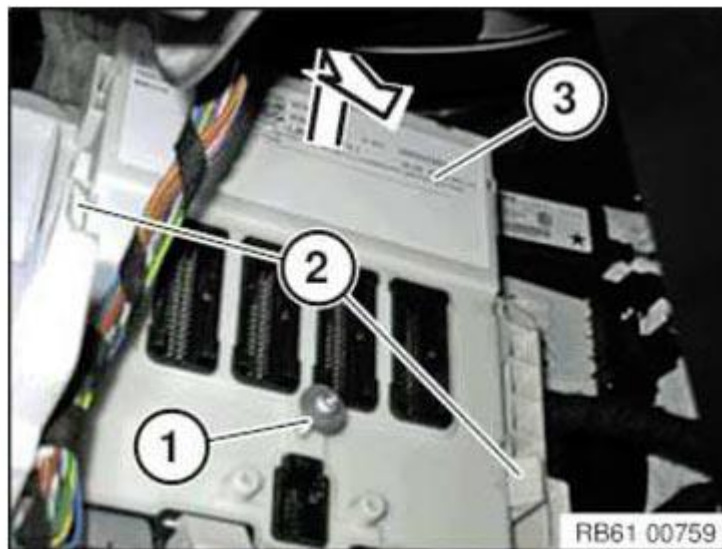


**Fig. 656: Identifying Plug Connections**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release latch mechanisms (1) and slide BDC control unit (2) upward slightly.

*Installation note:*

Please ensure correct latching of the BDC control unit.



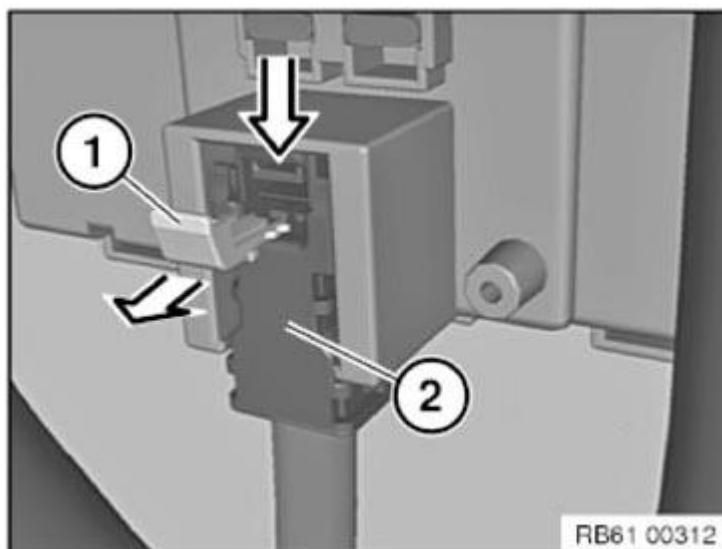
**Fig. 657: Sliding BDC Control Unit**

Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage to positive battery cable connector.

**Unlock the positive battery cable connector:**

1. Loosen lock (1) in direction of arrow.
2. Unlock top positive battery cable connector (2) in direction of arrow.
3. Disconnect battery positive lead (2).



**Fig. 658: Removing Top Positive Battery Cable Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

Feed BDC control unit out of bracket.

**Replacement:**

The BDC control unit makes functions available from the former control units FRM (footwell module), CAS (Car Access System), JBE (junction box electronics) and ZGM (central gateway module). After the BDC is replaced, it is therefore necessary to start up the integrated central gateway module (ZGM); during this process, the configuration of the vehicle and the connection in FlexRay is learned in again. An adjustment

also needs to be performed on the electronic transmission control (EGS) and electric steering lock (ELV) after the BDC is replaced. In this case, the BDC control unit transfers the individual code to the EGS or ELV. After the BDC is replaced, it is absolutely essential for all ID transmitters (ignition keys) to be re-initialized.

Carry out **VEHICLE PROGRAMMING/CODING**.

**Additionally reset the start inhibit:**

- 01 Drive
- Engine start
- Reset the start inhibit

## **61 35 179 REPLACING AND INSTALLING (REPLACING) THE SOLAR RAIN/LIGHT SENSOR AND CONDENSATION SENSOR**

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

**Necessary preliminary tasks:**

- Remove **INTERIOR MIRROR**

**Removal:**

Disconnect connector (1).

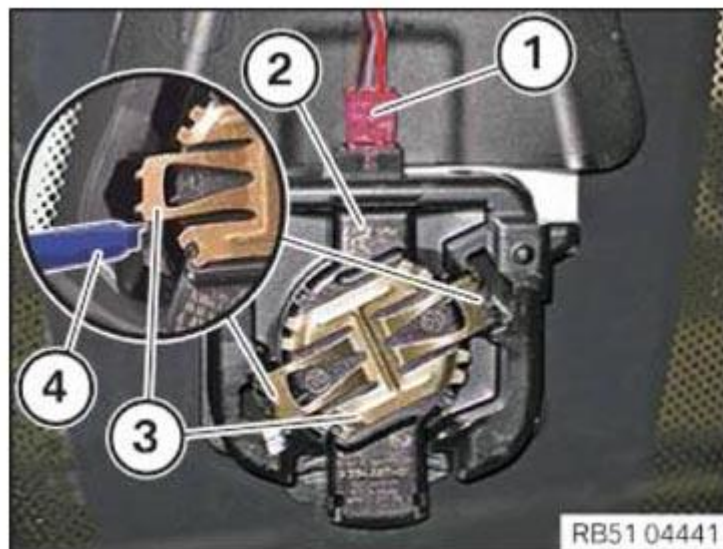
Unlock the rain/light/solar and condensation sensor (2) from the metal spring (3).

To do so, compress the metal spring (3) from both sides, insert a screwdriver (4) from the side and lift the latch mechanism.

Risk of damage.

**IMPORTANT:**

After loosening lock, wait approx. 30 min. at 20Â°C for silicone surface to relax.



**Fig. 659: Removing Solar Rain/Light And Condensation Sensor From Metal Spring Using Screwdriver**  
Courtesy of BMW OF NORTH AMERICA, INC.

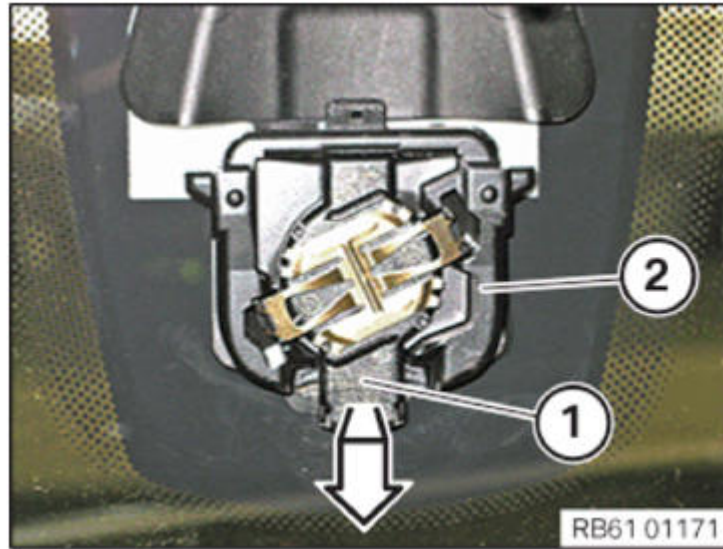
Pull the rain/light/solar and condensation sensor (1) slowly from holder (2) in direction of arrow.

**NOTE:**

**When replacing the windscreen, only remount the rain/light/solar and condensation sensor (1) after disassembly of the windscreen. Pull off the rain/light/solar and condensation sensor (1) slowly while observing from outside the release of the silicone surface.**



The silicone surface must evenly loosen from the windscreen, if applicable, pull off slower.



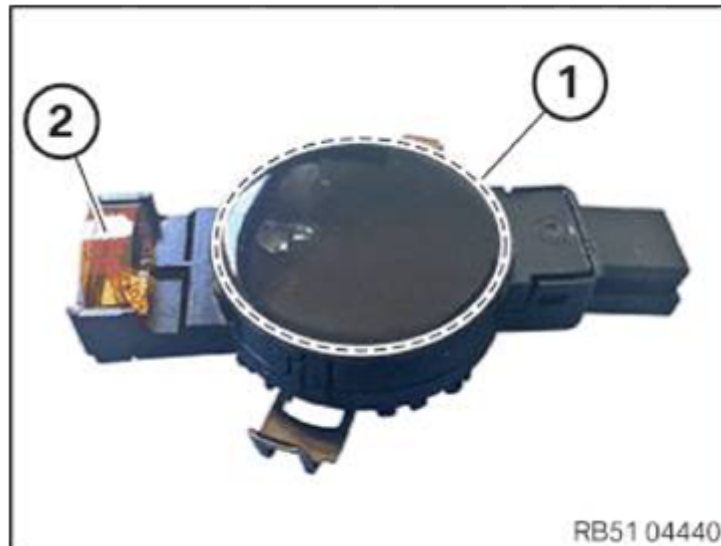
**Fig. 660: Pulling Rain/Light/Solar And Condensation Sensor From Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

Risk of damage.

The silicone-coated surface (1) and the printed circuit board (2) on the rain/light/solar and condensation sensor must not be touched or damaged.

When replacing the windscreen, immediately install the rain/light/solar and condensation sensor into the new windscreen following removal.

IMPORTANT:



**Fig. 661: Identifying Rain/Light/Solar And Condensation Sensor Silicone Coated Surface And Printed Circuit Board**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage.

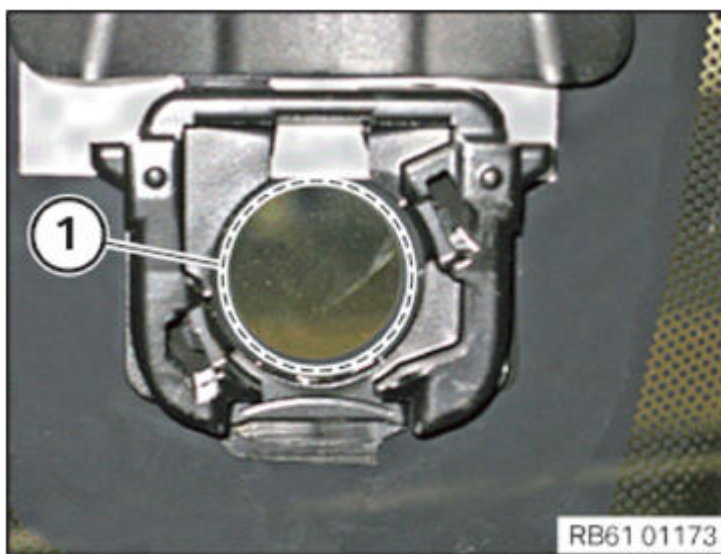
The surface (1) on the windscreen must not be touched or damaged.

The separating oil of the rain/light/solar and condensation sensor might have left easily removable residues in the area (1).

This is not considered a damage of the rain/light/solar and condensation sensor.

Remove all residues of the separating oil inside and outside the area (1).

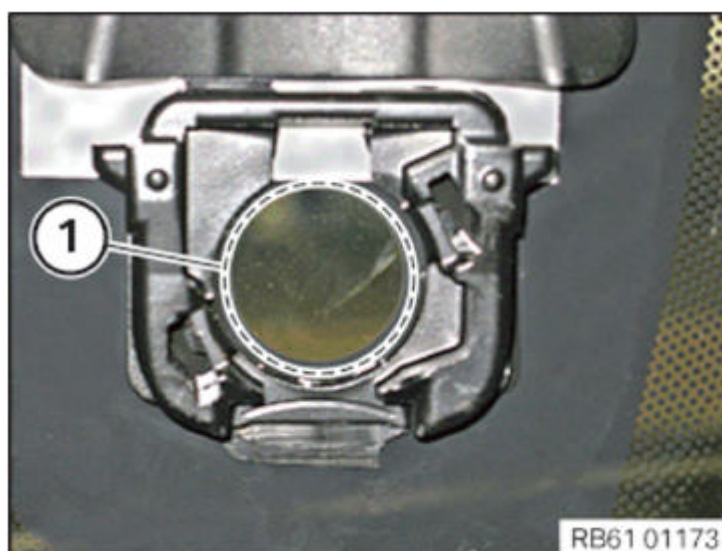




**Fig. 662: Identifying Silicone-Coated Surface On Windscreen**  
Courtesy of BMW OF NORTH AMERICA, INC.

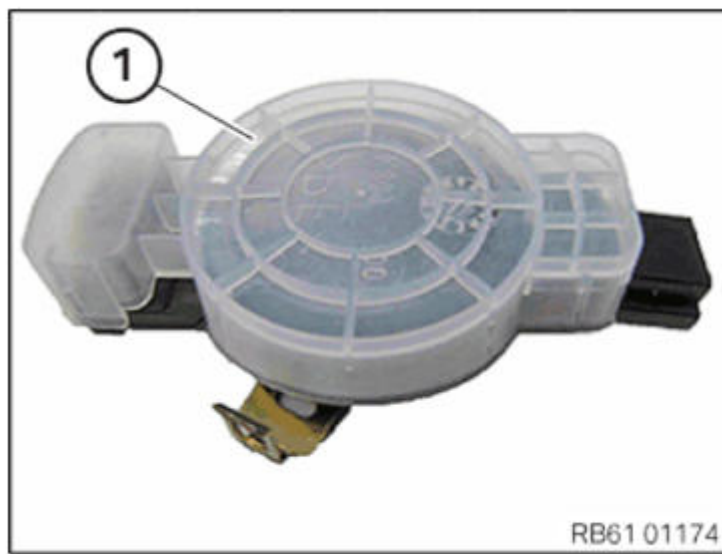
**Replacement:**

Carefully clean the windscreen at the contact area (1) with the rain/light/solar and condensation sensor. All residues of silicone and separating oil need to be removed.



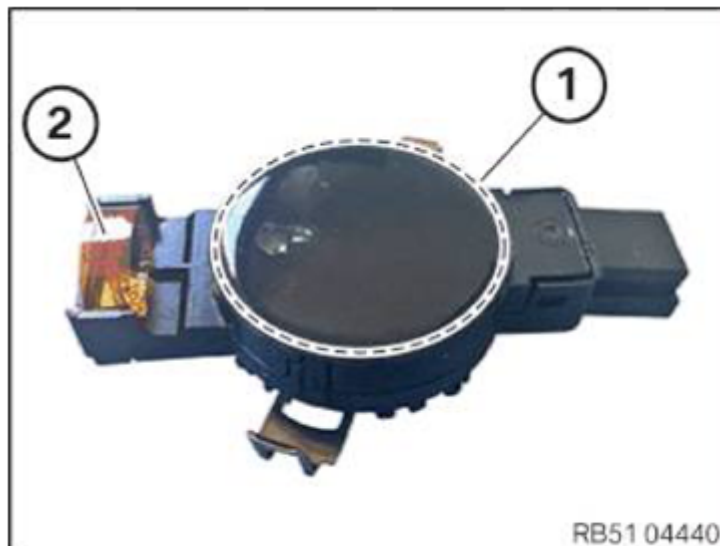
**Fig. 663: Identifying Silicone-Coated Surface On Windscreen**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove protective cover (1) from new rain/light/solar and condensation sensor.



**Fig. 664: Identifying Rain/Light/Solar And Condensation Sensor Protective Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

The silicone-coated surface (1) and the printed circuit board (2) on the rain/light/solar and condensation sensor must not be touched or damaged.



IMPORTANT:

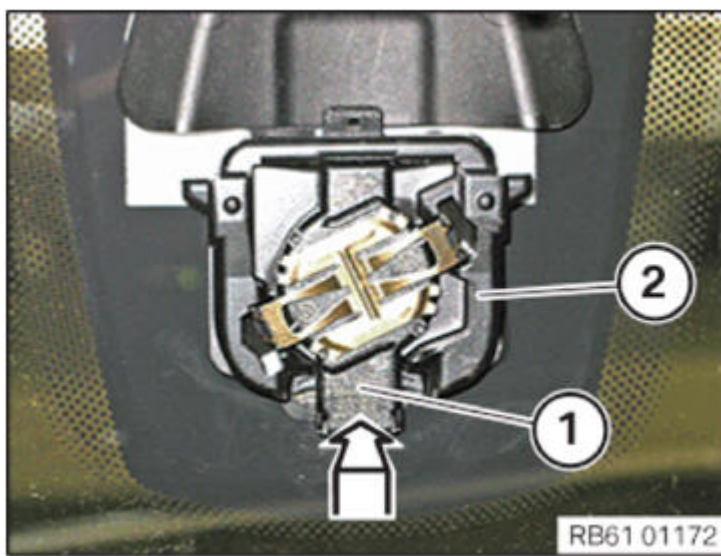
**Fig. 665: Identifying Rain/Light/Solar And Condensation Sensor Silicone Coated Surface And Printed Circuit Board**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

IMPORTANT: Risk of damage.

The silicone-coated surface on the rain/light/solar and condensation sensor must not be touched or damaged.

Feed the rain/light/solar and condensation sensor (1) into holder (2) in direction of arrow.



**Fig. 666: Feeding Rain/Light/Solar And Condensation Sensor Into Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

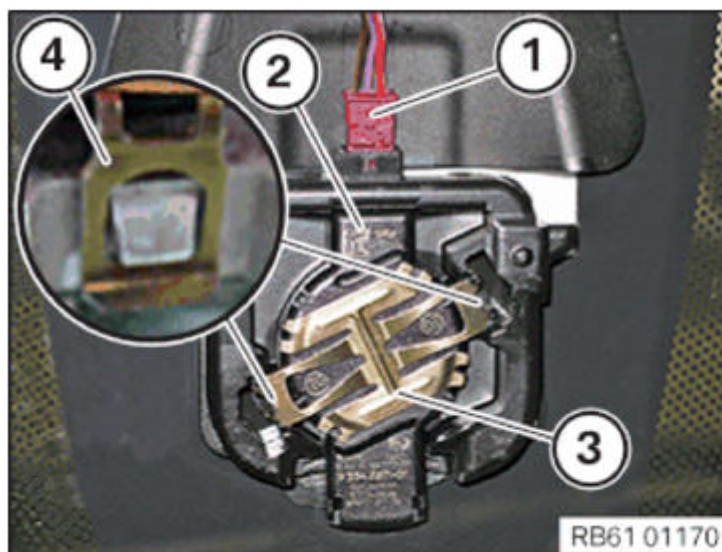
*Installation note:*

Connect connector (1) only after the rain/light/solar and condensation sensor has been locked.

Press on the rain/light/solar and condensation sensor (2) at the metal spring (3) in a centered position.

To lock, consecutively press down both sheet metal tabs (4) on each side.

Connect connector (1) with the rain/light/solar and condensation sensor (2).

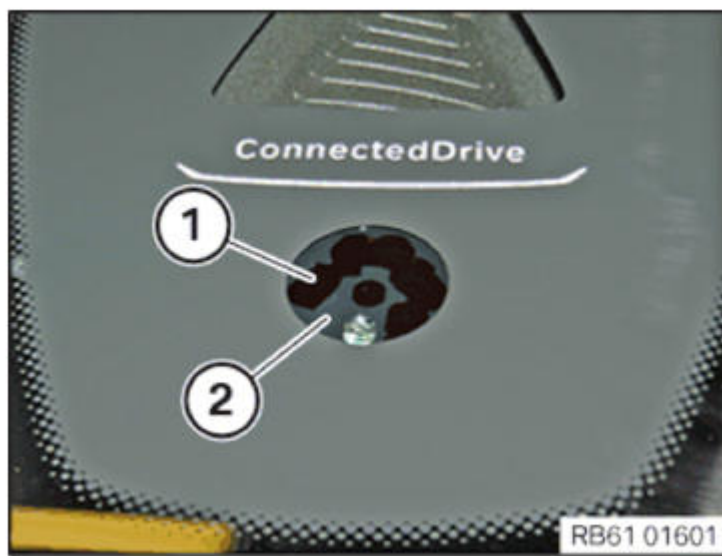


**Fig. 667: Connecting Connector With Rain/Light/Solar And Condensation Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Visible shades (1 and 2) do not have any air pockets, but show the optical element of the sensor.

Visible shades (1 and 2) do not represent **any** functional limitation.



**Fig. 668: Identifying Optical Element Of Sensor**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:**

- Initialization and encoding are performed automatically by BDC control unit.

**Required reworking:**

- Remove **INTERIOR MIRROR**

**WINDSCREEN WIPERS**

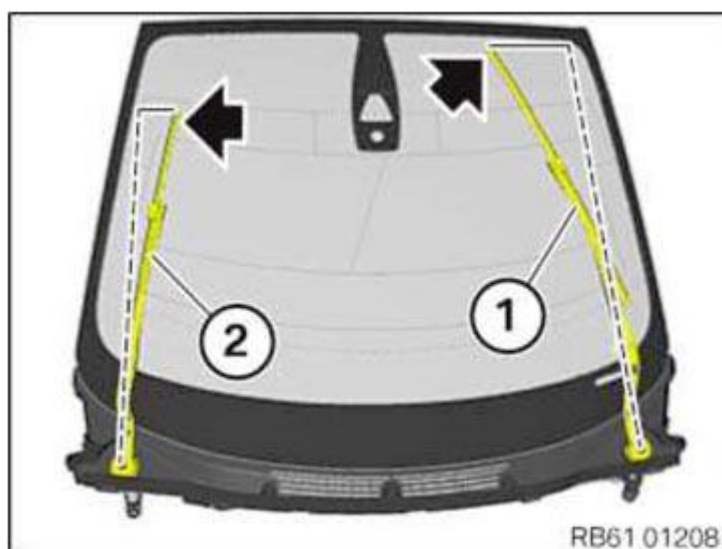
**61 61 800 BASIC SETTING FOR WINDSCREEN WIPERS**

**Basic setting:**

Move wiper drive to wiper park position and keep supplied with current (self-locking facility active).

Mount wiper arm in wiper park position.

Start teach-in (without LIN communication/voltage interruption).



**Fig. 669: Locating Windscreen Wipers**  
 Courtesy of BMW OF NORTH AMERICA, INC.

1. Start diagnosis system





	passenger side		passenger side		passenger side		
I 01	85.2 $\hat{A}^\circ$ $\hat{A}\pm 2 \hat{A}^\circ$	85.2 $\hat{A}^\circ$ $\hat{A}\pm 2 \hat{A}^\circ$	-5 $\hat{A}\pm 3$	-5 $\hat{A}\pm 3$	32 mm $\hat{A}\pm 3$ mm	32 mm $\hat{A}\pm 3$ mm	$\hat{A}$

## 61 61 252 REMOVING AND INSTALLING/REPLACING LEFT WIPER MOTOR

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)**.

**IMPORTANT:** Before disassembling the wiper arm, allow the vehicle to go to sleep. Once the vehicle has gone to sleep, wiper arms can be moved without causing any damage.

### Necessary preliminary tasks:

- Remove **COWL PANEL COVER**

Release nuts (1; 2; 3).

Tightening torque **61 61 1AZ** .

Lift console for windscreen wiper system (5).

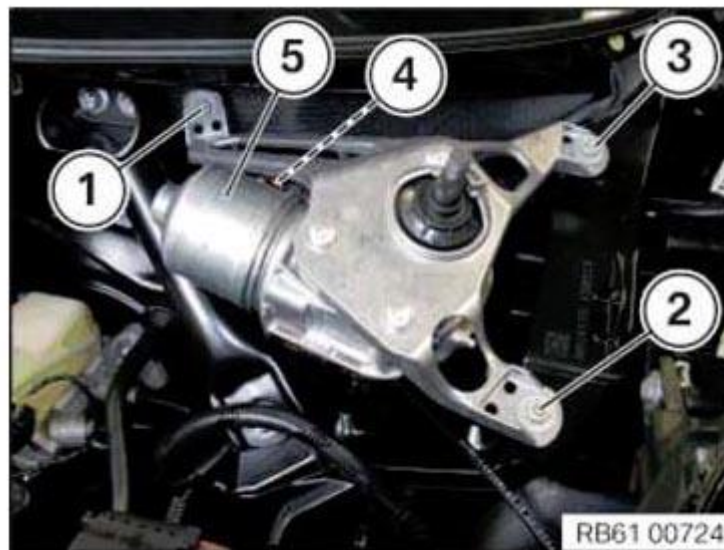
Unlock plug connection (4) and disconnect.

Remove console for windscreen wiper system (5).

*Installation note:*

Attach nuts in **specified sequence (1; 2; 3)** .

Make sure mounting bracket for windscreen wiper system is fitted correctly.



**Fig. 671: Identifying Left Wiper Motor, Plug Connection And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Before mounting the wiper arm, observe the **NOTES ON THE BASIC SETTING**.

## 61 61 253 REMOVING AND INSTALLING/REPLACING RIGHT WIPER MOTOR

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)**.

**IMPORTANT:** Before disassembling the wiper arm, allow the vehicle to go to sleep. Once the vehicle has gone to sleep, wiper arms can be moved without causing any damage.



**Necessary preliminary tasks:**

- Remove **COWL PANEL COVER**

Release nuts (1; 2; 3).

Tightening torque **61 61 1AZ** .

Unlock plug connection (4) and disconnect.

Detach console for windscreen wiper system (5).

*Installation note:*

Attach nuts in **specified sequence (1; 2; 3)** .

Make sure mounting bracket for windscreen wiper system is fitted correctly.



**Fig. 672: Identifying Right Wiper Motor, Plug Connection And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Before mounting the wiper arm, observe the **NOTES ON THE BASIC SETTING**.

**61 61 100 REMOVING AND INSTALLING/REPLACING BOTH WINDSCREEN WIPER ARMS**

*Operation is described in:*

**REPLACING THE LEFT OR RIGHT WIPER ARM**

**61 61 041 REPLACING BOTH WINDSCREEN WIPER BLADES**

*Operation is described in:*

**REPLACING LEFT OR RIGHT WINDSCREEN WIPER BLADE**

**61 61 131 REPLACING BOTH WIPER BLADES (BOSCH AEROTWIN)**

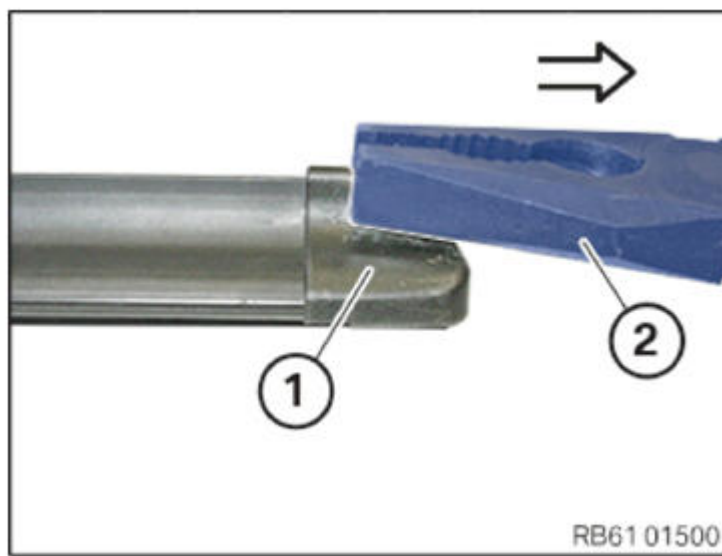
IMPORTANT: Make sure the wiper arm does not touch the windscreen without its wiper blade.

**Necessary preliminary work:**

- Remove **BOTH WIPER BLADES**

**Removal:**

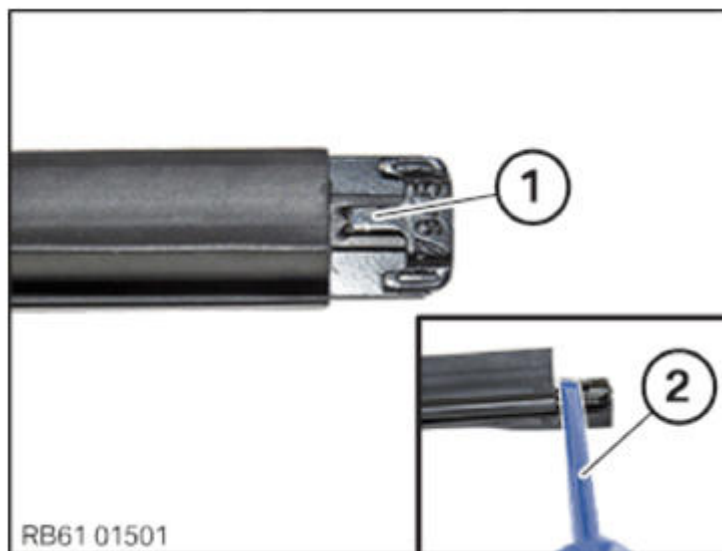
Pull off both sealing caps (1) using a suitable tool (2).



**Fig. 673: Pulling Both Sealing Caps Using Suitable Tool**  
Courtesy of BMW OF NORTH AMERICA, INC.

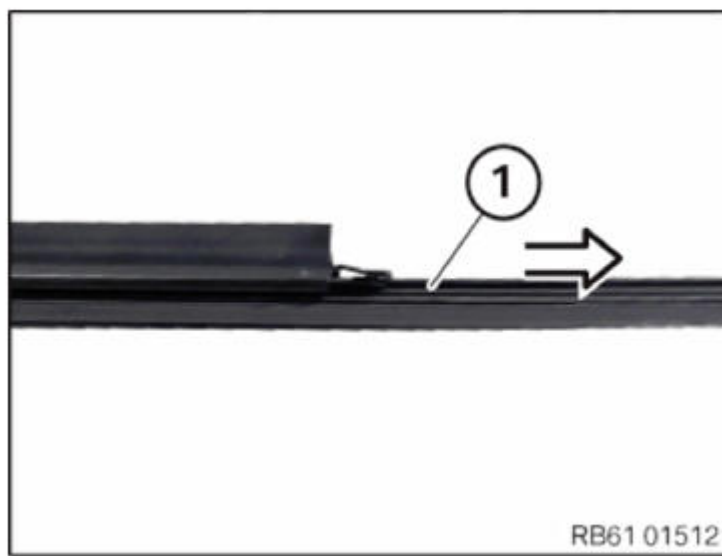
IMPORTANT: Do not excessively bend the retaining tab (risk of breakage).

Slightly bend retaining tab (1) upwards using a suitable tool (2) only to the point where the wiper blade is easily accessible.



**Fig. 674: Bending Retaining Tab Using Suitable Tool**  
Courtesy of BMW OF NORTH AMERICA, INC.

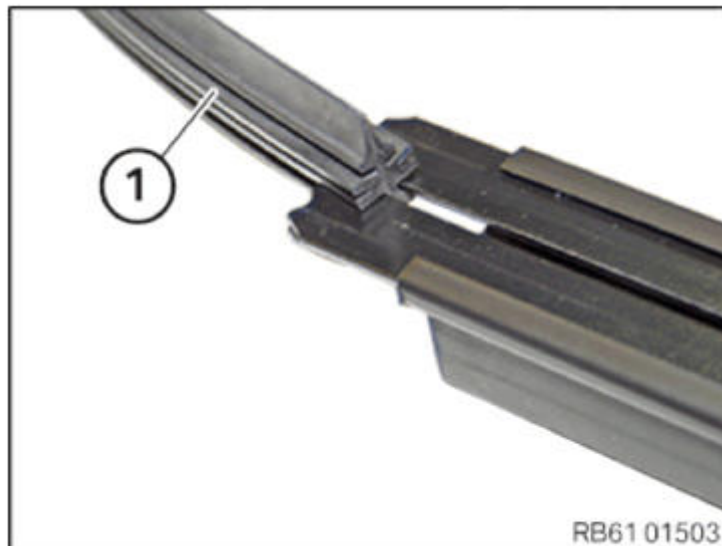
Pull out wiper blade (1) in the direction of the arrow.



**Fig. 675: Pulling Wiper Blade**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Insert wiper blade (1).



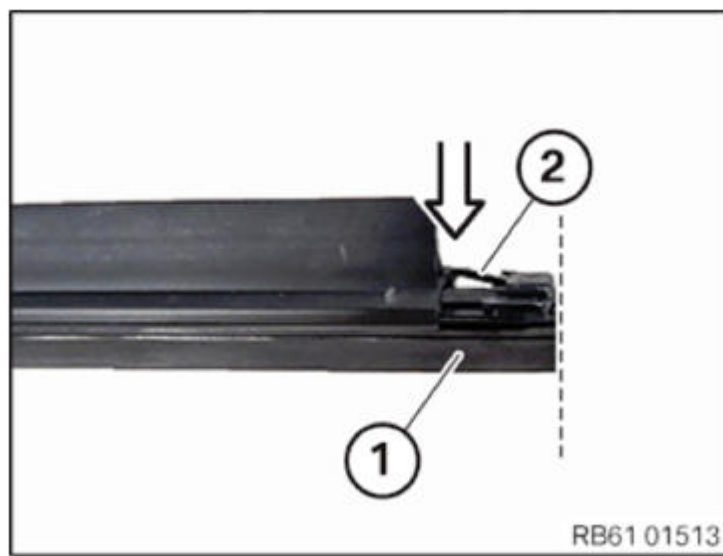
**Fig. 676: Identifying Wiper Blade**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Retaining tab (2) must not be missing or damaged.

Position wiper blade (1) flush.

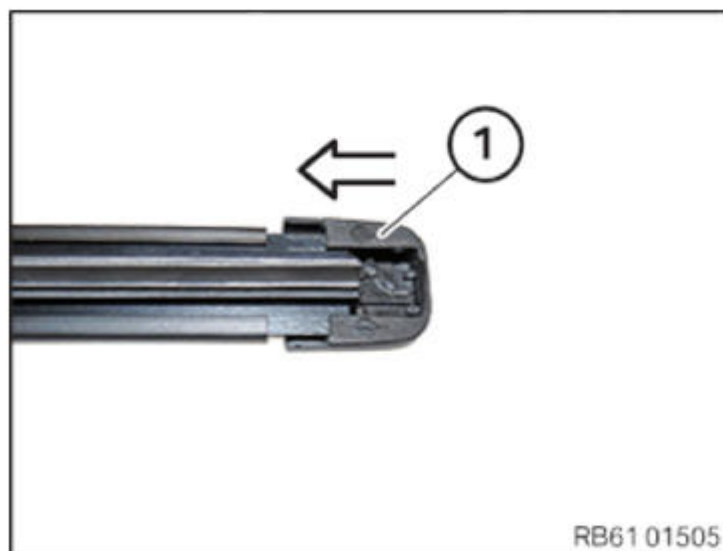
Carefully bend retaining tab (2) in the direction of the arrow using a suitable tool until the wiper blade (1) is clamped.



**Fig. 677: Positioning Wiper Blade**

Courtesy of BMW OF NORTH AMERICA, INC.

Push on sealing caps (1) until they noticeably engage.



**Fig. 678: Pushing Sealing Caps**

Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Install **BOTH WIPER BLADES**

**61 61 021 REPLACING LEFT OR RIGHT WINDSCREEN WIPER BLADE**

**IMPORTANT:** Make sure the wiper arm does not contact the windscreen without its wiper blade.

**NOTE:** In the event of a customer complaint regarding the cleaning or wiping performance or noise build-up (scratching, squeaking) by the wiper blades, proceed as follows: First check whether the complaint is caused by dirt (preservation wax on new vehicles, resins or other environmental influences) on the windscreen; if necessary, clean the windscreen thoroughly. Replace the wiper blades only if cleaning the windscreen fails to remedy the situation.

Move wipers into fold-out position:

- Switch on terminal "R" and then switch off again immediately
- Press wiper lever upwards and hold for approx. 3 seconds until wiper arms stop in roughly vertical position (fold-out position)

Take infrared remote key (ignition key).

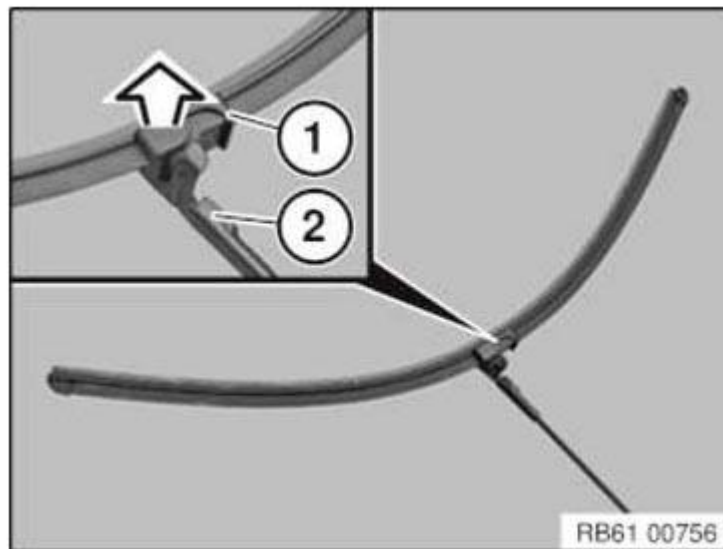
Raise wiper arm (2) and fold out wiper blade (1).

Remove wiper blade (1) from wiper arm (2) in direction of arrow.

*Installation note:*

Make sure wiper blade (2) is guided.

Fold wiper arms onto windscreen.



**Fig. 679: Removing Wiper Blade From Wiper Arm**

Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Before switching on terminal "R" or the ignition or starting the engine, you must fold the wiper arms onto the windscreen otherwise damage will be caused.  
Switch on terminal "R".  
Move the windscreen wipers to the rest position with a flick wipe.

### **61 61 081 REPLACING THE LEFT OR RIGHT WIPER ARM**

**Special tools required:**

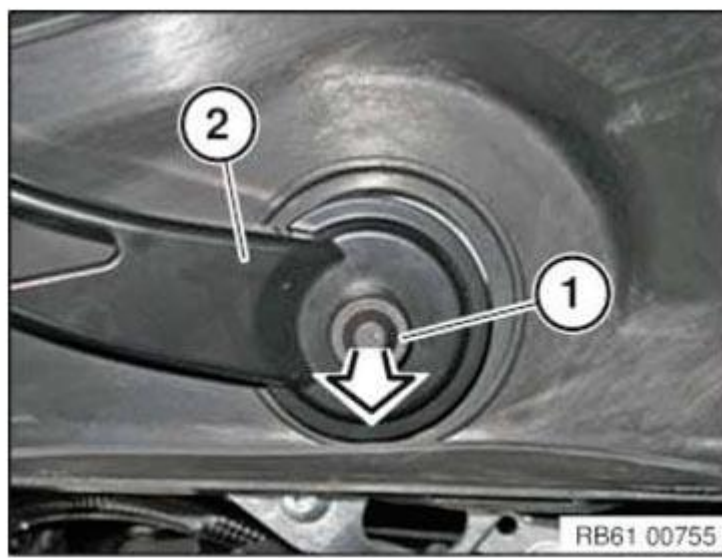
- [2 348 527](#)

IMPORTANT: Before disassembling the wiper arm, allow the vehicle to go to sleep.  
Self-locking facility is not functional after the vehicle goes to sleep.

Take off cap.

Release nut underneath.

Tightening torque [61 61 3AZ](#) .



**Fig. 680: Removing Wiper Arm Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Do not bend windscreen wiper arm during removal (risk of breakage).

Pull off wiper arm using special tool [2 348 527](#).



**Fig. 681: Pulling Off Wiper Arm Using Special Tool (2 348 527)**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Before mounting the wiper arm, observe the [NOTES ON THE BASIC SETTING](#).

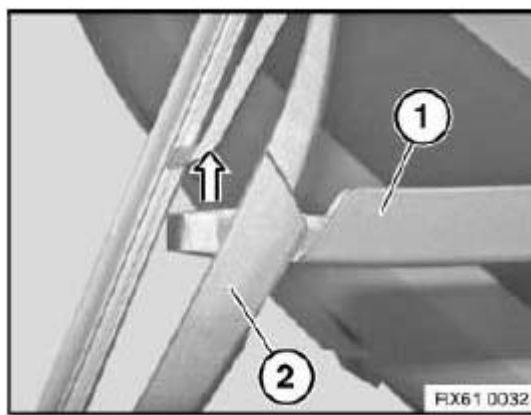
## **TAILGATE WINDOW WIPER**

### **61 62 020 REMOVING AND INSTALLING/REPLACING REAR WINDOW WIPER BLADE**

Erect wiper arm.

Slide wiper blade in direction of arrow and release from the wiper arm.





**Fig. 682: Removing Rear Wiper Blade**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 62 060 REMOVING AND INSTALLING/REPLACING REAR WIPER MOTOR**

Necessary preliminary tasks:

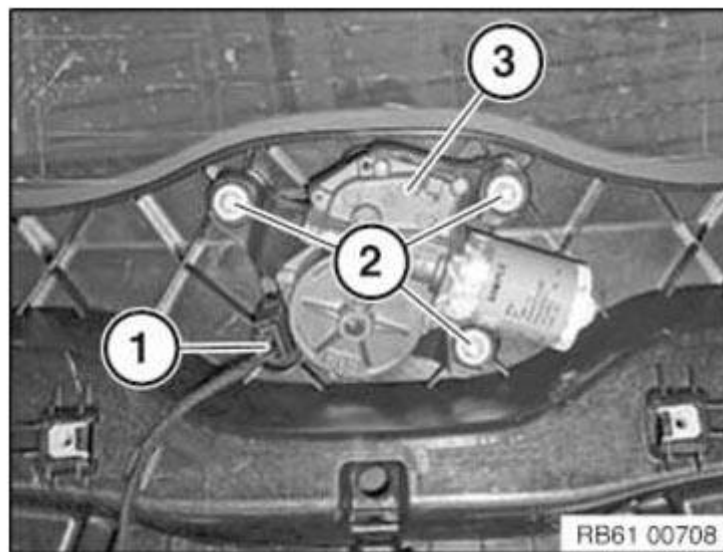
- Remove **REAR WINDOW WIPER ARM**
- Remove **TRIM FOR REAR LID**

Disconnect plug connection (1).

Unfasten screws (2).

Tightening torque **61 61 5AZ** .

Remove rear wiper motor (3).



**Fig. 683: Identifying Rear Wiper Motor And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **61 62 030 REMOVING AND INSTALLING/REPLACING WIPER ARM ON REAR WINDOW**

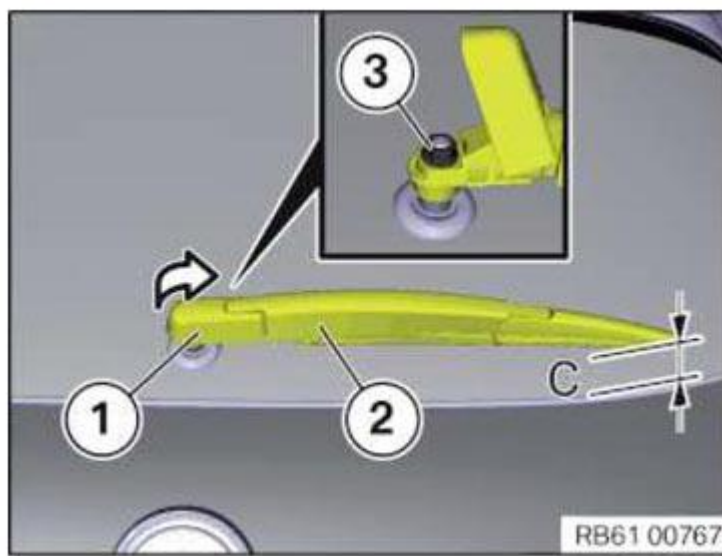
Special tools required:

- **61 6 060**

Fold open protective cap (1) in direction of arrow and release nut (3).

Tightening torque **61 61 6AZ** .

Press off wiper arm (2) with special tool **61 6 060** and remove.



**Fig. 684: Opening Protective Cap**

Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

Before fitting wiper arm, allow wiping system to run two wipe cycles into wiper park position.

Set dimension (C) between wiper arm and rear window edge.

Dimension (C):  $35 \pm 3$  mm.

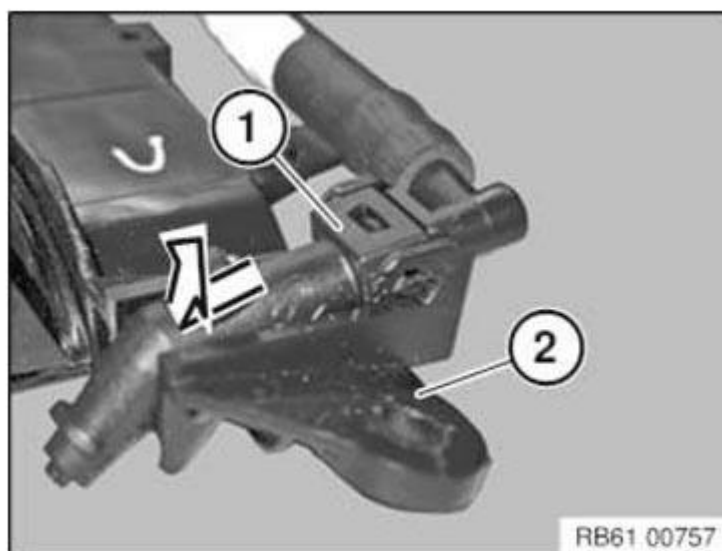
**61 62 115 REPLACING WASHER JET FOR REAR WINDSCREEN WASHER SYSTEM**

**Necessary preliminary tasks:**

- Remove **ADDITIONAL BRAKE LIGHT**

Disconnect hose connection (1).

Remove washer jet (1) from additional brake light (2) in direction of arrow.



**Fig. 685: Removing Washer Jet From Additional Brake Light**

Courtesy of BMW OF NORTH AMERICA, INC.

**WINDSCREEN WASHER SYSTEM**

**61 71 061 REMOVING AND FITTING/REPLACING WATER TANK FOR WINDOW WASHER SYSTEM**

### Necessary preliminary tasks:

- Remove **FRONT LUGGAGE COMPARTMENT WELL**

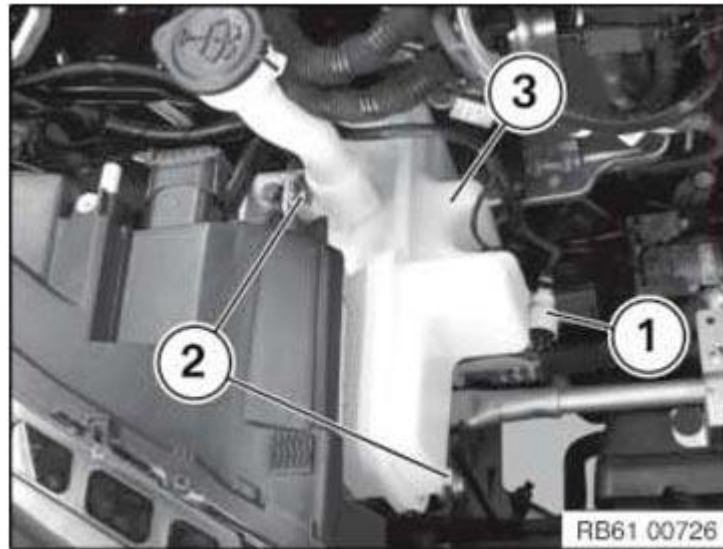
**NOTE:** Catch any escaping washer fluid if necessary.

Remove windscreen washer pump (1).

Unfasten screws (2).

Tightening torque **61 61 4AZ**.

Remove washer fluid reservoir (3).



**Fig. 686: Identifying Windscreen Washer Pump And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### *Installation note:*

- Coat sealing ring of washer pump with lubricant
- Route windscreen washer pump hose pipes without kinks and clip in to corresponding holder
- Fill fluid reservoir

### **Replacement:**

- Replace strainer in washer pump
- Coat sealing ring of washer pump with lubricant
- Remount level sensor
- Fill fluid reservoir

## **61 71 030 REMOVING AND INSTALLING/RENEWING ALL WASHER JETS OF WINDSCREEN WASHER SYSTEM**

### Necessary preliminary tasks:

- Remove **FRONT WHEEL ARCH COVER** (rear section) on the right
- Remove **TRIM ON SIDE PANEL** at front right

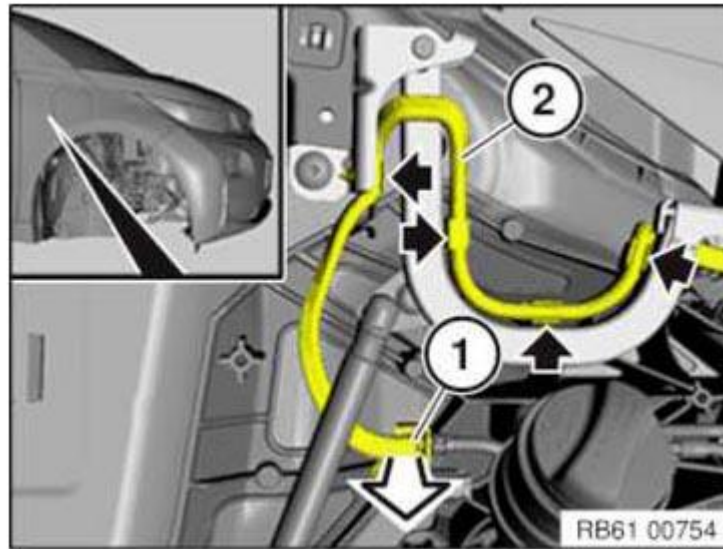
Release holder (1) in direction of arrow.

Unlock and disconnect plug connection and hose connection on holder (1).

Release line (2) from brackets and feed out.

### *Installation note:*

- Make sure line is correctly laid.



**Fig. 687: Releasing Holder**

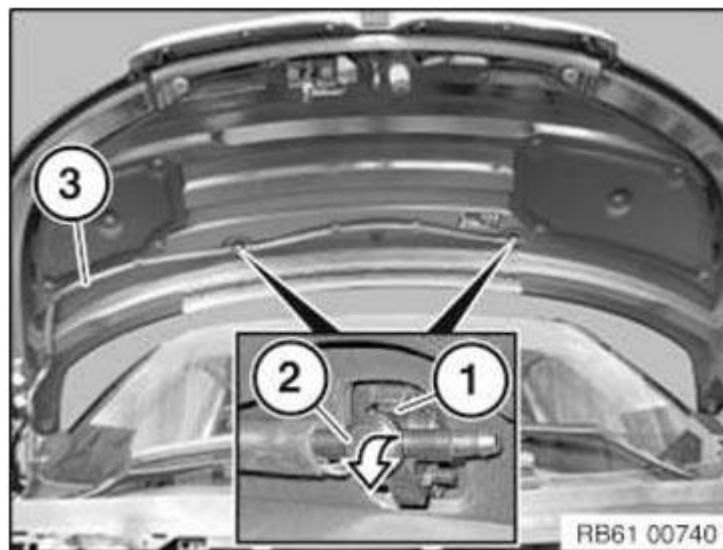
Courtesy of BMW OF NORTH AMERICA, INC.

Release retaining lugs (1) and take off washer jet (2) in direction of arrow.

Release jet chain (3) from brackets and remove.

*Installation note:*

- Retaining lugs (1) must not be damaged.
- Check washer jet setting and correct if necessary.
- Observe washer fluid reservoir filling capacity.



**Fig. 688: Releasing Retaining Lugs**

Courtesy of BMW OF NORTH AMERICA, INC.

**61 71 150 REMOVING AND INSTALLING/REPLACING REAR WINDSCREEN WASHER PUMP FOR WINDSCREEN WASHER SYSTEM**

*Operation is identical to:*

**REMOVING AND INSTALLING/REPLACING WINDSCREEN WASHER PUMP**

**61 71 100 REMOVING AND INSTALLING/REPLACING WINDSCREEN WASHER PUMP**

Before replacing the windscreen washer pump, check the washer fluid reservoir for dirt contamination and clean if necessary.

**Necessary preliminary tasks:**

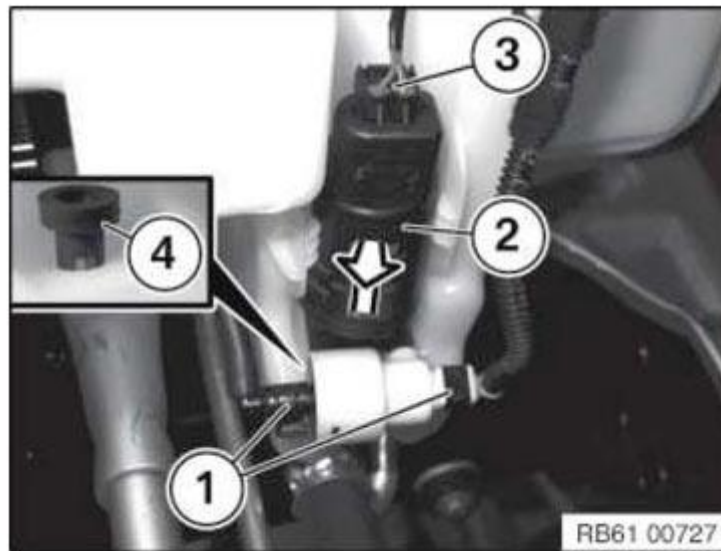
- Remove **FRONT LUGGAGE COMPARTMENT WELL**

**NOTE:** Catch any escaping washer fluid if necessary.

Unlock and disconnect hose pipes (1) on windscreen washer pump (2).

Unfasten plug connection (3) and disconnect.

Pull windscreen washer pump (2) out of washer fluid reservoir in direction of arrow.



**Fig. 689: Pulling Windscreen Washer Pump Out Of Washer Fluid Reservoir**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Replace strainer (4) in windscreen washer pump.
  - Coat sealing ring of windscreen washer pump with lubricant
  - Lay hose pipe of windscreen washer pump without kinks
  - Top up the washer fluid reservoir
-

## ELECTRICAL

### General Electrical System - Special Tools - All I3 Models - i3

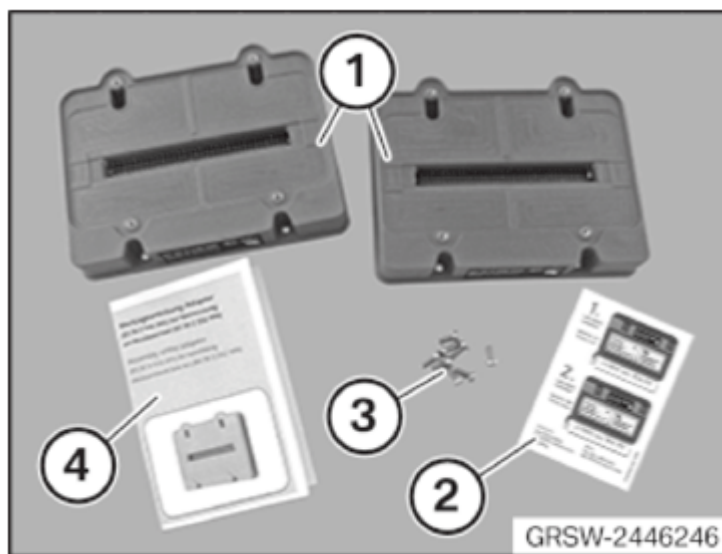
## GENERAL ELECTRICAL SYSTEM

### 2446246 ADAPTER MP

**NOTE:** The adapter is only required for the initial delivery series of the test box set (delivery 2015). A voltage filter is required to protect the new test box set from damage. It is mounted between the test box and the 3-way adapter.

#### SI number

02 15 15 (355)



**Fig. 1: Identifying Adapter (2446246).**  
Courtesy of BMW OF NORTH AMERICA, INC.

### 2410561 ADAPTER MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP

#### SI number

02 10 15 (242)





**Fig. 2: Identifying Adapter (2410561)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2407625 ADAPTER MP**

**NOTE:** Connection of the EoS tester to the 24-pin communication connection of the high-voltage battery unit

**SI number**

08 07 15 (266)



**Fig. 3: Identifying Adapter (2407625)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2353362 ADAPTER MP**

**NOTE:** Applies to: BMW i Aftersales High Voltage accessories/replacement for EoS diagnosis tester 2 353 250

**Storage Location**

Individual

**SI number**

02 09 13 (931)



**Fig. 4: Identifying Adapter (2353362)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2352718 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** 33-pin I cable Applies to: BMW i Aftersales Basic diagnosis with installed automatic transmission with control unit removed. Measurement directly in the automatic transmission.

**Storage Location**

Individual

**SI number**

02 03 13 (902)



**Fig. 5: Identifying Adapter Cable (2352718)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2350531 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** 46-pin adapter cable for DSC control unit Applies to: BMW i Aftersales Basic

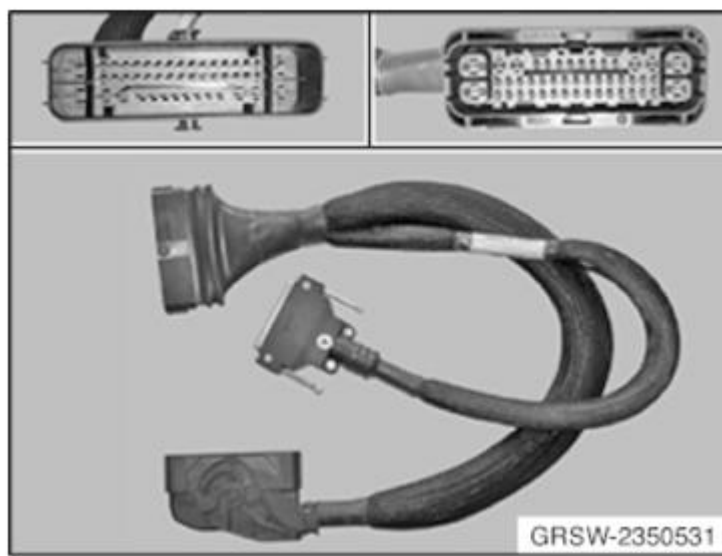
**Storage Location**

C104

B107

**SI number**

02 07 13 (909)



**Fig. 6: Identifying Adapter Cable (2350531)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2410550 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Valid only for BMW i Service format basic diagnosis of the electrical machine electronics on the low voltage side.

**Storage Location**

R204

M112

**SI number**

02 11 15 (293)



**Fig. 7: Identifying Adapter Cable (2410550)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2287951 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** 6-pin I cable applies to: BMW i Aftersales Basic For diagnosis of the rotor position sensor on the range extender electrical machine.

**Storage Location**

R203

J106

SI number

02 01 14 (083)



**Fig. 8: Identifying Adapter Cable (2287951)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2288280 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** 2-pin I cable applies to: BMW i Aftersales Basic For measuring the temperature sensor on the electrical machine.

Storage Location

R202

J105

SI number

02 02 14 (084)



**Fig. 9: Identifying Adapter Cable (2288280)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2354545 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:**

Applies to: BMW i Aftersales Basic 1-pin grounding cable, length 4 meters, for diagnostic work on vehicles with CFRP.

**Storage Location**

G113

**SI number**

02 13 13 (974)



**Fig. 10: Identifying Adapter Cable (2354545)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2288281 ADAPTER CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:**

Applies to: BMW i Aftersales Basic six-pin I-cable for diagnosis for the electrical machine (rotor position sensor and temperature sensor)

**Storage Location**

R201

L103

**SI number**

02 03 14 (085)



**Fig. 11: Identifying Adapter Cable (2288281)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2353365 CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Applies to: BMW i Aftersales High Voltage is replaced by 83 30 2 405 037.

SI number

08 06 13 (932)



**Fig. 12: Identifying Cable (2353365)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2353364 CABLE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales High Voltage is replaced by 83 30 2 405 036.

SI number

08 06 13 (932)



**Fig. 13: Identifying Cable (2353364)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2353363 CHARGER AM**

**NOTE:** State of charge adjustment of new HV battery modules before installation



in the HV battery, valid for: BMW i Aftersales high voltage will be replaced by 2359907.

**SI number**

08 06 13 (932)



**Fig. 14: Identifying Charger (2353363).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2336626 CONNECTOR HOUSING MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

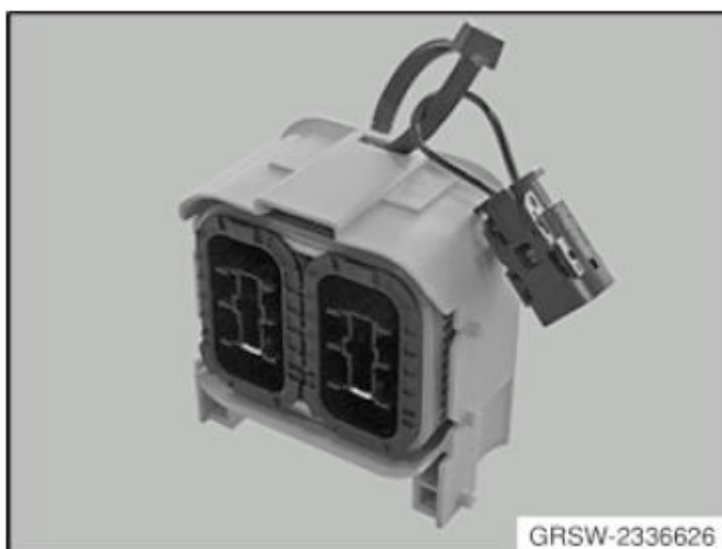
**NOTE:** For troubleshooting at the high voltage connector (connector from "Kostal")

**Storage Location**

S203

**SI number**

02 05 13 (907)



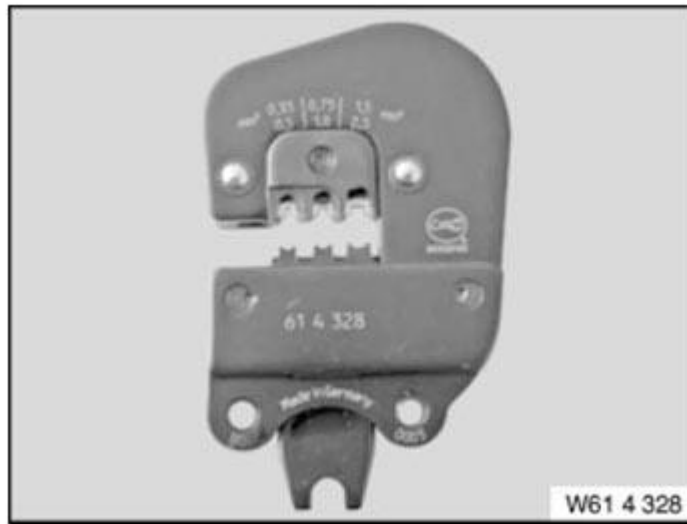
**Fig. 15: Identifying Connector Housing (2336626).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**614328 CRIMPING TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** (Universal crimping head) For crimping contacts (without seal) and cable cross-sections from 0.35 - 2.5 mm. As from 03/2010 61 4 328 will not longer be supplied in set 61 4 320. Order by way of separate special tool number 61 4 340.

**SI number**

02 01 10 (615)



**Fig. 16: Identifying Crimping Tool (614328)**

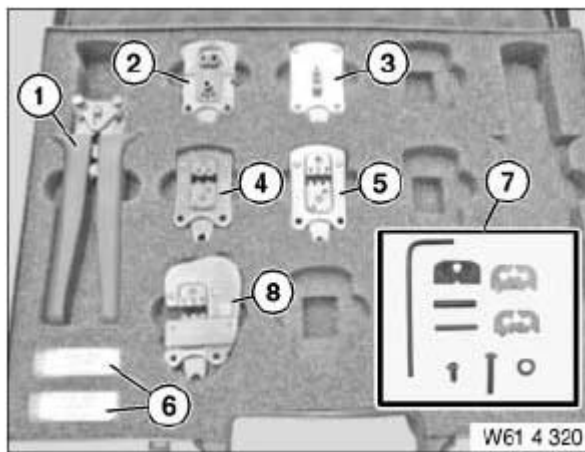
Courtesy of BMW OF NORTH AMERICA, INC.

**614329 CRIMPING TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Replaces special tool 61 4 322 as of 03/2010. Can be ordered separately again as of 04/2012.

**SI number**

02 01 10 (615)



**Fig. 17: Identifying Crimping Tool (614329)**

Courtesy of BMW OF NORTH AMERICA, INC.

**614323 CRIMPING TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

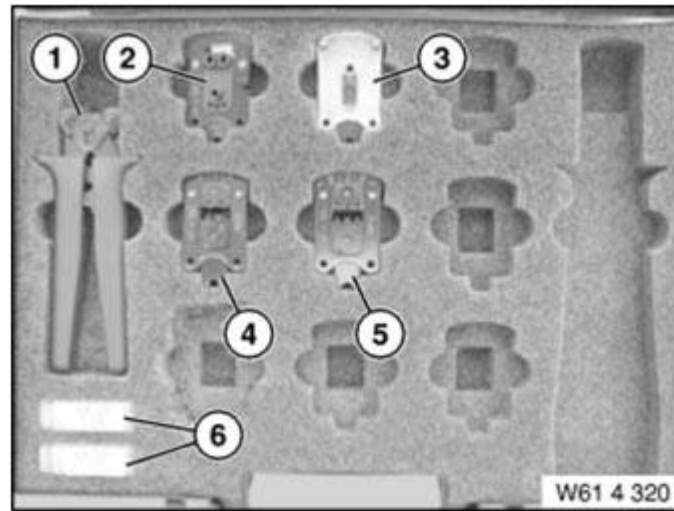
**NOTE:** (Crimping head) For crimping optical fibre contacts

**Storage Location**

M22 x 201

SI number

02 04 06 (293)



**Fig. 18: Identifying Crimping Tool (614323)**

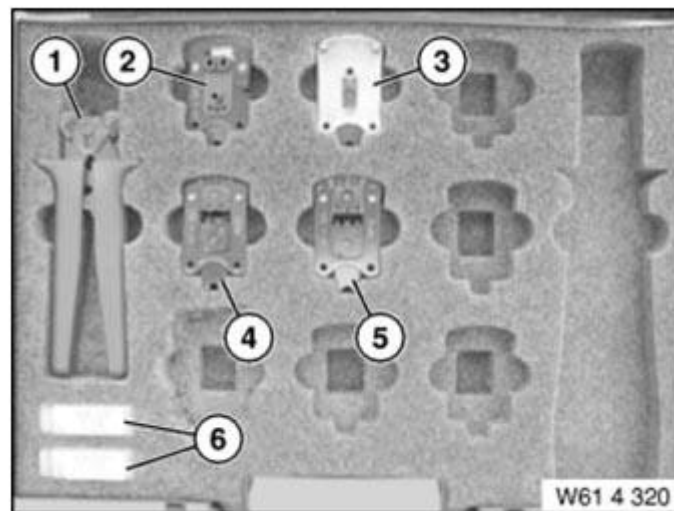
Courtesy of BMW OF NORTH AMERICA, INC.

**614322 CRIMPING TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** (Crimping head) For stripping insulation and cutting optical fibre to length Replaced as from 03/2010 by [61 4 329](#) (0 496 847).

SI number

02 01 10 (615)



**Fig. 19: Identifying Crimping Tool (614322)**

Courtesy of BMW OF NORTH AMERICA, INC.

**614320 CRIMPING TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** (Crimping set with pliers) For optical fibres and cable repairs. As from 06/2006 extended by universal crimping head 61 4 328. As from 03/2010 61 4 328 will be removed from the set and can be ordered separately under 61 4 340. As from 03/2010 61 4 322 will be replaced by [61 4 329](#). As from 03/2010 [61 4 326](#) will only be available as a replacement.

Storage Location

Individual

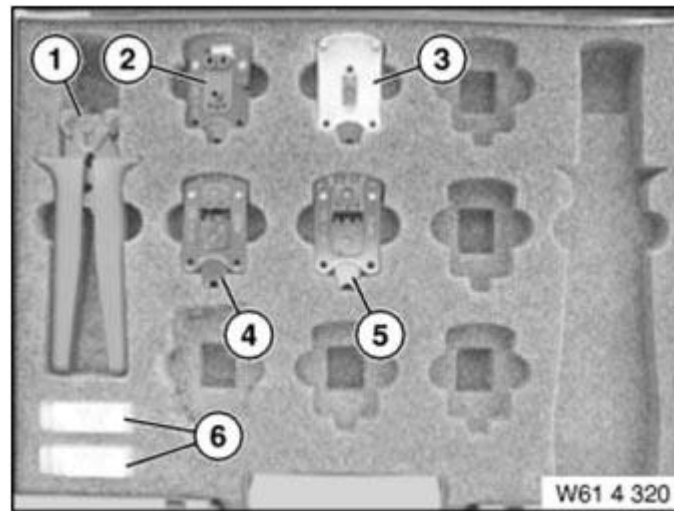
01 14 01 (766)

Consisting of:

1 = [0494159](#) Handle

**NOTE:** Basic handle for crimping heads

2 = 0494160 Crimping tool



**Fig. 20: Identifying Crimping Tool (614320)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** (Crimping head) For stripping insulation and cutting optical fibre to length Replaced as from 03/2010 by [61 4 329](#) (0 496 847).

3 = 0494161 Crimping tool

**NOTE:** (Crimping head) For crimping optical fibre contacts

4 = 0494162 Crimping tool

**NOTE:** (Crimping head) For crimping MQS contacts

6 = 0494164 Supplement

**NOTE:** (Replacement blade) For face-cutting optical fibres. From 03/2006, no longer included in set 61 4 320 but individually available as a replacement set. Replacement blade only suitable for 61 4 322.

5 = 0494178 Crimping tool

**NOTE:** (crimping head) For crimping MPQ contacts

7 = 0494320 Supplement

**NOTE:** (Replacement knife) With tool for changing blades in stripping unit. Must be ordered separately, not included in 61 4 320 delivery specification! Discontinued as from 03/2010.

8 = 0495555 Crimping tool

**NOTE:** (Universal crimping head) For crimping contacts (without seal) and cable cross-sections from 0.35 - 2.5 mm. As from 03/2010 61 4 328 will not

longer be supplied in set 61 4 320. Order by way of separate special tool number 61 4 340

2 = 0496847 Crimping tool

**NOTE:** Replaces special tool 61 4 322 as of 03/2010. Can be ordered separately again as of 04/2012.

### 614325 CRIMPING TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP

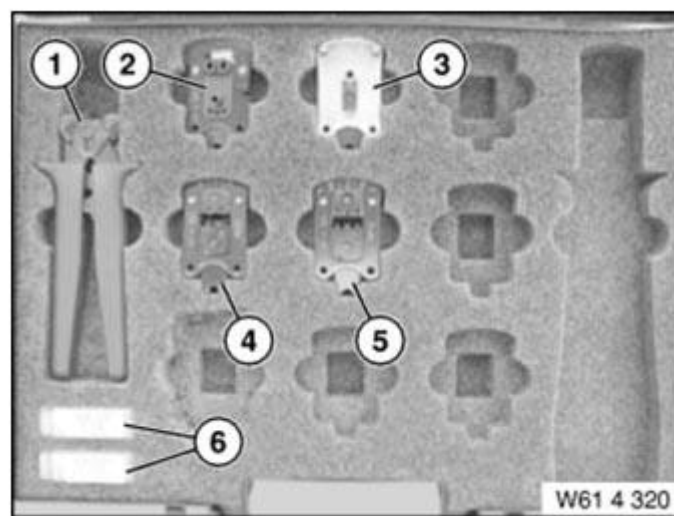
**NOTE:** (crimping head) For crimping MPQ contacts

#### Storage Location

M22 x 201

#### SI number

02 04 06 (293)



**Fig. 21: Identifying Crimping Tool (614325).**

Courtesy of BMW OF NORTH AMERICA, INC.

### 2339646 CRIMPING TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP

**NOTE:** Crimping pliers CS40 for mounting matrices to process cable contacts for wires with cable cross-sections of 16mm<sup>2</sup> (with matrix 83302352539) to 35mm<sup>2</sup> (with matrix 83302339647). Delivery specification of crimping pliers CS40 including case and ring spanner (for emergency release).

#### Storage Location

Individual

#### SI number

02 08 12 (892)



**Fig. 22: Identifying Crimping Tool (2339646)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**614324 CRIMPING TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** (Crimping head) For crimping MQS contacts

**Storage Location**

M22 x 201

**SI number**

02 04 06 (293)



**Fig. 23: Identifying Crimping Tool (614324)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2356858 DEVICE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales High Voltage set of special tools: 83 30 2 356 858 consisting of: crossmember: 83 30 2 356 852 Fixture: 83 30 2 356 857

**Storage Location**

Individual

**SI number**

01 17 13 (983)



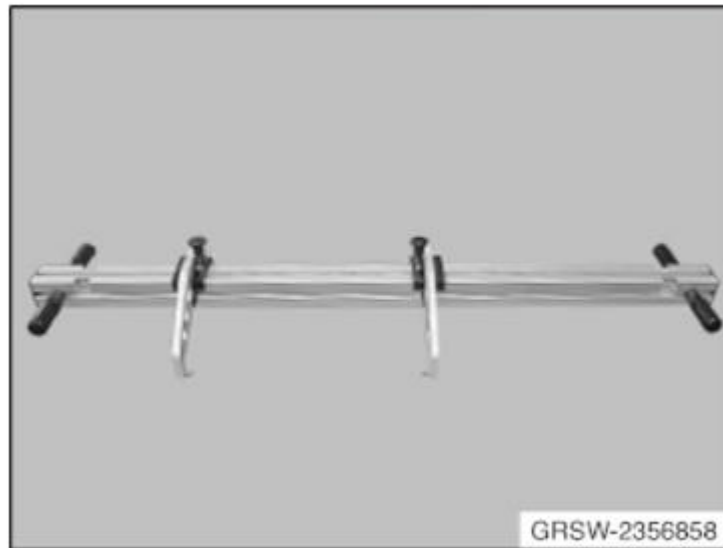
Consisting of:

1 = [2356852](#) Lifting gear

**NOTE:** Cross member with handle for the module jack

2 = 2356857 Fixture

**NOTE:** Mounting on the traverse for lifting the HV modules



**Fig. 24: Identifying Device (2356858)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2407378 DIE-PLATE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Matrices for Nano MQS contacts. A suggested storage location is the plastic case of the crimping tool set (0 496 833).

SI number

02 08 15 (239)

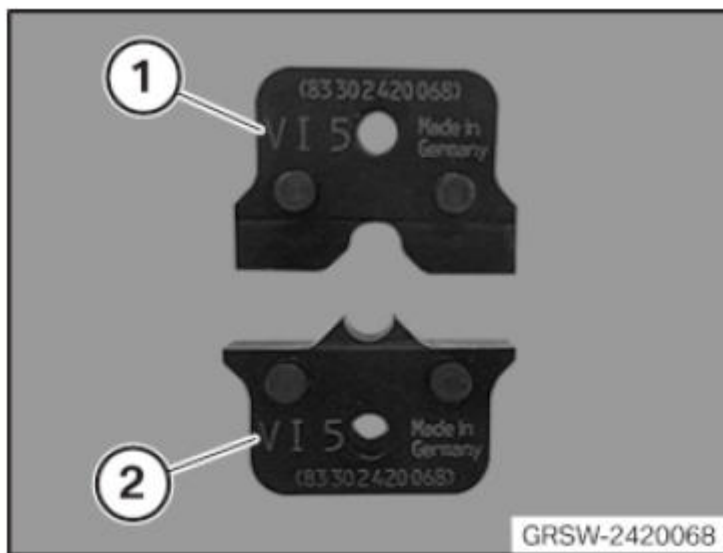


**Fig. 25: Identifying Die-Plate (2407378)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2420068 DIE-PLATE MP**

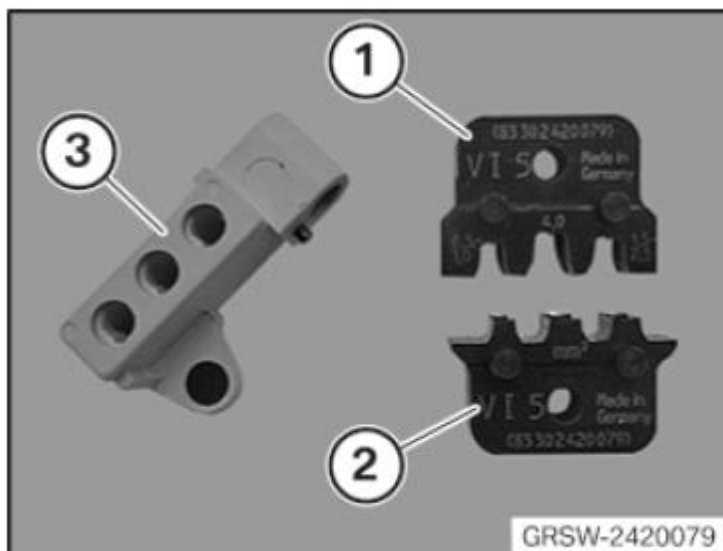
**NOTE:** For crimping aerial line connector diameter 5.1 mm<sup>2</sup> - replaces 0493149



**Fig. 26: Identifying Die-Plate (2420068).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2420079 DIE-PLATE MP**

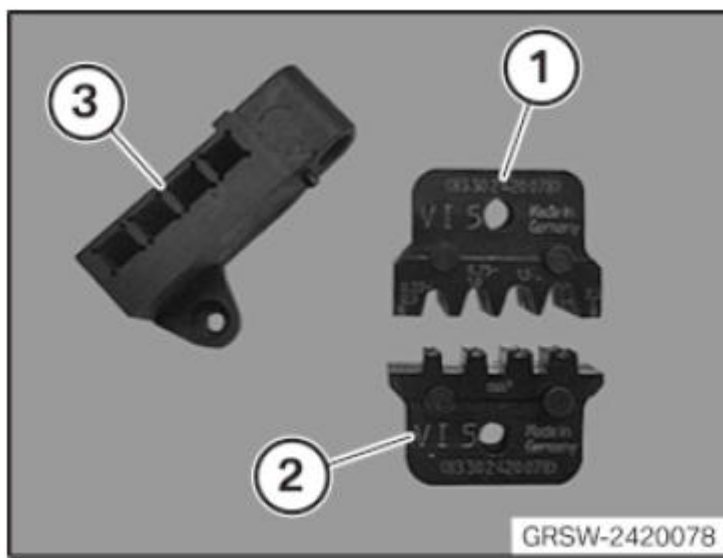
**NOTE:** For crimping line cross-section 0.5 - 1.0 mm<sup>2</sup> , 1.5 - 2.5 mm<sup>2</sup> , 4.0 mm<sup>2</sup> contact system 2.5 - replaces 0495195



**Fig. 27: Identifying Die-Plate (2420079).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2420078 DIE-PLATE MP**

**NOTE:** For crimping with line cross-section 0.35 - 0.5 mm<sup>2</sup> , 0.75 - 1.0 mm<sup>2</sup> , 1.5 mm<sup>2</sup> , 2.5 mm<sup>2</sup> round plug contacts/sleeves - replaces 0492910



**Fig. 28: Identifying Die-Plate (2420078)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**610220 DIE-PLATE MP**

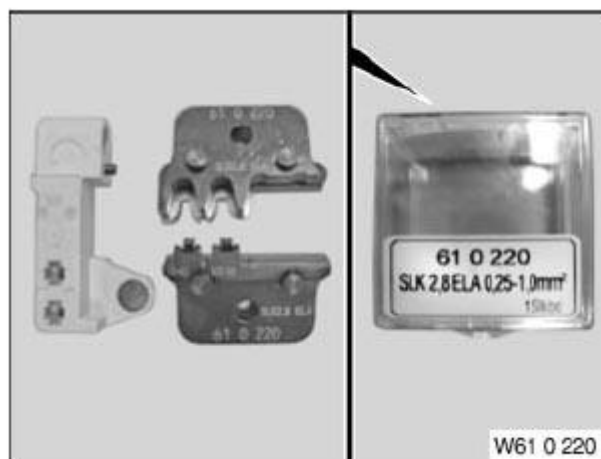
**NOTE:** (Matrix for SLK 2.8) (crimp insert set for bushing contact 2.8) in conjunction with crimping pliers 61 0 202 (from set 61 0 200)

**Storage Location**

X204

**SI number**

02 02 05 (194)



**Fig. 29: Identifying Die-Plate (610220)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

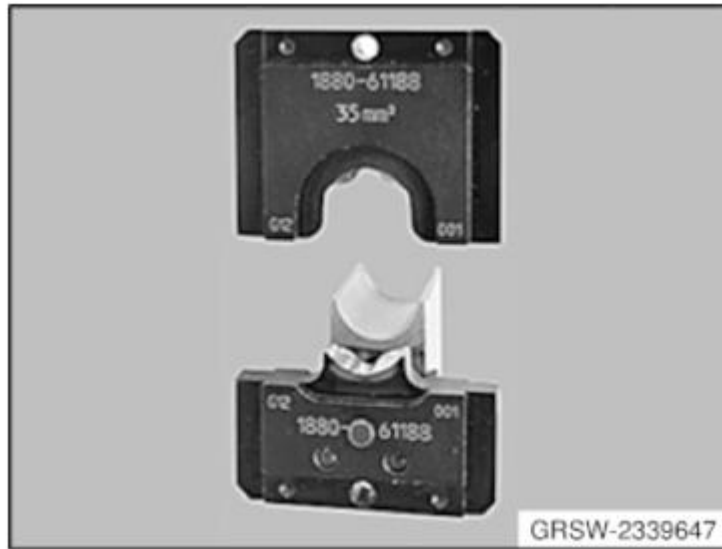
**2339647 DIE-PLATE MP**

**NOTE:** For crimping butt connectors with outer diameter 12.0 mm and lines with cable cross-sections of 35 mm<sup>2</sup> . In conjunction with crimping pliers 83 30 2 339 646.

**Storage Location**

Individual

**SI number**



**Fig. 30: Identifying Die-Plate (2339647)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**616060 EXTRACTOR MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** (Wiper arm puller, universal) To pull off wiper arm from drive shaft

**Storage Location**

C3

**SI number**

01 10 99 (433)

Consisting of:

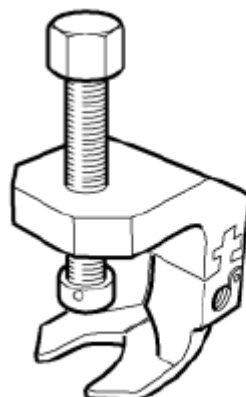
1 = 0494704 Basic body

2 = 0494705 Claw

(Left/right claw)

3 = 0494706 Spindle

4 = 0494707 Synchronizing key



W61 6 060

**Fig. 31: Identifying Extractor (616060)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2348527 EXTRACTOR MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** For disassembly of front wiper arms Applies to: BMW i Aftersales

**Storage Location**

C36

**SI number**

01 26 13 (995)



**Fig. 32: Identifying Extractor (2348527)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2357270 EYE BOLT MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales High Voltage Set consisting of 4 eye bolts.

**Storage Location**

Individual

**SI number**

01 19 13 (985)



**Fig. 33: Identifying Eye Bolt (2357270)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356949 FIXTURE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic

**Storage Location**

Individual

**SI number**

01 23 13 (989)



**Fig. 34: Identifying Fixture (2356949)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2357221 FIXTURE MINIMUM SET: MECHANICAL TOOLS AM**

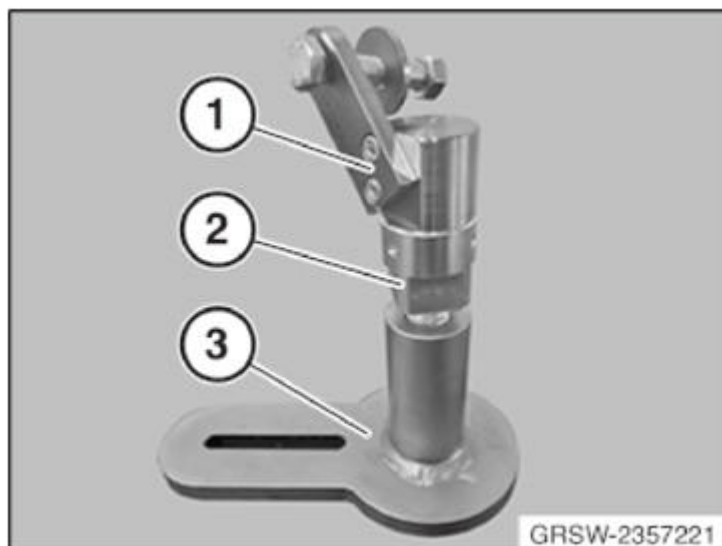
**NOTE:** Applies to: BMW i Aftersales Basic mounting for drive unit (electrical machine/transmission and optional REX) on the mobile major assembly table lift MHT 1200 81 22 2 184 136, is required three times, support base 83302357221\_C including bracket 83302357221\_B and tab 83302357221\_A

**Storage Location**

Individual

**SI number**

01 22 13 (988)

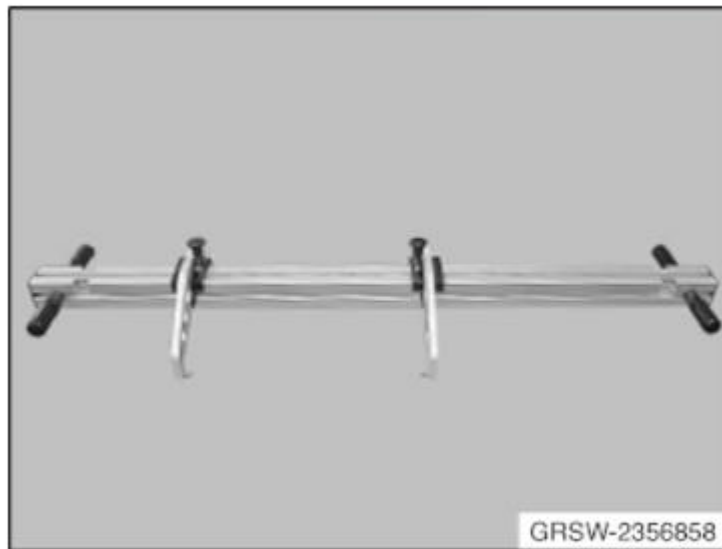




**Fig. 35: Identifying Fixture (2357221)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356857 FIXTURE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Mounting on the traverse for lifting the HV modules



**Fig. 36: Identifying Fixture (2356857)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2360334 FOIL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Foil set alphabets (L - R) for cable cabinet 2

**Storage Location**

Individual

**SI number**

02 08 14 (115)



**Fig. 37: Identifying Foil (2360334)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356849 GAUGE MINIMUM SET: MECHANICAL TOOLS**

**NOTE:** Applies to: BMW i Aftersales High Voltage for calibrating the module

levels in the HV battery I12 Silhouette foil is included in the delivery specification.

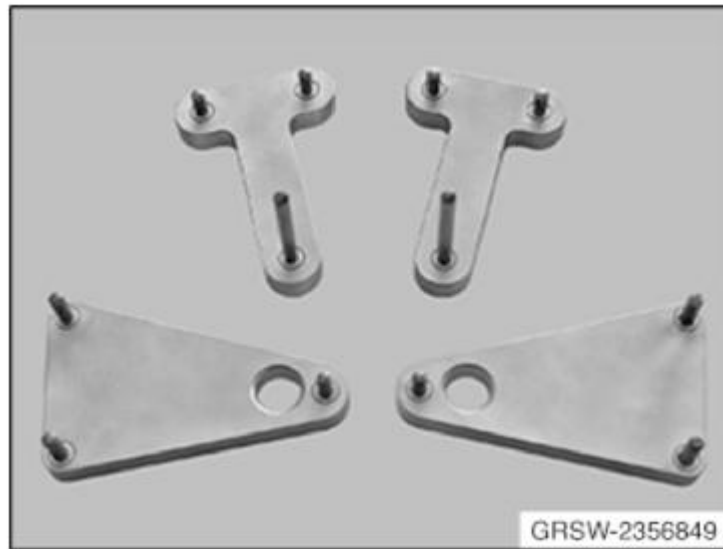
**Storage Location**

B35

B36

**SI number**

01 18 13 (984)



**Fig. 38: Identifying Gauge (2356849)**

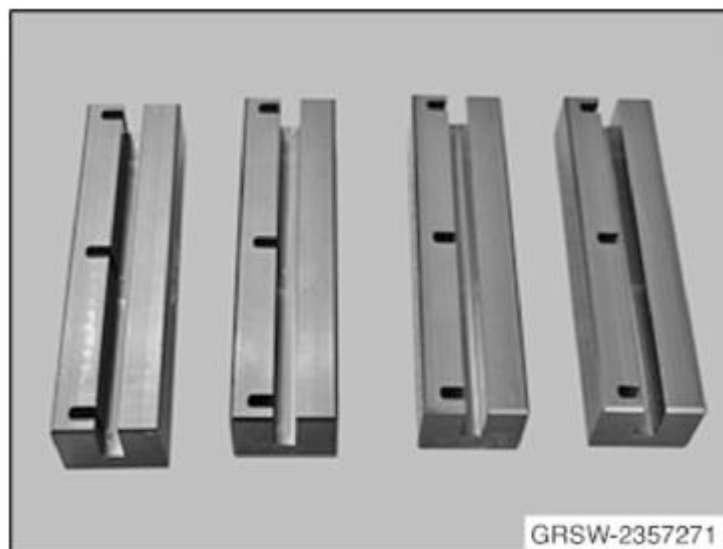
Courtesy of BMW OF NORTH AMERICA, INC.

**2357271 GUARD MINIMUM SET: MECHANICAL TOOLS**

**NOTE:** Replaced by 83 30 2 288 986

**SI number**

01 19 13 (985)



**Fig. 39: Identifying Guard (2357271)**

Courtesy of BMW OF NORTH AMERICA, INC.

**614321 HANDLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

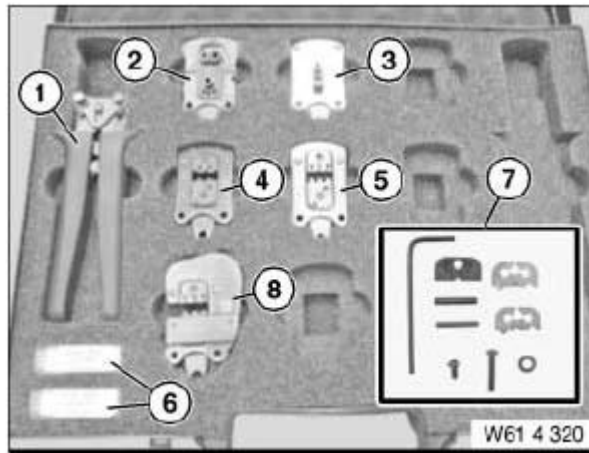
**NOTE:** Basic handle for crimping heads

**Storage Location**

M22 x 201

**SI number**

02 01 06 (283)



**Fig. 40: Identifying Handle (614321)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2360980 HOLDER AM**

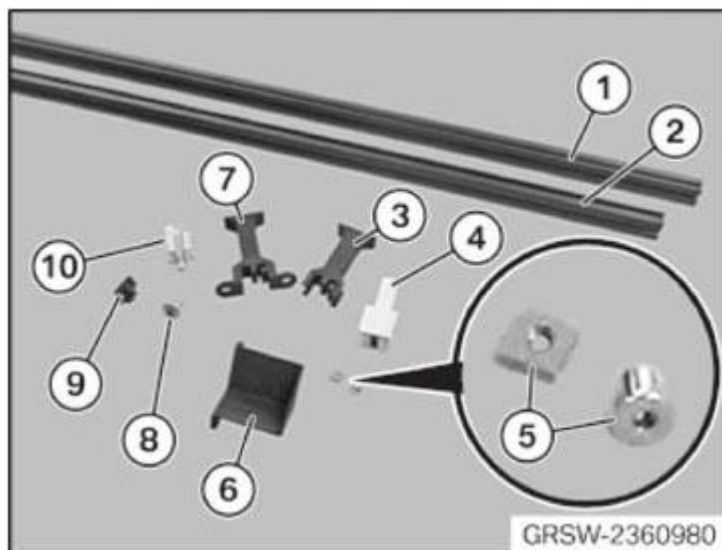
**NOTE:** Holder set for tool cabinet 550

**Storage Location**

Individual

**SI number**

02 09 14 (116)

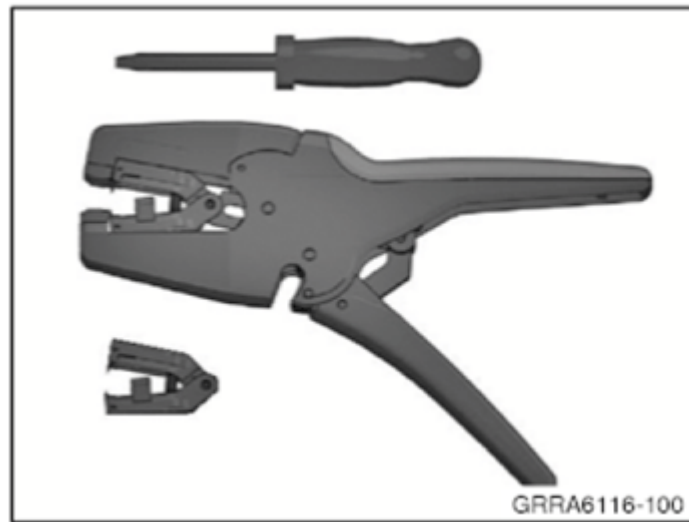


**Fig. 41: Identifying Holder (2360980)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2221123 KNIFE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Replacement knife for insulation strippers 83 30 2 221 122

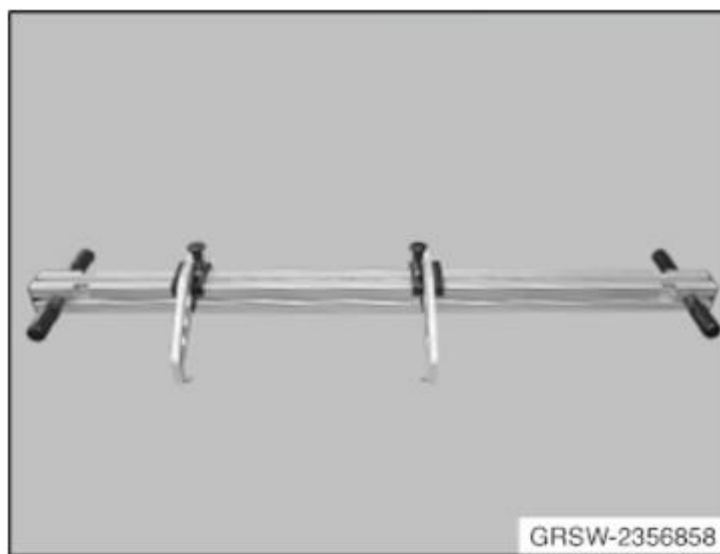


**Fig. 42: Identifying Knife (2221123)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356852 LIFTING GEAR MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Cross member with handle for the module jack



**Fig. 43: Identifying Lifting Gear (2356852)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2360081 LIFTING GEAR AM**

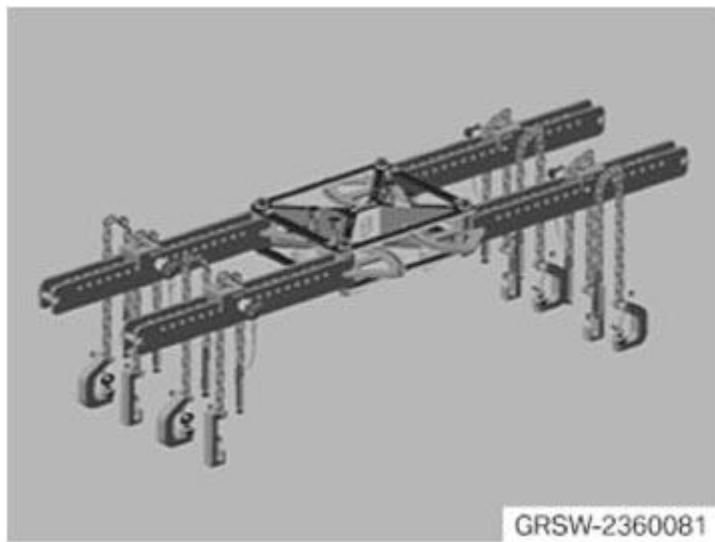
In conjunction with:

**WORKSHOP CRANE WSK**

**NOTE:** Multi-service lifting gear for mounting high-voltage battery units or other loads.

**Storage Location**

Individual



**Fig. 44: Identifying Lifting Gear (2360081)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356947 LIFTING GEAR MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Consisting of 4 tensioning straps and eyes, as well as 4 reinforcing shims. Applies to: BMW i Aftersales Basic

**Storage Location**

Individual

**SI number**

01 19 13 (985)



**Fig. 45: Identifying Lifting Gear (2356947)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356946 MANDREL MINIMUM SET: MECHANICAL TOOLS AM**

In conjunction with:

**81222184136**

**NOTE:** Applies to: BMW i Aftersales Basic set consisting of 2 mandrels for guiding the HV battery on installation of the HV

**Storage Location**

Individual

SI number

01 21 13 (987)



**Fig. 46: Identifying Mandrel (2356946)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2359966 PLIERS MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** For tightening and cleanly cutting off plastic cable straps in high-voltage battery units.

Storage Location

Individual

SI number

02 05 14 (104)



**Fig. 47: Identifying Pliers (2359966)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2221122 PLIERS MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Automatic self-adjusting insulation strippers for one-or multi-wire cables with a cross-section of 0.03 to 10 mm



**Storage Location**

Individual

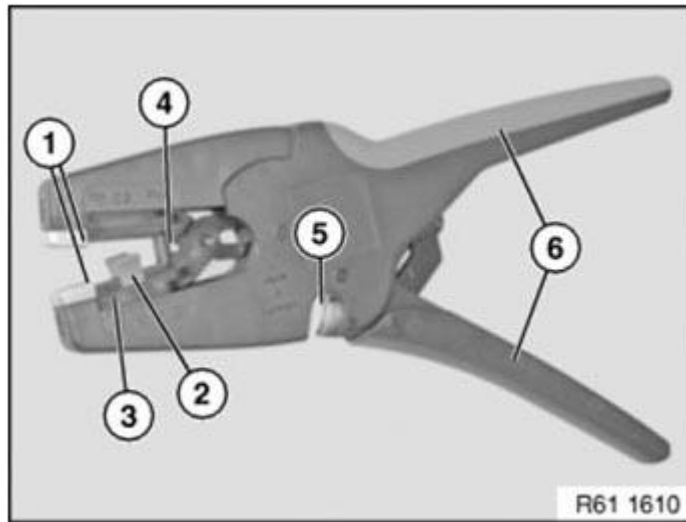
**SI number**

02 07 11 (721)

Consisting of:

1 = 2221123 Knife

**NOTE:** Replacement knife for insulation strippers 83 30 2 221 122



**Fig. 48: Identifying Pliers (2221122)**

Courtesy of BMW OF NORTH AMERICA, INC.

**610325 RELEASE TOOL MP**

**NOTE:** (release tool "JPT")

**Storage Location**

X205

**SI number**

02 05 06 (294)



**Fig. 49: Identifying Release Tool (610325)**

Courtesy of BMW OF NORTH AMERICA, INC.

## 610316 RELEASE TOOL MP

**NOTE:** (release tool for flat spring contacts with double retaining tab "SPT 4.8" "JPT 2.8") Replaces from 09/2005 special tool 61 1 136

### Storage Location

X205

### SI number

02 05 05 (217)



**Fig. 50: Identifying Release Tool (610316)**

Courtesy of BMW OF NORTH AMERICA, INC.

## 610317 RELEASE TOOL MP

**NOTE:** (release tool for LSK 8) Replaces from 09/2005 special tool 61 1 200

### Storage Location

Individual

### SI number

02 05 05 (217)



**Fig. 51: Identifying Release Tool (610317)**

Courtesy of BMW OF NORTH AMERICA, INC.

## 2354571 REMOVAL AID AM

**NOTE:** For removing the "Car-Sharing" module 3.0 in "DriveNow" vehicles

### Storage Location

Individual

### SI number

01 31 13 (001)



**Fig. 52: Identifying Removal Aid (2354571)**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 2357269 SHACKLE MINIMUM SET: MECHANICAL TOOLS AM

**NOTE:** Applies to: BMW i Aftersales High Voltage Set consisting of 4 pieces.

### Storage Location

Individual

### SI number

01 19 13 (985)



**Fig. 53: Identifying Shackle (2357269)**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 2357541 SOCKET WAF 46 MINIMUM SET: MECHANICAL TOOLS

**NOTE:** Applies to: BMW i Aftersales High Voltage socket SW10 (with magnet)

square socket, drive 6.3 = 1/4 inch contour-graphic-silhouette foil is included in the delivery specification.

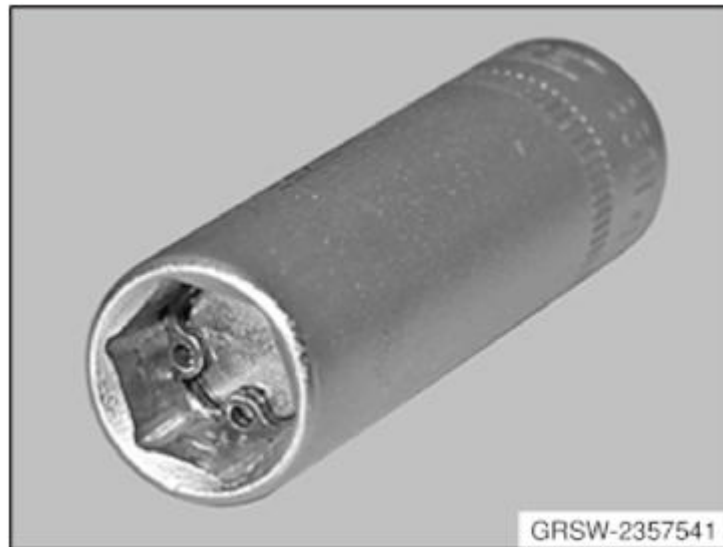
**Storage Location**

B36

C36

**SI number**

01 34 13 (007)

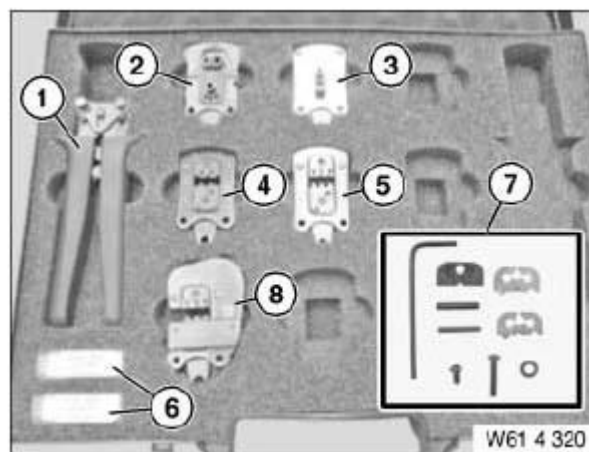


**Fig. 54: Identifying Socket WAF 46 (2357541)**

Courtesy of BMW OF NORTH AMERICA, INC.

**614327 SUPPLEMENT MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** (Replacement knife) With tool for changing blades in stripping unit. Must be ordered separately, not included in 61 4 320 delivery specification! Discontinued as from 03/2010.



**Fig. 55: Identifying Supplement (614327)**

Courtesy of BMW OF NORTH AMERICA, INC.

**614326 SUPPLEMENT MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

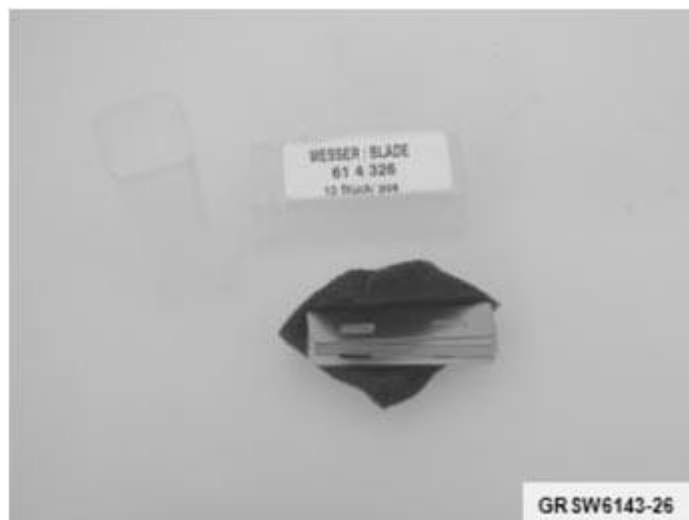
**NOTE:** (Replacement blade) For face-cutting optical fibres. From 03/2006, no longer included in set 61 4 320 but individually available as a replacement set. Replacement blade only suitable for 61 4 322.

**Storage Location**

M22 x 201

**SI number**

02 04 06 (293)



**Fig. 56: Identifying Supplement (614326)**

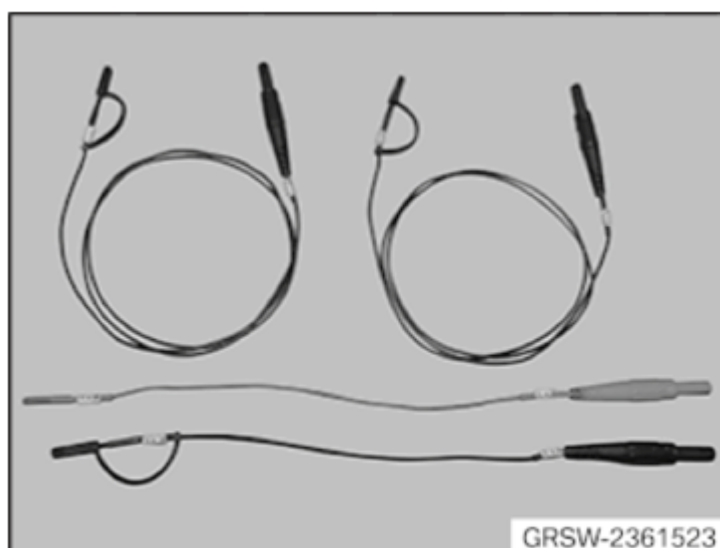
Courtesy of BMW OF NORTH AMERICA, INC.

**2361523 TEST CABLE MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** For measuring NanoMQS contacts. Supplementary set for cable case.83302299380

**SI number**

02 07 14 (113)



**Fig. 57: Identifying Test Cable (2361523)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2352990 TESTER MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Test box set (2 x 66 Pole) incl. LED display and templates for existing adapter cables. Suitable for all adapter cables with D sub plug. Consists of: 1. Case, 2 test boxes (67 - 132 pins), 3. connecting cable, 4. template set, 5. connecting cable long, 6. ground terminal, 7. connecting cable short, 8. test box 1 (1-66 pins)

**Storage Location**

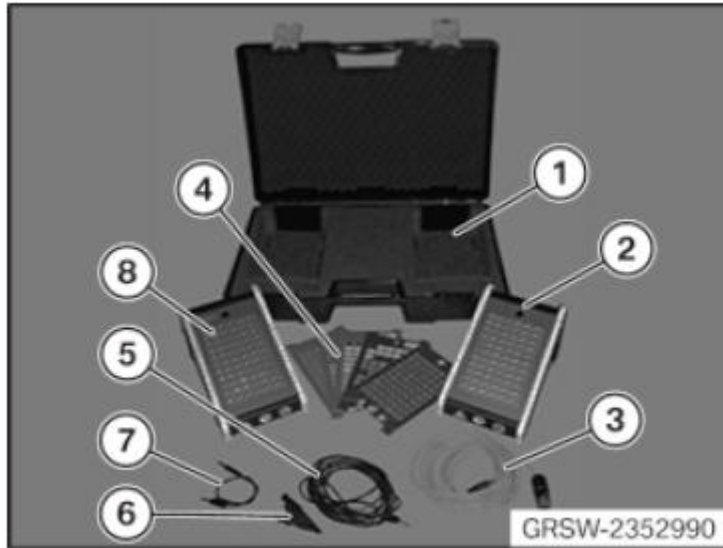
Individual

**SI number**

02 10 15 (242)

Consisting of:

1 = 2410561 Adapter



**Fig. 58: Identifying Tester (2352990)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2353250 TESTER MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Applies to: BMW i Aftersales High Voltage test for HV safety of the HV battery includes: 83 30 2 353 361 wiring harness 83 30 2 353 251 vacuum bell I3 83 30 2 353 360 vacuum bell I8 83 30 2 353 362 adapter

**Storage Location**

Individual

**SI number**

02 09 13 (931)





**Fig. 59: Identifying Tester (2353250)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2407379 TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Stripping tool for stripping insulation of Nano MQS cable cross-sections.

**Storage Location**

Individual

**SI number**

02 08 15 (239)



**Fig. 60: Identifying Tool (2407379)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2337974 TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Cable shears. To professionally cut through cables with a cross-section of 10 mm<sup>2</sup> - 70 mm<sup>2</sup> .

**Storage Location**

A34

**SI number**

02 07 12 (859)



**Fig. 61: Identifying Tool (2337974)**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

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**ELECTRICAL****General Electrical System - Tightening Torques - All I3 Models - i3****AUXILIARY CABLE****61 12 AUXILIARY CABLE****TIGHTENING TORQUE SPECIFICATION - AUXILIARY CABLE**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Positive battery cable to power distribution module	I01 REX	Â	Â	8 Nm

**BATTERY AND TERMINAL****61 21 BATTERY WITH TERMINAL****TIGHTENING TORQUE SPECIFICATION - BATTERY WITH TERMINAL I 01**

Â	Type	Thread	Tightening specifications	Dimension
1AZ IBS with battery cable, negative terminal	I01	M6	Â	5.0 Nm
2AZ Terminal adapter, positive terminal Terminal adapter, negative terminal	I01	M6x30 (with microencapsulation "Precote 85" or locking agent Loctite 270)	Use new ISA screws	6.0 Nm
3AZ Battery tray to VAM	I01	BM8x25	Â	19.0 Nm
4AZ Battery to battery tray	I01	M6x20	Â	8.0 Nm
5AZ Ground cable to ground pin	I01	M8	Â	15.20 Nm

**HIGH-VOLTAGE BATTERY UNIT****61 27 HIGH-VOLTAGE BATTERY UNIT****TIGHTENING TORQUE SPECIFICATION - HIGH-VOLTAGE BATTERY UNIT**

Â	Type	Thread	Tightening specifications	Dimension
1AZ High-voltage battery unit to drive module	I01	M8	Replace screw	28 Nm
2AZ Potential compensation to drive module	I01	M6	Observe instructions for potential compensation screw connections!	11.8 Nm
3AZ End cover to pan	I01	M6	T30	8.5 Nm
4AZ Cell block strut	I01	M6	Replace screw	11.8 Nm

Â	Type	Thread	Tightening specifications	Dimension
5AZ Gasket screw, end cover	I01	M6	Replace screw	7 Nm
6AZ Cell block to pan	I01	M6	Â	11.8 Nm
7AZ Expansion valve to pan	I01	M5	Â	13 Nm
8AZ Vent unit to pan	I01	M5	Â	4 Nm
9AZ Safety box to pan	I01	M6	Â	11.8 Nm
10AZ Control unit of high-voltage battery unit to safety box	I01	Â	Oval-head screw	1.1 Nm
11AZ High-voltage connector to pan	I01	M5	Â	5 Nm
12AZ High-voltage connector to pan	I01	M4	Â	2.4 Nm
13AZ Housing, communication wiring harness to pan	I01	Â	Oval-head screw	2 Nm
14AZ Holder for control unit, high-voltage battery unit	I01	Â	Oval-head screw	1.1 Nm
15AZ Repair screw with nut for lid	I01	M6	Â	11.8 Nm
16AZ Potential compensation to radiator	I01	Â	Observe instructions for potential compensation screw connections!	14 Nm

## CONTROL UNITS

### 61 35 CONTROL UNITS

#### TIGHTENING TORQUE SPECIFICATION - CONTROL UNITS I 01, I 12

Â	Type	Thread	Tightening specifications	Dimension
1AZ Control unit BDC	I 01	Screw	Â	1.7 Nm
	I 12	M5x40 screw	Â	2.3 Nm
2AZ Control unit, hybrid drive interface module	I 01	M5x16 screw	Â	2.0 Nm
	I 12	Plastic nut	Â	2.0 Nm

## HIGH-VOLTAGE ACCUMULATOR SYSTEM

### 61 25 HIGH-VOLTAGE ACCUMULATOR SYSTEM

#### TIGHTENING TORQUE SPECIFICATION - HIGH-VOLTAGE ACCUMULATOR SYSTEM

Â	Type	Thread	Tightening specifications	Dimension	Angle of rotation
1AZ Convenience charging electronics on crossmember and drive module	I01	M8	Â	19 Nm	Â
2AZ Tension relief on convenience charging electronics	I01	M6	Â	8 Nm	Â

## HIGH-VOLTAGE CABLES

### 61 12 HIGH-VOLTAGE CABLES

#### TIGHTENING TORQUE SPECIFICATION - HIGH-VOLTAGE CABLES

Â	Type	Thread	Tightening specifications	Dimension
1AZ Holder, charging socket	I01	M5	Â	4.5 Nm
2AZ Cable routing to Life module	I01	M5	Â	4.5 Nm
3AZ Ground pin to Life module	I01	M10	Â	17 Nm
4AZ Cable routing, high-voltage cable to drive module	I01	M6	Â	12 Nm
5AZ High-voltage cable holder to Drive module	I01 REX	M6	Â	12 Nm
6AZ Sheet metal bracket on electrical machine electronics	I01	M6	Â	8 Nm
7AZ Holder for tension relief on electrical machine electronics and sheet metal bracket	I01	M6	Â	8 Nm
8AZ Tension relief on holder for tension relief	I01	M6	Â	8 Nm
9AZ Shaft to drive-module	I01	M6	Â	12 Nm

## HORN/FANFARE

### 61 33 HORN/FANFARE

#### TIGHTENING TORQUE SPECIFICATION - HORN/FANFARE I 01, I 12

Â	Type	Thread	Tightening specifications	Dimension
1AZ Fanfare to cross member	i01	M6x20	Â	8 Nm
	i12	M6x16	Â	8 Nm

## POWER DISTRIBUTION BOX, POWER SUPPORT POINTS

### 61 14 POWER DISTRIBUTION BOX, POWER SUPPORT POINTS

#### TIGHTENING TORQUE SPECIFICATION - POWER DISTRIBUTION BOX AND POWER SUPPORT POINTS (I 01)

Â	Type	Thread	Tightening specifications	Dimension
1AZ Battery cable Plus to B+ multifuse distributor	I01/I12	M8	Â	15 Nm Â±1 Nm

Â	Type	Thread	Tightening specifications	Dimension
2AZ Battery cable Plus to B+ multifuse distributor Positive power feed to power distribution box	I01/I12	M6	Â	8 Nm Â±1 Nm
3AZ Power distribution box, front to holder	I01	Â	Â	2.5 Nm
	I12	Â	Â	2.3 Nm

## SWITCH

### 61 31 SWITCH

#### TIGHTENING TORQUE SPECIFICATION - SWITCH I 01, I 12

Â	Type	Thread	Tightening specifications	Dimension
1AZ Gear lever switch	I 01	M5x20	Â	6.0 Nm
	I 12	Oval-head screw	New screws	3.3 Nm
2AZ Switch, EMF to cover	I 01	Oval-head screw	Â	0.8 Nm
	I 12	Oval-head screw	Â	1.1 Nm
3AZ Steering column switch cluster	I 01	Â	Â	6.0 Nm
	I 12	TS5x22	Â	6.0 Nm
4AZ Start/stop switch	I 12	Oval-head screw	Â	1.8 Nm
5AZ Lighting switch	I 12	Oval-head screw	Â	1.8 Nm
6AZ Controller	I 12	Oval-head screw	Â	1.8 Nm
7AZ Rocker switch for automatic transmission	I 12	Oval-head screw	Â	1.8 Nm
8AZ Switch for multifunction steering wheel	I 12	Oval-head screw	Â	1.8 Nm

## WINDSCREEN WIPERS

### 61 61 WINDSCREEN WIPERS

#### TIGHTENING TORQUE SPECIFICATION - WINDSCREEN WIPERS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Wiper console, front	I01/I12	Â	Â	7.6 Nm
2AZ Decoupling buffer, wiper console, front	I01/I12	Â	Â	7.6 Nm
3AZ Wiper arm, front	I01/I12	Â	Â	30.0 Nm
4AZ Washer fluid reservoir	I01	Â	Â	4.0 Nm
	I12	M6x25	Â	3.5 Nm
5AZ Rear wiper electric motor	I01	Â	Â	7.6 Nm
6AZ Wiper arm, rear	I01	Â	Â	13.5 Nm





## ELECTRICAL

### Operating Fluids Electrical System

#### 1.0 BATTERY

Only distilled water (available locally) is to be used when topping up the electrolyte level.

If a new battery (delivered dry) is to be placed into service, use only battery electrolyte ("sulfuric acid"), available locally.

#### 2.0 SEALANT/SUPER GLUE/CONTACT CLEANER

##### SEALANT

Aftermarket accessory installations which require routing electrical wires through metal body panels are to have the access holes sealed.

Wurth Part No. 893430

##### SUPER GLUE

The rubber seal around the trunk release button of E39 vehicles can be repositioned with Wurth Rubberized Super Glue (Part No. 893 4103).

#### 3.0 ELECTRICAL CONTACT ENHANCER AND CONTACT CLEANER

##### ELECTRICAL CONTACT/CONNECTOR GREASE

NyoGel 760G is resistive to moisture and can be used for a lubrication of tin-lead type electrical connectors.

NyoGel 760G BMW Part No. 83 23 0 392 297

##### ELECTRICAL CONTACT ENHANCER

Stabilant 22A evaporates and leaves a thin polymer film which is conductive between the mating surfaces, while staying non-conductive between adjacent pins. At the same time it prevents the formation of any further harmful deposits.

Wurth Part No. 893622 (Stabilant 22A)

**Note 1:** Stabilant 22A must not be used on Oxygen Sensor connectors. To function, oxygen sensors require a flow of oxygen through the terminal connector to the sensor element. Stabilant 22A will affect this flow of oxygen, and will result in irreparable damage to the sensor.

**Note 2:** Stabilant 22A must not be used on plug connectors which carry fiber optics. Stabilant 22A may migrate to the fiber optic and attenuate the optical signal.

##### CONTACT CLEANER SPRAY

Use to clean electrical and electronic components of dirt, grease, etc. Will not harm components or epoxy coverings. Allow to air dry. Do not dry with shop air supply as this may contaminate the connector.

Wurth Part No. 89365 (Zero Residue Electrical Contact Cleaner)

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## EMISSION CONTROL ABBREVIATIONS Gasoline & Diesel

### "A"

#### A/C

Air Conditioning

#### A/C-ISUS

A/C Idle Speed-Up Solenoid

#### A/F

Air/Fuel

#### AAI

Air Assist Injector

#### ACL

Air Cleaner (Thermostatic Air Cleaner)

#### ACL-BMS

ACL Bimetallic Sensor

#### ACL-CKV

ACL Check Valve

#### ACL-DV

ACL Delay Valve

#### ACL-ESC

Electronic Spark Control

#### ACL-PVS

ACL Ported Vacuum Switch

#### ACL-RDV

ACL Reverse Delay Valve

#### ACL-RDVS

ACL Reverse Delay Valve (Single)

#### ACL-TCV

ACL Thermal Control Valve

#### ACL-TS

ACL Temperature Sensor

**ACL-TSOV**

ACL Temperature Sensor Override Valve

**ACL-TVS**

ACL Thermal Vacuum Switch

**ACL-TVV**

ACL Thermal Vacuum Valve

**ACL-VCDV**

ACL Vacuum Control Delay Valve

**ACL-VCV**

ACL Vacuum Control Valve

**ACL-VM**

ACL Vacuum Motor

**ACL-WP**

ACL Wax Pellet Type Motor

**ADS**

Anti-Dieseling Solenoid

**AFR**

Air/Fuel Ratio Sensor

**AFS**

Air/Fuel Ratio Sensor

**AIH**

Air Intake Heaters

**AIH-TS**

AIH Temperature Sensor

**AIR**

Air Injection System

**AIS**

Air Injection System

**AIS-ACV**

AIS Air Control Valve

**AIS-AF**

Air Injection System Air Filter

**AIS-AMV**

AIS Air Management Valve

**AIS-ASV**

AIS Air Switching Valve

**AIS-BPV**

AIS By-Pass Valve

**AIS-CC**

AIS Computer Controlled

**AIS-CKV**

AIS Check Valve

**AIS-CSV**

AIS Control Solenoid Valve

**AIS-CV**

AIS Combination Valve

**AIS-DV**

AIS Diverter Valve

**AIS-IMCV**

AIS Intake Manifold Change-Over Valve

**AIS-MCV**

AIS Manifold Change-Over Valve

**AIS-OWV**

AIS One Way Valve

**AIS-PAF**

AIS Pulse Air Feeder

**AIS-PM**

AIS Pump Motor

**AIS-PV**

AIS Pneumatic Valve

**AIS-RV**

AIS Relief Valve

**AIS-SAV**

AIS Secondary Air Valve



**AIS-SOL**

AIS Solenoid

**AIS-SV**

AIS Solenoid Valve

**AIS-VCV**

AIS Vacuum Control Valve

**AIS-VSV**

AIS Vacuum Switching Valve

**AIS-VT**

AIS Vacuum Tank

**AIS-VCV**

AIS Vacuum Control Valve

**AIS-VSV**

AIS Vacuum Switching Valve

**AIV**

Air Injection Valve

**AIV-SOL**

Air Injection Valve Solenoid

**ALVW**

Adjusted Loaded Vehicle Weight

**AMV**

Air Management Valve

**AP**

Air Pump Injection System

**AP-ABV**

Air Pump Air Bypass Valve

**AP-ACV**

AP Air Control Valve

**AP-AMV**

AP Air Management Valve

**AP-ASRV**

AP Air Switching Relief Valve

**AP-ASS**

AP Air Switching Solenoid

**AP-ASV**

AP Air Switching Valve

**AP-BP**

AP By-Pass Valve

**AP-BPV**

AP By-Pass Valve

**AP-CKV**

AP Check Valve

**AP-CS**

AP Control Solenoid

**AP-CV**

AIR Cut-Off Valve

**AP-DCTO**

AP Dual Coolant Temperature Override

**AP-DLY**

AP Delay Valve

**AP-DV**

AP Diverter Valve

**AP-EADV**

AP Electric Air Control Diverter Valve

**AP-EAMR**

AP Electric Air Management Relay

**AP-EAMS**

AP Electric Air Management Solenoid

**AP-EAP**

AP Electric Air Pump

**AP-EC**

AP Electromagnetic Clutch

**AP-ERLY**

AP Electric Air Pump Relay

**AP/PAIR**

Pulsed Secondary Air Injection

**AP-RDV**

AP Reed Valve

**AP-RV**

AP Relief Valve

**AP-SOL**

AP Solenoid

**AP-SOV**

AP Shut-Off Valve

**AP-SV**

AP Solenoid Valve

**AP-SWV**

AP Switchover Valve

**AP-TV**

AP Transmitting Valve

**AP-VCS**

AP Vacuum Control Solenoid

**AP-VCSV**

AP Vacuum Controlled Air Shut-Off Valve

**AP-VCV**

AP Vacuum Control Valve

**AP-VSV**

AP Vacuum Switching Valve

**A/T**

Automatic Transmission

**ATCV**

Air Temperature Control Valve

**"B"****BP/EGR**

Backpressure EGR System

**BP/EGR-BPS**

BP/EGR Backpressure Sensor

**BP/EGR-BPT**

BP/EGR Backpressure Transducer

**BP/EGR-BPV**

BP/EGR Backpressure Valve

**BP/EGR-BS**

BP/EGR Bleed Solenoid

**BP/EGR-BVSV**

BP/EGR Bimetallic Vacuum Switching Valve

**BP/EGR-C**

BP/EGR Controller

**BP/EGR-CLR**

BP/EGR Cooler

**BP/EGR-CS**

BP/EGR Control Solenoid

**BP/EGR-CTO**

BP/EGR Coolant Temperature Override

**BP/EGR-CV**

BP/EGR Control Valve

**BP/EGR-DCTO**

BP/EGR Dual Coolant Temperature Override

**BP/EGR-DS**

BP/EGR Diagnostic Solenoid

**BP/EGR-DSOL**

BP/EGR Duty Solenoid

**BP/EGR-DTVSW**

BP/EGR Distributor Thermal Vacuum Switch

**BP/EGR-DV**

BP/EGR Delay Valve

**BP/EGR-EET**

BP/EGR Electric Transducer

**BP/EGR-EPV**

BP/EGR External Pressure Valve

**BP/EGR-FDV**

BP/EGR Forward Delay Valve

**BP/EGR-LCV**

BP/EGR Vacuum Control Valve

**BP/EGR-LC**

BP/EGR Load Control Valve

**BP/EGR-OVS**

BP/EGR Orifice Valve Sensing

**BP/EGR-PS**

BP/EGR Position Sensor

**BP/EGR-PT**

BP/EGR Pressure Transducer

**BP/EGR-PVS**

BP/EGR Ported Vacuum Switch

**BP/EGR-RES**

BP/EGR Reservoir

**BP/EGR-RST**

BP/EGR Restrictor

**BP/EGR-SOL**

BP/EGR Solenoid

**BP/EGR-TCTVS**

BP/EGR Torque Converter Thermal Vacuum Switch

**BP/EGR-TCV**

BP/EGR Thermal Control Valve

**BP/EGR-TCVLV**

BP/EGR Temperature Control Valve

**BP/EGR-T**

BP/EGR Temperature Sensor

**BP/EGR-TS**

BP/EGR Temperature Sensor

**BP/EGR-TVC**

BP/EGR Thermal Control Valve

**BP/EGR-TVS**

BP/EGR Thermal Vacuum Switch

**BP/EGR-TVV**

BP/EGR Thermal Vacuum Valve

**BP/EGR-VC**

BP/EGR Diagnostic Valve

**BP/EGR-VCV**

BP/EGR Vacuum Control Valve

**BP/EGR-VM**

BP/EGR Vacuum Modulator

**BP/EGR-VRV**

BP/EGR Vacuum Regulator Valve

**BP/EGR-VS**

BP/EGR Vacuum Switch

**BP/EGR-VSOL**

BP/EGR Vent Solenoid

**BP/EGR-VSV**

BP/EGR Vacuum Switching Valve

**"C"****C-4**

Computer Controlled Catalytic Converter

**CAC**

Charge Air Cooler

**CAS**

Clean Air System

**CB**

Crankcase Breather

**CB-VC**

Crankcase Breather-Vapor Canister

**CBPS**

Coasting By-Pass System

**CBVC**

Crankcase Breather Vapor Canister

**CCIEV**

Coolant Controlled Idle Enrichment Valve

**CCO**

Computerized Engine Controls



**CCS**

Controlled Combustion System

**CCV**

Closed Crankcase Ventilation

**CD-REGVLV**

Crankcase Depression Regulator Valve

**CDRV**

Crankcase Depression Relief Valve

**CEAB**

Cold Engine Air Bleed

**CEAB-TVS**

CEAB Thermal Vacuum Switch

**CEAB-TVV**

CEAB Thermal Vacuum Valve

**CEC**

Computerized Engine Controls

**CESS**

Cold Engine Sensor Switch

**CETS**

Cold Engine Temperature Switch

**CFI**

Continuous Fuel Injection

**CMH**

Cold Mixture Heater

**CNG**

Compressed Natural Gas

**CO**

Carbon Monoxide

**CO2**

Carbon Dioxide

**CPI**

Central Port Injection

**CRV**

Coasting Richer Valve

## **CSI**

Central Sequential Injection

## **CTAVS**

Cold Temperature Activated Vacuum System

## **CTOX**

Continuous Trap Oxidizer

## **CVOT**

Crankcase Ventilation Orifice Tube

## **CVOT-CKV**

Crankcase Ventilation Orifice Tube Check Valve

## **"D"**

### **DCLV**

Deceleration Valve

### **DCS**

Deceleration Control System

### **DDI**

Direct Diesel Injection

### **DFI**

Direct Diesel Injection

### **DI**

Direct Injection

### **DKV**

Deceleration Kick Valve

### **DLCV**

Deceleration Mixture Control Valve

### **DM-TL**

Diagnostic Module Tank Leakage

### **DMS**

Dual Manifold System

### **DOC**

Diesel Oxidation Catalyst

### **DOHC**

Dual Overhead Cam

**DPD**

Dual Point Distributor

**DPF**

Diesel Particulate Filter

**DPF/TWC**

Combination Diesel Particulate Filter and Three Way Catalyst

**DPFE**

Differential Pressure Feedback EGR Valve

**DPFEGR**

Differential Pressure Feedback EGR Valve

**DTM**

Deceleration Throttle Modulator

**"E"**

**EAIR**

Electric Air Injection System

**EAIR-DV**

EAIR Diverter Valve

**EC**

Computerized Engine Controls

**ECM**

Electronic Control Module

**ECU**

Electronic Control Unit

**EDC**

Electronic Diesel Control

**EDS**

Electronic Diesel System

**EEC**

Electronic Engine Control

**EFE**

Early Fuel Evaporation

**EFE-CKV**

EFE Check Valve

**EFE-CV**

EFE Control Valve

**EFE-DTVS**

EFE Delay Thermal Vacuum Switch

**EFE-HTR**

EFE Heater

**EFE-HCV**

EFE Heat Control Valve

**EFE-OTS**

EFE Oil Temperature Switch

**EFE-PTC**

EFE Positive Temperature Coefficient (Intake Heater Grid)

**EFE-PVS**

EFE Ported Vacuum Switch

**EFE-SOL**

EFE Solenoid

**EFE-TVS**

EFE Thermal Vacuum Switch

**EFE-TVV**

EFE Thermal Vacuum Valve

**EFE-VSV**

EFE Vacuum Switching Valve

**EFI**

Electronic Fuel Injection

**EFI-MA**

EFI Mass Airflow Sensor

**EFI-MAF**

EFI Mass Airflow Sensor

**EGR**

Exhaust Gas Recirculation System

**EGR-BCS**

EGR Boost Check Solenoid

**EGR-BPBV**

EGR By-Pass Backpressure Valve

**EGR-BPT**

EGR Backpressure Transducer

**EGR-BPV**

EGR By-Pass Valve

**EGR-BS**

EGR Bleed Solenoid

**EGR-BSSV**

EGR Boost Sensor Solenoid Valve

**EGR-BV**

EGR Bypass Valve

**EGR-BVSV**

EGR Bimetallic Vacuum Switching Valve

**EGR-C**

EGR Controller

**EGR-CC**

EGR Coolant Controlled

**EGR-CLR**

EGR Cooler

**EGR-VSOL**

EGR Vacuum Solenoid

**EGR-CKV**

EGR Check Valve

**EGR-CS**

EGR Control Solenoid

**EGR-CSOL**

EGR Cut-Off Solenoid

**EGR-CSV**

EGR Control Solenoid

**EGR-CTO**

EGR Coolant Temperature Override

**EGR-CTS**

EGR Charge Temperature Sensor

**EGR-CTSW**

EGR Charge Temperature Switch

**EGR-CTTS**

EGR Coolant Temperature Thermoswitch

**EGR-CV**

EGR Control Valve

**EGR-CVCV**

EGR Constant Vacuum Control Valve

**EGR-CVS**

EGR Control Vent Solenoid

**EGR-DC**

EGR Digital Control

**EGR-DCTO**

EGR Dual Coolant Temperature Override

**EGR-DPFE**

Differential Pressure Feedback EGR Sensor

**EGR-DPFS**

EGR Differential Pressure Feedback Sensor

**EGR-DS**

EGR Diagnostic Solenoid

**EGR-DSOL**

EGR Duty Solenoid

**EGR-DTVS**

EGR Delay Thermal Vacuum Switch

**EGR-DTVSW**

EGR Distributor Thermal Vacuum Switch

**EGR-DV**

EGR Delay Valve

**EGR-EPRS**

EGR Exhaust Pressure Regulator Solenoid

**EGR-EPRV**

EGR Exhaust Pressure Regulator Valve



**EGR-EPV**

EGR External Pressure Valve

**EGR/EVAP-CSV**

EGR/EVAP Control Solenoid Valve

**EGR-EVR**

EGR Vacuum Regulator

**EGR-EVRV**

EGR Electronic Vacuum Regulator Valve

**EGR-FDV**

EGR Forward Delay Valve

**EGR-FJS**

EGR Floor Jet System

**EGR-FPS**

EGR Feedback Pressure Sensor

**EGR-LCV**

EGR Load Control Valve

**EGR-MAP**

EGR Manifold Absolute Pressure Sensor

**EGR-PFE**

EGR-PFE Sensor

**EGR-PS**

EGR Position Sensor

**EGR-PSW**

EGR Pulse Switch

**EGR-PVS**

EGR Ported Vacuum Switch

**EGR-REG**

EGR Regulator

**EGR-RES**

EGR Reservoir

**EGR-RST**

EGR Restrictor

**EGR-SC**

EGR Signal Converter

**EGR-SEC**

EGR, Secondary

**EGR-SEN**

EGR Sensor

**EGR-SM**

EGR Stepper Motor

**EGR-SOL**

EGR Solenoid

**EGR-SU**

EGR Switchover Valve

**EGR-SUB**

Sub-EGR Valve

**EGR-SV**

EGR Switchover Valve

**EGR-SVV**

EGR Solenoid Vacuum Valve

**EGR-T**

EGR Temperature Sensor

**EGR-TC**

EGR Transmission Controlled

**EGR-TCTVS**

EGR Torque Converter Thermal Vacuum Switch

**EGR-TCV**

EGR Thermal Control Valve

**EGR-TCVLV**

EGR Temperature Control Valve

**EGR-TRANS**

EGR Transducer

**EGR-TS**

EGR Temperature Sensor

**EGR-TSW**

EGR Temperature Switch

**EGR-TV**

EGR Thermal Valve

**EGR-TVD**

EGR Throttle Valve Diaphragm

**EGR-TVS**

EGR Thermal Vacuum Switch

**EGR-TVSOL**

EGR Throttle Valve Solenoid

**EGR-TVV**

EGR Thermal Vacuum Valve

**EGR-V**

EGR Valve

**EGR-VA**

EGR Vacuum Amplifier

**EGR-VCV**

EGR Vacuum Control Valve

**EGR-VM**

EGR Vacuum Modulator

**EGR-VR**

EGR Vacuum Regulator

**EGR-VRS**

EGR Vacuum Regulator Solenoid

**EGR-VRSV**

EGR Vacuum Regulator Solenoid Valve

**EGR-VRV**

EGR Vacuum Regulator Valve

**EGR-VS**

EGR Vacuum Switch

**EGR-VSDV**

EGR Vacuum Switch Dump Valve

**EGR-VSEN**

EGR Vacuum Sensor

**EGR-VSOL**

EGR Vent Solenoid

**EGR-VSS**

EGR Vacuum Switching Solenoid

**EGR-VST**

EGR Vacuum Surge Tank

**EGR-VSV**

EGR Vacuum Switching Valve

**EGR-VVCS**

EGR Venturi Vacuum Control System

**EGRB**

EGR Boost Sensor

**EGRC**

EGR Control Solenoid

**EGRC-BPT**

EGR Control Backpressure Transducer

**EGRC-SV**

EGR Control Solenoid Valve

**EHOC**

Electronically Heated Oxidation Catalyst

**EHTWC**

Electronically Heated Three-Way Catalyst

**EI**

Electronic Ignition System

**EIS**

Electronic Ignition System

**ELB**

Electronic Lean Burn

**EPR**

Exhaust Pressure Regulator

**EPR-SOL**

EPR Solenoid

**ESA**

Electronic Spark Advance

**ESIM**

Evaporative System Integrity Monitor

**EVAP**

Fuel Evaporative System

**EVAP-AAC**

EVAP Auxiliary Air Control

**EVAP-BPSV**

EVAP By-Pass Solenoid Valve

**EVAP-BVSV**

EVAP Bimetallic Vacuum Switching Valve

**EVAP-CAV**

EVAP Canister Air Valve

**EVAP-CCV**

EVAP Control Canister Close Valve

**EVAP-CCVSV**

EVAP Control Canister Vent Shut Valve

**EVAP-CCVSV**

EVAP Closed Canister Valve Vacuum Switching Valve

**EVAP-CDCV**

EVAP Canister Drain Cut Valve

**EVAP-CKV**

EVAP Check Valve

**EVAP-CPCS**

EVAP Canister Purge Control Solenoid

**EVAP-CPCSV**

EVAP Canister Purge Control Solenoid Valve

**EVAP-CPCV**

EVAP Canister Purge Control Valve

**EVAP-CPRV**

EVAP Canister Purge Regulator Valve

**EVAP-CPSV**

EVAP Canister Vent Shut Valve

**EVAP-CPT**

EVAP Canister Purge Timer

**EVAP-CPTVS**

EVAP Canister Purge Thermal Vacuum Switch

**EVAP-CPV**

EVAP Canister Vent Valve

**EVAP-CPVCSV**

EVAP Canister Purge Volume Control

**EVAP-CPVCV**

EVAP Canister Purge Volume Control Valve

**EVAP-CPVDV**

EVAP Canister Purge Vacuum Delay Valve

**EVAP-CPVR**

EVAP Canister Purge Valve Resonator

**EVAP-CS**

EVAP Control Solenoid

**EVAP-CSPS**

EVAP Control System Pressure Sensor

**EVAP-CSPV**

EVAP Canister Purge Valve

**EVAP-CST**

EVAP Canister Surge Tank

**EVAP-CSV**

EVAP Control Solenoid Valve

**EVAP-CT**

EVAP Catch Tank

**EVAP-CV**

EVAP Control Solenoid Valve

**EVAP-CVCS**

EVAP Canister Vent Control Solenoid

**EVAP-CVCSV**

EVAP Canister Vent Control Solenoid Valve

**EVAP-CVCV**

EVAP Canister Vent Control Valve



**EVAP-CVS**

EVAP Canister Vent Solenoid

**EVAP-CVSV**

EVAP Carburetor Vent Switching Valve

**EVAP-CVV**

EVAP Canister Vent Valve

**EVAP-DCTO**

EVAP Dual Coolant Temperature Override

**EVAP-DF**

EVAP Drain Filter

**EVAP-DPS**

EVAP Differential Pressure Sensor

**EVAP-DV**

EVAP-Drain Valve

**EVAP-ESIM**

Evaporative System Integrity Monitor

**EVAP-EV**

EVAP Emission Valve

**EVAP-FBVV**

EVAP Fuel Bowl Vent Valve

**EVAP-FBVS**

EVAP Fuel Bowl Vent Solenoid

**EVAP-FCV**

EVAP Fuel Cut Valve

**EVAP-FLS**

EVAP Fuel Level Sensor

**EVAP-FOLV**

EVAP Fuel Overflow Limiter Valve

**EVAP-FR/FTPS**

EVAP Rollover Valve/Fuel Tank

**EVAP-FS**

EVAP Flow Switch

**EVAP-FSV**

EVAP Flow Switchover Valve

**EVAP-FTCV**

EVAP Tank Pressure Control Valve

**EVAP-FTEV**

EVAP Fuel Tank EVAP Valve

**EVAP-FTPCSV**

EVAP Fuel Tank Pressure Control Solenoid Valve

**EVAP-FTPS**

EVAP Fuel Tank Pressure Sensor

**EVAP-FTS**

EVAP Fuel Temperature Sensor

**EVAP-FVCV**

EVAP Fuel Vapor Control Valve

**EVAP-FVS**

EVAP Fuel Vapor Separator

**EVAP-FVTS**

EVAP Fuel Vapor Temperature Sensor

**EVAP-FVV**

EVAP Fuel Vent Valve

**EVAP-FVVV**

EVAP Fuel Vapor Vent Valve

**EVAP-FWV**

EVAP Fuel Vent Valve

**EVAP-IVS**

EVAP Inner Vent Solenoid

**EVAP-LDAF**

EVAP Leak Detection Pump Air Filter

**EVAP-LDP**

EVAP Leak Detection Pump

**EVAP-LDPAF**

EVAP Leak Detection Pump Air Filter

**EVAP-LDPF**

EVAP Leak Detection Pump Filter

**EVAP-LDPVV**

EVAP Leak Detection Pump Vent Valve

**EVAP-LSEP**

EVAP Liquid Separator

**EVAP-NVLD**

EVAP Natural Vacuum Leak Detection

**EVAP-ORVR**

Evaporative On-Board Refueling Vapor Recovery System

**EVAP-ORVRCV**

Evaporative On-Board Refueling Vapor Recovery Check Valve

**EVAP-ORVRFTVRV**

EVAP-ORVR Fuel Tank Vapor Recirculation

**EVAP-OVCV**

EVAP Outer Vent Control Valve

**EVAP-OWV**

EVAP One-Way Valve

**EVAP-PCDV**

EVAP Purge Control Diaphragm Valve

**EVAP-PCS**

EVAP Purge Control Solenoid Valve

**EVAP-PCSV**

EVAP Purge Cut-Off Solenoid Valve

**EVAP-PFS**

EVAP Purge Flow Sensor

**EVAP-PFSVVS**

EVAP Purge Flow Switching Valve Vacuum Switching Valve

**EVAP-PPS**

EVAP Proportional Purge Solenoid

**EVAP-PR**

EVAP Purge Resonator

**EVAP-PRRV**

EVAP Pressure Relief Rollover Valve

**EVAP-PRV**

EVAP Pressure Relief Valve

**EVAP-PS**

EVAP Purge Solenoid

**EVAP-PSOL**

EVAP Purge Solenoid

**EVAP-PSSV**

EVAP Pressure Switching Solenoid

**EVAP-PSVVS**

EVAP Pressure Switching Valve Vacuum Switching Valve

**EVAP-PV**

EVAP Purge (Frequency) Valve

**EVAP-PVS**

EVAP Ported Vacuum Switch

**EVAP-RV**

EVAP Rollover Valve

**EVAP-RV/FTPS**

EVAP Rollover Valve/Fuel Tank

**EVAP-RVSV**

EVAP Rollover Vapor Separator Valve

**EVAP-SNR**

EVAP Canister Sensor

**EVAP-SOL**

EVAP Solenoid

**EVAP-SOV**

EVAP Shutoff Valve

**EVAP-SSV**

EVAP Shut-Off Solenoid Valve

**EVAP-SV**

EVAP Solenoid Valve

**EVAP-TC**

EVAP Trap Canister

**EVAP-TS**

EVAP Temperature Switch

**EVAP-TPBPV**

EVAP Tank Pressure By-Pass Valve

**EVAP-TPCS**

EVAP Tank Pressure Control Solenoid

**EVAP-TPCV**

EVAP Tank Pressure Control Valve

**EVAP-TRWV**

EVAP Tree-Way Valve

**EVAP-TV**

EVAP Thermal Valve

**EVAP-TVS**

EVAP Thermal Vacuum Switch

**EVAP-TVV**

EVAP Thermal Vacuum Valve

**EVAP-TWV**

EVAP Two-Way Valve

**EVAP-VC**

EVAP Vapor Canister

**EVAP-VCAT**

EVAP Vapor Canister Air Tank

**EVAP-VCF**

EVAP Vapor Canister Filter

**EVAP-VCSV**

EVAP Vapor Canister Shut-off Valve

**EVAP-VCTV**

EVAP Vacuum Control Valve

**EVAP-VCV**

EVAP Vacuum Canister Valve

**EVAP-VCVS**

EVAP Vapor Canister Vent Solenoid

**EVAP-VLFR**

EVAP Vent Line Flow Restrictor

**EVAP-VM**

EVAP Vacuum Motor

**EVAP-VMV**

EVAP Vapor Management Valve

**EVAP-VPS**

EVAP Vapor Pressure Sensor

**EVAP-VPSVSV**

EVAP Vapor Pressure Sensor Vacuum Switching Valve

**EVAP-VS**

EVAP Vacuum Sensor

**EVAP-VSOL**

EVAP Ventilation Solenoid

**EVAP-VSOL/LDP**

EVAP Ventilation Solenoid/Leak Detection Pump

**EVAP-VST**

EVAP Vacuum Surge Tank

**EVAP-VSV**

EVAP Vacuum Switching Valve

**EVAP-VV**

EVAP Ventilation Valve

**EVRS**

EGR Vacuum Regulator Solenoid

**"F"**

**FBC**

Feedback Carburetor

**FCOV**

Fuel Change Over Valve

**FF**

Flex Fuel

**FF-CKV**

Fuel Fill Check Valve

**FF-FCV**

Fuel Tank Fuel Cut-Off Valve

**FF-FLVV**



Fuel Tank Fill Limit Vent Valve

**FFC-PVRV**

Fuel Fill Cap Pressure Vacuum Relief Valve

**FGOV**

Fuel Gravity/Overflow Valve

**FGVV**

Fuel Gravity Vent Valve

**FI**

Fuel Injected

**FICD**

Fast Idle Control Device

**FISR**

Fast Idle Solenoid Relay

**FLV**

Fill Limit Valve

**FLVV**

Fill Limiting Vent Valve

**FP-CKV**

Fill Pipe Check Valve

**FP-RV**

Fill Pipe Rollover Valve

**FR**

Fill Pipe Restrictor

**FT-FLVV**

Fuel Tank Fill Limit Vent Valve

**FT-GVV**

Fuel Tank Grade Vent Valve

**FT-OPRV**

Fuel Tank Over Pressure Vent Valve

**FT-PCV**

Fuel Tank Pressure Control Valve

**FT-VCV**

Fuel Tank Vapor Control Valve

**FT-VRV**

Fuel Tank Vapor Recirculation Valve

**FTCV**

Fuel Tank Check Valve

**FTDPS**

Fuel Tank Differential Pressure Sensor

**FTEV**

Fuel Tank EVAP Valve

**FTPS**

Fuel Tank Pressure Sensor

**FTT**

Fuel Tank Temperature Sensor

**FTTS**

Fuel Tank Temperature Sensor

**FTV/LSV**

Fuel Tank Vapor/Liquid Separation Valve

**FTVCV**

Fuel Tank Vapor Control Valve

**FTVPRV**

Fuel Tank Ventilation Pressure Retention Valve

**FVPS**

Fuel Vapor Pressure Sensor

**FTVV**

Fuel Tank Vent Valve

**FVV**

Fuel Vapor Valve

**"G"****GVWR**

Gross Vehicle Weight Rating

**"H"****HAC**

High Altitude Compensator

**HAFS**

Heated Air Fuel Ratio Sensor

## **HAI**

Hot Air Intake

## **HAS**

High Altitude System

## **HC**

Hydrocarbons

## **HCAC-VSV**

Hydrocarbon Absorber Catalyst Vacuum Switching Valve

## **HDC**

Heavy Duty Cooling

## **HDC-CTO**

HDC Coolant Temperature Override

## **HFM-SFI**

Hot Film Engine Management SFI

## **HIC**

Hot Idle Compensator

## **HIM**

Heated Intake Manifold

## **HO**

High Output

## **HO2S**

Heated Oxygen Sensor

## **HP**

High Performance

## **HP**

Horsepower

## **HPCA**

Housing Pressure Cold Advance

## **HSC**

High Swirl Combustion

## **"I"**

## **IAC**

Idle Air Control Valve

## **IACV-SW**

IACV Switch

## **ICOM**

Idle Compensator

## **IDI**

Indirect Diesel Injection

## **IES**

Idle Enrichment System

## **IMCO**

Improved Combustion System

## **"K"**

## **KS**

Knock Sensor

## **"L"**

## **LH-SFI**

Hot Wire Sequential Multiport Fuel Injection

## **LVFD**

Liquid/Vapor Fuel Discriminator

## **LVW**

Loaded Vehicle Weight

## **"M"**

## **MD-TICS**

Timing & Injection rate Control System

## **MDP**

Manifold Differential Pressure sensor

## **ME-SFI**

Motor Electronics Sequential Fuel Injection

## **MFI**

Multiport Fuel Injection

## **MFI-MAF**

MFI Mass Airflow Sensor

**MFLS**

Main Fuel Level Sensor

**MI**

Mechanical Fuel Injection

**MIL**

Malfunction Indicator Light

**M/T**

Manual Transmission

**"N"****NAC**

Nitrogen Oxides (NO<sub>x</sub>) Adsorbing Catalyst

**NLV**

Non-Linear Valve

**NOS**

NO<sub>x</sub> Sensor

**NO<sub>x</sub>**

NO<sub>x</sub> Emission Control

**NO<sub>x</sub>ATWC**

NO<sub>x</sub> Adsorptive TWC

**NO<sub>x</sub>C**

Nitrogen Oxide Catalyst

**NO<sub>x</sub>S**

Nitrogen Oxide Sensor

**NO<sub>x</sub>TWC**

NO<sub>x</sub> Adsorptive TWC

**NSC**

Nitrogen Oxides (NO<sub>x</sub>) Storage Catalyst

**"O"****OBD**

On-Board Diagnostic System

**PBD (F)/(P)**

Full/Partial On-Board Diagnostic

**OC**

Oxidation Catalytic Converter

**OHC**

Overhead Cam

**ORVR**

On-Board Refueling Vapor Recovery

**ORVR-COV**

ORVR Cut-Off Valve

**ORVR-CV**

ORVR Control Valve

**ORVR-FAV**

ORVR Fresh Air Valve

**ORVR-FMV**

ORVR Flow Management Valve

**ORVR-FTVCV**

ORVR Fuel Tank Vapor Control Valve

**ORVR-FTVRV**

ORVR Fuel Tank Vapor Recirculation Valve

**ORVR-FVRS**

ORVR Fuel Vapor Recovery System

**ORVR-FVV**

ORVR Fuel Vent Valve

**ORVR-LV**

ORVR Leveling Valve

**ORVR-OCKV**

ORVR Overfill Check Valve

**ORVR-RCV**

ORVR Refueling Control Valve

**ORVR-VCV**

ORVR Vapor Cut Valve

**ORVR-VRV**

ORVR Vapor Recirculating Valve

**ORVR-VSV**

ORVR Vent Shut Valve



**ORVR-VV**

ORVR Vent Valve

**OVCV**

Outer Vent Control Valve

**O2S**

Oxygen Sensor

**"P"****PAIR**

Pulsed Secondary Air Injection

**PAIR-ABV**

PAIR Anti-Backfire Valve

**PAIR-ACOV**

PAIR Air Cut-Off Valve

**PAIR-ACS**

PAIR Air Control Solenoid

**PAIR-ACV**

PAIR Air Control Valve

**PAIR-AIV**

PAIR Air Injection Valve

**PAIR-ASCS**

PAIR Air Suction Control Solenoid

**PAIR-ASOV**

PAIR Air Shutoff Valve

**PAIR-ASS**

PAIR Air Switching Solenoid

**PAIR-ASV**

PAIR Air Switching Valve

**PAIR-ASVL**

PAIR Air Suction Valve

**PAIR-AVCS**

PAIR Air Valve Control Solenoid

**PAIR-CSV**

PAIR Control Solenoid Valve

**PAIR-CKV**

PAIR Check Valve

**PAIR-DV**

PAIR Diverter Valve

**PAIR-PAF**

PAIR Pulse Air Feeder

**PAIR-PAV**

PAIR Pulse Air Valve

**PAIR-RES**

PAIR Resonator

**PAIR-RV**

PAIR Reed Valve

**PAIR-SCSV**

PAIR Swirl Control Solenoid Valve

**PAIR-SCV**

PAIR Swirl Control Valve

**PAIR-SOL**

PAIR Solenoid

**PAIR-VSV**

PAIR Vacuum Switching Valve

**PCM**

Powertrain Control Module

**PCV**

Positive Crankcase Ventilation

**PCV-DOV**

PCV Dual Orifice Valve

**PCV-HCB**

PCV Heated Crankcase Breather

**PCV-HE**

PCV Heating Element

**PCV-PRV**

PCV Pressure Regulator Valve

**PCV-SOL**

PCV Solenoid

## **PEVR**

Power Enrichment Vacuum Regulator

## **PPM**

Parts Per Million

## **PTOX**

Periodic Trap Oxidizer

## **PURCV**

Purge Crankcase Ventilation

## **PVCS**

Ported Valve Control System

## **PVCS-A**

PVCS Actuator

## **PVCS-CS**

PVCS Control Solenoid

## **PVLCS**

Power Valve Control System

## **"R"**

## **RC**

NOx Reduction Catalyst

## **ROV**

Rollover Valve

## **"S"**

## **SAI-SV**

Secondary Air Injection Shutoff Valve

## **SAIR-CV**

Secondary Air Injection Control Valve

## **SC**

Supercharged or Super Charger

## **SC MFI**

Supercharged Multiport Fuel Injection

## **SCR**

Selective Catalytic Reduction

**SCSV**

Swirl Control Solenoid Valve

**SCV**

Swirl Control Valve

**SCV-A**

SCV Actuator

**SFI**

Sequential Multiport Fuel Injection

**SFI-MAF**

SFI Mass Airflow Sensor

**SFLS**

Sub-Fuel Level Sensor

**SOHC**

Single Overhead Cam

**SPK**

Spark Controls

**SPK-AVM**

SPK Advance Vacuum Modulator

**SPK-BVSV**

SPK Bimetal Vacuum Switching Valve

**SPK-CC**

SPK Computer Controlled

**SPK-CKV**

SPK Check Valve

**SPK-CSSA**

SPK Cold Start Spark Advance System

**SPK-CSSH**

SPK Cold Start Spark Hold System

**SPK-CTO**

SPK Coolant Temperature Override

**SPK-DAVS**

SPK Distributor Vacuum Advance Solenoid

**SPK-DCKV**

SPK Distributor Check Valve

**SPK-DCTO**

SPK Dual Coolant Temperature Override

**SPK-DDD**

SPK Dual Diaphragm Distributor

**SPK-DMV**

SPK Distributor Modulator Valve

**SPK-DPD**

SPK Dual Point Distributor

**SPK-DPVS**

SPK Distributor Ported Vacuum Switch

**SPK-DRCV**

SPK Distributor Retard Control Valve

**SPK-DRS**

SPK Distributor Retard Solenoid

**SPK-DSVMV**

SPK Distributor Spark Vacuum Modulator Valve

**SPK-DTVS**

SPK Distributor Thermal Vacuum Switch

**SPK-DTVV**

SPK Distributor Thermal Vacuum Valve

**SPK-DV**

SPK Delay Valve

**SPK-DVA**

SPK Distributor Vacuum Advance

**SPK-DVAS**

SPK Distributor Vacuum Advance Solenoid

**SPK-DVCS**

SPK Distributor Vacuum Control Solenoid

**SPK-DVCSW**

SPK Distributor Vacuum Controlled Switch

**SPK-DVCV**

SPK Distributor Vacuum Control Valve

**SPK-DVDV**

SPK Distributor Vacuum Delay Valve

**SPK-DVRS**

SPK Distributor Vacuum Retard Switch

**SPK-DVRV**

SPK Distributor Vacuum Regulating Valve

**SPK-DVVV**

SPK Distributor Vacuum Vent Valve

**SPK-EAVS**

SPK Electronically Actuated Vacuum Switch

**SPK-EDM**

SPK Electronic Distributor Modulator

**SPK-EI**

SPK Electronic Ignition

**SPK-ESA**

SPK Electronic Spark Advance

**SPK-ESC**

SPK Electronic Spark Control (Retard)

**SPK-ESS**

SPK Electronic Spark Selection

**SPK-EST**

SPK Electronic Spark Timing

**SPK-FDV**

SPK Forward Delay Valve

**SPK-HPCA**

SPK Housing Pressure Cold Advance

**SPK-ITCS**

SPK Ignition Timing Control System

**SPK-ITVS**

SPK Ignition Timing Vacuum Switch

**SPK-NLVR**

SPK Non-Linear Vacuum Regulator

**SPK-OSAC**



**SPK-PVA**

SPK Ported Vacuum Advance

**SPK-PVS**

SPK Ported Vacuum Switch

**SPK-RDO**

SPK Retard Delay Orifice

**SPK-RDV**

SPK Reverse Delay Valve

**SPK-RDVD**

SPK Reverse Delay Valve (Dual)

**SPK-RDVLV**

SPK Retard Delay Valve

**SPK-RDVS**

SPK Reverse Delay Valve (Single)

**SPK-RETS**

SPK Retard Switch

**SPK-SC**

SPK Speed Controlled

**SPK-SDV**

SPK Spark Delay Valve

**SPK-SOL**

SPK Solenoid

**SPK-SRRV**

SPK Spark Relay Regulator Valve

**SPK-TAVIA**

SPK Temperature Activated Vacuum Ignition Advance

**SPK-TCS**

SPK Transmission Controlled Spark

**SPK-TCSYS**

SPK Timing Control System

**SPK-TIDC**

SPK Thermostatic Ignition Distributor Control

**SPK-TV**

SPK Thermal Valve

**SPK-TVS**

SPK Thermal Vacuum Switch

**SPK-VACTO**

SPK Vacuum Advance Coolant Temperature Override

**SPK-VAS**

SPK Vacuum Advance Solenoid

**SPK-VAV**

SPK Vacuum Advance Valve

**SPK-VR**

SPK Vacuum Retard

**SPK-VRSW**

SPK Vacuum Retard Switch

**SPK-VSV**

SPK Vacuum Switching Valve

**SPK-VTCS**

SPK Vacuum Timing Control System

**SPL**

Smoke Puff Limiter

**SRI**

Service Reminder Indicator

**SSCA**

Stepped Speed Control Actuator

**SSCS**

Stepped Speed Control Solenoid

**STS**

Service Throttle Soon Light

**STVS**

Secondary Throttle Valve System

**SUB-HO2S**

Sub-Heated Oxygen Sensor (after CAT)

**SUB-O2S**

Sub-Oxygen Sensor

## **SUB-TWC**

Sub Three-Way Catalytic Converter

## **"T"**

### **TAA**

Turbo Air-To-Air

### **TAA**

Throttle Actuator Assembly

### **TAB**

Thermactor Air By-Pass

### **TAD**

Thermactor Air Diverter

### **TAC**

Thermostatic Air Cleaner

### **TBI**

Throttle Body Injection

### **TBPCS**

Throttle By-Pass Control System

### **TC**

Turbo Charger

### **TCC**

Torque Converter Clutch

### **TCCL**

Torque Converter Control

### **TCD**

Throttle Closing Dashpot

### **TC-DV**

TC Delay Valve

### **TC-TVC**

TC Thermal Vacuum Switch

### **TC-VS**

TC Vacuum Switch

### **TD**

Thermactor Diverter

**TFT**

Tank Fuel Temperature Sensor

**THOS2**

Third Heated Oxygen Sensor

**TICV**

Thermal Ignition Control Valve

**TIV**

Thermal Idle Valve

**TK**

Throttle Kicker

**TLUC**

Transmission Lock-Up Converter

**TLUC-TVS**

TLUC Thermal Vacuum Switch

**TLUC-VS**

TLUC Vacuum Switch

**TM**

Throttle Modulator

**TOS**

Throttle Opener System

**TP**

Throttle Positioner

**TPI**

Tuned Port Fuel Injection

**TPV**

Throttle Poppet Valve

**TR**

Thermal Reactor

**TRC**

Throttle Return Control

**TRCS**

Throttle Return Control Solenoid

**TRCTL**

Throttle Return Control Throttle Lever Actuator

**TRSCV**

Throttle Return Solenoid Control Valve

**TRTVV**

Temperature Regulator Thermal Vacuum Valve

**TRVV**

Transmission Vacuum Valve

**TSOL**

Throttle Solenoid

**TVISD**

Throttle Vacuum Idle Speed Diaphragm

**TVM**

Transmission Vacuum Modulator

**TVS**

Thermal Vacuum Switch

**TWC**

Three-Way Catalytic Converter

**TWC+OC**

Three-Way + Oxidation Catalytic Converter

**"V"****VA**

Vacuum Advance Unit

**VAC-AMP**

Vacuum Amplifier

**VA-CTO**

VA Coolant Temperature Override

**VC**

Vapor Canister

**VCV**

Vacuum Cut Valve

**VCV-BV**

VCV By-Pass Valve

**VLFR**

Vent Line Flow Restrictor/Anti-Trickle Fill Valve

**"W"****WU**

Warm-Up Catalyst

**WU-OC**

Warm-Up Oxidation Converter

**WU-TWC**

Warm-Up Three-Way Catalytic Converter

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## ENGINE COOLING

### Radiator Operating Fluids

## RADIATOR - OPERATING FLUIDS

### 1.0 REQUIREMENTS MADE OF ENGINE COOLANT

Pure water is unsuitable as a coolant not just because of the lack of protection against freezing. Good functioning of the cooling system is only guaranteed once a suitable anti-freezing and anti-corrosive agent, or antifreeze for short, has been added.

The cooling system of BMW vehicles must only be filled with the anti-freezing and anti-corrosive agents approved for this purpose. The filling and maintenance instructions to be found in the Repair Instructions and operating instructions must be observed.

Antifreeze agents must meet the following requirements:

- They must guarantee operability of the cooling system in winter (anti-freezing protection by lowering the freezing point) and in summer (prevent boiling and boiling over of the coolant).
- They must protect metal components that come into contact with the coolant (grey cast iron, steel, aluminium alloy, brass, copper and solder) against corrosion and cavitation.
- They must be neutral with respect to rubber and plastic parts in the coolant circuit.
- They must guarantee the consistency of the above-mentioned quality criteria.

To create these coolant properties, the anti-freezing and anti-corrosive agents must be mixed to the correct ratio with water.

#### Prescribed mixture for coolant:

50 % antifreeze for anti-freezing protection down to  $-38\text{ }^{\circ}\text{C}$

The original coolant mixture poured into the cooling system at the factory has this antifreeze-to-water ratio.

If the proportion of antifreeze is less than 40 % to  $-29\text{ }^{\circ}\text{C}$  (i.e. the water content is higher than 60 %), not only the degree of protection against freezing, but also protection against corrosion is reduced. When the water content is too high, this can lead to premature overheating in very hot weather or hot climates and as a consequence lead to coolant being ejected out of the system and damage to the engine through overheating.

This means that it is essential that an anti-freezing and anti-corrosive agent is added even in the tropics.

Too high a concentration, more than 55 % down to  $-47\text{ }^{\circ}\text{C}$ , leads to deterioration of the cooling properties (heat transfer) and protection against freezing-up is modified in the opposite direction, i.e. it also deteriorates.

The amounts of antifreeze required for providing protection against freezing-up are stated as percentage figures on the containers.

#### Minimum requirements concerning water quality:

- Appearance: colourless, clear
- Sediment, without suspended matter
- pH value: 6.5-8.0
- Total hardness, max.:  $20\text{ }^{\circ}\text{dH}$  (German hardness grade) or in new measuring unit:
- Total hardness, max.:  $3.6\text{ mmol Ca}^{2+}/\text{ltr}$ .

- Chloride content: max. 100 mg/ltr.
- Sulphate content: max. 100 mg/ltr.

Potable tap water usually fulfils these requirements. Local water utilities can provide information about the quality of the water they supply. If necessary, the water must be treated (e.g. softened) or distilled water must be used.

The quality of regenerated sea water (as found in the Gulf states) is inadequate!

Status 12/2006

## **2.0 CHANGE INTERVAL, CHANGE AND CHECK OF COOLANT, DISPOSAL, CLEANING THE COOLING SYSTEM**

### **Change interval, change and check of coolant**

Regular testing of the coolant composition as part of inspections I and II. Due to decreasing corrosion protective effect the change interval of 4 years (3 years for M-power vehicles) has to be maintained. The antifreeze concentration of the coolant should be checked before the start of the cold season. Checking the composition is also necessary after adding coolant. When adjusting and checking the concentration, a areometer spindle is required (antifreeze tester). Mixing the approved substances with each other is allowed.

The technical advancement has made it possible, that no coolant change is required for the vehicles specified below.

- E65 from 09/2003
- E85 from market introduction
- Condition Based Service-vehicles from 09/2003
- Service interval indicator-vehicles with petrol engines from 03/2003
- Service interval indicator vehicles with diesel engine from 09/2003
- M-vehicles from 09/2003
- All vehicles with market introduction after 09/2003

### **Disposal**

For the disposal of the coolant, the safety data sheets of the manufacturers for antifreeze and corrosion inhibitors or the legal regulations of the individual countries must be observed.

Status 04/2014

## **3.0 APPROVED ANTIFREEZE AND CORROSION INHIBITORS**

A special antifreeze and corrosion inhibitor is mandatory for the MINI Diesel engine W16.

IMPORTANT:

For approved antifreeze and corrosion inhibitors for the W16 engine see Appendix 3.2.

For approved antifreeze and corrosion inhibitors for W11, W12, W17, N12, N14 engine see Appendix 3.1.

With the protection of the environment in mind, BMW has been filling all of its vehicles with nitrite- and amino-free antifreeze and corrosion inhibitors since mid-1986 as standard practice.

The use of antifreeze and corrosion inhibitors that contain nitrites and amines is no longer permissible.

Trade name	BMW part number	Container size
BMW Antifreeze	83 51 2 355 290	1.5-litre can
BMW Antifreeze	83 51 2 355 291	60-litre barrel

Trade name	Manufacturer/Supplier
Alpine C48 Longlife Antifreeze	Mitan Mineralol GmbH
Antifreeze concentrate AWM G11	Tosol-Sintez
Aral Antifreeze Extra	Aral AG
AVIA Antifreeze APN	AVIA Mineralol AG
BMW Antifreeze	BMW AG
Castrol Radiocool NF	Castrol International
Fuchs MAINTAIN FRICOFIN	Fuchs Europe Schmierstoffe GmbH
Glysantin® G48®-24 Engine Coolant	THEBE UNICO
Glysantin® G48®	BASF series introduction
Lukoil Antifreeze HD G11	Lukoil
Lukoil Coolant Plus	Lukoil Lubricants Austria GmbH
OMV Coolant Plus	OMV AG
Zerex G48® Antifreeze	Valvoline

Status 11/2015

### **3.1 APPROVED ANTIFREEZE AND CORROSION INHIBITORS FOR MINI EXCEPT W16 DIESEL**

### **3.2 APPROVED ANTIFREEZE AND CORROSION INHIBITORS FOR MINI W16 DIESEL**

### **3.3 APPROVED ANTIFREEZE AND CORROSION INHIBITORS FOR BMW I**

### **4.0 COOLANT ADDITIVES**

BMW does not approve the use of coolant additives that e.g. provide additional protection against corrosion or are aimed at sealing hairline cracks.

Due to the poorer transfer of heat from the cylinder head to the coolant, this can lead to heat accumulation and hot spots, which in turn can lead to cylinder head gaskets burning through and cracking of the cylinder head.

We cannot provide warranty for any consequences and effects the use of such additives may have.

## **1.0 GENERAL INFORMATION ON LONG-TERM ANTIFREEZE AND CORROSION INHIBITORS**

The cooling system of BMW cars must only be filled with reputable brand name ethylene glycol long-term antifreeze having corrosion inhibitors that are compatible with aluminum radiators.

Coolants must fulfill four basic requirements.

- Guarantee sufficient cooling.
- Protect various metals (gray cast iron, steel, aluminum alloys, brass, copper and solder) against corrosion.
- Prevent excessive silicate gel precipitation, which may cause clogging of the cooling system.
- Guarantee operation of cooling system in winter (prevent freezing of coolant) and in summer by boosting the boiling point.

The quality or grade of a long-term antifreeze and corrosion inhibitor is very important to be able to protect metal (gray cast iron, steel, aluminum alloys, brass, copper and solder) in the cooling system against corrosion. It guarantees full operation of the cooling system in winter and also increases the boiling point at high outside temperatures and under heavy loads.

### **INITIAL FILLING IN FACTORY**

The factory fills the cooling system for protection against freezing, for the U. S. and Canada, down to -34°F (-37°C). This means an antifreeze ratio of 50% antifreeze and 50% water. In severely cold areas, the antifreeze can be increased to 60% which provides freezing protection down to -62°F (-52°C). Do not exceed a 60% ratio of antifreeze.

The specified antifreeze ratio is important, since an insufficient amount would impair antifreezing and corrosion inhibiting protection. An excessive amount would not improve freezing protection, but instead reduce freezing protection.

## **CHANGE INTERVALS**

Regular checking of coolant concentration is part of Inspection I or II. Refer to applicable Model Year Service Maintenance Checklist for change intervals.

## **LONG-TERM COOLANT**

The BMW engine coolant has a long-term rating, except when the cooling system requires repairs. This coolant does not require a service interval if no repairs are made to the vehicles cooling system. Drained coolant is not to be re-used. Top up with new coolant.

## **REMARKS AND LIMITATIONS**

Only tap water of drinking quality with the following properties may be used as coolant.

Appearance - colorless, clear

Residue - without suspended matter

pH value - 6.5 - 8.0

Total hardness - max. 357 PPM Calcium Carbonate

Chloride content - max. 100 mg/l

Sulfate content - max. 100 mg/l

The antifreeze concentration in a cooling system should be checked before the beginning of winter. When determining the mixture concentration it is important to make sure that there is sufficient protection against freezing.

A hydrometer (radiator antifreeze tester) is required for correct determination of antifreeze concentration. The composition of long-term antifreezes and corrosion inhibitors differs between manufacturers.

BMW Anti-Freeze/Coolant contains no nitrites or phosphates and has been formulated to prevent excessive silicate dropout. Order the 1 gallon container under BMW Part No. 82 14 1 467 704.

**NOTE: Do not mix BMW Anti-Freeze/Coolant with different antifreezes which contain nitrites and/or phosphates and a high silicate formulation.**

## **2.0 COOLANT ADDITIVES**

No aftermarket coolant additives, including but not limited to those which provide additional corrosion inhibition or seal off minor leaks are approved by BMW.

Use of non-approved coolant additives may cause reduced heat transfer from the cylinder head to the coolant and the formation of hot spots. This can cause the burning through of cylinder head gaskets and/or cracking of the cylinder head.

BMW NA cannot accept the liability for the resulting effects and consequential damage caused by the use of coolant additives.

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## ENGINE

### Cooling System - Repair - All I3 Models - i3

## COOLANT, CHECKING COOLING SYSTEM

### 17 00... BLEEDING AND FILLING COOLING CIRCUIT (HIGH-TEMPERATURE COOLING SYSTEM) FOR RANGE EXTENDER WITH VACUUM FILLING UNIT

#### Special tools required:

- 00 2 030
- 17 0 100

Type	Model	Adapter Y from 17 0 100
I01	i3 REX	17 0 109

#### Lifetime coolant filling:

Never reuse used coolant!

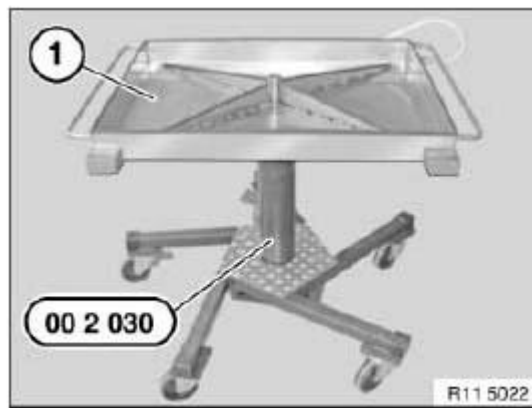
IMPORTANT: When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

#### Note on ordering:

- Filler unit no. 81 39 2 152 473
- Collecting vessel no. 81 49 2 152 347
- Adapter: 17 0 100

IMPORTANT: Risk of slipping due to coolant on the floor.  
**Danger of injury!**



**Fig. 1: Identifying Drip Tray And Special Tool (00 2 030).**

Courtesy of BMW OF NORTH AMERICA, INC.

Catch and dispose of emerging coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).

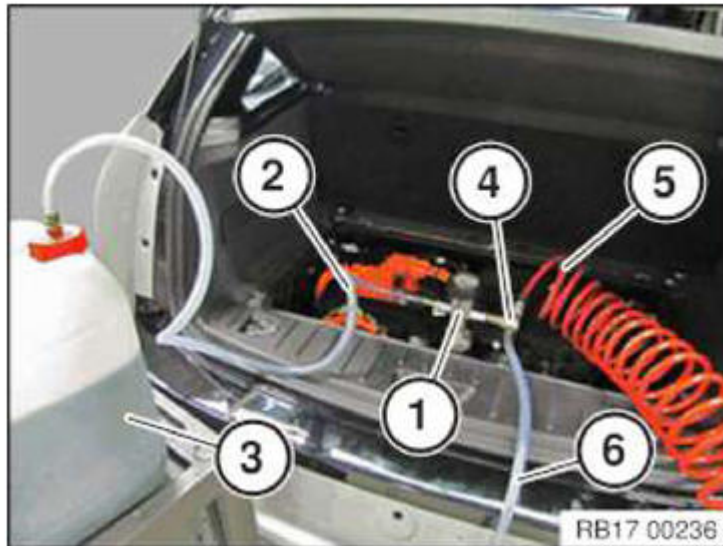
#### Recycling:

Observe country-specific waste disposal regulations.



**IMPORTANT:** Check all the coolant hoses before filling the cooling system with the vacuum filling unit.

If necessary, replace damaged and porous coolant hoses.



**Fig. 2: Identifying Vacuum Filling Unit Components**  
Courtesy of BMW OF NORTH AMERICA, INC.

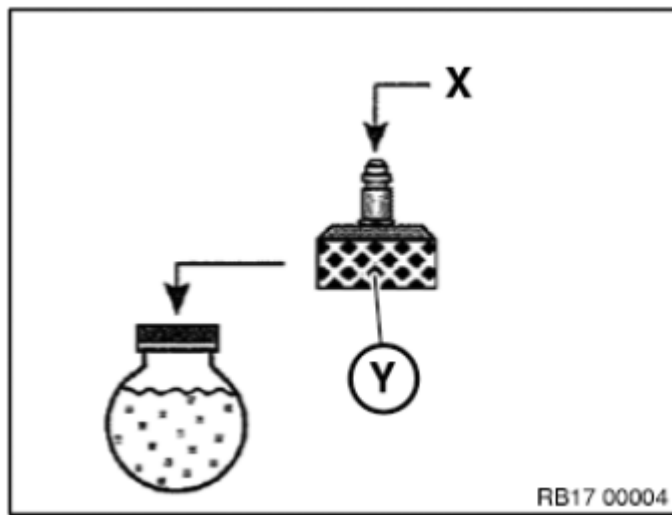
- 1) Filling unit with vacuum meter and shutoff valves
- 2) Filler hose
- 3) Coolant container
- 4) Venturi nozzle
- 5) Compressed air connection (max. 6 bar)
- 6) Outgoing-air hose (lead outgoing-air hose into a collecting container)

### **Preconditions**

- Cooling system expansion tank must be empty.
- There must be sufficiently premixed coolant in the filling unit container, 1 - 2 liters more than the vehicle filling capacity.
  - Use only **RECOMMENDED COOLANT** .
  - Observe **MIXTURE RATIO** .
  - Observe **CAPACITIES** .
- Position the filling unit container at the same height as the coolant expansion tank.
- Compressed-air connection with 6 bar pressure present.
- Set vehicle heater to maximum temperature.

Select adapter (Y) according to table and connect to coolant expansion tank.

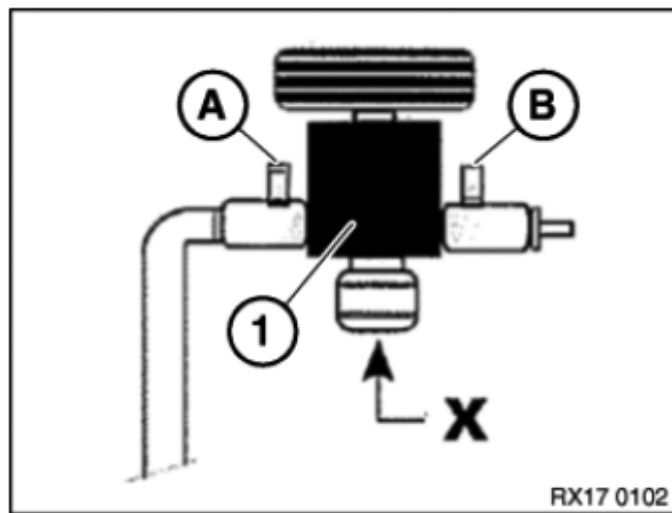
Connect filler unit to adapter connection (X).



**Fig. 3: Identifying Adapter And Adapter Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Shutoff valves (A) and (B) of the filling unit (1) must be closed.

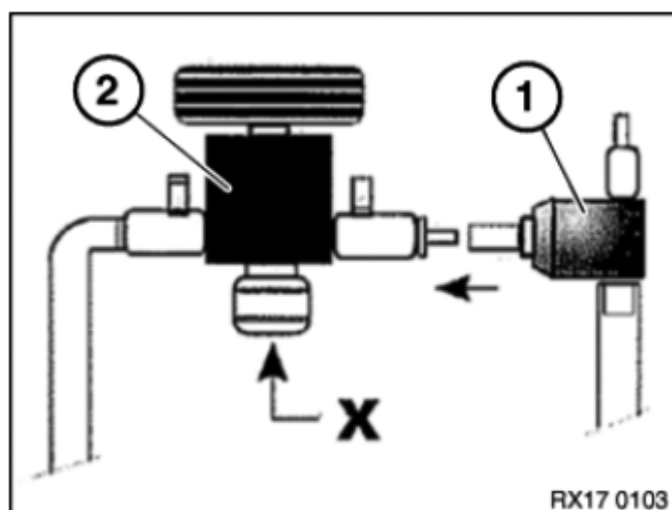
(X) Expansion tank connection



**Fig. 4: Identifying Filling Unit Shut-Off Valves And Expansion Tank Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect venturi nozzle (1) to filling unit (2).

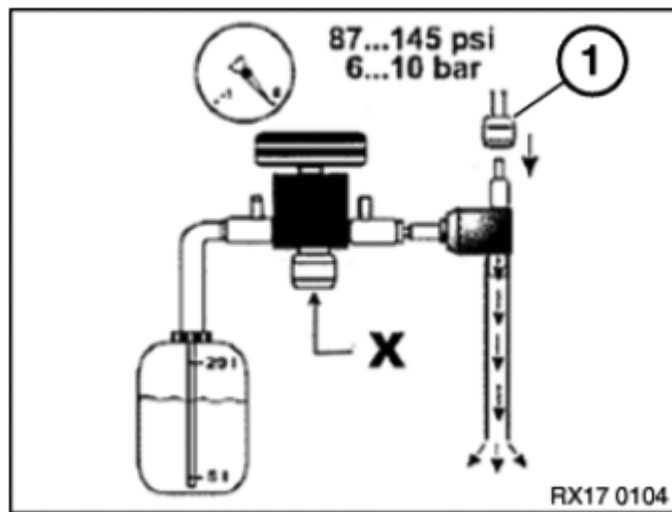
(X) Expansion tank connection



**Fig. 5: Connecting Venturi Nozzle And Filling Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect compressed air (1).

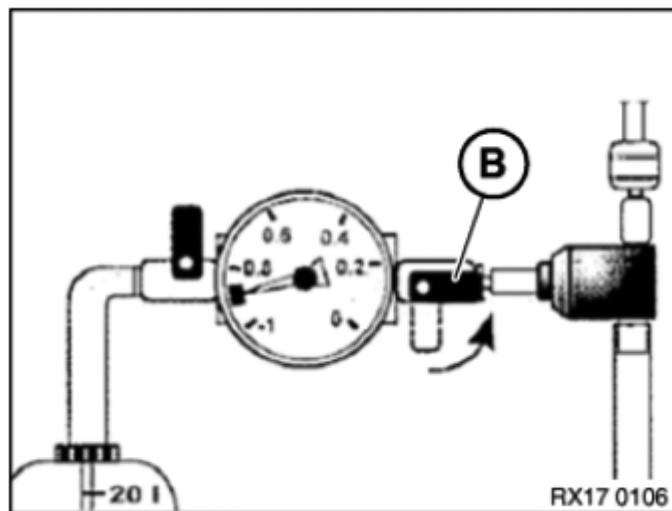
(X) Expansion tank connection



**Fig. 6: Connecting Compressed Air Line**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open shutoff valve (B).

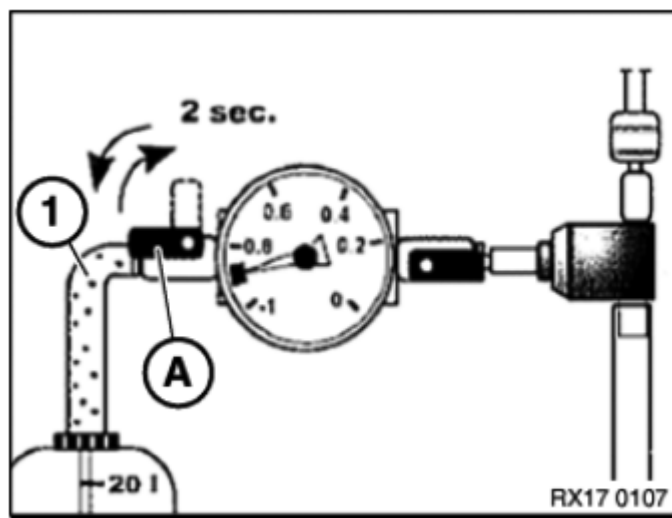
The venturi nozzle produces a flow noise.



**Fig. 7: Opening Shut-Off Valve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Then open shutoff valve (A) until the filling hose (1) is free of bubbles.

Close shutoff valve (A) again. The filling hose (1) is vented in this way.



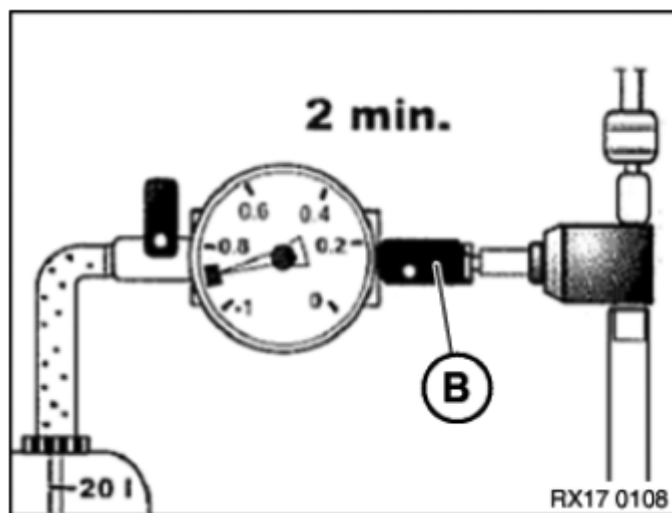
**Fig. 8: Opening/Closing Shut-Off Valve**

Courtesy of BMW OF NORTH AMERICA, INC.

Shutoff valve (B) will remain open.

Generate vacuum in coolant system for approx. 2 minutes. The end vacuum is reached at a vacuum of -0.7 to -0.95 bar. Green scale on the vacuum meter.

**NOTE:** The coolant hoses contract during vacuum build-up.

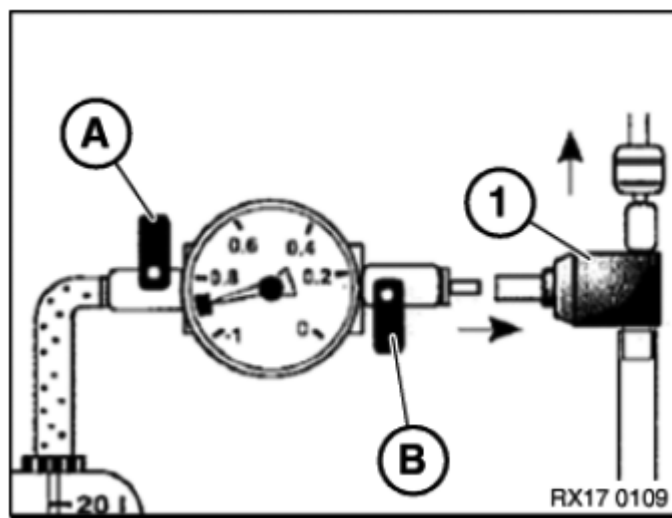


**Fig. 9: Checking Shut-Off Valve Opening Time**

Courtesy of BMW OF NORTH AMERICA, INC.

Then close shutoff valve (B) again.

Both shutoff valves (A) and (B) must be closed. Then seal Venturi nozzle (1).



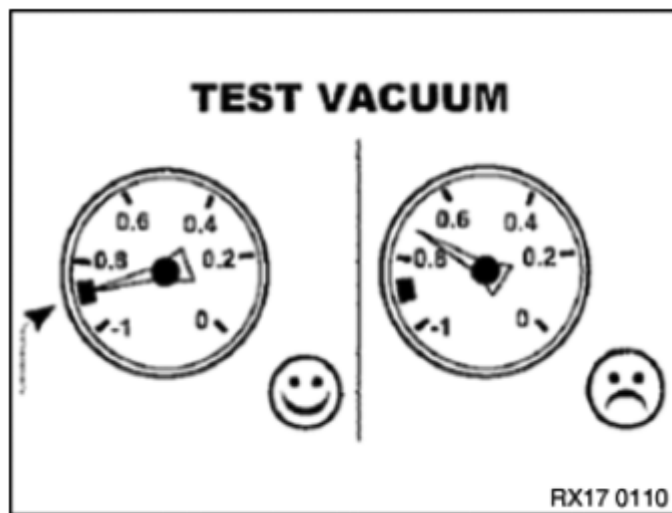
**Fig. 10: Closing Shut-Off Valves (A/B)**

Courtesy of BMW OF NORTH AMERICA, INC.

The cooling system must hold the vacuum for 30 s. If the needle in the vacuum meter falls, this indicates a leak in the cooling system.

If the vacuum remains constant, proceed with filling.

In event of leaks, check cooling system for leaks.

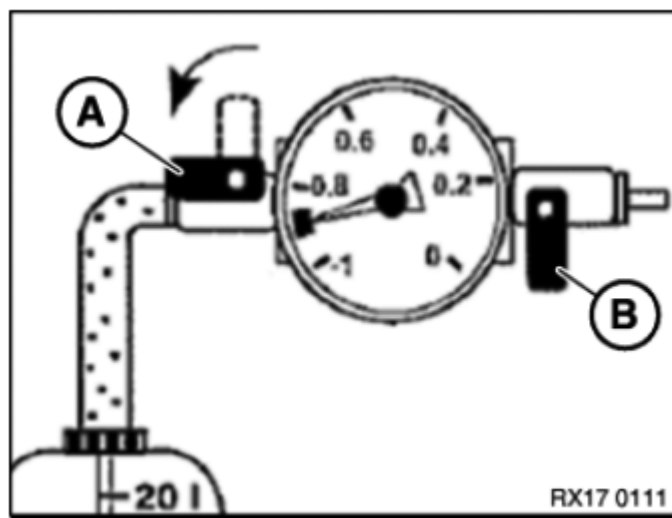


**Fig. 11: Checking Vacuum Meter Needles**

Courtesy of BMW OF NORTH AMERICA, INC.

There must be sufficiently premixed coolant in the filling unit container: 1 - 2 liters  
**IMPORTANT:** more than the vehicle filling capacity.

Position the filling unit container at the same height as the coolant expansion tank.



**Fig. 12: Opening/Closing Shut-Off Valve**  
 Courtesy of BMW OF NORTH AMERICA, INC.

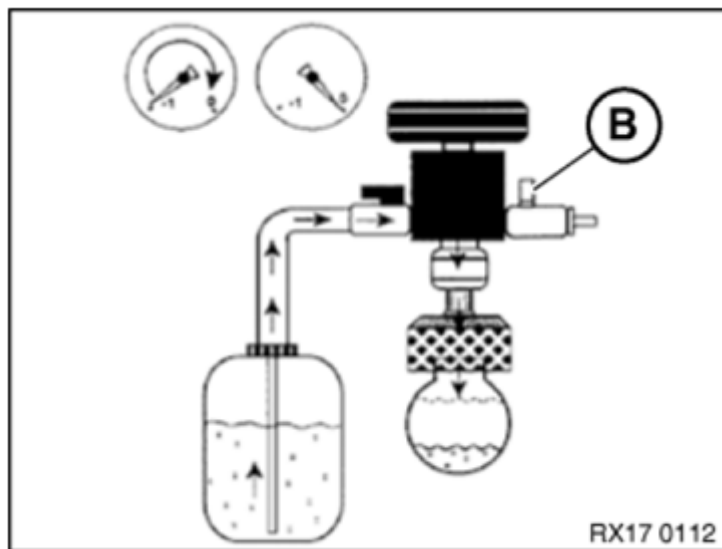
Shut-off valve (B) remains closed during the filling process.

To fill the cooling system, open shutoff valve (A) to filling unit container.

Coolant is now added.

The filling procedure is finished when the needle in the vacuum meter is at 0 bar or no longer falls.

If necessary, reduce remaining vacuum. Open shutoff valve (B) to do so.



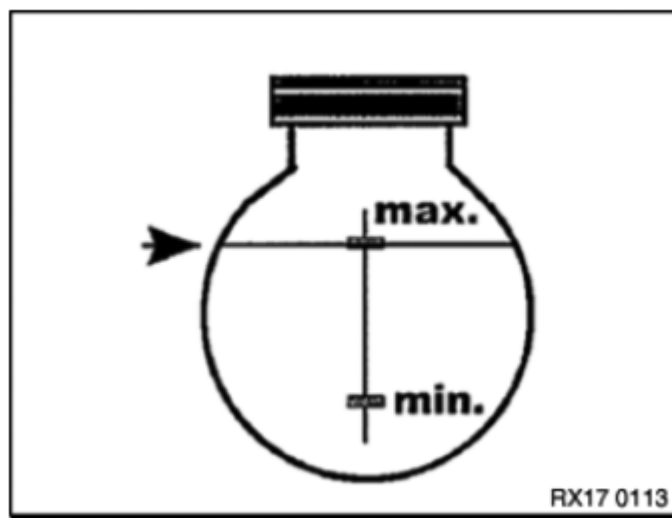
**Fig. 13: Filling Coolant Into Cooling System**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove filling unit with adapter from expansion tank.

Adjust coolant level to maximum.

Close coolant expansion tank.





**Fig. 14: Locating Coolant Maximum And Minimum Levels**

Courtesy of BMW OF NORTH AMERICA, INC.

After the cooling system has been filled with the vacuum filling unit, another bleeding procedure must be performed.

- **BLEED HIGH-TEMPERATURE COOLING SYSTEM**

Check function of cooling system.

Check cooling system for tightness.

**64 00... BLEEDING AND FILLING THE COOLING CIRCUIT FOR HEATING WITH THE VACUUM FILLING UNIT**

Special tools required:

- 00 2 030
- 17 0 100

Type	Model	Adapter Y from 17 0 100
I01	i3, i3 REX	17 0 109

**Lifetime coolant filling:**

Never reuse used coolant!

IMPORTANT: When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

IMPORTANT: You must protect the alternator against contamination by coolant when carrying out repair work on the cooling circuit.

Cover alternator with suitable materials.

Failure to comply with this procedure may result in an alternator malfunction.

Note on ordering:

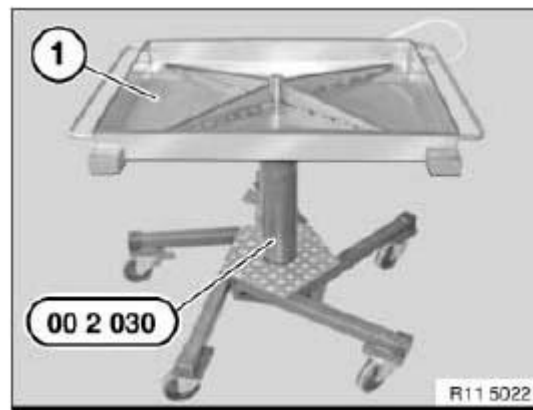
- Filler unit no. 81 39 2 152 473
- Collecting vessel no. 81 49 2 152 347
- Adapter: 17 0 100

IMPORTANT: Risk of slipping due to coolant on the floor.  
**Danger of injury!**

Catch and dispose of emerging coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).

### Recycling:

Observe country-specific waste disposal regulations.

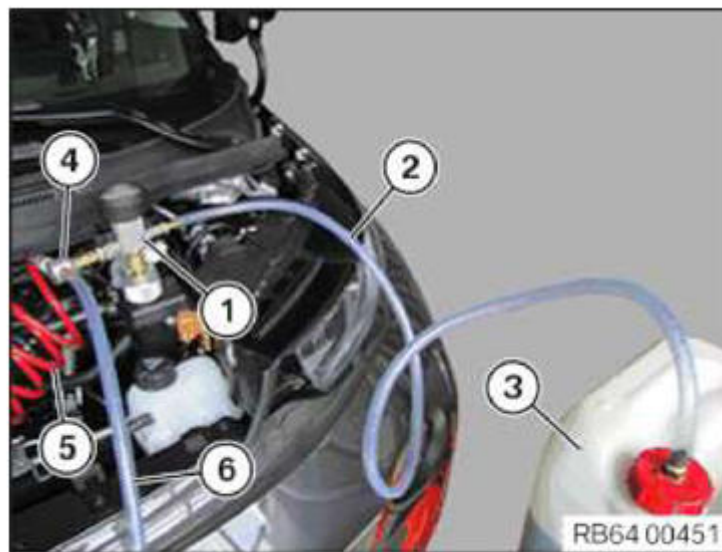


**Fig. 15: Identifying Drip Tray And Special Tool (00 2 030).**

Courtesy of BMW OF NORTH AMERICA, INC.

Check all the coolant hoses before filling the cooling system with the vacuum filling unit.  
**IMPORTANT:** unit.

If necessary, replace damaged and porous coolant hoses.



**Fig. 16: Identifying Vacuum Filling Unit Components**

Courtesy of BMW OF NORTH AMERICA, INC.

- 1) Filling unit with vacuum meter and shutoff valves
- 2) Filler hose
- 3) Coolant container
- 4) Venturi nozzle
- 5) Compressed air connection (max. 6 bar)
- 6) Outgoing-air hose (lead outgoing-air hose into a collecting container)

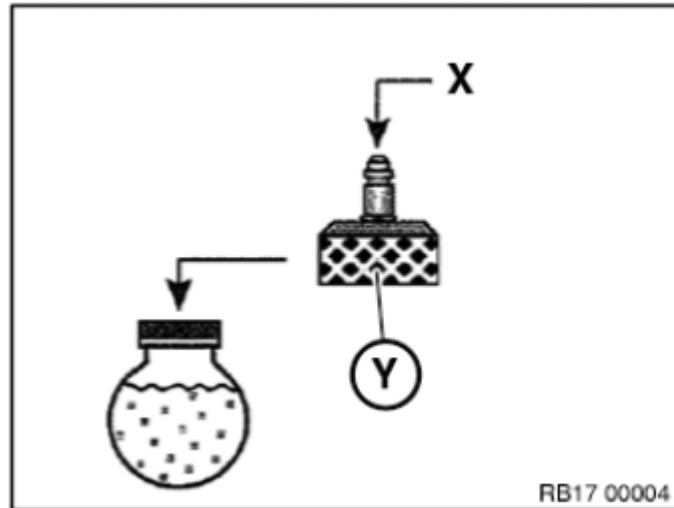
### Preconditions

- Cooling system expansion tank must be empty.
- There must be sufficiently premixed "**coolant concentrate i3**" (part number: 83 51 2 355 296) in the filling unit container, 1 - 2 liters more than the vehicle filling capacity.
  - Only use "**coolant concentrate i3**".

- In all equipment versions, the heater circuit is filled with approx. 2 liters with a **mixing ratio of 50/50** , which provides freezing protection down to - 40 Å°C.
- Position the filling unit container at the same height as the coolant expansion tank.
- Compressed-air connection with 6 bar pressure present.
- Set vehicle heater to maximum temperature.

Select adapter (Y) according to table and connect to coolant expansion tank.

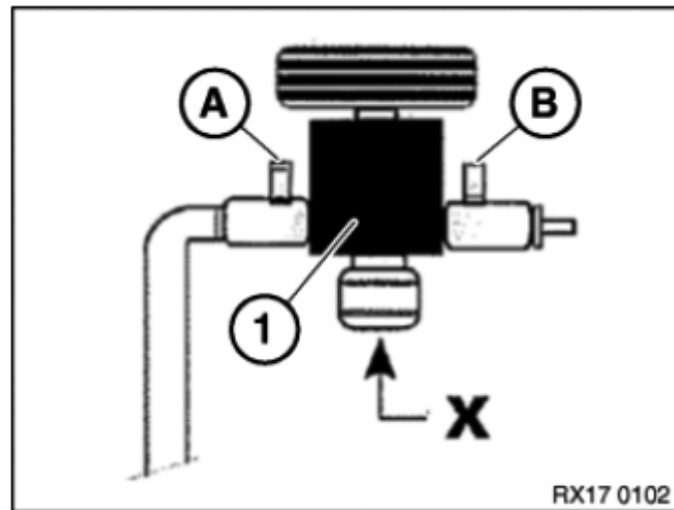
Connect filler unit to adapter connection (X).



**Fig. 17: Identifying Adapter And Adapter Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Shutoff valves (A) and (B) of the filling unit (1) must be closed.

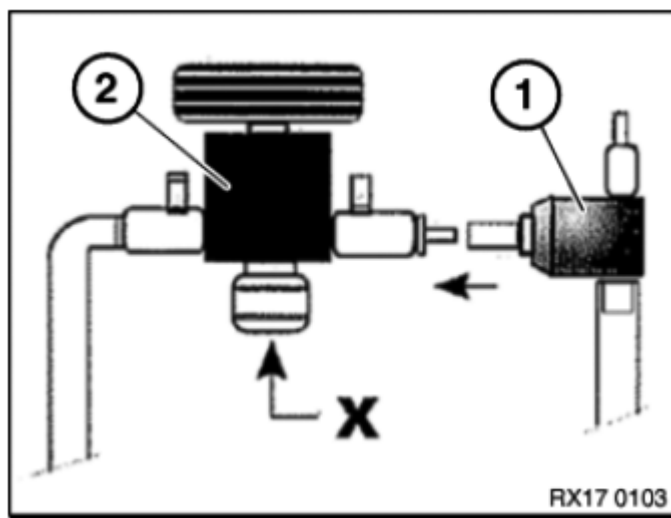
(X) Expansion tank connection



**Fig. 18: Identifying Filling Unit Shut-Off Valves And Expansion Tank Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect venturi nozzle (1) to filling unit (2).

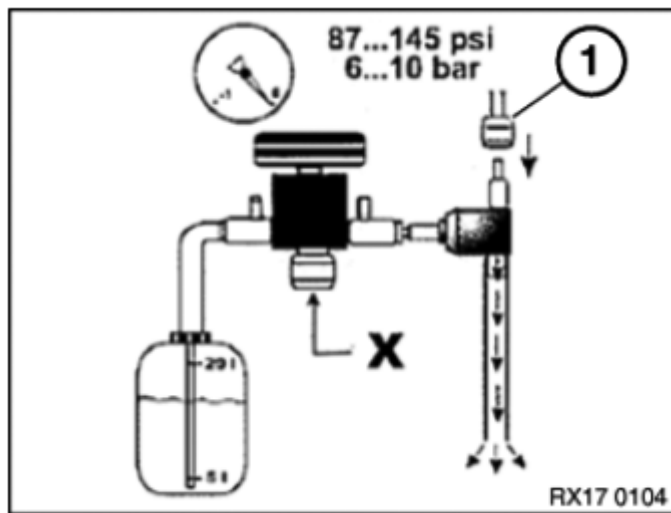
(X) Expansion tank connection



**Fig. 19: Connecting Venturi Nozzle And Filling Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect compressed air (1).

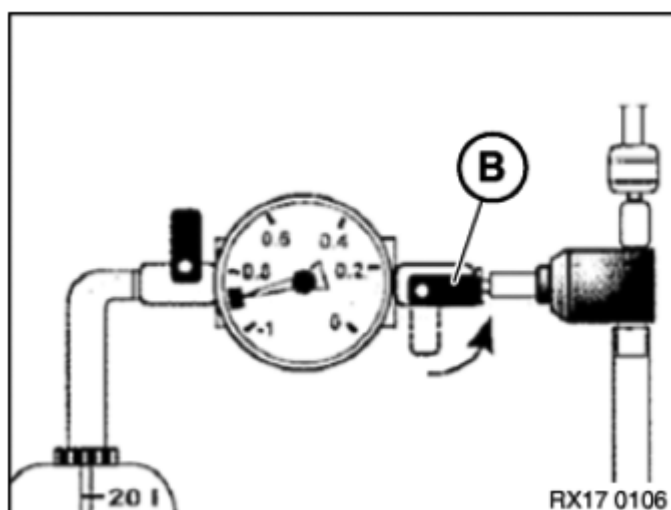
(X) Expansion tank connection



**Fig. 20: Connecting Compressed Air Line**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Open shutoff valve (B).

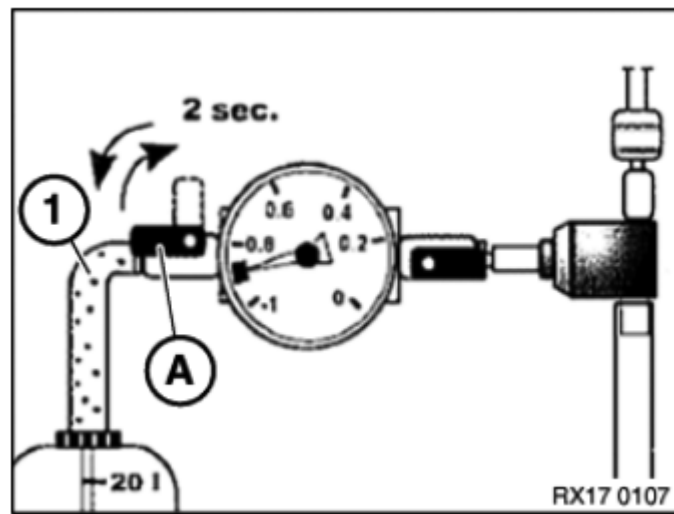
The venturi nozzle produces a flow noise.



**Fig. 21: Opening Shut-Off Valve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Then open shutoff valve (A) until the filling hose (1) is free of bubbles.

Close shutoff valve (A) again. The filling hose (1) is vented in this way.



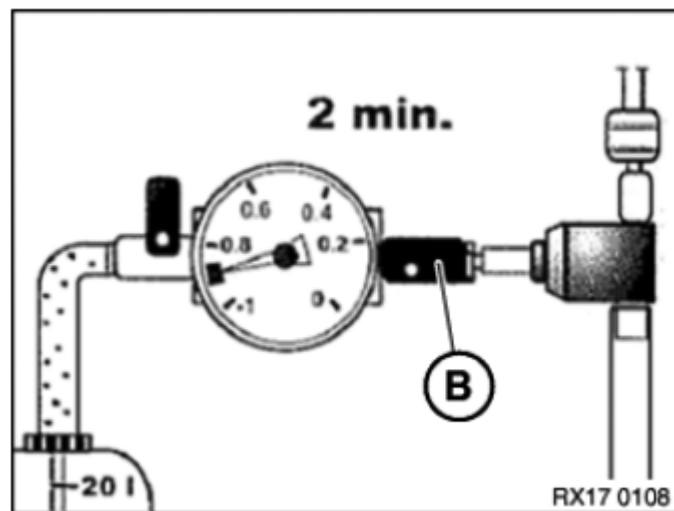
**Fig. 22: Opening/Closing Shut-Off Valve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Shutoff valve (B) will remain open.

Generate vacuum in coolant system for approx. 2 minutes. The end vacuum is reached at a vacuum of -0.7 to -0.95 bar.

Green scale on the vacuum meter.

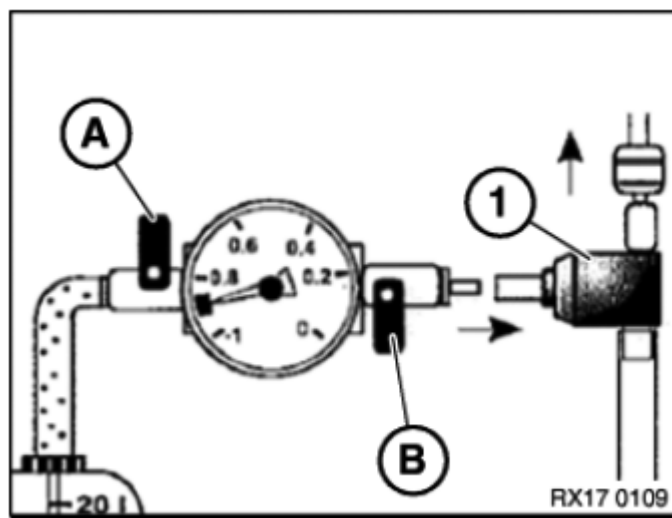
**NOTE:** The coolant hoses contract during vacuum build-up.



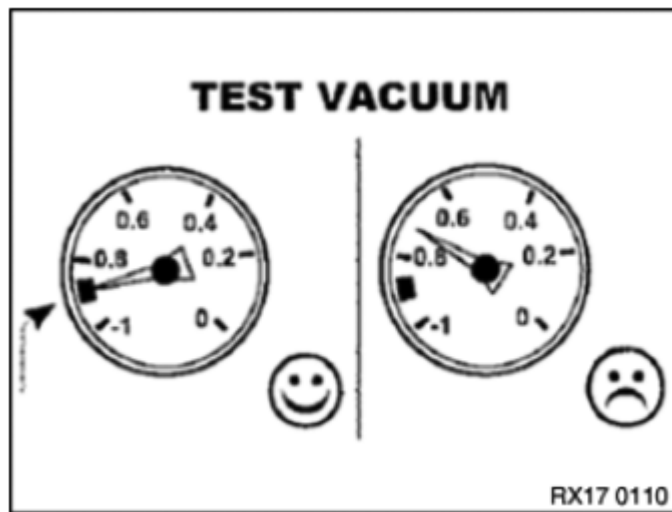
**Fig. 23: Checking Shut-Off Valve Opening Time**  
Courtesy of BMW OF NORTH AMERICA, INC.

Then close shutoff valve (B) again.

Both shutoff valves (A) and (B) must be closed. Then seal Venturi nozzle (1).



**Fig. 24: Closing Shut-Off Valves (A/B)**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 25: Checking Vacuum Meter Needles**  
 Courtesy of BMW OF NORTH AMERICA, INC.

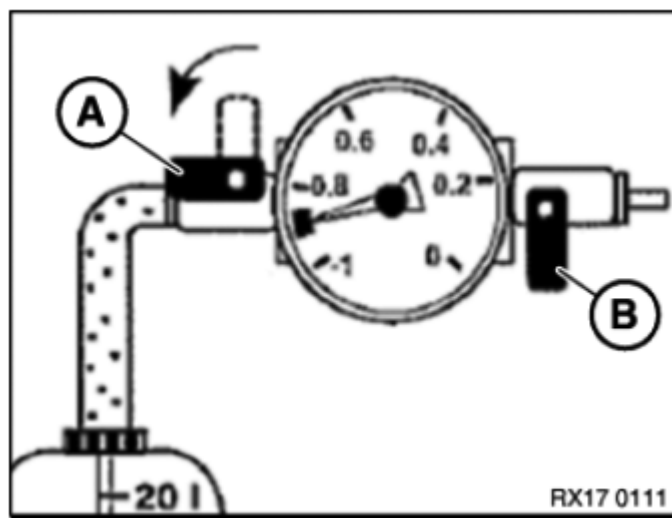
The cooling system must hold the vacuum for 30 s. If the needle in the vacuum meter falls, this indicates a leak in the cooling system.

If the vacuum remains constant, proceed with filling.

In event of leaks, check cooling system for leaks.

There must be sufficiently premixed coolant in the filling unit container: 1 - 2 liters  
**IMPORTANT:** more than the vehicle filling capacity.  
 Position the filling unit container at the same height as the coolant expansion tank.





**Fig. 26: Opening/Closing Shut-Off Valve**

Courtesy of BMW OF NORTH AMERICA, INC.

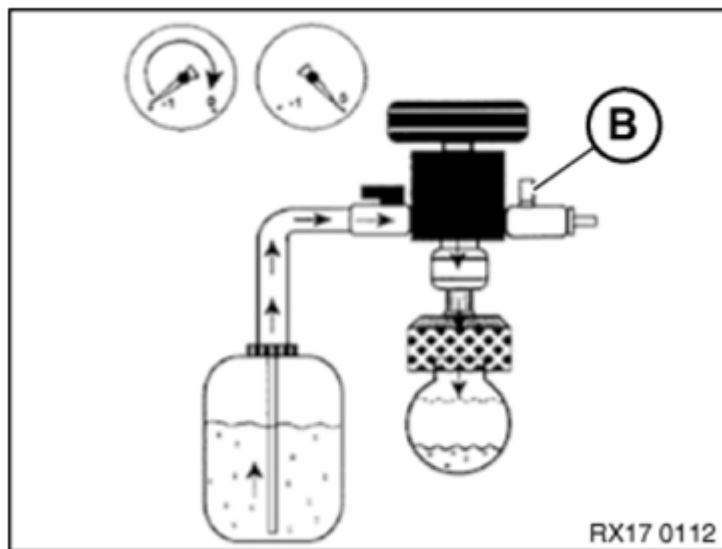
Shut-off valve (B) remains closed during the filling process.

To fill the cooling system, open shutoff valve (A) to filling unit container.

Coolant is now added.

The filling procedure is finished when the needle in the vacuum meter is at 0 bar or no longer falls.

If necessary, reduce remaining vacuum. Open shutoff valve (B) to do so.



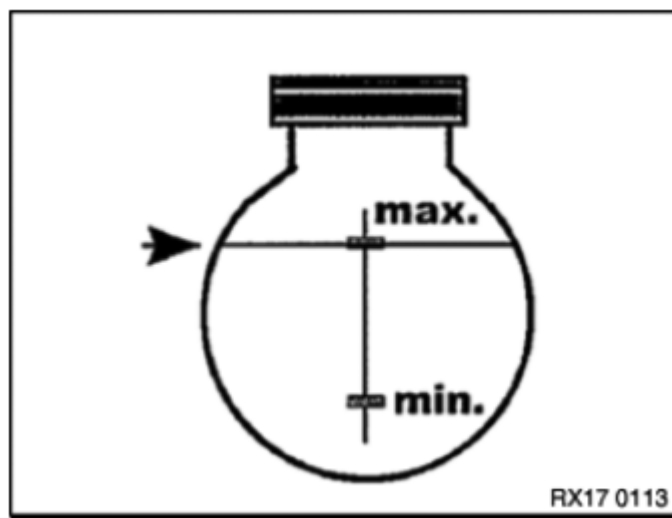
**Fig. 27: Filling Coolant Into Cooling System**

Courtesy of BMW OF NORTH AMERICA, INC.

Remove filling unit with adapter from expansion tank.

Adjust coolant level to maximum.

Close coolant expansion tank.



**Fig. 28: Locating Coolant Maximum And Minimum Levels**

Courtesy of BMW OF NORTH AMERICA, INC.

Check function of cooling system.

Check cooling system for tightness.

### **17 00... BLEEDING COOLING SYSTEM FOR DRIVE (LOW-TEMPERATURE COOLING SYSTEM) (I01)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**WARNING:** Risk of scalding!  
Open sealing cap only after engine has cooled down.

**IMPORTANT:** Lifetime coolant filling:  
Never reuse used coolant!

When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

Follow notes for **CARRYING OUT REPAIR WORK ON THE COOLING SYSTEM**.

The following bleeding procedure is necessary when a part is replaced in the cooling system or when the cooling system is refilled.

Low-temperature cooling system may only be filled by means of **VACUUM FILLING DEVICE!**

**IMPORTANT:** Filling specification absolutely must be adhered to.

If the specified filling specification is not adhered to (especially watering can filling), sufficient cooling of the E-components cannot be guaranteed.

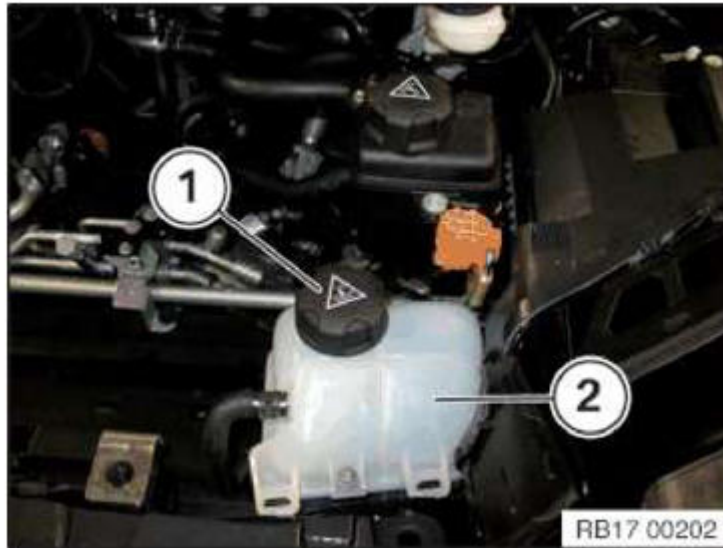
It is not permissible to operate the vehicle if the filling procedure has not been completely performed. This may lead to functional limitations (degradation).

#### **Filling and bleeding the NT cooling system (low-temperature cooling system):**

1. Before beginning the filling procedure, ensure that the heater circuit is filled and bled.
2. Evacuate and fill NT cooling circuit with a **VACUUM FILLING UNIT** approved by BMW.  
Remove vacuum filling unit after evacuating and filling.

3. Connect vehicle to high-voltage charging socket. Switch on ignition/terminal 15 (without operating brake pedal). Switch on light. Apply parking brake. Press button P on gear selector switch.
4. **Starting bleeding procedure:** Set heating control to max. temperature. Operate brake pedal and keep depressed, then fully depress accelerator pedal for <10 s. The procedure with a duration of 12 minutes is started.
5. Check coolant level of expansion tank after bleeding procedure of 12 minutes (coolant no longer flows through ventilation line into expansion tank).
6. If necessary, top up coolant and adjust to max. Close expansion tank.

Close sealing cap (1) on expansion tank (2) for NT cooling system.



**Fig. 29: Identifying Expansion Tank And Sealing Cap**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **17 00 BLEEDING RANGE EXTENDER COOLING SYSTEM (HIGH-TEMPERATURE COOLING SYSTEM) (I01)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**WARNING:** Risk of scalding!  
Open sealing cap only after engine has cooled down.

**Lifetime coolant filling:**

Never reuse used coolant!

When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore

**IMPORTANT:** be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

Follow notes for **CARRYING OUT REPAIR WORK ON THE COOLING SYSTEM**.

**IMPORTANT:** The following bleeding procedure is necessary when a part is replaced in the cooling system or when the cooling system is refilled.

HT cooling system must only be filled using the **VACUUM FILLING UNIT!**

Filling specification absolutely must be adhered to.

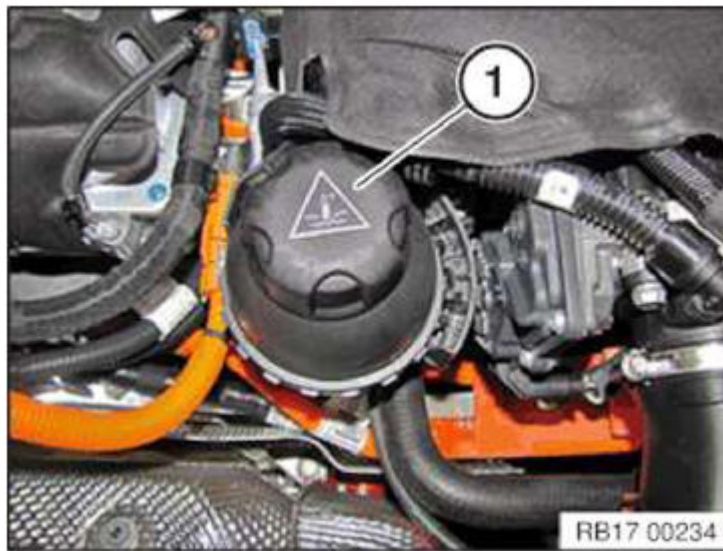
If the specified filling specification is not adhered to (especially watering can filling), sufficient cooling of the E-components cannot be guaranteed.

It is not permissible to operate the vehicle if the filling procedure has not been completely performed. This may lead to functional limitations (degradation).

### Fill and bleed high-temperature cooling system:

1. Before starting the filling procedure, it must be ensured that the **heater circuit** and **LOW-TEMPERATURE COOLING SYSTEM** are filled and bled!
2. Evacuate and fill the high-temperature cooling circuit with a **VACUUM FILLING DEVICE AUTHORIZED BY BMW**. Remove vacuum filling unit after evacuating and filling.
3. **Starting bleeding procedure:** Start REX (range extender) using tester job and allow to run for approx. 10 min.
4. After engine running has finished, check the coolant level in the expansion tank and adjust to MAX.

Lock sealing cap (1) on expansion tank for high-temperature cooling system.



**Fig. 30: Identifying Expansion Tank Sealing Cap**  
Courtesy of BMW OF NORTH AMERICA, INC.

### 64 10 031 DRAIN AND TOP UP COOLANT, HEATER CIRCUIT

#### Special tools required:

- 00 2 030

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:** Risk of scalding!  
Only carry out repair work on the cooling system after the cooling system has cooled down!

#### Lifetime coolant filling:

Never reuse used coolant!

**IMPORTANT:** When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

### Installation note:

The cooling circuit of the heating may **ONLY** be filled with "**coolant concentrate i3**" (part number: 83 51 2 355 296).

"**Coolant concentrate i3**" must **NOT** be mistaken for **G48** or mixed with it.

In all equipment specifications, the heater circuit is filled with approx. 2 liters in a **mixture ratio** of **50/50** which provides freezing protection down to  $-40\text{ }^{\circ}\text{C}$ .

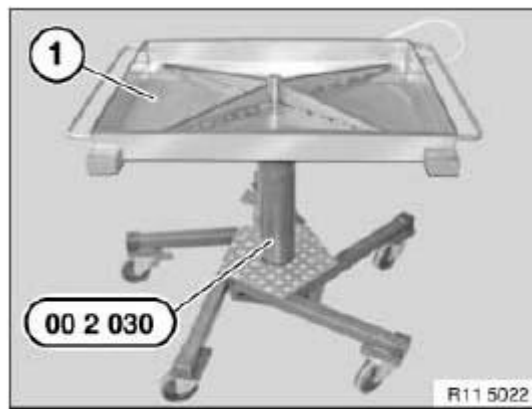
### Protective measures/rules of conduct:

- Wear protective goggles.
- Wear protective gloves.
- Note national regulations.

**IMPORTANT:** For dirt contamination of the cooling system (e.g. by engine oil), the cooling system must be rinsed with water until all dirt contamination is removed!

**IMPORTANT:** Risk of skidding due to coolant on the floor.  
**Danger of injury!**

Catch and dispose of drained coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).



**Fig. 31: Identifying Drip Tray And Special Tool (00 2 030).**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Recycling:

Observe country-specific waste disposal regulations.

### Necessary preliminary work:

- Remove **FRONT LUGGAGE COMPARTMENT WELL** .

### Draining coolant:

Open sealing cap (1) on coolant expansion tank.





**Fig. 32: Identifying Coolant Expansion Tank Sealing Cap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and remove coolant hose (1).

Drain, catch and dispose of coolant.



**Fig. 33: Identifying Coolant Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### **Adding coolant:**

The cooling circuit of the heating may **ONLY** be filled with "coolant concentrate i3" .

"Coolant concentrate i3" must **NOT** be mistaken for G48 or mixed with it.

In all equipment specifications, the heater circuit is filled with approx. 2 liters in a **mixture ratio** of **50/50** which provides freezing protection down to  $-40\text{ }^{\circ}\text{C}$ .

Fill and bleed **COOLING SYSTEM WITH VACUUM FILLING UNIT**.

#### **17 00 016 DRAINING AND REFILLING COOLING CIRCUIT (HIGH-TEMPERATURE COOLING SYSTEM) OF RANGE EXTENDER (I01)**

#### **Special tools required:**

- 00 2 030

**WARNING:** High-voltage system - danger to life



Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:**

**Risk of scalding!**

**Only carry out repair work on the cooling system after the cooling system has cooled down!**

**Lifetime coolant filling:**

Never reuse used coolant!

**IMPORTANT:** When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

*Installation note:*

Use only **RECOMMENDED COOLANT** .

Observe **MIXTURE RATIO** .

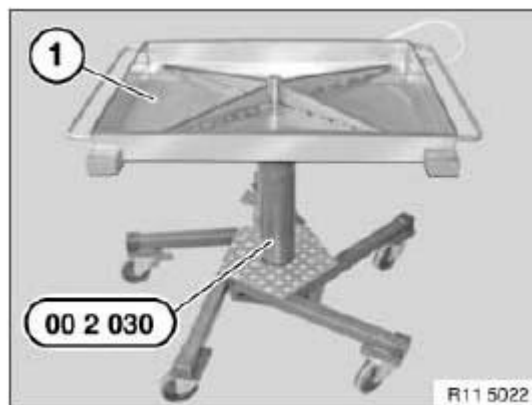
**Protective measures/rules of conduct:**

- Wear protective goggles.
- Wear protective gloves.
- Note national regulations.

**IMPORTANT:** For dirt contamination of the cooling system (e.g. by engine oil), the cooling system must be rinsed with water until all dirt contamination is removed!

**IMPORTANT:** Risk of skidding due to coolant on the floor.  
**Danger of injury!**

Catch and dispose of drained coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).



**Fig. 34: Identifying Drip Tray And Special Tool (00 2 030)**

Courtesy of BMW OF NORTH AMERICA, INC.

**Recycling:**

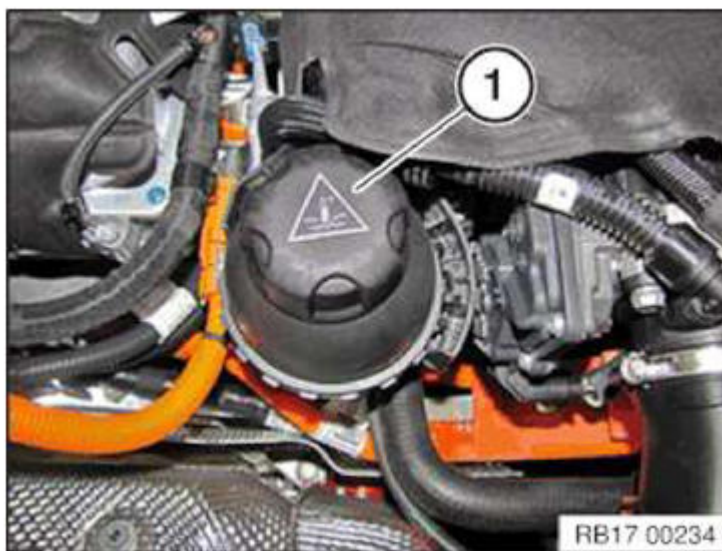
Observe country-specific waste disposal regulations.

**Necessary preliminary work:**

- Remove **SERVICE CAP IN LUGGAGE COMPARTMENT** .

## Draining coolant:

Open sealing cap (1) on coolant expansion tank.



**Fig. 35: Identifying Expansion Tank Sealing Cap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Partially release sound insulation.

Release screw (1).

Tightening torque **11 51 2AZ** .

Drain, catch and dispose of coolant.



**Fig. 36: Identifying Sound Insulation Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

## Adding coolant:

Use only **RECOMMENDED COOLANT** .

Observe **MIXTURE RATIO** .

Observe **CAPACITIES** .

Fill and bleed **HIGH-TEMPERATURE COOLING SYSTEM WITH VACUUM FILLING UNIT**.

**Observe bleeding instructions without fail.**

## BLEED HIGH-TEMPERATURE COOLING SYSTEM.

Assemble engine.

Check cooling system for leaks.

### **17 00 015 DRAINING AND TOPPING UP COOLING CIRCUIT (LOW TEMPERATURE COOLING SYSTEM) FOR DRIVE (I01)**

**Special tools required:**

- 00 2 030

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:** Risk of scalding!  
Only carry out repair work on the cooling system after the cooling system has cooled down!

**Lifetime coolant filling:**

Never reuse used coolant!

**IMPORTANT:** When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

*Installation note:*

Use only **RECOMMENDED COOLANT** .

Observe **MIXTURE RATIO** .

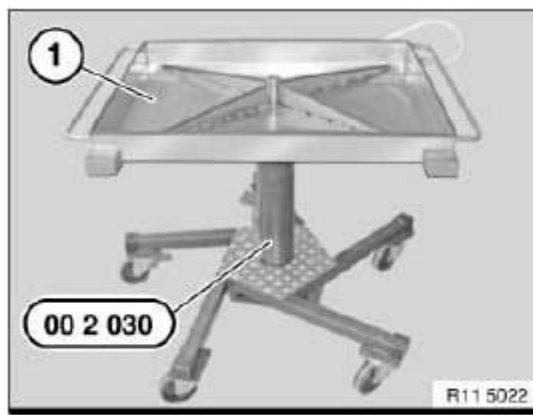
**Protective measures/rules of conduct:**

- Wear protective goggles.
- Wear protective gloves.
- Note national regulations.

**IMPORTANT:** For dirt contamination of the cooling system (e.g. by engine oil), the cooling system must be rinsed with water until all dirt contamination is removed!

**IMPORTANT:** Risk of skidding due to coolant on the floor.  
**Danger of injury!**

Catch and dispose of drained coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).



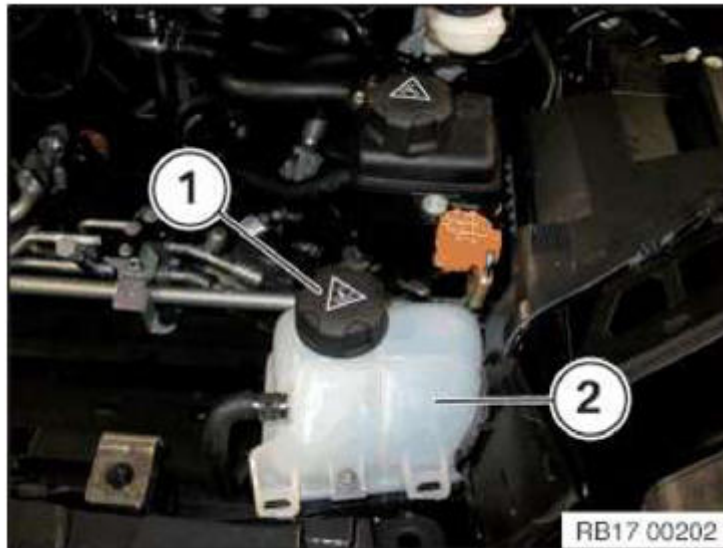
**Fig. 37: Identifying Drip Tray And Special Tool (00 2 030)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Recycling:**

Observe country-specific waste disposal regulations.

**Draining coolant:**

Open sealing cap (1) on coolant expansion tank.



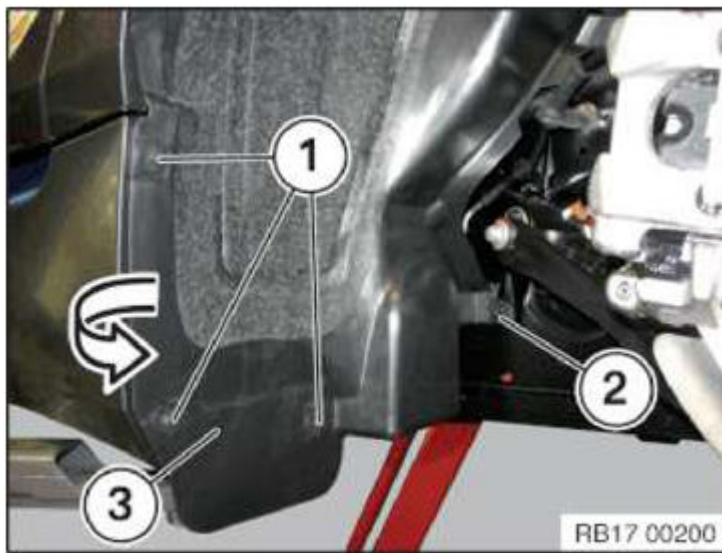
**Fig. 38: Identifying Expansion Tank And Sealing Cap**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Procedure for i3 BEV (Battery Electric Vehicle):**

Release screws (1).

Slacken nut (2).

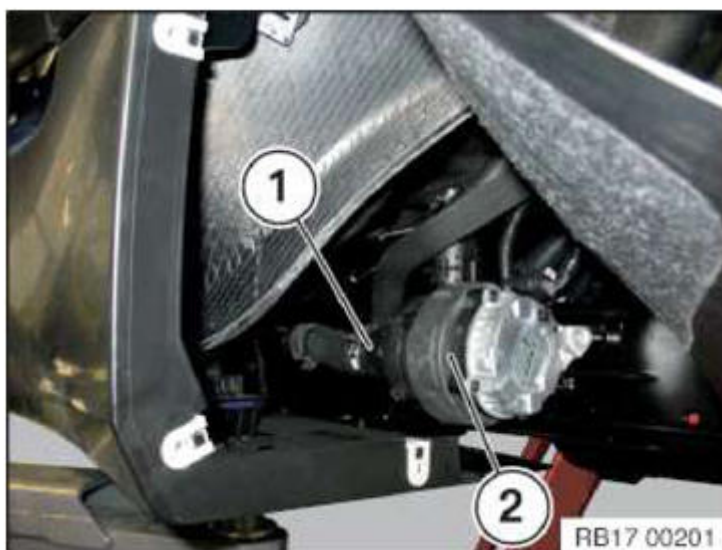
Fold wheel arch cover front section, rear left (3) to one side.



**Fig. 39: Folding Wheel Arch Cover Front Section, Rear Left (i3 BEV)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock coolant hose (1) from coolant pump (2) and pull off.

Drain, catch and dispose of coolant.



**Fig. 40: Identifying Coolant Pump And Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

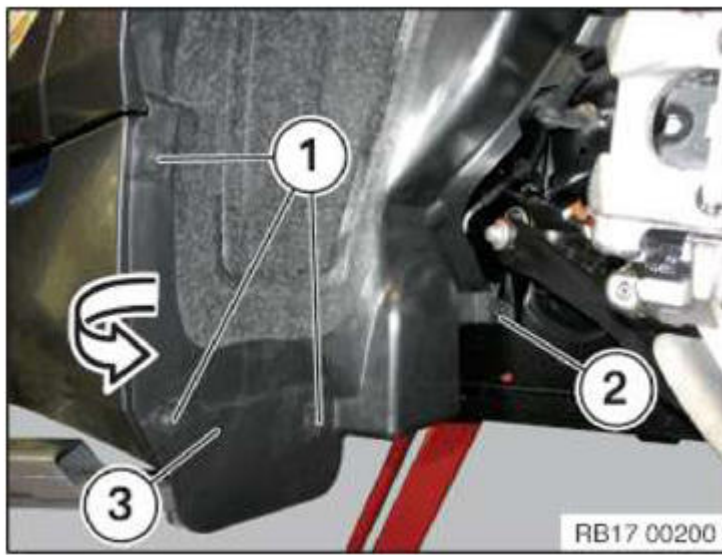
**Procedure for i3 REX (range extender):**

Release screws (1).

Slacken nut (2).

Fold wheel arch cover front section, rear left (3) to one side.

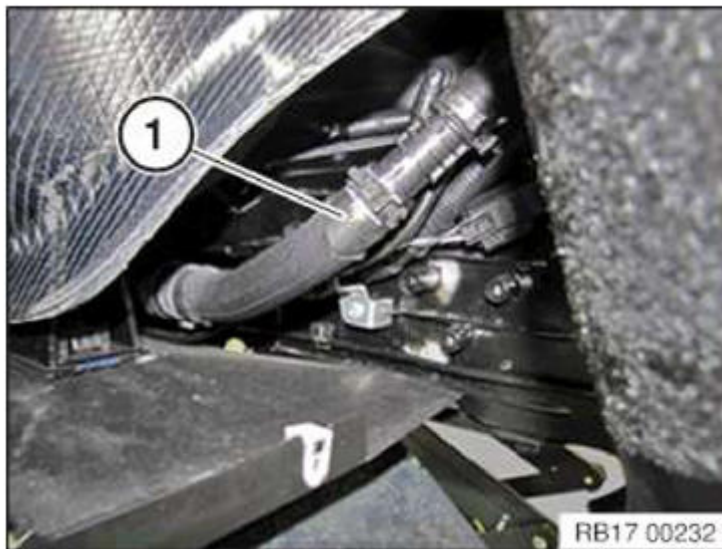




**Fig. 41: Folding Wheel Arch Cover Front Section, Rear Left (i3 BEV)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and detach coolant hose (1).

Drain, catch and dispose of coolant.



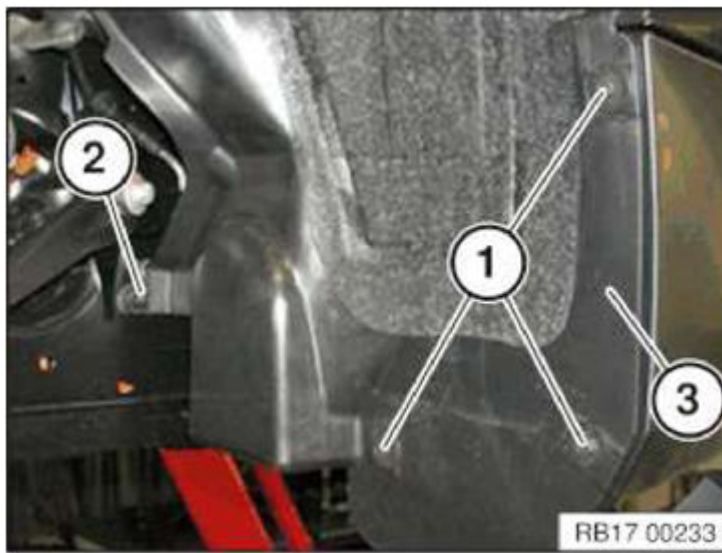
**Fig. 42: Identifying Cooling Circuit Coolant Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Slacken nut (2).

Fold wheel arch cover front section, rear right (3) to one side.



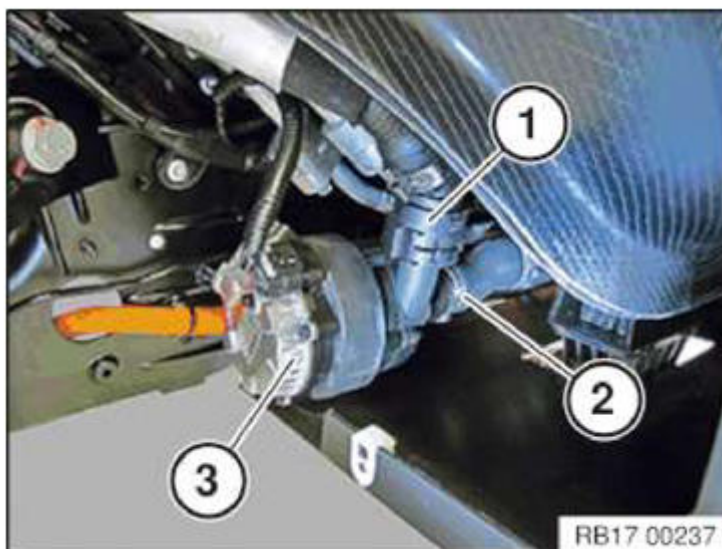


**Fig. 43: Identifying Wheel Arch Cover Front Section Rear Right, Screws And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock coolant hoses (1) and (2) from coolant pump (3) and pull off.

Replace faulty clamp.

Drain, catch and dispose of coolant.



**Fig. 44: Identifying Coolant Pump And Hoses**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Adding coolant:**

Use only **RECOMMENDED COOLANT** .

Observe **MIXTURE RATIO** .

Observe **CAPACITIES** .

Fill and bleed **LOW TEMPERATURE COOLING SYSTEM**.

**Observe bleeding instructions without fail.**

**BLEED LOW TEMPERATURE COOLING SYSTEM!**

Assemble engine.

Check cooling system for leaks.

**WARNING:** Risk of scalding. Only carry out repair work on the cooling system after the engine has cooled down.

IMPORTANT: Wear protective gloves and safety goggles.

**Lifetime coolant filling:**

Never reuse used coolant.

IMPORTANT: When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

*Installation note:*

Use only **RECOMMENDED COOLANT** .

Observe **MIXTURE RATIO** .

Open cooling system only when it has cooled down.

IMPORTANT: Opening the cooling system while hot can result in air entering the system. This can cause overheating with permanent damage to the engine.

You must protect the alternator against dirt contamination before carrying out any repair work on the cooling circuit.

Cover alternator with suitable materials.

IMPORTANT: Failure to comply with this procedure may result in an alternator malfunction.

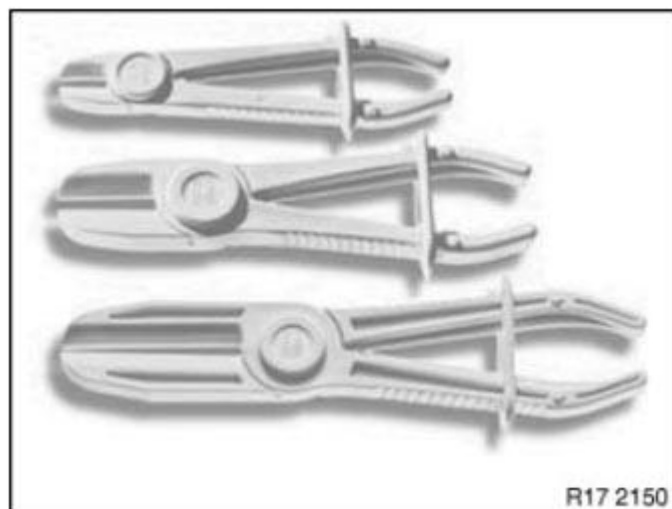
Do not fill coolant expansion tank over maximum level, as overfilling will cause the coolant to overflow. This may give rise to traces of coolant on the expansion tank or in the engine compartment and wrongly suggest possible leaks.

## Recycling

Catch and dispose of drained coolant.

Observe country-specific waste disposal regulations.

**NOTE:** To disconnect coolant hoses, use commercially available disconnect tools such as HAZET brand tools (see table).



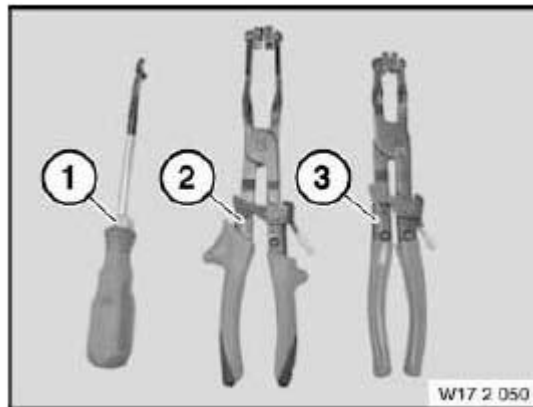
**Fig. 45: Identifying Disconnect Tools**

Courtesy of BMW OF NORTH AMERICA, INC.

HAZET number:	Description
4590-1	Disconnect-pliers, length (mm): 150
4590-2	Disconnect-pliers, length (mm): 180
4590-3	Disconnect-pliers, length (mm): 253
4590/2	Disconnect-plier set
4590/3	Disconnect-plier set

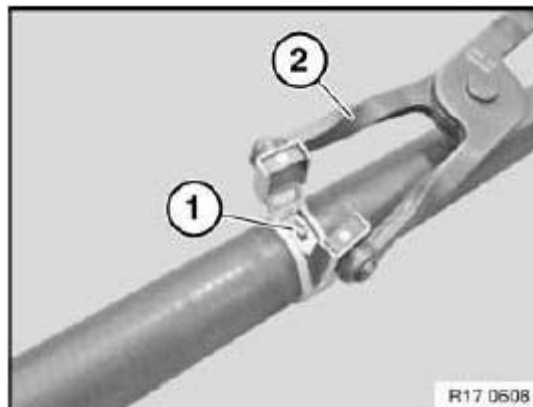
Set of special tools 17 2 050 for removing and installing the spring bracket clamps for coolant hoses.

- (1) Release tool.
- (2) Pliers (bent version).
- (3) Pliers (straight version).



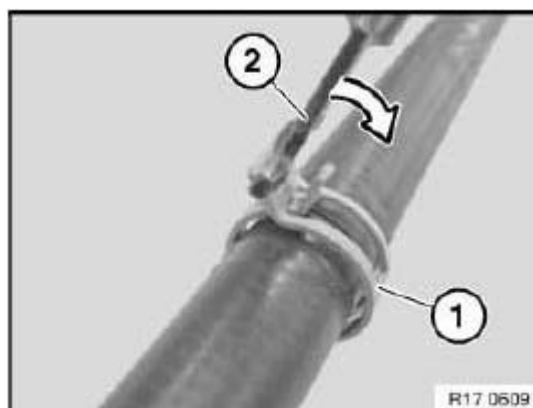
**Fig. 46: Identifying Release Tool And Pliers (Bent/Straight)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Loosen spring strap (1) with the pliers (2).



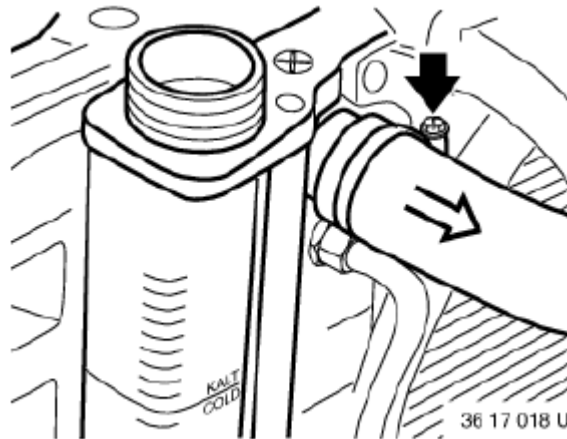
**Fig. 47: Identifying Spring Strap And Pliers**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock spring strap (1) with the release tool (2).



**NOTE: Tightening torque for hose clamps**

WAF 5	1.0 - 1.5 Nm
WAF 6	2.5 - 3.5 Nm

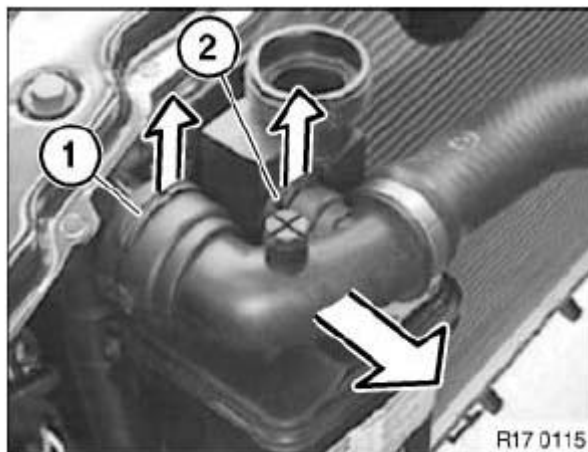


**Fig. 49: Locating Cooling System Hose Clamp**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Instructions for dismantling/assembly of coolant hose quick-release couplings**

**Dismantling of quick-release coupling**

Pull out lock (1) and (2). Pull off hose.

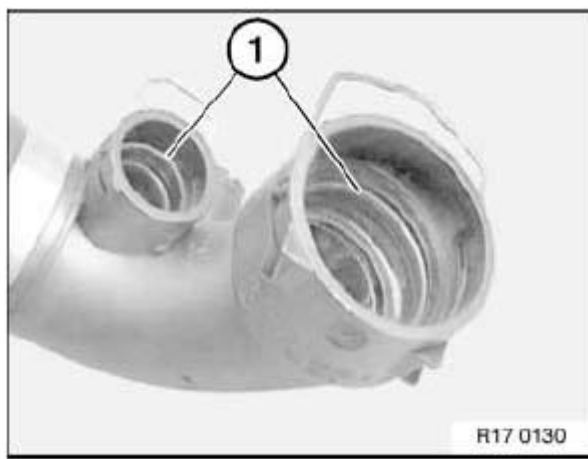


**Fig. 50: Removing Cooling System Quick-Release Coupling**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

Check O-rings (1).

Do not coat O-rings (1) with lubricant.



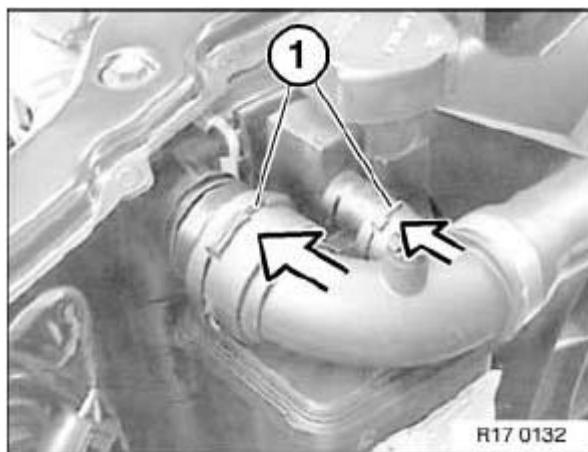
**Fig. 51: Identifying Cooling System Hose O-Rings**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Assembly of quick-release coupling**

Press in lock (1) before installing quick-release coupling.

Push on hose.

Quick-release couplings must clearly snap audibly into place.



**Fig. 52: Installing Cooling System Quick-Release Couplings**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**17 00... VENTING AND FILLING COOLING CIRCUIT (LOW-TEMPERATURE COOLING SYSTEM) FOR DRIVE WITH VACUUM FILLING UNIT**

**Special tools required:**

- 00 2 030
- 17 0 100

Type	Model	Adapter Y from 17 0 100
I01	i3, i3 REX	17 0 109

**IMPORTANT: Lifetime coolant filling:**  
 Never reuse used coolant!

When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

You must protect the alternator against contamination by coolant when carrying out repair work on the cooling circuit.  
**IMPORTANT:** Cover alternator with suitable materials.  
Failure to comply with this procedure may result in an alternator malfunction.

Note on ordering:

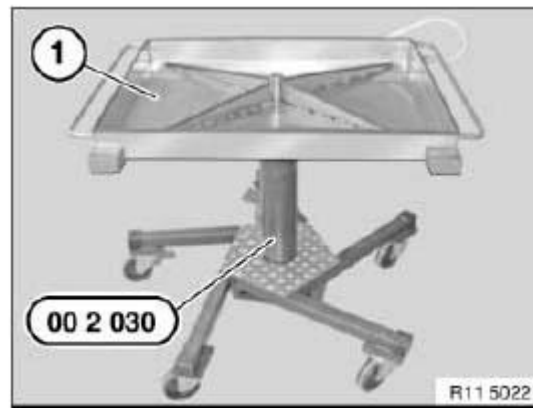
- Filler unit no. 81 39 2 152 473
- Collecting vessel no. 81 49 2 152 347
- Adapter: 17 0 100

**IMPORTANT:** Risk of slipping due to coolant on the floor.  
**Danger of injury!**

Catch and dispose of emerging coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).

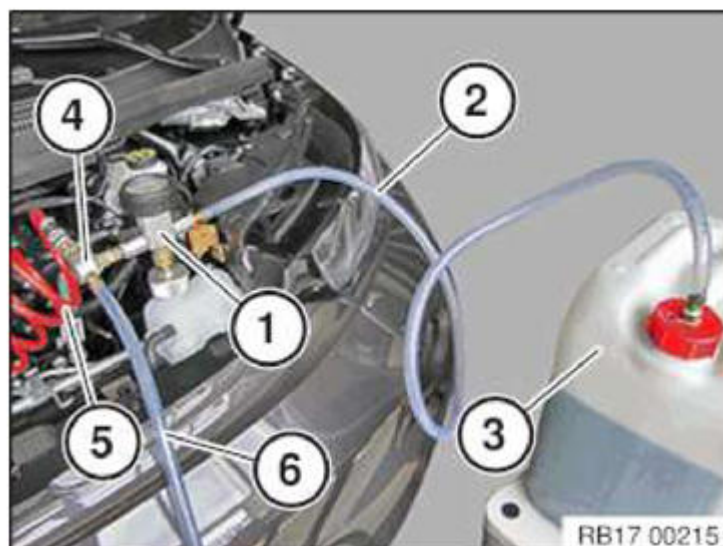
### Recycling:

Observe country-specific waste disposal regulations.



**Fig. 53: Identifying Drip Tray And Special Tool (00 2 030)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check all the coolant hoses before filling the cooling system with the vacuum filling unit.  
**IMPORTANT:** If necessary, replace damaged and porous coolant hoses.



**Fig. 54: Identifying Vacuum Filling Unit Components**  
Courtesy of BMW OF NORTH AMERICA, INC.



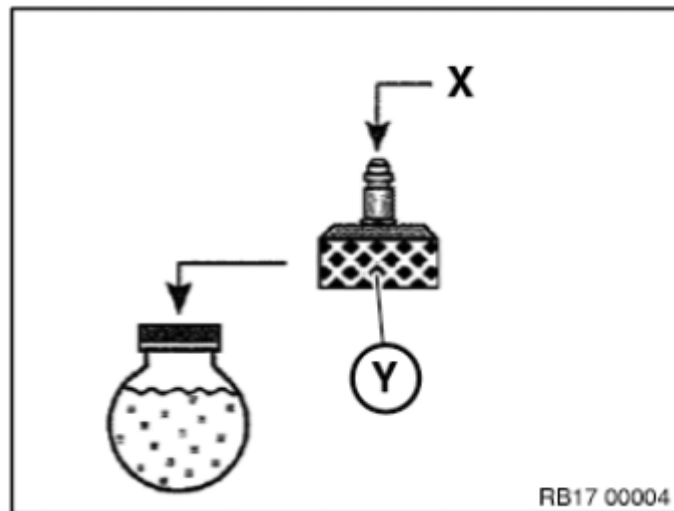
- 1) Filling unit with vacuum meter and shutoff valves
- 2) Filler hose
- 3) Coolant container
- 4) Venturi nozzle
- 5) Compressed air connection (max. 6 bar)
- 6) Outgoing-air hose (lead outgoing-air hose into a collecting container)

### Preconditions

- Cooling system expansion tank must be empty.
- There must be sufficiently premixed coolant in the filling unit container, 1 - 2 liters more than the vehicle filling capacity.
  - Use only **RECOMMENDED COOLANT** .
  - Observe **MIXTURE RATIO** .
  - Observe **FILLING CAPACITY** .
- Position the filling unit container at the same height as the coolant expansion tank.
- Compressed-air connection with 6 bar pressure present.
- Set vehicle heater to maximum temperature.

Select adapter (Y) according to table and connect to coolant expansion tank.

Connect filler unit to adapter connection (X).

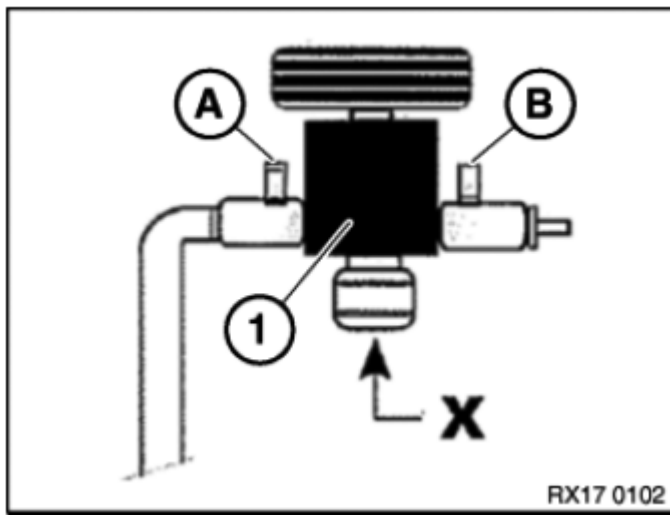


**Fig. 55: Identifying Adapter And Adapter Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

Shutoff valves (A) and (B) of the filling unit (1) must be closed.

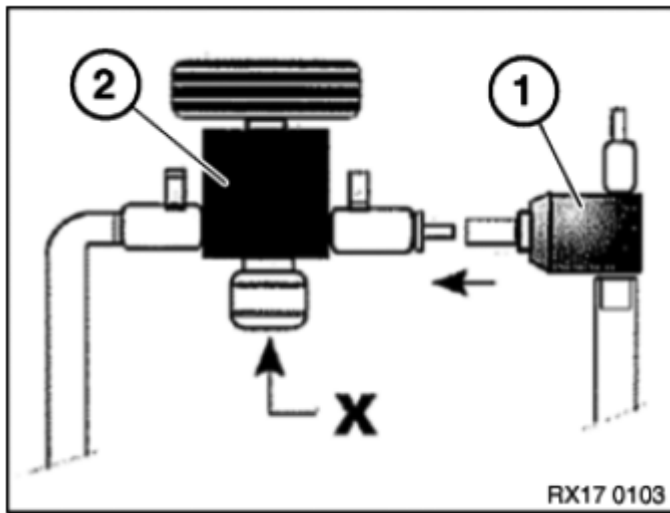
(X) Expansion tank connection



**Fig. 56: Identifying Filling Unit Shut-Off Valves And Expansion Tank Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect venturi nozzle (1) to filling unit (2).

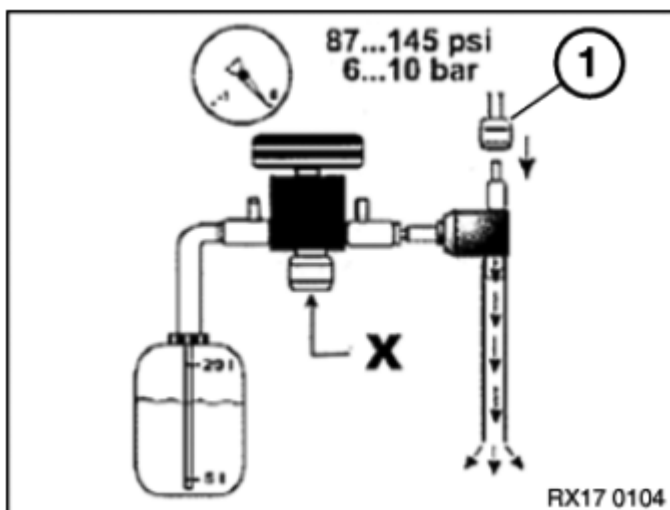
(X) Expansion tank connection



**Fig. 57: Connecting Venturi Nozzle And Filling Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect compressed air (1).

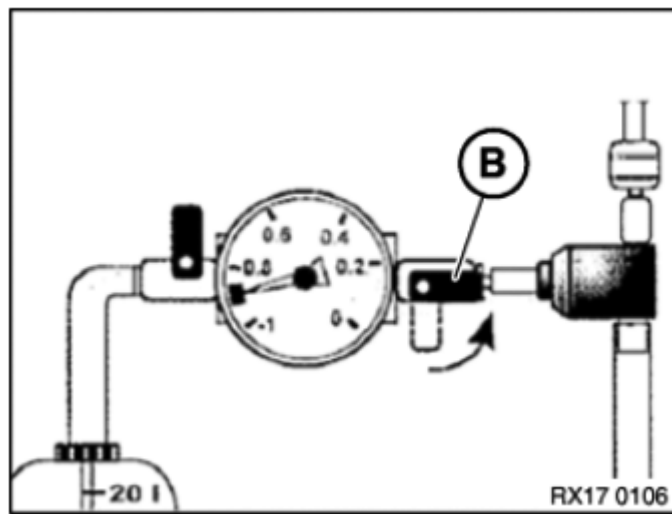
(X) Expansion tank connection



**Fig. 58: Connecting Compressed Air Line**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open shutoff valve (B).

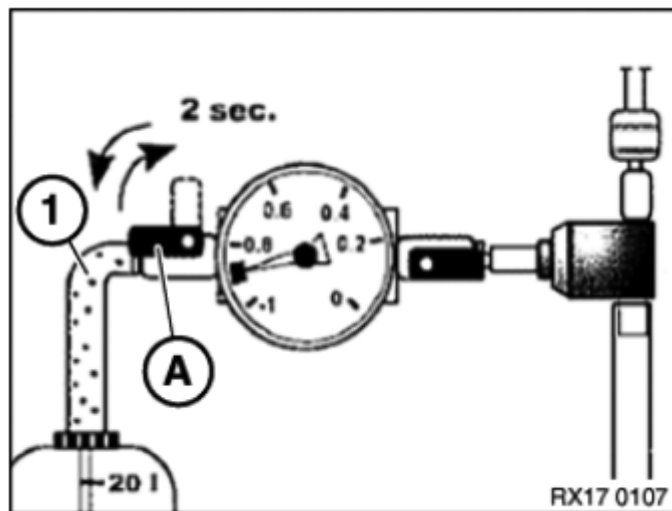
The venturi nozzle produces a flow noise.



**Fig. 59: Opening Shut-Off Valve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Then open shutoff valve (A) until the filling hose (1) is free of bubbles.

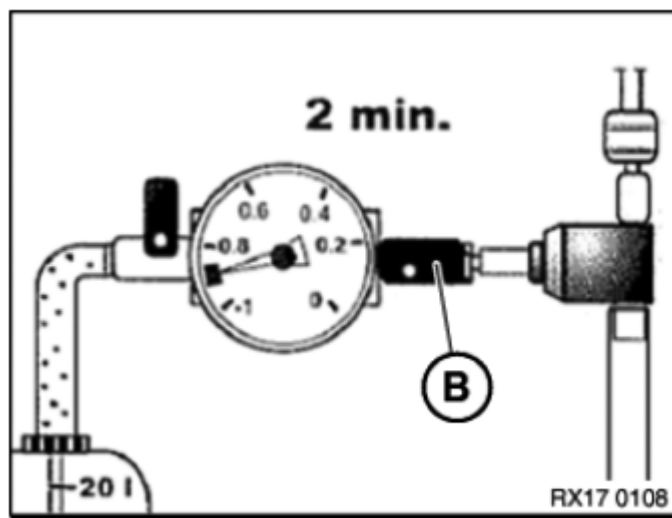
Close shutoff valve (A) again. The filling hose (1) is vented in this way.



**Fig. 60: Opening/Closing Shut-Off Valve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Shutoff valve (B) will remain open.

Generate vacuum in coolant system for approx. 2 minutes. The end vacuum is reached at a vacuum of -0.7 to -0.95 bar. Green scale on the vacuum meter.

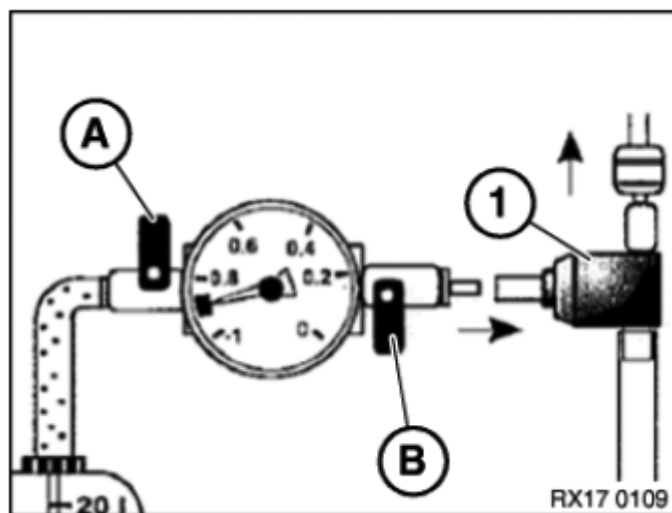


**Fig. 61: Checking Shut-Off Valve Opening Time**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** The coolant hoses contract during vacuum build-up.

Then close shutoff valve (B) again.

Both shutoff valves (A) and (B) must be closed. Then seal Venturi nozzle (1).

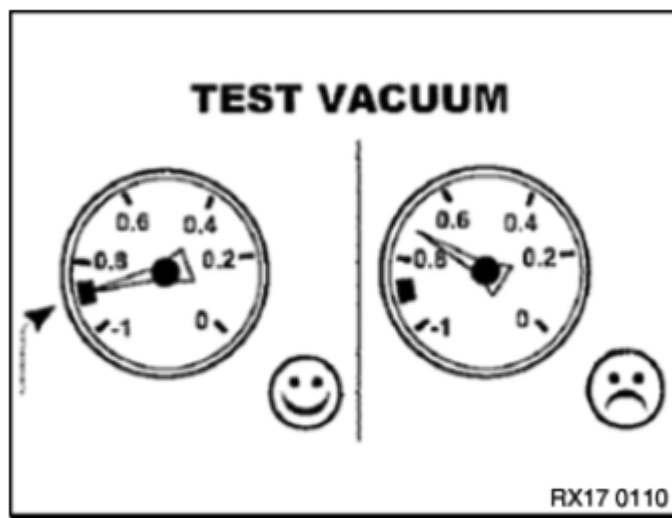


**Fig. 62: Closing Shut-Off Valves (A/B)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

The cooling system must hold the vacuum for 30 s. If the needle in the vacuum meter falls, this indicates a leak in the cooling system.

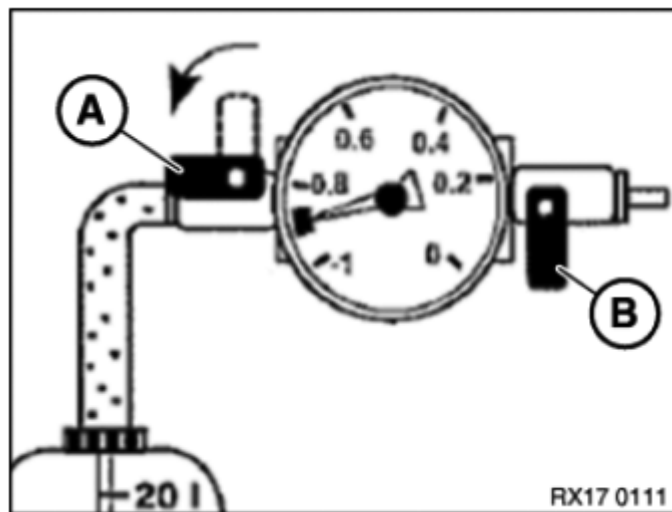
If the vacuum remains constant, proceed with filling.

In event of leaks, check cooling system for leaks.



**Fig. 63: Checking Vacuum Meter Needles**  
 Courtesy of BMW OF NORTH AMERICA, INC.

There must be sufficiently premixed coolant in the filling unit container: 1 - 2 liters  
**IMPORTANT:** more than the vehicle filling capacity.  
 Position the filling unit container at the same height as the coolant expansion tank.



**Fig. 64: Opening/Closing Shut-Off Valve**  
 Courtesy of BMW OF NORTH AMERICA, INC.

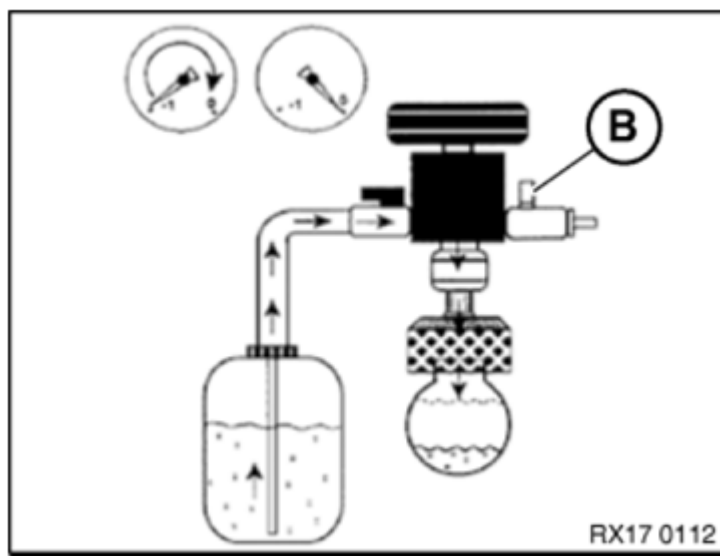
Shut-off valve (B) remains closed during the filling process.

To fill the cooling system, open shutoff valve (A) to filling unit container.

Coolant is now added.

The filling procedure is finished when the needle in the vacuum meter is at 0 bar or no longer falls.

If necessary, reduce remaining vacuum. Open shutoff valve (B) to do so.

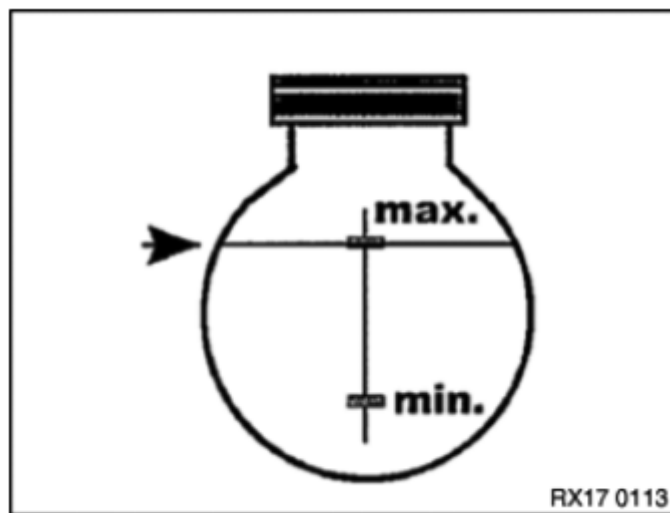


**Fig. 65: Filling Coolant Into Cooling System**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove filling unit with adapter from expansion tank.

Adjust coolant level to maximum.

Close coolant expansion tank.



**Fig. 66: Locating Coolant Maximum And Minimum Levels**  
 Courtesy of BMW OF NORTH AMERICA, INC.

After the cooling system has been filled with the vacuum filling unit, another bleeding procedure must be performed.

- **BLEED LOW-TEMPERATURE COOLING SYSTEM**

Check function of cooling system.

Check cooling system for tightness.

## **ENGINE RADIATOR WITH ATTACHMENT**

### **64 53... INSTRUCTIONS FOR REPLACEMENT OF AIR CONDITIONING CAPACITORS AND RADIATOR/COOLERS**

**IMPORTANT:** Even when they are correctly installed or due to normal driving, radiators (oil cooler, radiator, charge air cooler) or air conditioning condensers may show slight impressions or deformations on their discs (1).

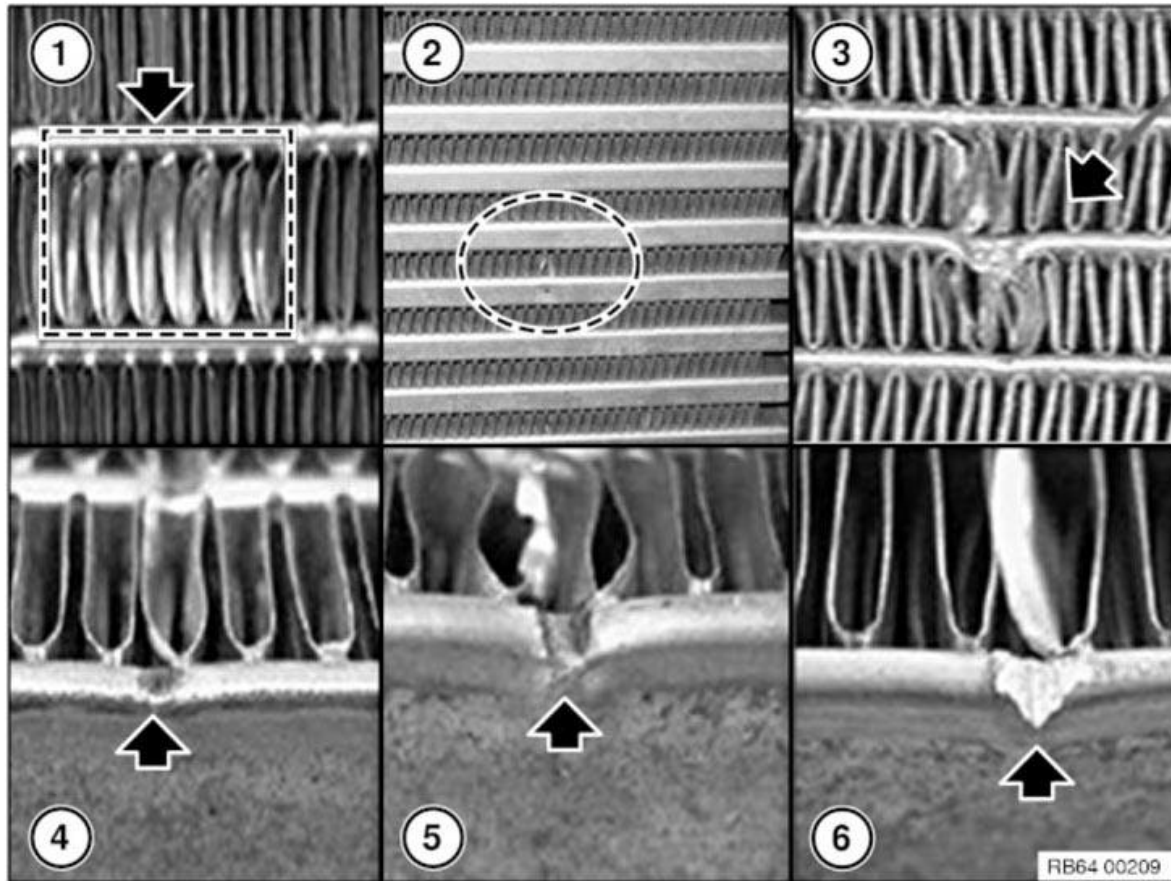


A slight sag with a large radius for the air conditioning condenser is also permissible. As long as tightness/function are not degraded and an adequate distance of a few mm between the radiator and air conditioning condenser remains in place, **this is not damage in either case.**

**Radiators or air conditioning condensers are not to be replaced in these cases!**

**NOTE:** The deformations shown in Fig. (1) can be bent back with a standard fin comb.

Damage to lines carrying media or on the flat pipe require exchange of the radiator or air conditioning condenser (2-6).



**Fig. 67: Locating Radiator And Air Conditioning Condenser Flat Pipe Lines Damage**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Dryer flask** (integrated in the air conditioning condenser):

Round dents/depressions are permitted.

**The air conditioning condenser is not to be replaced in this case.**

### **17 11 000 REMOVING AND INSTALLING RADIATOR (I01)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**WARNING:** Risk of scalding!  
Only perform this repair work after engine has cooled down.

**IMPORTANT:** Wear safety goggles and protective gloves.

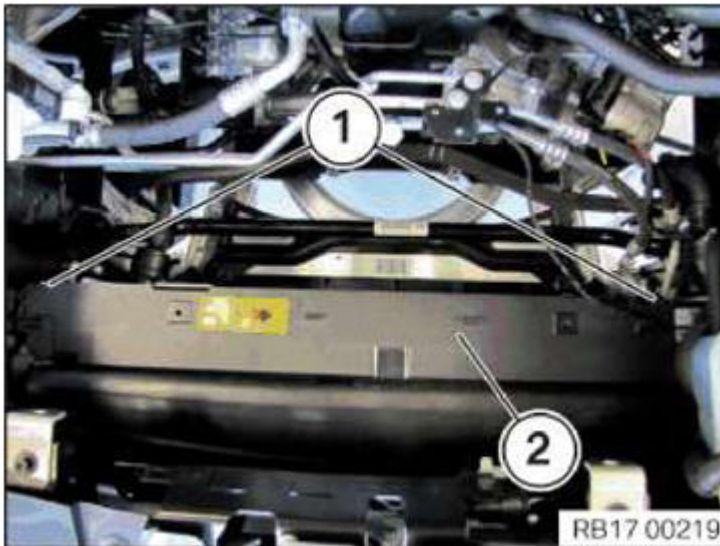
*Necessary preliminary tasks:*

- Follow instructions for [REPAIR WORK ON THE COOLING SYSTEM](#).
- Remove [FAN COWL](#).
- Drain [COOLANT FOR ELECTRIC MOTOR](#) (low temperature cooling system).
- Unlock and detach coolant hoses on radiator.

Release screws (1).

Tightening torque [17 10 4AZ](#) .

Remove cover (2).



**Fig. 68: Identifying Radiator Cover And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove radiator (1) towards top.



**Fig. 69: Identifying Radiator**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Reassemble the vehicle.

### **17 11 100 REMOVING AND INSTALLING/RENEWING COOLANT EXPANSION TANK (I01)**

Special tools required:

- [17 2 052](#)

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

IMPORTANT: Risk of scalding!  
Only perform this repair work after engine has cooled down.

## Recycling

Catch and dispose of drained coolant in a suitable container.

Observe country-specific waste disposal regulations.

*Necessary preliminary tasks:*

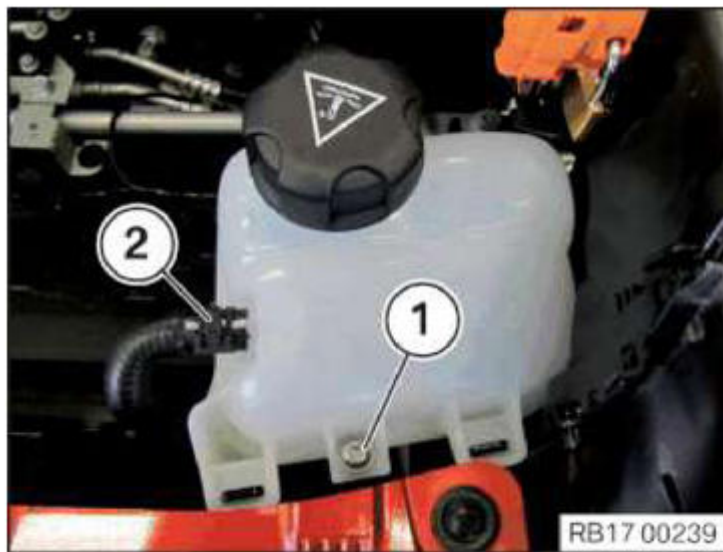
- Remove front **LUGGAGE COMPARTMENT WELL** .
- Disconnect coolant hoses from expansion tank for coolant.
- Follow instructions for **REPAIR WORK ON THE COOLING SYSTEM**.

Release spring band clamp using special tool **17 2 052** and pull off hose (1).

Release screw (2).

Tightening torque **17 10 2AZ** .

Release expansion tank (3) from rubber mount and raise slightly until lower coolant hose is accessible.



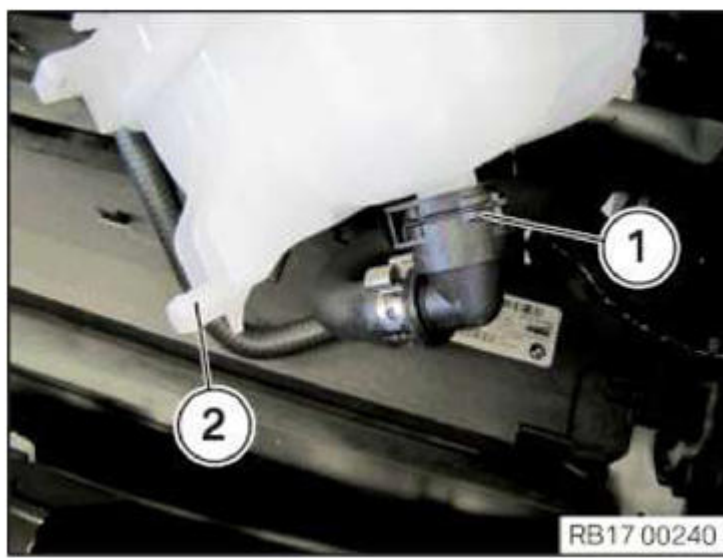
**Fig. 70: Identifying Coolant Expansion Tank Hose And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and detach lower coolant hose (1). Catch and dispose of escaping coolant.

Remove expansion tank.

*Installation note:*

Make sure the bearing journal (2) is installed in the correct installation position in the rubber mount.



**Fig. 71: Identifying Expansion Tank Lower Coolant Hose And Bearing Journal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Top up coolant.

Check expansion tank for leaks.

### **17 11 035 REMOVING AND INSTALLING/RENEWING FAN COWL WITH ELECTRIC FAN (I01)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe the **SAFETY INFORMATION** for working with electric vehicles.

#### **Necessary preliminary work:**

- Switch off ignition.
- Release **WASHER FLUID RESERVOIR FOR WINDOW WASHER SYSTEM** and place to one side.

#### **Only US version with additional reinforcement:**

- Remove **RIGHT HEADLIGHT** .
- Release **WASHER FLUID RESERVOIR FOR WINDOW WASHER SYSTEM** and place to one side.
- Loosen the **COOLANT EXPANSION TANK** and put to one side.

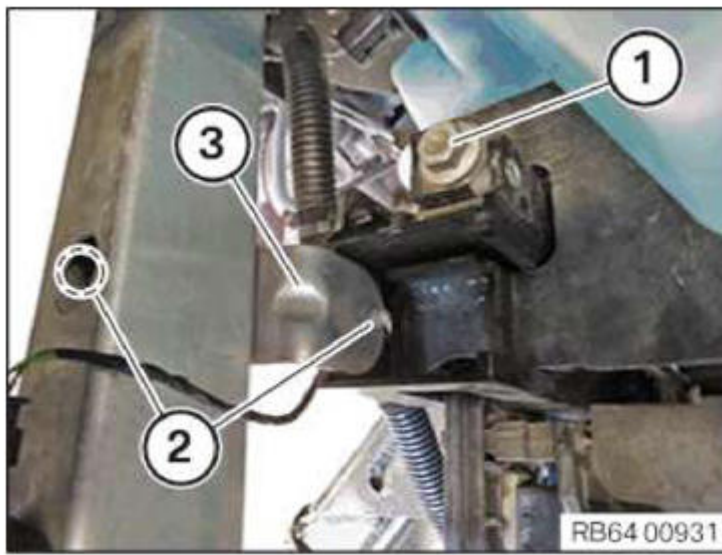
#### **For US version:**

Release screw (1).

Tightening torque **17 10 6AZ** .

Release screws (2) and remove holder (3).





**Fig. 72: Identifying Fan Cowl Screws And Holder (US Version).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**For US version:**

Release screws (1).

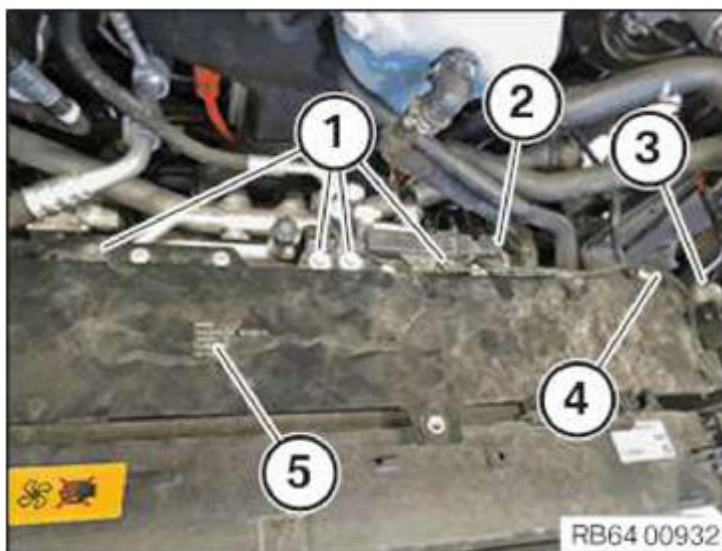
Unlock and disconnect connector (2).

Release screw (3).

Tightening torque [17 10 6AZ](#) .

Unfasten cable strap (4).

Remove the strut (5).



**Fig. 73: Identifying Fan Cowl Screws, Connector, Cable Strap And Strut (US Version).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [17 10 6AZ](#) .

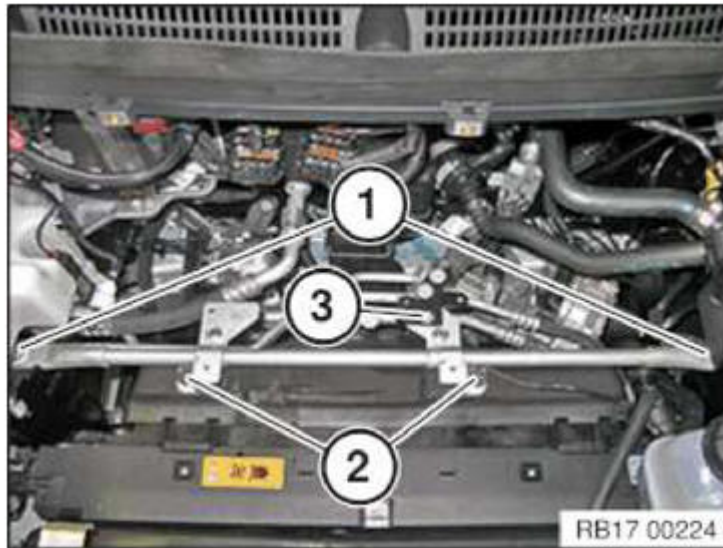
Unfasten screws (2).

Tightening torque [17 10 7AZ](#) .

Unscrew nut (3).

Tightening torque [17 10 8AZ](#) .

Remove crash strut.



**Fig. 74: Identifying Fan Cowl Screws And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip coolant hose from clamps (2) at air duct.



**Fig. 75: Identifying Air Duct Coolant Hose Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [17 10 1AZ](#) .

Feed out air duct (2) upwards and remove.





**Fig. 76: Identifying Air Duct And Screws**

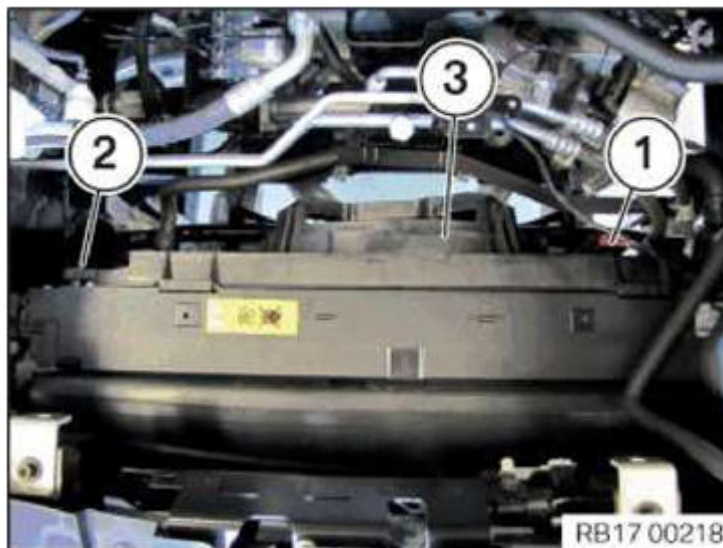
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock connector (1) and pull off.

Loosen screw (1).

Tightening torque **17 10 3AZ** .

Remove fan cowl (3) towards top.



**Fig. 77: Identifying Fan Cowl, Screw And Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Check stored fault messages.  
Delete the fault memory.

### **17 11 015 REMOVING AND INSTALLING/REPLACING (I01) HEAT EXCHANGER FOR ENGINE COOLANT**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**IMPORTANT:** Risk of scalding!  
Only perform this repair work after engine has cooled down.

## Recycling

Catch and dispose of drained coolant in a suitable container.

Observe country-specific waste disposal regulations.

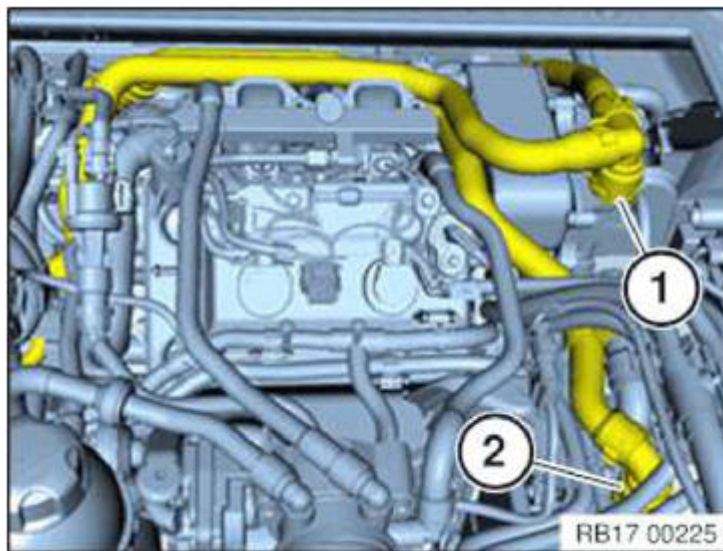
### Necessary preliminary tasks:

- Drain **COOLANT FOR ELECTRIC MOTOR** (low-temperature cooling system).
- Drain **COOLANT FOR RANGE EXTENDER** (high-temperature cooling system).
- Remove **INTAKE PLENUM**.
- Follow instructions for **REPAIR WORK ON THE COOLING SYSTEM**.

Unlock and pull off coolant hose (1) from heat exchanger.

Unlock and pull off coolant hose (2) from range extender electrical machine electronics (REME).

Lay both coolant hoses to one side.



**Fig. 78: Identifying Heat Exchanger And Range Extender Electrical Machine Electronics Coolant Hose**

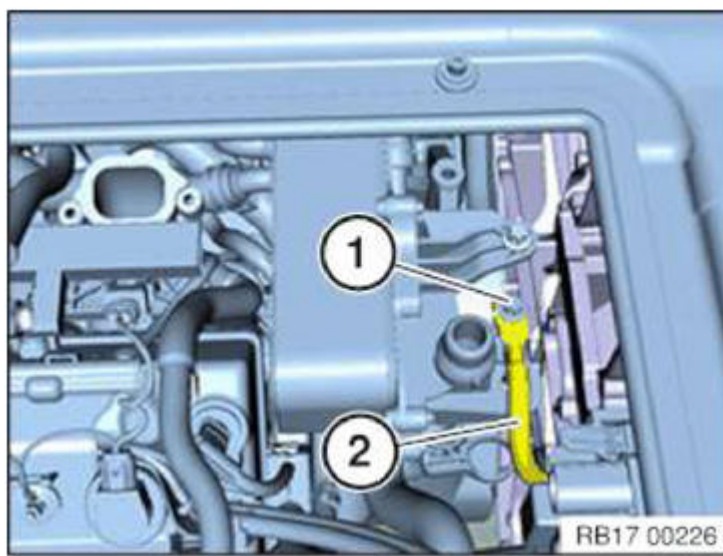
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

IMPORTANT: Observe notes on **EARTH BONDING SCREW CONNECTIONS** !

Tightening torque **12 42 3AZ**.

Lay grounding cable (2) to one side.

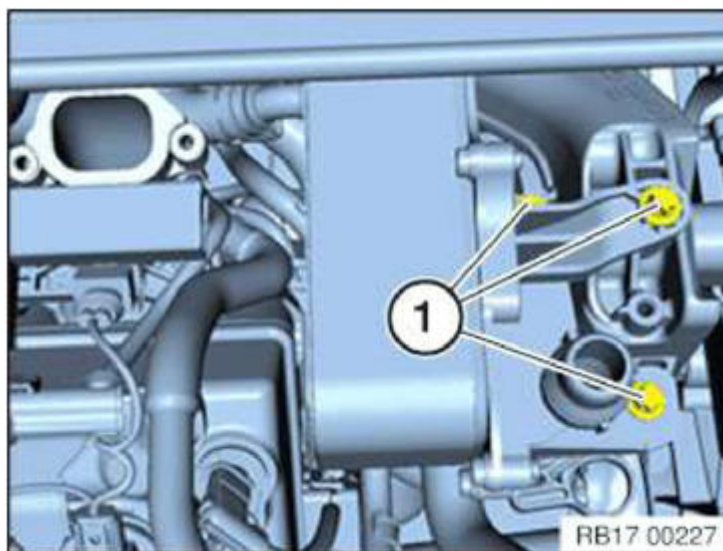


**Fig. 79: Identifying Engine Coolant Heat Exchanger Screw And Grounding Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Replace screws.

Tightening torque [17 10 5AZ](#) .



**Fig. 80: Identifying Engine Coolant Heat Exchanger Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release clamp (1) and pull coolant hose (2) off of T-piece.

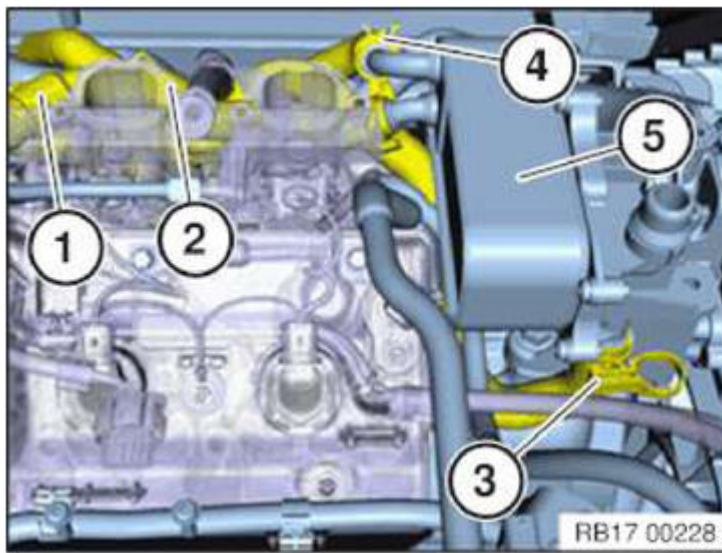
If necessary, replace clamp.

Unlock and pull off coolant hose (3) from below heat exchanger.

Release spring band clamp (4) and pull coolant line off of heat exchanger.

Feed out heat exchanger (5) together with coolant hose (2) and remove.

When **replacing** heat exchanger (5), remount coolant hose (2).



**Fig. 81: Identifying Heat Exchanger, Clamp, Spring Band Clamp And Coolant Hose (T-Piece/Heat Exchanger)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Assemble engine.

## COOLANT EXPANSION TANK

### 17 13 025 REMOVING AND INSTALLING/REPLACING COOLANT EXPANSION TANK FOR RANGE EXTENDER (I01)

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**IMPORTANT:** Risk of scalding!  
Only perform this repair work after engine has cooled down.

### Recycling

Catch and dispose of drained coolant in a suitable container.

Observe country-specific waste disposal regulations.

*Necessary preliminary tasks:*

- Remove **SERVICE CAP IN LUGGAGE COMPARTMENT** .
- Disconnect coolant hoses from expansion tank for coolant.
- Follow instructions for **REPAIR WORK ON THE COOLING SYSTEM**.

Unclip expansion tank (1) for range extender coolant out of bracket along line (2).

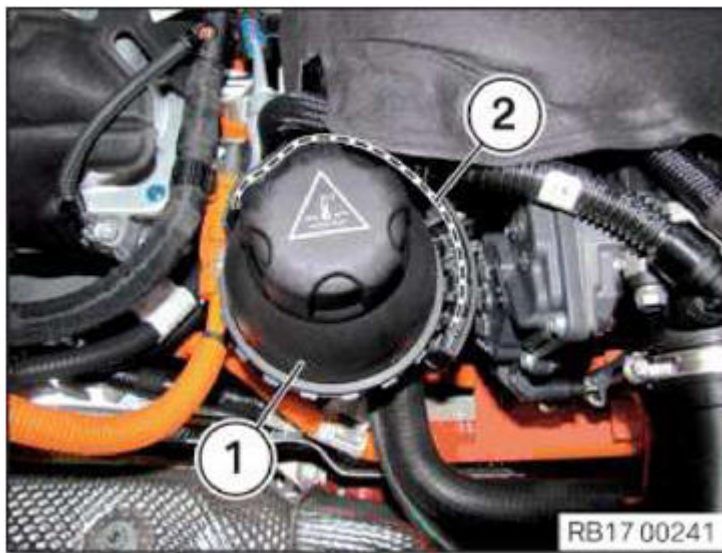
Move expansion tank slightly to one side to render coolant hoses accessible.

Unlock coolant hoses and detach.

Catch and dispose of escaping coolant.

Remove expansion tank (1) for range extender coolant.





**Fig. 82: Identifying Range Extender Expansion Tank And Bracket Line**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Top up coolant.

Check expansion tank for leaks.

## **ENGINE COMPARTMENT FAN**

### **17 40 015 REMOVING AND INSTALLING/REPLACING ENGINE COMPARTMENT FAN (I01)**

**WARNING:** High-voltage system - danger to life  
 Compliance with the following points is mandatory before beginning work:

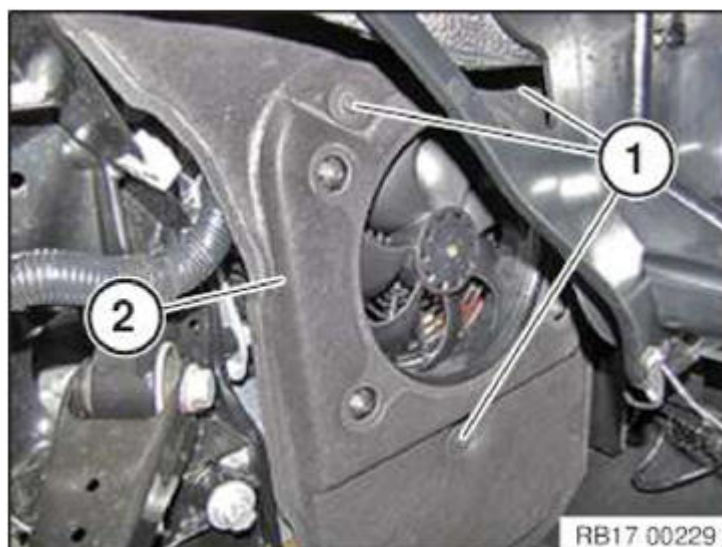
- De-energize the **HIGH-VOLTAGE SYSTEM** .
- Observe **SAFETY INFORMATION** for handling electric vehicles.

Necessary preliminary work:

- Remove **LUGGAGE COMPARTMENT SERVICE CAP** .
- Remove rear left **WHEEL ARCH COVER** .

Release screws (1).

Remove soundproofing (2).



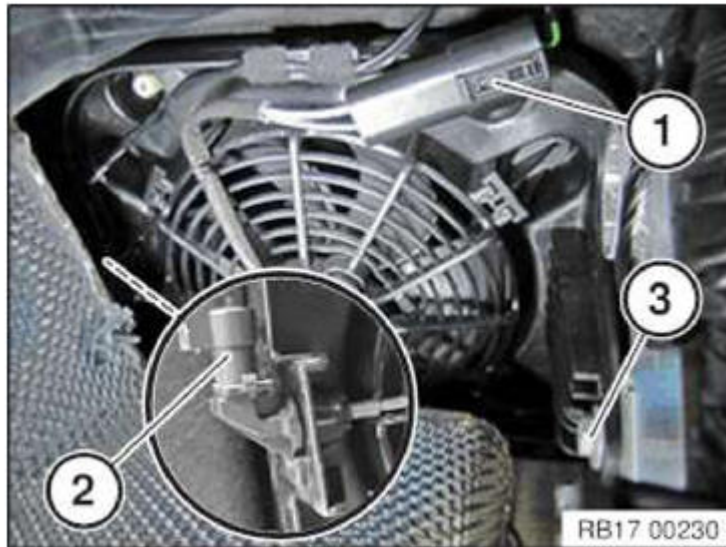
**Fig. 83: Identifying Engine Compartment Fan Screws And Soundproofing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and pull off connector (1) for fan.

Unlock and pull off connector (2) at temperature sensor and unclip cable from fan cowl.

Release screw (3).

Tightening torque [17 42 1AZ](#) .



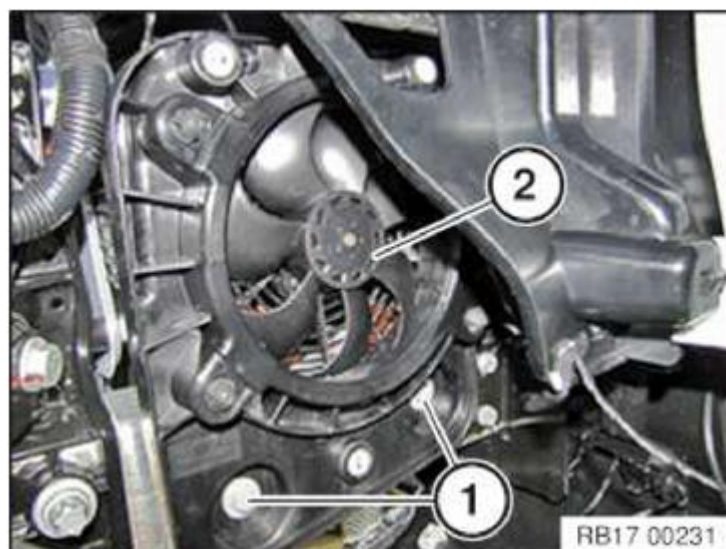
**Fig. 84: Identifying Screw, Fan And Temperature Sensor Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [17 42 2AZ](#) .

Remove fan for engine compartment (2).

**NOTE:** On replacement of fan, remount [TEMPERATURE SENSOR](#) .



**Fig. 85: Identifying Engine Compartment Fan And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Check stored fault messages.  
Clear diagnostic fault entries from fault memory.



# AIR CONDITIONING CAPACITORS AND RADIATOR/COOLERS

## 64 53... INSTRUCTIONS FOR REPLACEMENT OF AIR CONDITIONING CAPACITORS AND RADIATOR/COOLERS

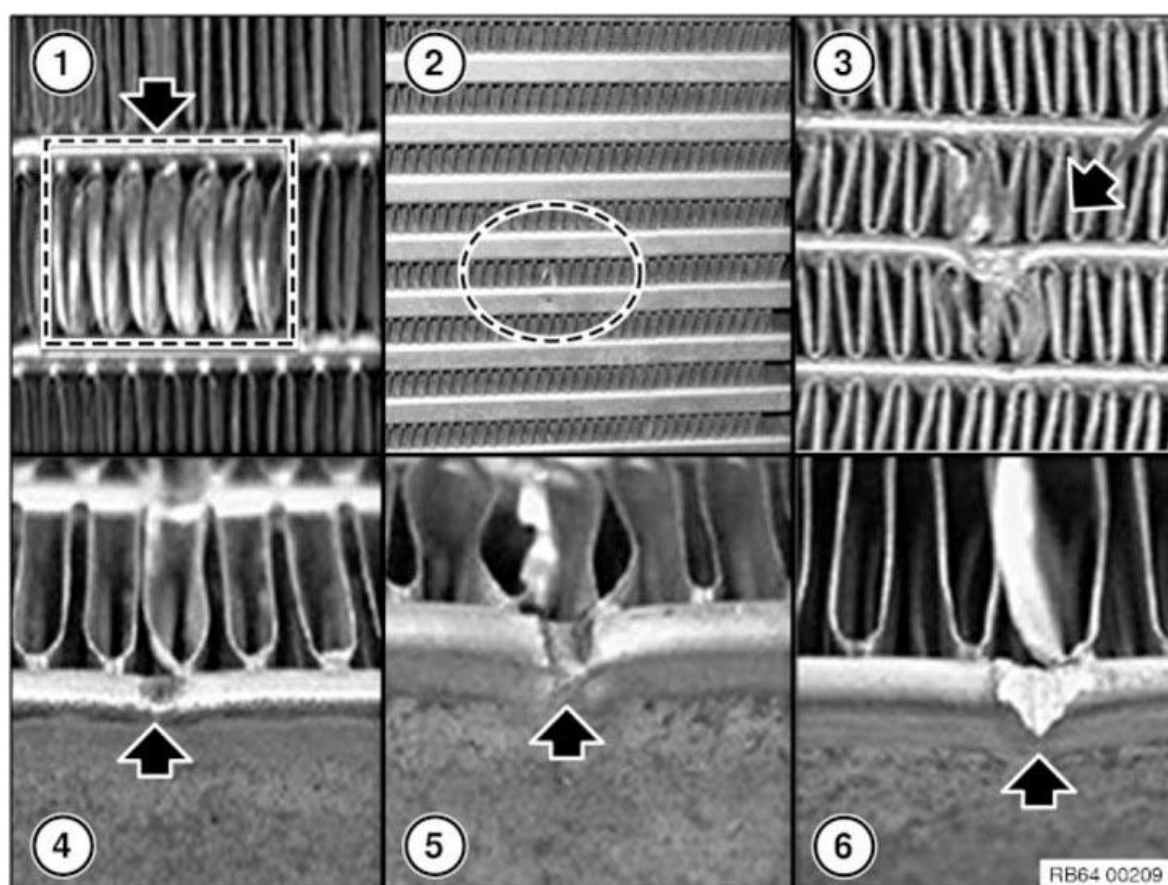
Even when they are correctly installed or due to normal driving, radiators (oil cooler, radiator, charge air cooler) or air conditioning condensers may show slight impressions or deformations on their discs (1).

**IMPORTANT:** A slight sag with a large radius for the air conditioning condenser is also permissible. As long as tightness/function are not degraded and an adequate distance of a few mm between the radiator and air conditioning condenser remains in place, **this is not damage in either case.**

**Radiators or air conditioning condensers are not to be replaced in these cases!**

**NOTE:** The deformations shown in Fig. (1) can be bent back with a standard fin comb.

Damage to lines carrying media or on the flat pipe require exchange of the radiator or air conditioning condenser (2-6).



**Fig. 86: Locating Radiator And Air Conditioning Condenser Flat Pipe Lines Damage**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Dryer flask** (integrated in the air conditioning condenser):

Round dents/depressions are permitted.

**The air conditioning condenser is not to be replaced in this case.**

## AUXILIARY COOLANT PUMP FOR COOLING CIRCUIT

### 17 61 000 REMOVING AND INSTALLING/REPLACING AUXILIARY COOLANT PUMP FOR COOLING CIRCUIT (LOW TEMPERATURE COOLING SYSTEM) FOR DRIVE (I01)

**Special tools required:**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:** Risk of scalding!  
Only carry out repair work on the cooling system after the cooling system has cooled down!

**Lifetime coolant filling:**

Never reuse used coolant!

**IMPORTANT:** When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

*Installation note:*

Use only **RECOMMENDED COOLANT** .

Observe **MIXTURE RATIO** .

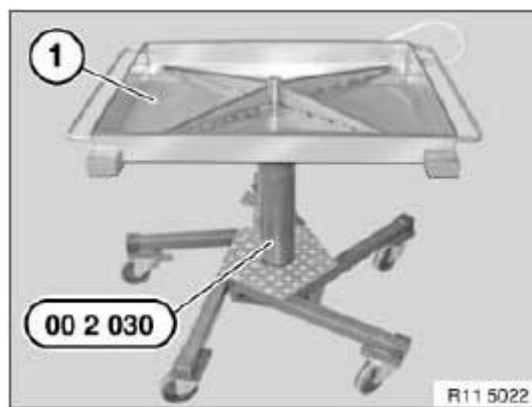
**Protective measures/rules of conduct:**

- Wear protective goggles.
- Wear protective gloves.
- Note national regulations.

**IMPORTANT:** For dirt contamination of the cooling system (e.g. by engine oil), the cooling system must be rinsed with water until all dirt contamination is removed!

**IMPORTANT:** Risk of skidding due to coolant on the floor.  
**Danger of injury!**

Catch and dispose of drained coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).



**Fig. 87: Identifying Drip Tray And Special Tool (00 2 030).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Recycling:**

Observe country-specific waste disposal regulations.

## Necessary preliminary work:

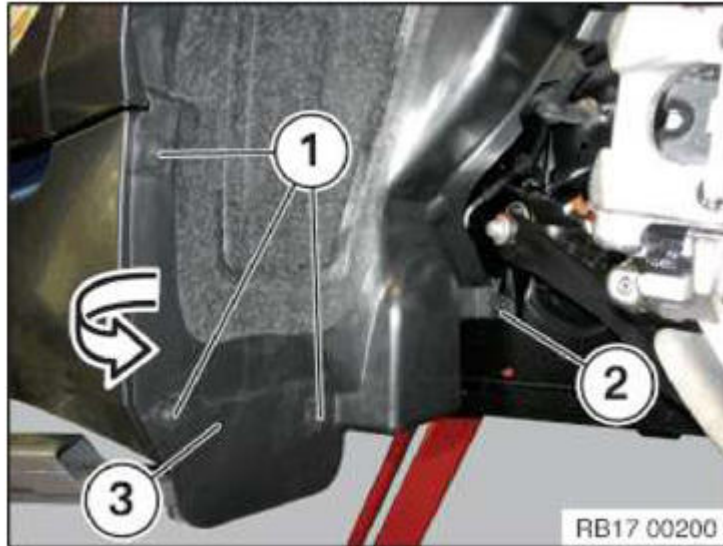
- Drain **COOLANT FOR ELECTRIC MOTOR** (low temperature cooling system).

### Procedure for I01 BEV (Battery Electric Vehicle):

Release screws (1).

Slacken nut (2).

Fold wheel arch cover front section, rear left (3) to one side.



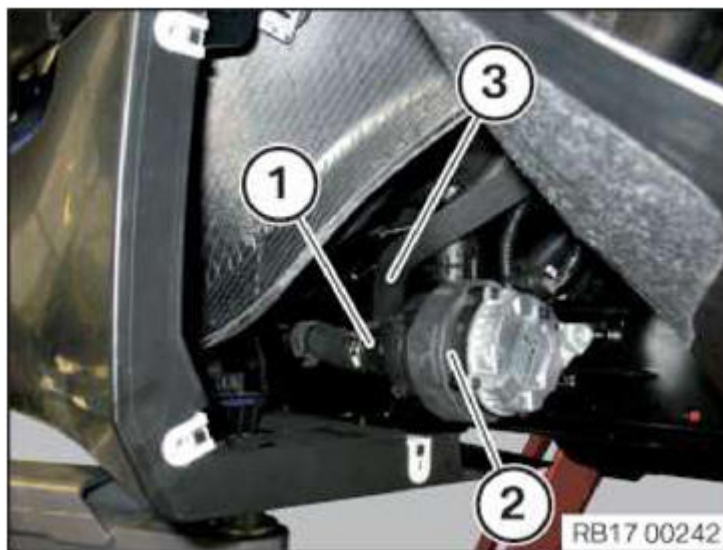
**Fig. 88: Folding Wheel Arch Cover Front Section, Rear Left (i3 BEV)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock coolant hose (1) from coolant pump (2) and pull off.

Unlock coolant hose (3) from coolant pump (2) and pull off.

Unlock connector on coolant hose (2) and pull off.

Pull off coolant pump (2) with rubber retainer and remove.



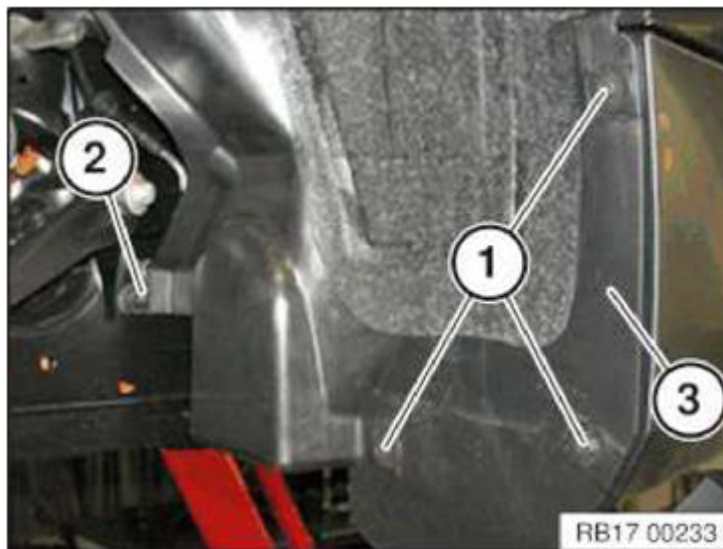
**Fig. 89: Identifying Auxiliary Coolant Pump And Hoses**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Procedure for I01 REX (range extender):

Release screws (1).

Slacken nut (2).

Fold wheel arch cover front section, rear right (3) to one side.



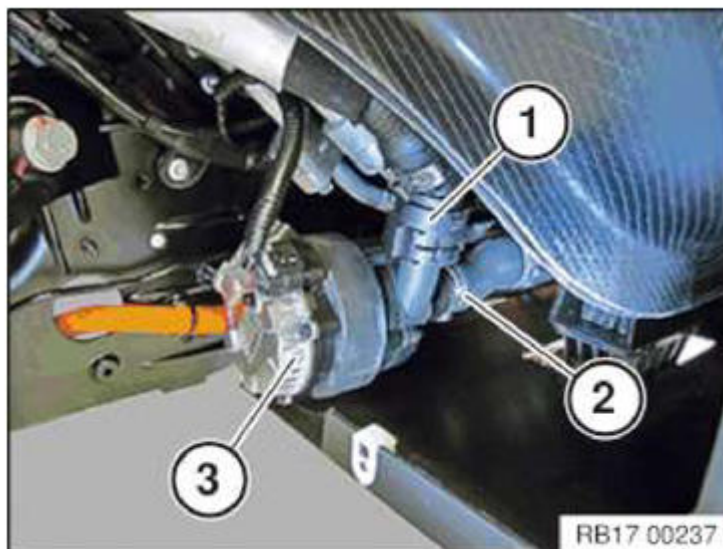
**Fig. 90: Identifying Wheel Arch Cover Front Section Rear Right, Screws And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock coolant hose (1) from coolant pump (3) and pull off.

Unlock coolant hose (2) from coolant pump (3) and pull off.

Unlock connector on coolant hose (3) and pull off.

Pull off coolant pump (3) with rubber retainer and remove.



**Fig. 91: Identifying Coolant Pump And Hoses**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Adding coolant:**

Use only **RECOMMENDED COOLANT** .

Observe **MIXTURE RATIO** .

Observe **CAPACITIES** .

Fill and bleed **LOW TEMPERATURE COOLING SYSTEM**.

**Observe bleeding instructions without fail.**

**BLEED LOW TEMPERATURE COOLING SYSTEM!**

Assemble engine.

Check cooling system for leaks.

---



[Back To Article](#)

## ENGINE

### Cooling System - Special Tools - All I3 Models - i3

## COOLING SYSTEM

### 2152473 FILLING DEVICE AM

In conjunction with: Adapter for connection to engine cooling system 17 0 100 = 0494417

**NOTE:** Vacuum filling device for filling the engine cooling system.

#### SI number

08 15 08 (481)



**Fig. 1: Identifying Filling Device (2152473)**

Courtesy of BMW OF NORTH AMERICA, INC.

### 172050 PLIERS AM

**NOTE:** (Set of pliers) For assembling and disassembling the spring band clamps (Coolant hoses)

#### Storage Location

B85

#### SI number

01 26 06 (321)

Consisting of:

1 = [0495795](#) Release tool

**NOTE:** Remaining inventories will be sold off and then no longer available individually, but as part of complete tool set 17 2 050 = 0495794 only.

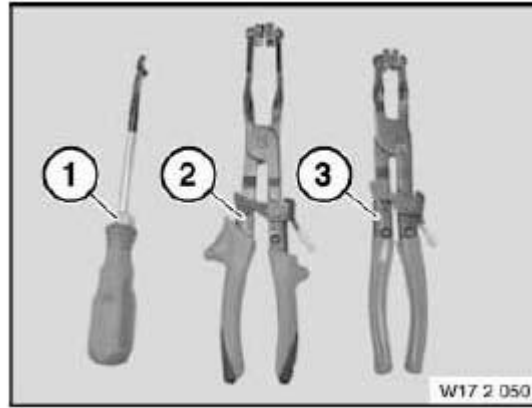
2 = 0495796 Pliers

**NOTE:** (Pliers (curved version) Remaining inventories will be sold off and then



no longer available as individual parts, but as part of complete tool set 17 2 050 = 0495794 only.

3 = 0495797 Pliers



**Fig. 2: Identifying Pliers (172050).**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** (Pliers (straight version) Remaining inventories will be sold off and then no longer available as individual parts, but as part of complete tool set 17 2 050 = 0495794 only.

### 172053 PLIERS AM

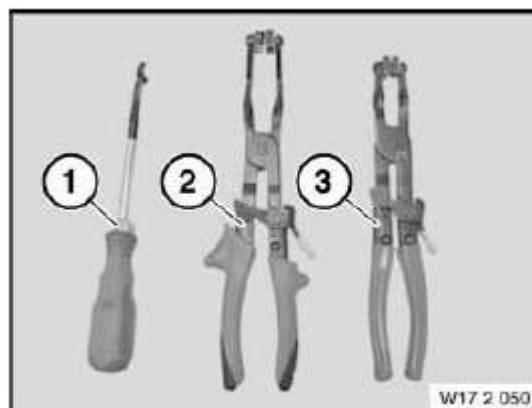
**NOTE:** (Pliers (straight version) Remaining inventories will be sold off and then no longer available as individual parts, but as part of complete tool set 17 2 050 = 0495794 only.

#### Storage Location

B85

#### SI number

01 26 06 (321)



**Fig. 3: Identifying Pliers (172053).**

Courtesy of BMW OF NORTH AMERICA, INC.

### 172052 PLIERS AM

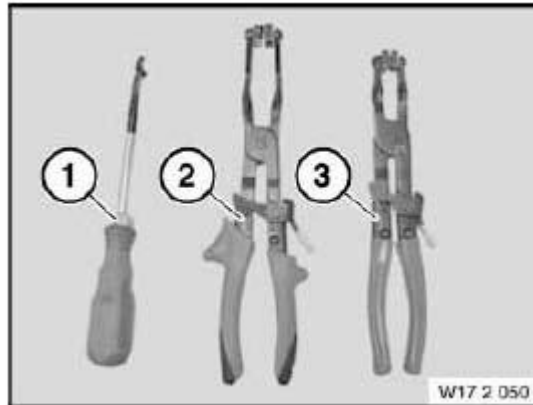
**NOTE:** (Pliers (curved version) Remaining inventories will be sold off and then no longer available as individual parts, but as part of complete tool set 17 2 050 = 0495794 only.

#### Storage Location

B85

SI number

01 26 06 (321)



**Fig. 4: Identifying Pliers (172052).**

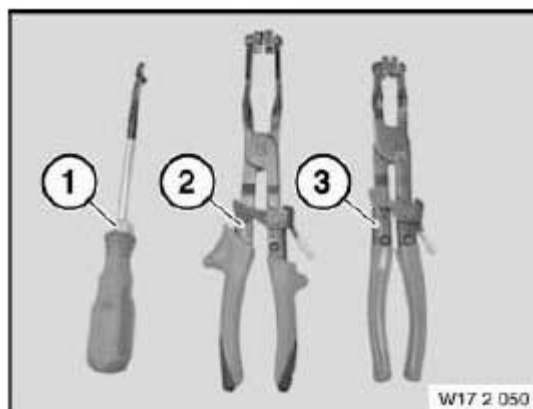
Courtesy of BMW OF NORTH AMERICA, INC.

**172051 RELEASE TOOL AM**

**NOTE:** Remaining inventories will be sold off and then no longer available individually, but as part of complete tool set 17 2 050 = 0495794 only.

Storage Location

B85



**Fig. 5: Identifying Release Tool (172051).**

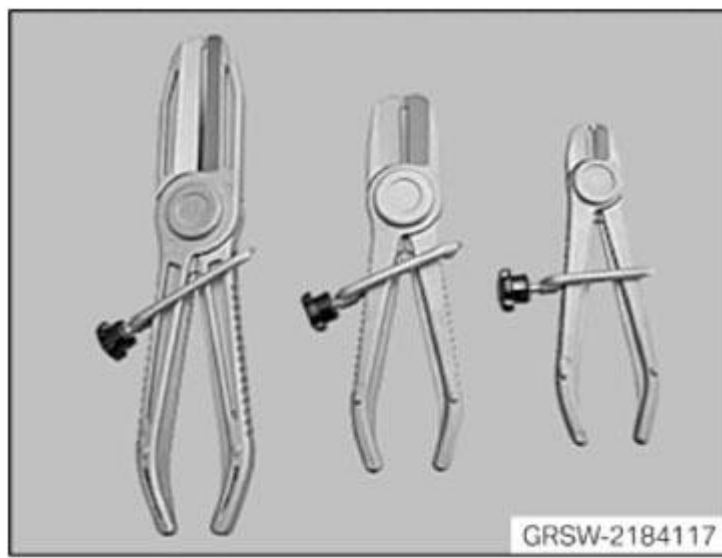
Courtesy of BMW OF NORTH AMERICA, INC.

**2184117 TOOL SET MECHANICAL TOOL**

**NOTE:** For disconnecting the coolant or fuel hoses.

SI number

08 03 10 (651)



**Fig. 6: Identifying Tool Set (2184117).**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

---

## ENGINE

### Cooling System - Technical Data - All I3 Models - i3

## COOLANT, COOLING SYSTEM TEST

### 17 00 COOLANT, COOLING SYSTEM TEST I01

#### COOLANT AND COOLING SYSTEM TEST I01 SPECIFICATION

Model series	I01	I01	I01	I01
Model designation	i3 BEV	i3 BEV (SA4U8/SA4U7)	i3 REX	i3 REX (SA4U8/SA4U7)
NT cooling system coolant quantity	4.3 L	4.5 L	8.0 L	8.2 L
HT cooling system coolant quantity	-	-	1.6 L	1.6 L
Test pressure for cooling system (excess pressure)	1.5 bar	1.5 bar	1.5 bar	1.5 bar

---

## ENGINE

### Cooling System - Tightening Torques - All I3 Models - i3

#### ELECTRICAL FAN (I01)

##### 17 42 ELECTRICAL FAN (I01)

#### TIGHTENING TORQUE SPECIFICATION - ELECTRICAL FAN (I01)

Â	Type	Thread	Tightening specifications	Dimension
1AZ Fan to strut brace	I01 REX M6	Â	Â	8 Nm
2AZ Fan to crash box	I01 REX M8	Â	Â	12 Nm

#### RADIATOR, EXPANSION TANK, LINES (I01)

##### 17 10 RADIATOR, EXPANSION TANK, LINES (I01)

#### TIGHTENING TORQUE SPECIFICATION - RADIATOR, EXPANSION TANK AND LINES (I01)

Â	Type	Thread	Tightening specifications	Dimension
1AZ Air duct upper section to air duct lower section	I01	Â	Â	4 Nm
2AZ Expansion tank to holder	I01	Â	Â	10 Nm
3AZ Fan cowl on radiator	I01	Â	Â	6 Nm
4AZ Cooling module cover, top	I01	Â	Â	6 Nm
5AZ Heat exchanger to engine mounting bracket	I01	M6	Replace screws.	10 Nm
6AZ Crash strut to Drive module	I01	M14x1.5	Â	100 Nm
7AZ Crash strut to air duct	I01	Â	Â	3 Nm
8AZ Crash strut to holder for air conditioning lines	I01	M6	Nut	8 Nm

---

## ENGINE

### Engine - Repair - Only I3 Models With Range Extender - i3

## ENGINE, GENERAL

### 11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS (W20)

#### Special tools required:

- [12 3 621](#)
- [2 357 744](#)
- 0 431 592

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the [HIGH-VOLTAGE SYSTEM](#) .
- Observe [SAFETY INFORMATION](#) for handling electric cars.

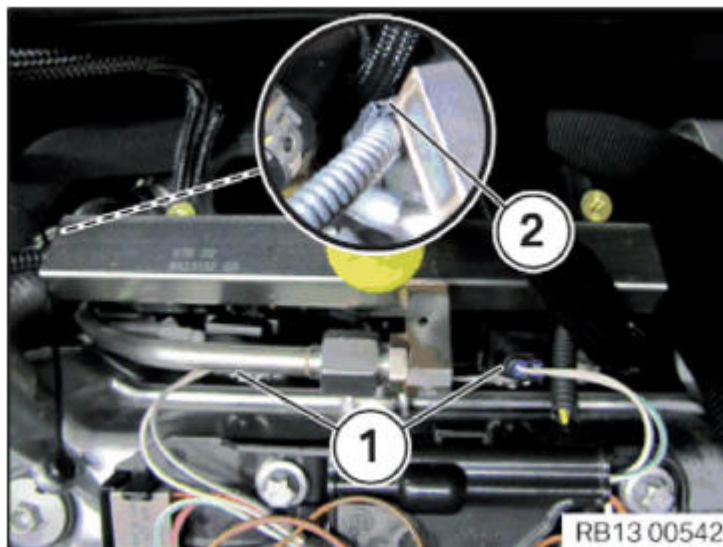
IMPORTANT: High pressures - mortal danger!

#### Necessary preliminary tasks:

- Remove [SPARK PLUGS](#) .

Unlock plug connections (1) of fuel injectors and pull off.

Unclip cable (2) from fuel injection pipe.



**Fig. 1: Identifying Fuel Injectors Plug Connections And Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push special tool [12 3 621](#) onto ignition coil in direction of arrow.



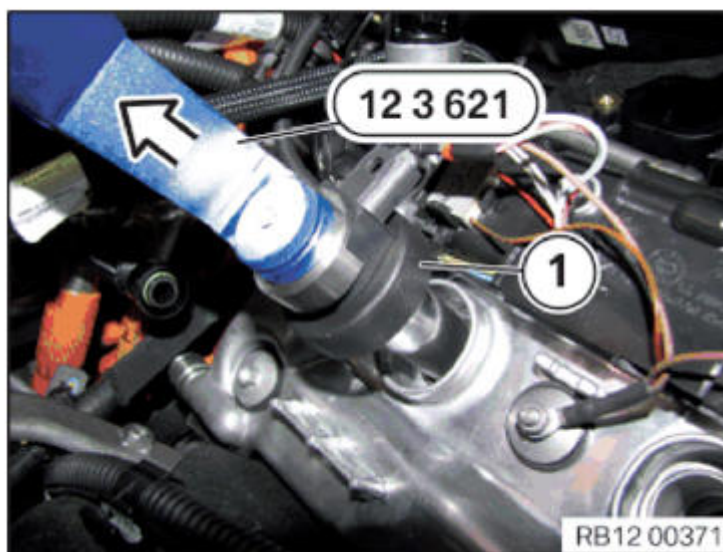


**Fig. 2: Pushing Special Tool (12 3 621) Onto Ignition Coil**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out ignition coil (1) by means of special tool [12 3 621](#) and remove.

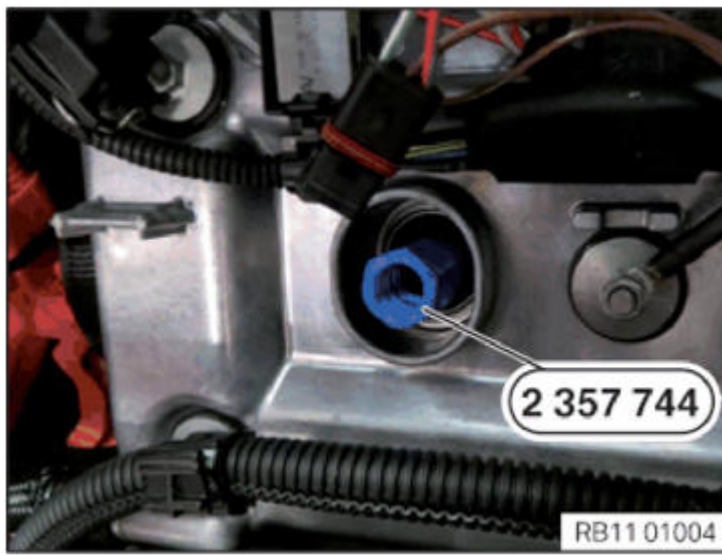
Slowly pull the ignition coil (1) up and out without jerking it.

**NOTE:** The compression test can only be initiated when both ignition coils are connected.



**Fig. 3: Pulling Out Ignition Coil With Special Tool (12 3 621)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw in special tool [2 357 744](#) by hand.



**Fig. 4: Screwing In Special Tool (2 357 744).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw in pressure sensor 0 431 592 by hand in special tool [2 357 744](#).

Connect diagnostic cable (1) with special tool 0 431 592.



**Fig. 5: Connecting Diagnostic Cable With Special Tool (0 431 592).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect measuring cable with Integrated Measurement Interface Box IMIB (1).



**Fig. 6: Connecting Measuring Cable With Integrated Measurement Interface Box IMIB**  
Courtesy of BMW OF NORTH AMERICA, INC.

Follow diagnosis instruction.

### **ENGINE IDENTIFICATION**

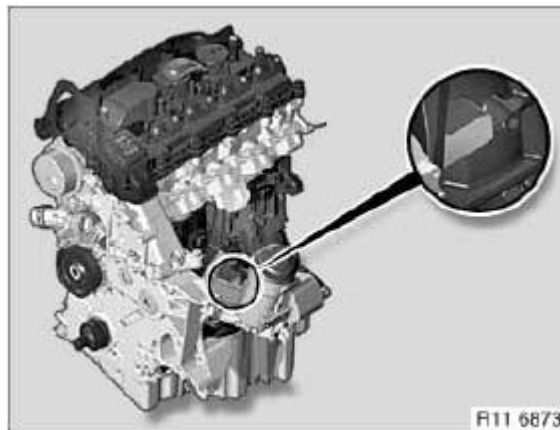
Engine number at the marked surface.

Replacement drives are already assigned a number containing the identification and engine number at the factory.

The old drive number must be imprinted for replacement crankcases.

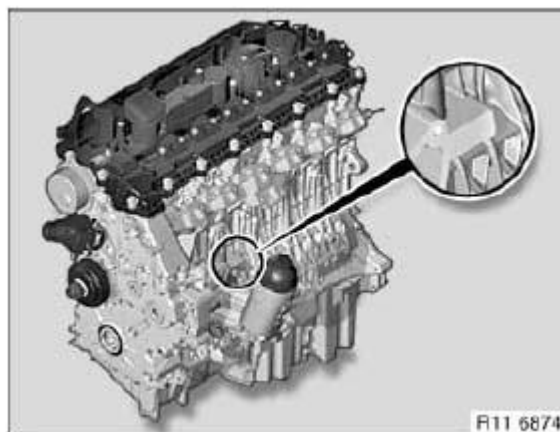
Magnesium crank cases feature a label, the engine number does not need to be embossed.

M47/M47TU/M47T2



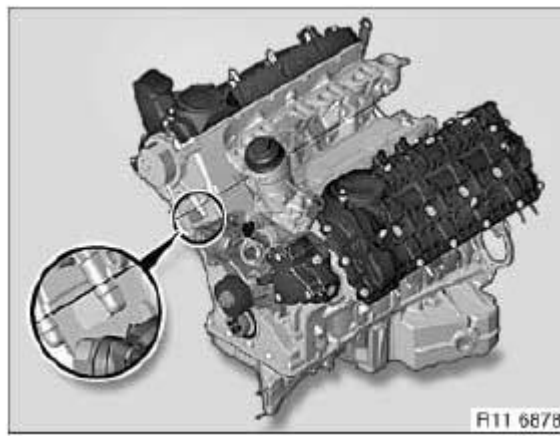
**Fig. 7: Identifying Engine Identification Mark - M47/M47TU/M47T2**  
Courtesy of BMW OF NORTH AMERICA, INC.

M57/M57TU/M57T2



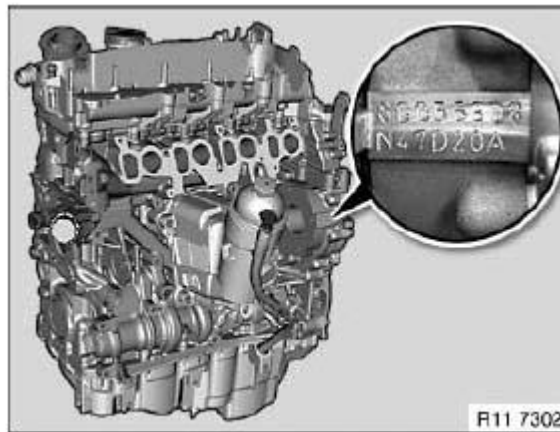
**Fig. 8: Identifying Engine Identification Mark - M57/M57TU/M57T2**  
Courtesy of BMW OF NORTH AMERICA, INC.

M67/M67TU



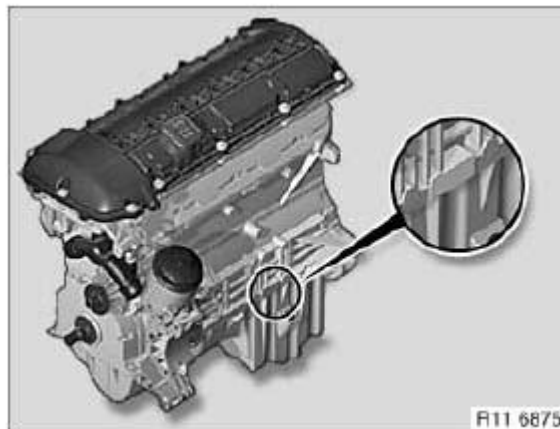
**Fig. 9: Identifying Engine Identification Mark - M67 / M67TU**  
Courtesy of BMW OF NORTH AMERICA, INC.

N47/N47S/N47C/N47T/N57/N57S/N57T



**Fig. 10: Identifying Engine Identification Mark - N47 /N47S/ N47C/N47T/N57/N57S/N57T**  
Courtesy of BMW OF NORTH AMERICA, INC.

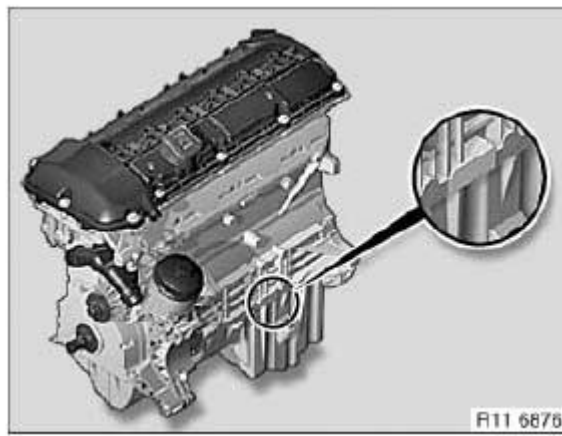
M52/M52TU



**Fig. 11: Identifying Engine Identification Mark - M52/M52TU**  
Courtesy of BMW OF NORTH AMERICA, INC.

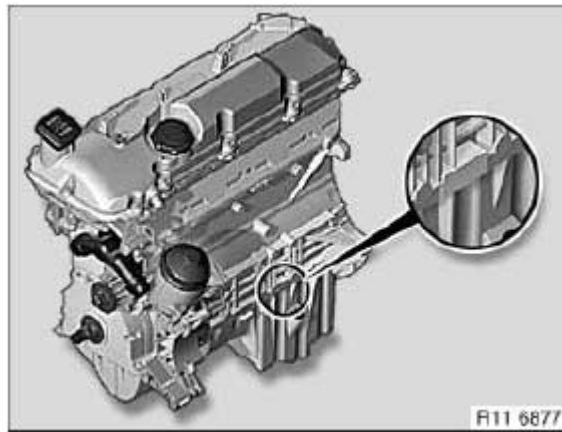
M54





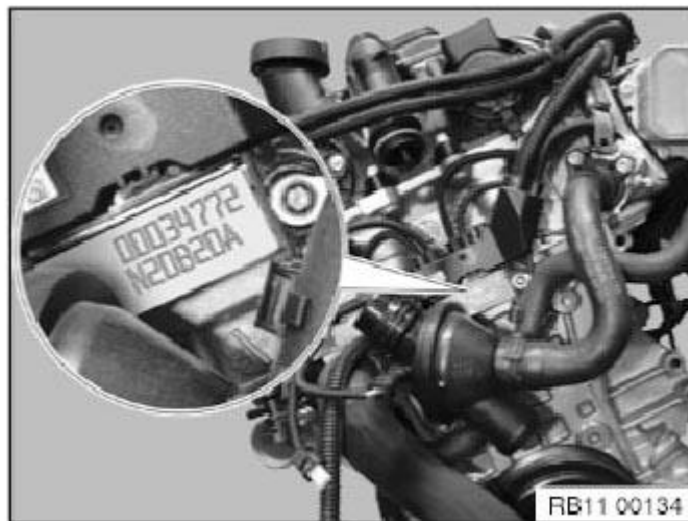
**Fig. 12: Identifying Engine Identification Mark - M54**  
Courtesy of BMW OF NORTH AMERICA, INC.

M56



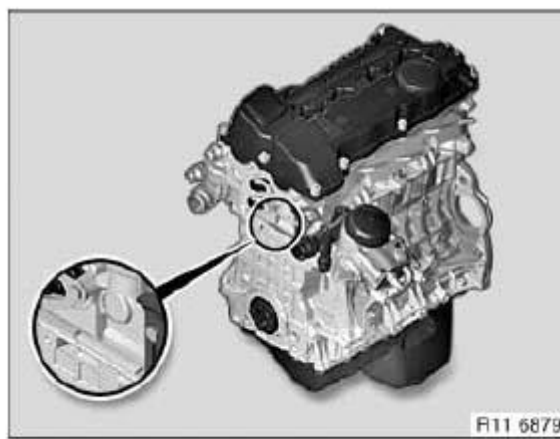
**Fig. 13: Identifying Engine Identification Mark - M56**  
Courtesy of BMW OF NORTH AMERICA, INC.

N20/N26



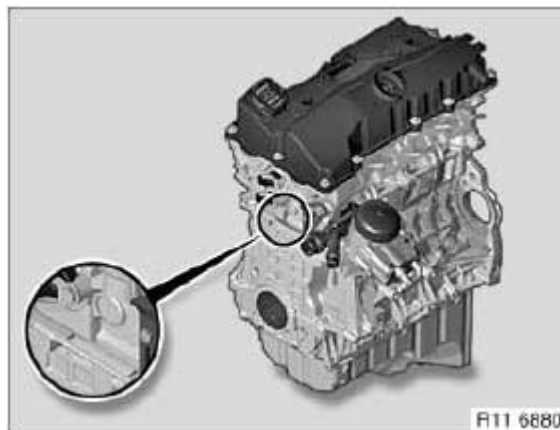
**Fig. 14: Identifying Engine Identification Mark - N20/N26**  
Courtesy of BMW OF NORTH AMERICA, INC.

N40/N45/N45T/N43



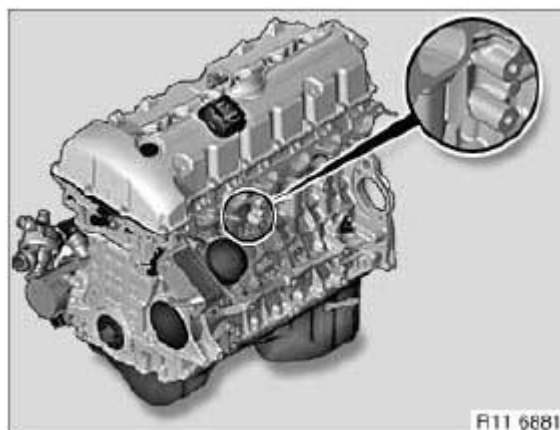
**Fig. 15: Identifying Engine Identification Mark - N40/N45/N45T/N43**  
Courtesy of BMW OF NORTH AMERICA, INC.

N42/N46/N46T



**Fig. 16: Identifying Engine Identification Mark - N42/N46/N46T**  
Courtesy of BMW OF NORTH AMERICA, INC.

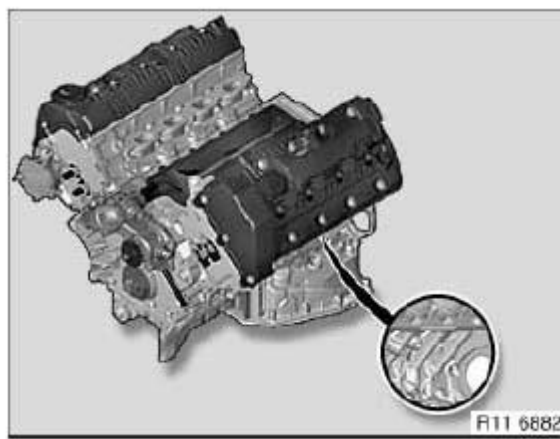
N51/N52/N52K/N52T/N53/N54/N55



**Fig. 17: Identifying Engine Identification Mark - N51/N52/N52K/N52T/N53/N54/N55**  
Courtesy of BMW OF NORTH AMERICA, INC.

N62/N62TU





**Fig. 18: Identifying Engine Identification Mark - N62/N62TU**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position (1) engine number.

Position (2) engine code letters.

N63, N63O1. N63O2

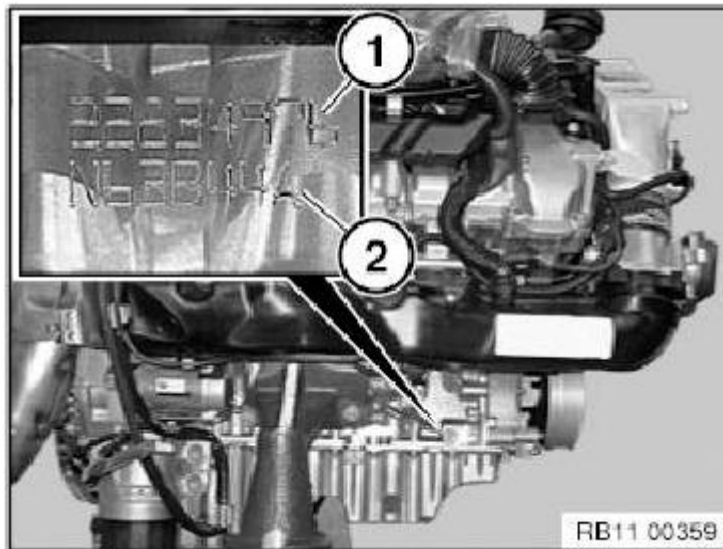
S63

N74, N74O1,

S63T0 to engine number 2001 0052 on right side cyl. 1-4.

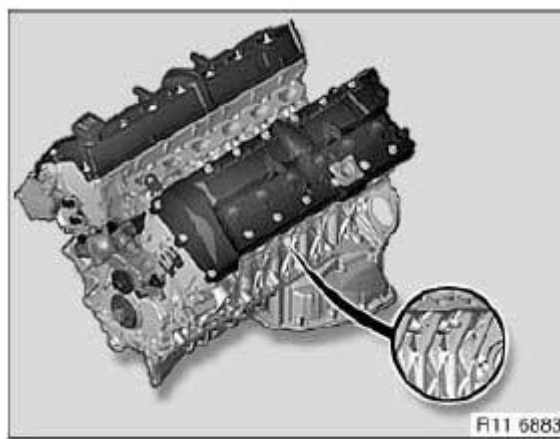
S63T0 from engine number 2001 0053 on left side cyl. 5-8.

E72 Vehicles must be imprinted on the left side cyl. 5-8.



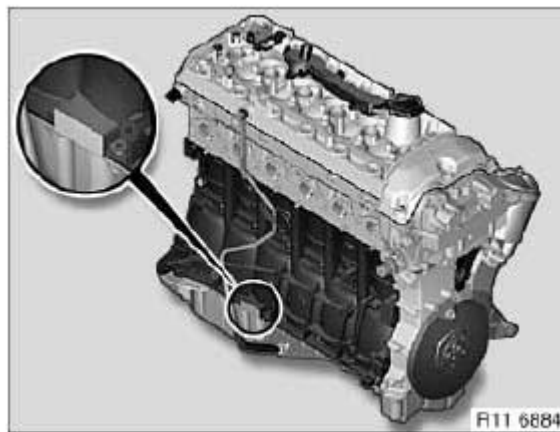
**Fig. 19: Identifying Engine Number And Code Letters**  
Courtesy of BMW OF NORTH AMERICA, INC.

N73



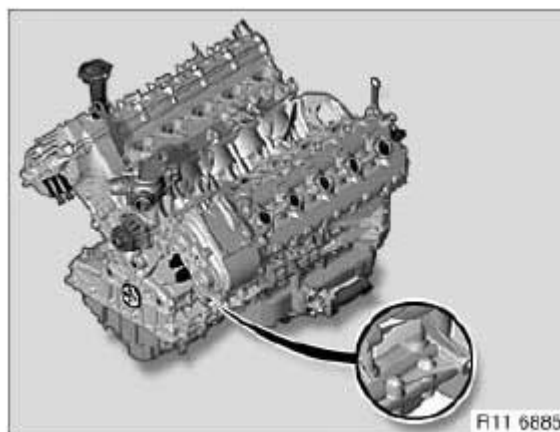
**Fig. 20: Identifying Engine Identification Mark - N73**  
Courtesy of BMW OF NORTH AMERICA, INC.

S54



**Fig. 21: Identifying Engine Identification Mark - S54**  
Courtesy of BMW OF NORTH AMERICA, INC.

S85/S65



**Fig. 22: Identifying Engine Identification Mark - S85/S65**  
Courtesy of BMW OF NORTH AMERICA, INC.

S55



**Fig. 23: Identifying Engine Identification Mark - S55**  
Courtesy of BMW OF NORTH AMERICA, INC.

W10/W11



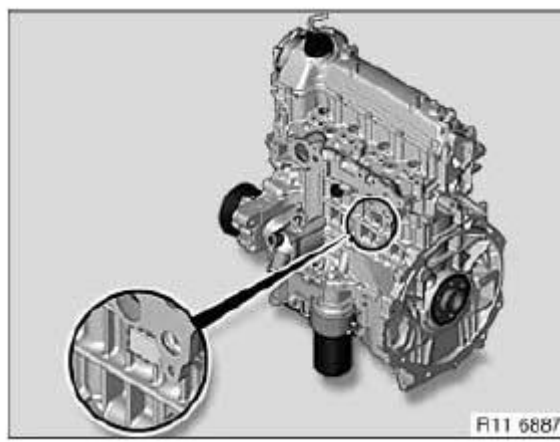
**Fig. 24: Identifying Engine Identification Mark - W10/W11**  
Courtesy of BMW OF NORTH AMERICA, INC.

W16



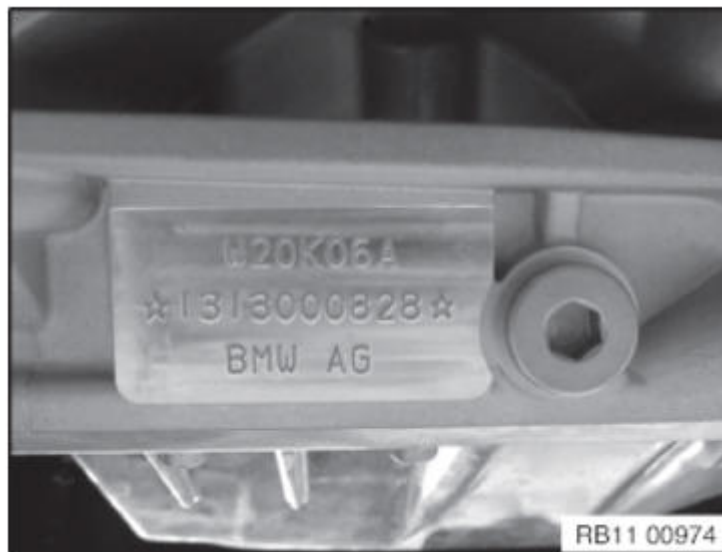
**Fig. 25: Identifying Engine Identification Mark - W16**  
Courtesy of BMW OF NORTH AMERICA, INC.

W17



**Fig. 26: Identifying Engine Identification Mark - W17**  
Courtesy of BMW OF NORTH AMERICA, INC.

W20



**Fig. 27: Engine Identification Mark - W20**  
Courtesy of BMW OF NORTH AMERICA, INC.

N12/N13/N14/N16/N18



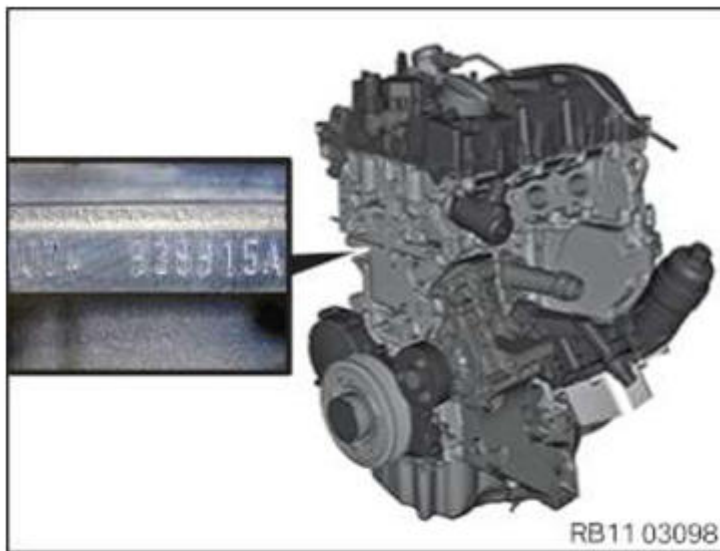
**Fig. 28: Identifying Engine Identification Mark - W16**  
Courtesy of BMW OF NORTH AMERICA, INC.

B37/B38 A /B47/B48 A



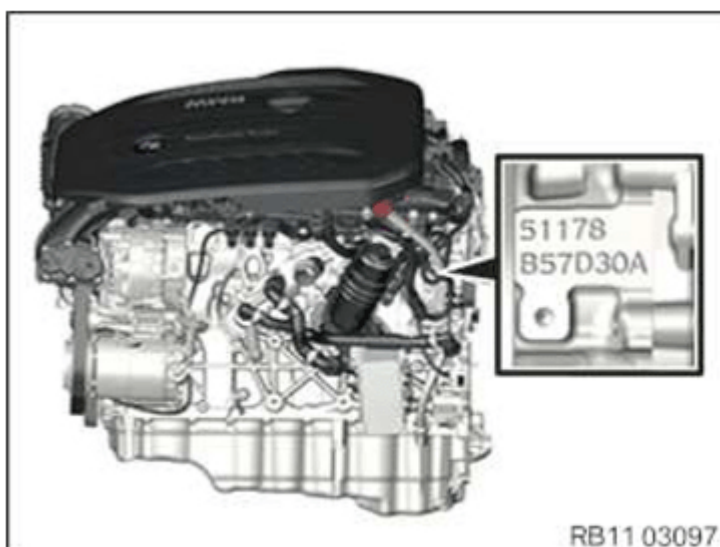
**Fig. 29: Identifying Engine Identification Mark - B37/B38A/B47/B48A**  
Courtesy of BMW OF NORTH AMERICA, INC.

B38 B /B48 B



**Fig. 30: Identifying Engine Identification Mark - B38B/B48B**  
Courtesy of BMW OF NORTH AMERICA, INC.

B57





B58



**Fig. 32: Identifying Engine Identification Mark - B58**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

### **11 00 ENGINE OIL CHANGE (W20)**

#### **Special tools required:**

- 0 401 554

#### **Attention!**

It is essential to adhere to the exact capacities specified.

Overfilling the engine with engine oil will result in **engine damage** .

Checking and drip-off times must be observed.

#### **Recycling:**

Catch and dispose of used oil in a suitable collecting vessel.

Observe country-specific waste disposal regulations.

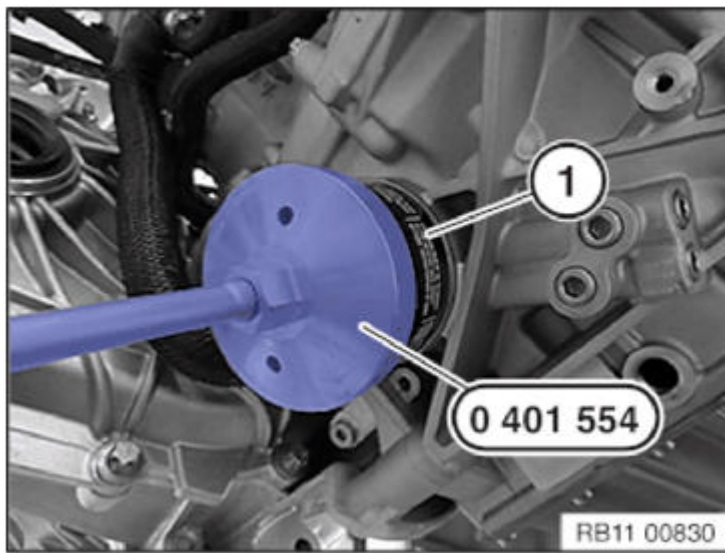
Release oil filter (1) with special tool 0 401 554.

*Installation note:*

Lightly oil sealing ring.

Tightening torque: **11 42 1AZ**





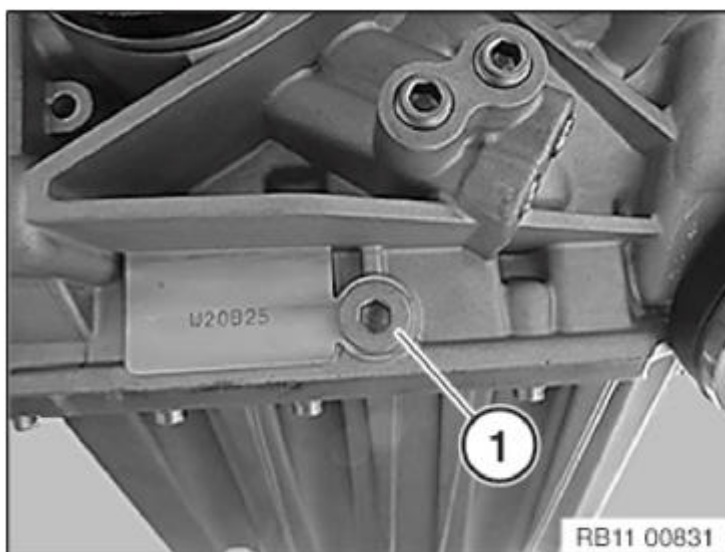
**Fig. 33: Releasing Oil Filter With Special Tool (0 401 554)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove oil drain plug (1).

*Installation note:*

Renew the sealing ring.

Tightening torque: **11 13 2AZ**



**Fig. 34: Identifying Oil Drain Plug**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Open the service flap in the luggage compartment.

Open oil filler cap (1).

Cover oil filler neck with an absorbent rag.

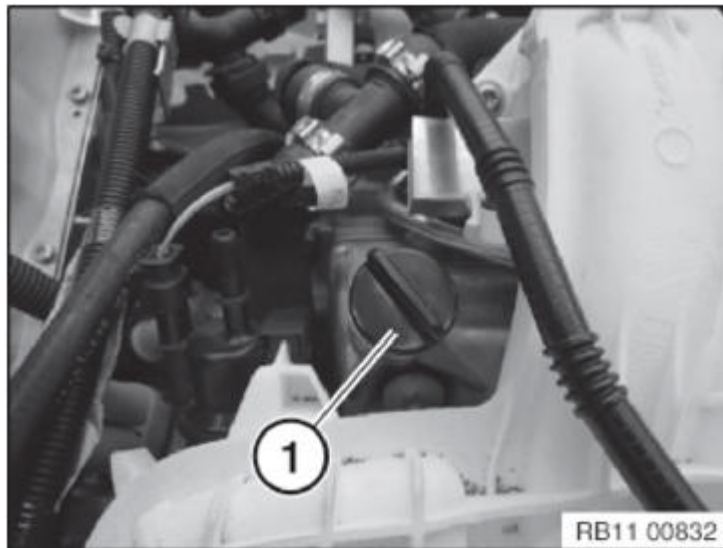
Pour in **ENGINE OIL** with a suitable funnel.

The following engine oils may be used:

BMW engine oil "Longlife-01 FE" SAE 0W-30, part # 83 21 2 405 945

BMW engine oil "Longlife-01" SAE 5W-30, part # 83 21 2 405 947

**NOTE:** For gasoline-powered engines, BMW "Longlife-04..." engine oils are only approved for the European region including Norway, Switzerland and



**Fig. 35: Identifying Oil Filler Cap**

Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Checking oil level:

- Park vehicle on a horizontal surface.

**Service Function:**

1. 01 Drive.
2. Range extender digital engine electronics.
3. Range extender service start.

Carry out leak test.

### **11 00 MOUNTING ENGINE ON ASSEMBLY STAND (W20)**

**Special tools required:**

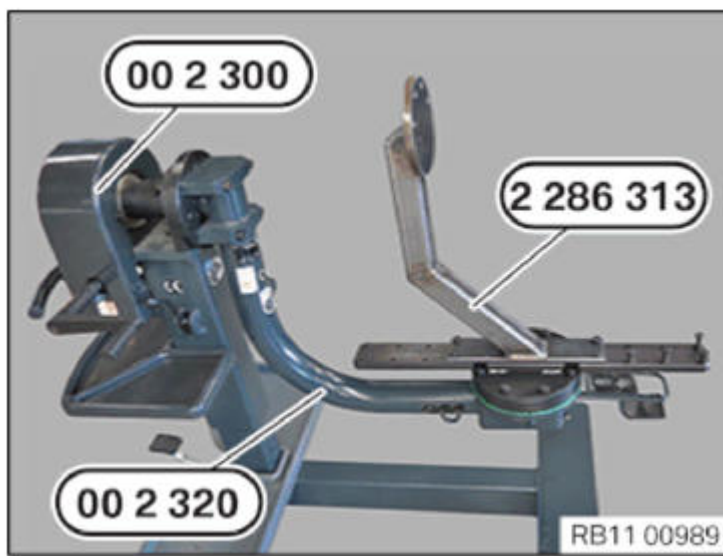
- 00 2 320
- 00 2 300
- 2 286 313
- 11 0 020

*Necessary preliminary tasks:*

- Remove COMPLETE DRIVE UNIT (RANGE EXTENDER).
- Remove ENGINE FROM DRIVE UNIT.

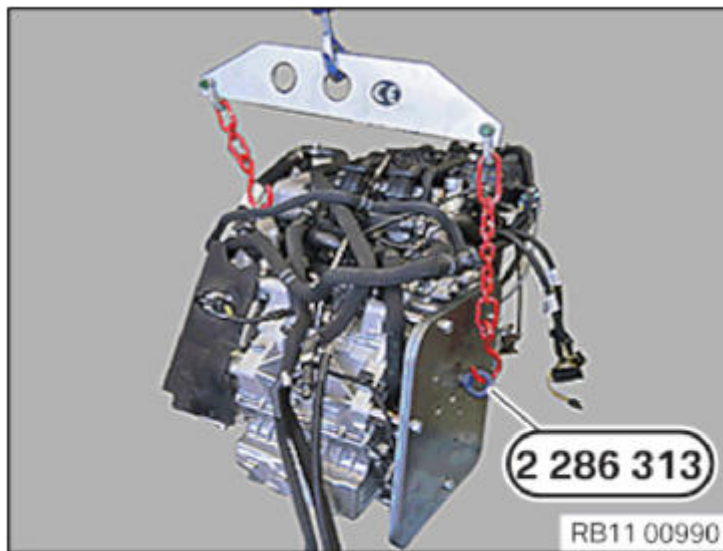
Mount special tool 00 2 320 on special tool 00 2 300.

Mount special tool 2 286 313 on special tool 2 286 313 .



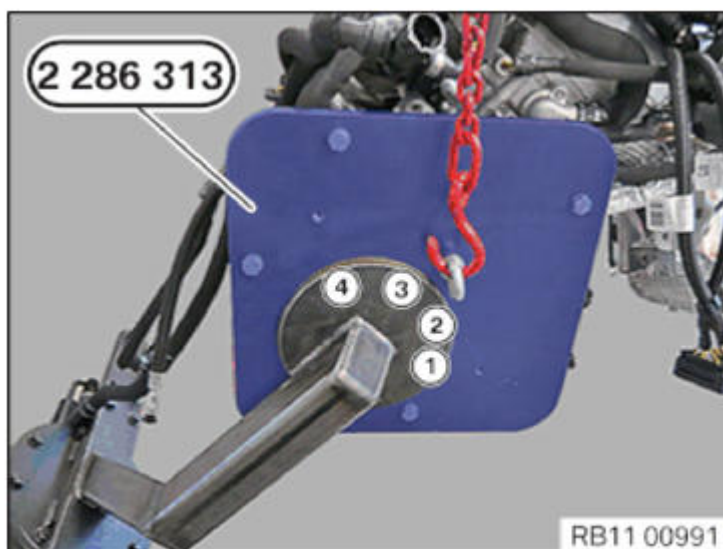
**Fig. 36: Mounting Special Tool (00 2 320) On Special Tool (00 2 300)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Mount special tool [2 286 313](#) on engine with range extender electrical machine.



**Fig. 37: Mounting Special Tool (2 286 313) On Engine**  
Courtesy of BMW OF NORTH AMERICA, INC.

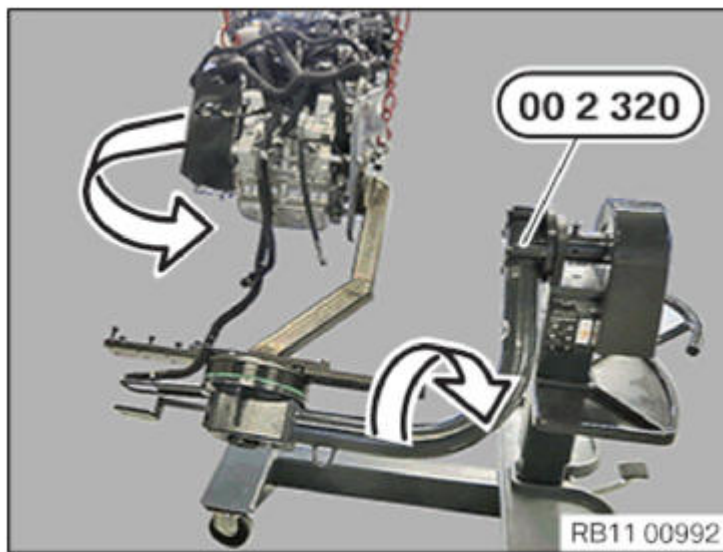
Secure the engine with the special tool [2 286 313](#) on the support arm with the screws (1 to 4).



**Fig. 38: Securing Engine With Special Tool (2 286 313)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Swivel the engine with the range extender electrical machine in the direction of the arrow.

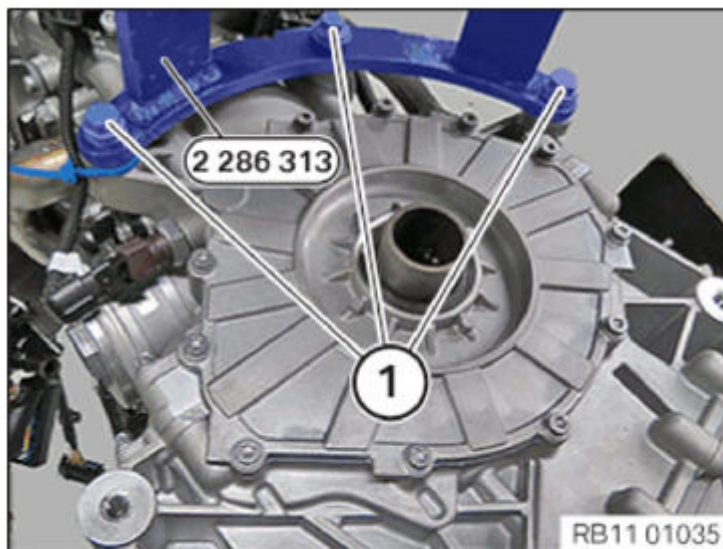
The range extender electrical machine must point upward for installation and disassembly.



**Fig. 39: Swiveling Engine With Range Extender Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach the **RANGE EXTENDER ELECTRICAL MACHINE** .

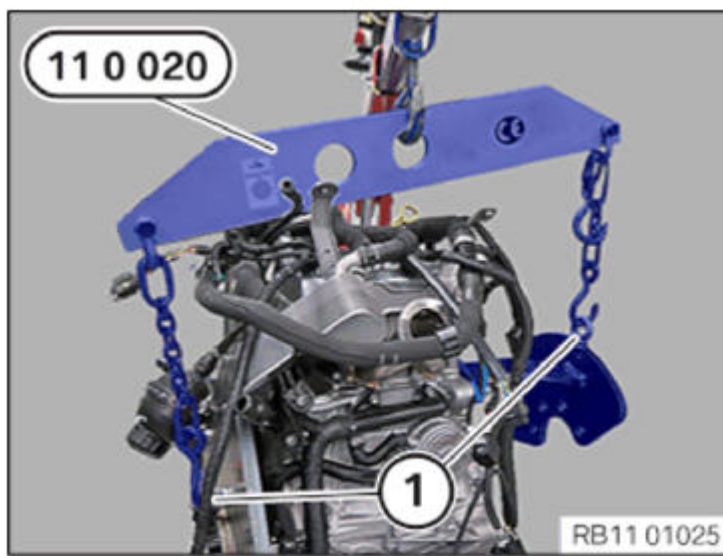
Secure special tool **2 286 313** on the alternator side with screws (1).



**Fig. 40: Secure Special Tool (2 286 313) On Alternator Side**  
Courtesy of BMW OF NORTH AMERICA, INC.

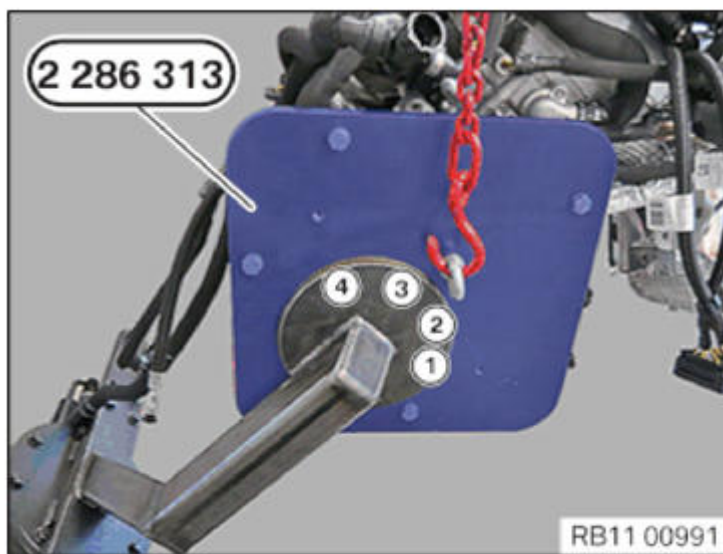
Attach the stand to the securing eye (1) with special tool 11 0 020.





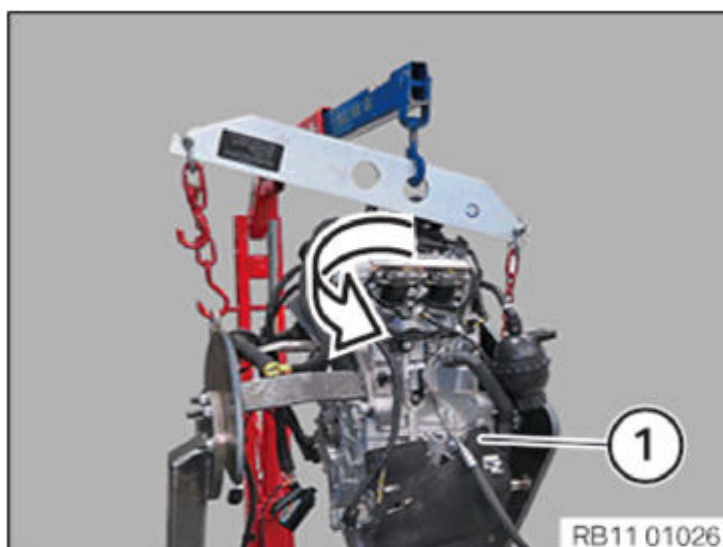
**Fig. 41: Attaching Stand To Securing Eye With Special Tool (11 0 020).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove screws (1 to 4).



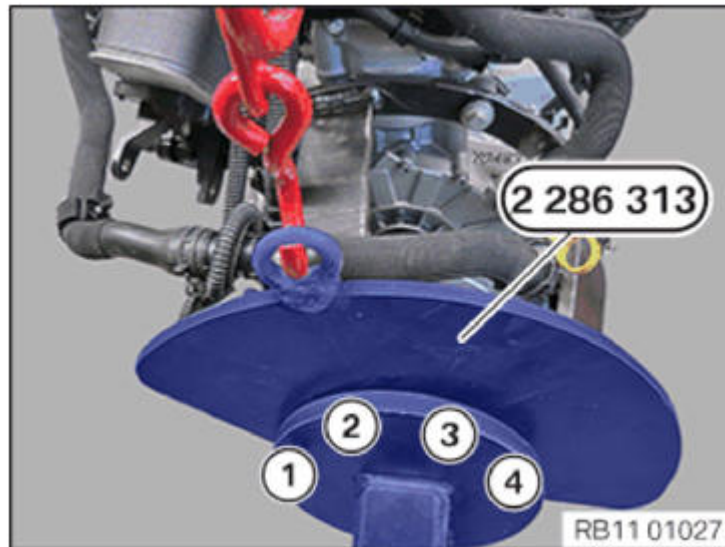
**Fig. 42: Securing Engine With Special Tool (2 286 313).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Swivel the engine (1) by 180°.



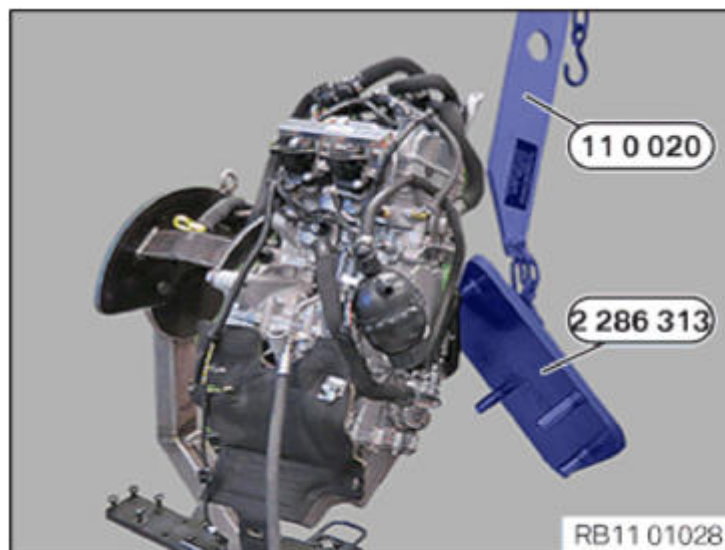
**Fig. 43: Swiveling Engine By 180 Degrees**  
Courtesy of BMW OF NORTH AMERICA, INC.

Secure the engine with the special tool [2 286 313](#) on the support arm with the screws (1 to 4).



**Fig. 44: Securing Engine With Special Tool (2 286 313) On Support Arm**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach the special tool [2 286 313](#) with a workshop crane and special tool 11 0 020.



**Fig. 45: Detaching Special Tool (2 286 313) With Workshop Crane And Special Tool (11 0 020)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Checking oil level:

- Park vehicle on a horizontal surface.

**Service Function:**

1. 01 Drive.
2. Range extender digital engine electronics.
3. Range extender service start.

Carry out leakage test for 20 min.

**IMPORTANT:** If there is an oil leak, the engine must be cleaned thoroughly.



1.0 Sealing compound for **injection** .

**INJECTION SEALING COMPOUND DESCRIPTION**

Â	Repair instructions (engine)	Designation	Part number	Application examples
1.1	N40, N42, N45, N46, N43, N45N, N46N	Loctite 171000 primer	83 19 7 515 683	For hardening Loctite 128357 sealing compound
1.2	N40, N42, N45, N46, N43, N45N, N46N, N55	Loctite 128357 liquid sealing compound	83 19 7 536 051	Sealing between crankcase upper and lower halves
1.3	N51, N52, N53, N54, N52N, N55	Loctite 171000 primer	83 19 7 515 683	For hardening Loctite 193140 sealing compound
1.4	N51, N52, N53, N54, N52N, N55, S55	Loctite 193140 liquid sealing compound	83 19 0 439 030	Sealing between crankcase upper and lower halves
1.5	S65, S85	Loctite 171000 primer	83 19 7 515 683	For hardening Loctite 193140 sealing compound
1.6	S65, S85	Loctite 193140 liquid sealing compound	83 19 0 439 030	Sealing between crankcase upper and lower halves
1.7	W20	Dow Corning liquid sealing compound	07 58 0 397 777	Sealing between crankcase upper and lower halves Sealing of oil sump

2.0 Sealing compound for **application** .

**SEALING COMPOUND APPLICATION DESCRIPTION**

Â	Designation in repair instructions	Designation	Part number	Application examples
2.1	M41, M47, M47TU, M47T2, M50, M51, M52, M52TU, M54, M57, M57TU, M57T2, M60, M62 N12, N14, N16, N18 N20, N26 N40, N42, N45, N45N, N46, N46N, N43, N47, N47top, N47C N47D1 N51, N52, N52N, N53, N54, N55, N57, N57T, N62, N62TU, N63, N63O1 N73, N73H, N74 S14, S38, S50, S52, S54, S62, S65, S85	Drei Bond 1209 liquid sealing compound	07 58 9 062 376	For sealing junction points on crankcase
2.2	N12, N13, N14, N16, N18, N20, N26 W10, W11, W16,	Loctite 5970 liquid sealing compound	83 19 0 404 517	Sealing between crankcase upper and lower sections.
2.2	N47top, N47D1, N47C1 N57D1 N57S1, B37, B38, B47, B48,	Loctite 5970 liquid sealing compound	83 19 0 404 517	Timing case cover sealing, oil sump, coolant pump, component carrier.
2.3	N12, N14, N16, N18 W16	Loctite 648 liquid sealing compound	07 58 9 067 732	Sealing between the seal plug and crankcase

Â	Designation in repair instructions	Designation	Part number	Application examples
2.4	N12, N13, N14, N16, N18 W16	Loctite 121078 liquid sealing compound	83 19 2 223 765	Sealing between cover sleeve and crankcase

### 3.0 Cleaning agent .

#### CLEANING AGENT DESCRIPTION

Â	Designation in repair instructions	Designation	Part number	Application examples
3.1	N12, N13, N14, N18, N20, N26, N45, N46, N45T, N46T, N43, N51, N52, N52Kp, N52TU, N53, N55, N63, N63S, N63 Hybrid, N63O1, N63O2 N73, N74 B37, B38 B47, B48, B58	Cold cleaner (chlorine free)	83 19 0 026 956	Cleaning assemblies, washing engine
3.2	M47, M47T1 M47T2, M57 M57T1, M57T2 N47 K/U/O/T 0/1 N47C	Universal cleaner	83 19 0 413 478	Clean intake pipe.

### 4.0 Lubricant for application .

#### LUBRICANT APPLICATION DESCRIPTION

Â	Designation in repair instructions	Designation	Part number	Application examples
4.1	N12, N13, N18, N20, N26, N42, N46, N46TU, N51, N52, N52KP, N52TU, N55, N62, N62TU, N63O0, N63O1, N63O2, N73 S55, S63T0 B38, B48, B58	Lubricating grease Longtime PD1	83 19 2 160 340	For greasing the splined shaft on actuator drive/gearing of intermediate shaft.
4.2	M47, M47TU, M47T2, M57, M57TU, M57T2,	High temperature paste	83 19 2 152 323	For greasing the thread on the exhaust turbocharger.
4.3	N12, N13, N14, N16, N18 N20, N26, N40, N42, N45, N45TU N46, N46TU, N43. N51, N52, N52Kp, N52TU, N53, N54, N55. N62, N62TU, N63O0, N63O1, N63O2 N73, N73H, N74. S63T1, S65, S85. B38, B48, B58	High temperature paste (NEVER- SEEZ compound)	83 19 2 158 851	For greasing the threads on the oxygen sensors.
4.4	N47, N47O1 N47C1, N47T N47D1 N57 N57D1 N63O0, N63O1, N63O2 S63, S63T0	Copper paste	81 22 9 400 794	For greasing the double hex head bolt on the exhaust turbocharger. For greasing the central bolt on the VANOS gear.
4.5	M47, M47TU, M47T2 M57, M57TU, M57T2 N47, N47O1 N47C1, N47T N47D1 N57 N57D1	High- temperature grease (UrethynE2).	83 23 0 441 070	For greasing the injectors or injector shafts. Solenoid valve and piezo injector.

Â	Designation in repair instructions	Designation	Part number	Application examples
4.6	N47T0, N47T1 N57T0, N57T1, N57S1 B47T0,	Assembly paste, ATE grease	83 19 9 407 854	For lubricating the O-rings of the pressure pipes. Multistage turbocharging assembly.
4.7	W20	Assembly paste, grease	No longer greased.	For greasing the torsion splined shaft.
4.8	N63O1, N63O2	Assembly paste, grease	83 23 9 407 778	For greasing the central bolt on the crankshaft.
4.9	W20	Assembly paste, grease	83 23 9 407 778	Grease O-ring on alternator.

#### 5.0 Lubricants to loosen locked screw connections .

#### LUBRICANTS FOR LOCKED SCREW CONNECTIONS

Â	Designation in repair instructions	Designation	Part number	Application examples
5.1	M47, M47TU, M47TU2, M57, M57TU, M57TU2. N47, N47C, N47D1, N57, N57D1, N57S1 W16, W17,	Brunox lubricating grease	83 23 0 445 529	For releasing the glow elements.
5.2	E89 F10, F11.	Brunox lubricating grease	83 23 0 445 529	For releasing and tightening the screw connection of the rubber mounts.

#### 6.0 Leak detection spray and contact spray

#### LEAK DETECTION SPRAY AND CONTACT SPRAY DESCRIPTION

Â	Designation in repair instructions	Designation	Part number	Application examples
6.1	Gasoline: N13, N20, N26, N54, N55 B38, B48, B58 Diesel fuel: M47, M47TU, M47TU2, M57, M57TU, M57TU2. N47, N47C, N47D1, N57, N57D1, B37, B47	Leak detection spray	83 19 9 407 861	Check charge air path for tightness. Example: leakage on charge air hose or charge air cooler.
6.2	S55	Contact spray	81 22 9 400 208	For cleaning and protecting of electrical plug connections.

### 11 00 599 REMOVING/INSTALLING ENGINE FROM DRIVE UNIT

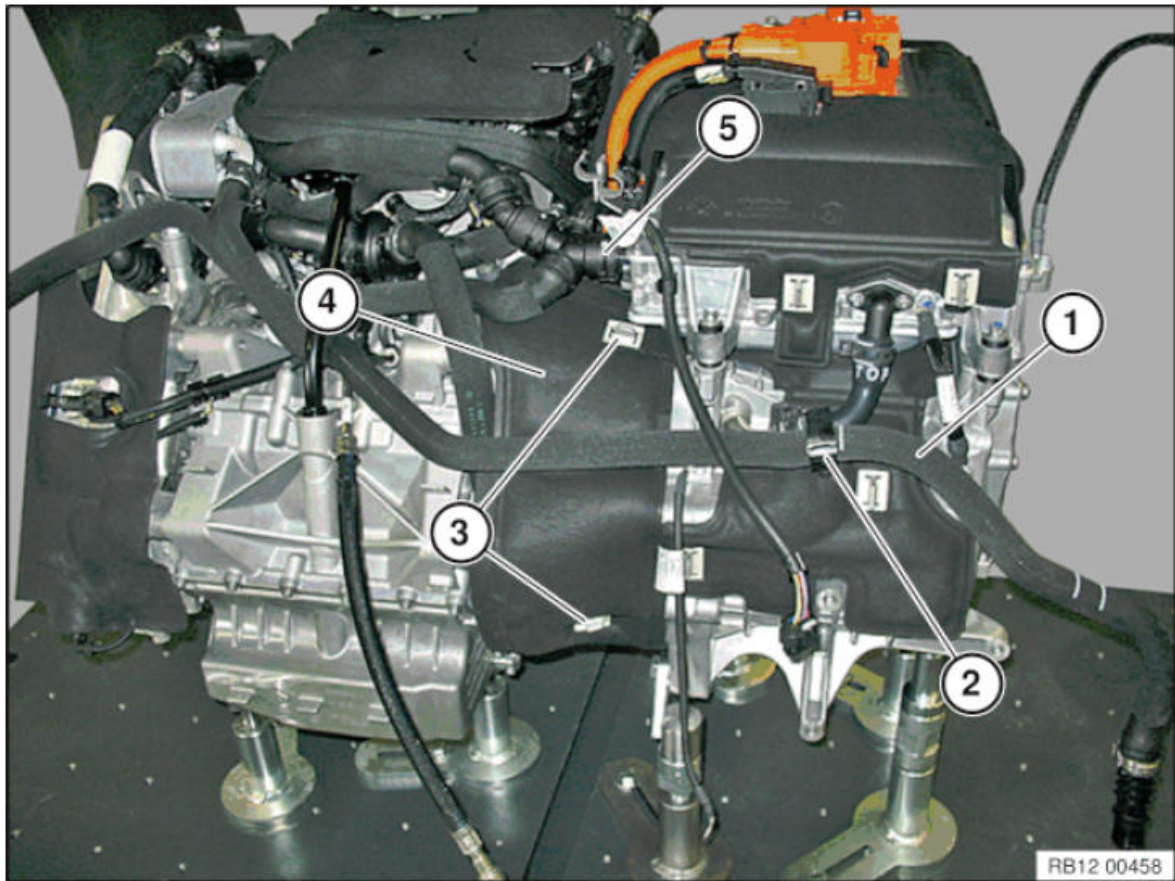
**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

*Necessary preliminary tasks:*

- Remove **COMPLETE DRIVE UNIT**

## REMOVAL:



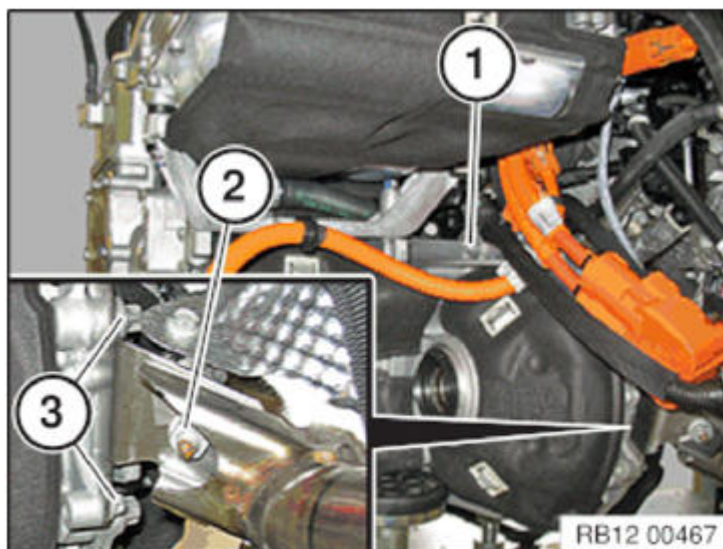
**Fig. 46: Identifying Coolant Hose, Retaining Clip, Clamps And Sound Insulation**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip and remove coolant hose (1) from retaining clip (2).

Lift clamps (3) off of sound insulation (4).

Feed out and remove sound insulation (4).

Unlock and disconnect coolant hose (5).



**Fig. 47: Identifying Screws And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

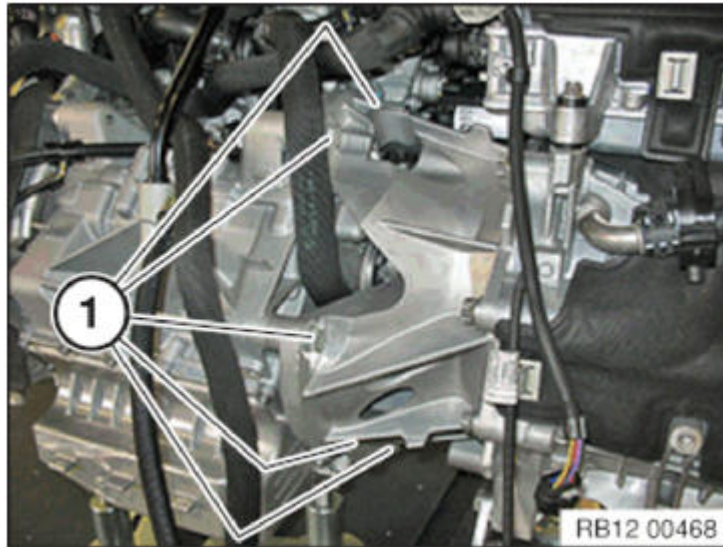
Release nut (2) on catalytic converter.



Release screws (3) from catalytic converter holder.

Feed out catalytic converter holder.

Release screws (1).

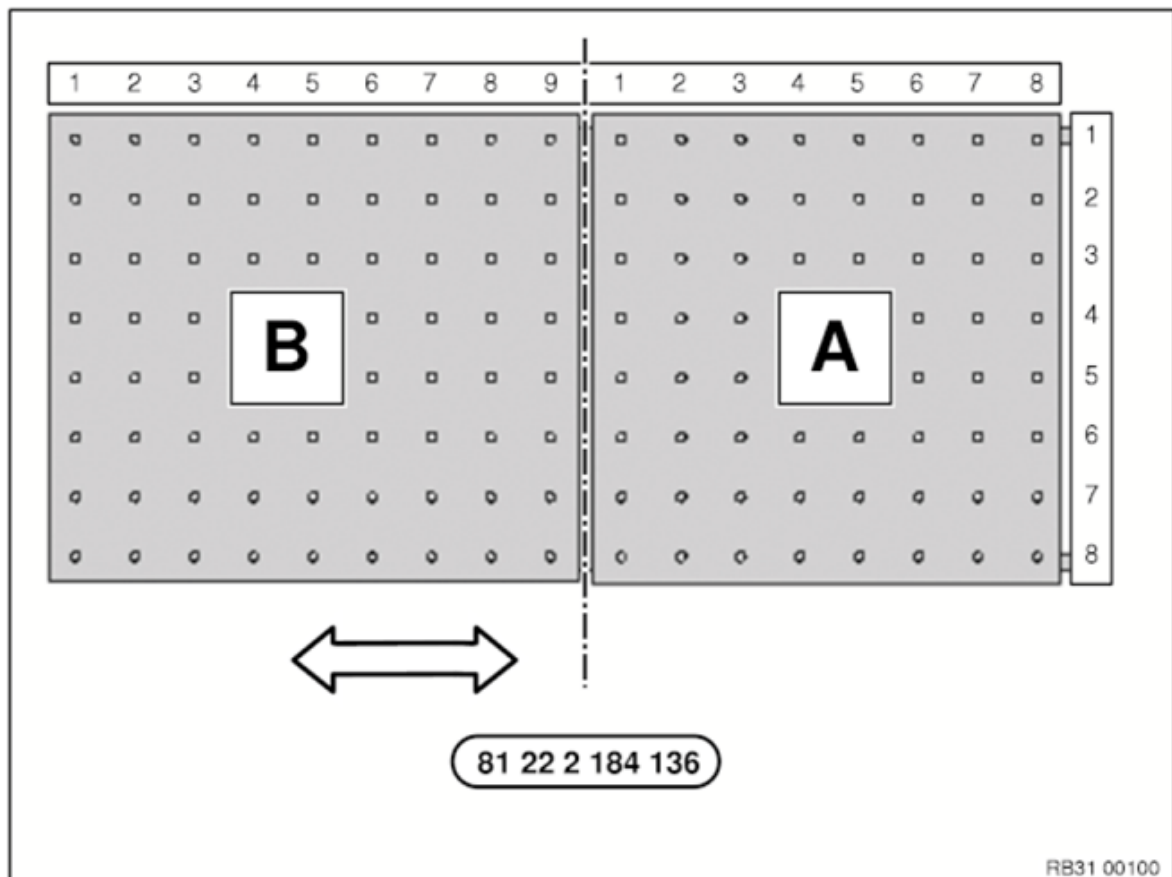


**Fig. 48: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**Overview of table lift:**

- A. Fixed table lift side
- B. Moving table lift side



**Fig. 49: Identifying Table Lift**

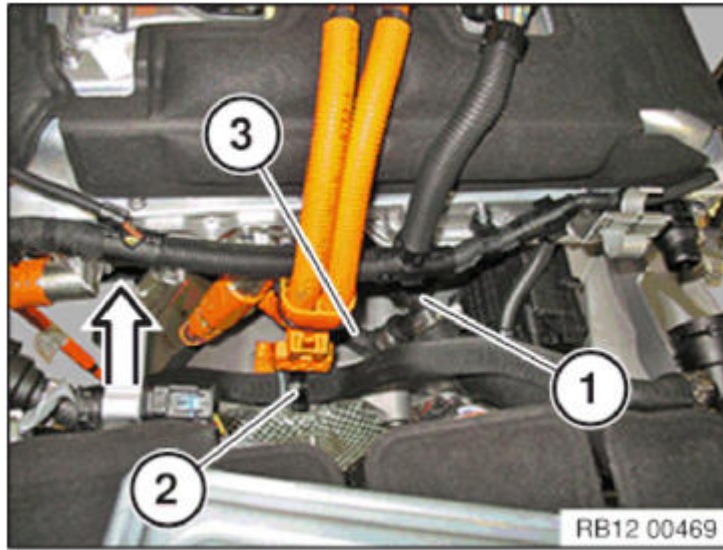
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Pull apart slightly for better accessibility of electrical machine with electrical machine electronics of range extender.

Unlock and disconnect coolant hose (1).

For alternating current rapid charging equipment (SA4U8): Detach coolant hose (2).

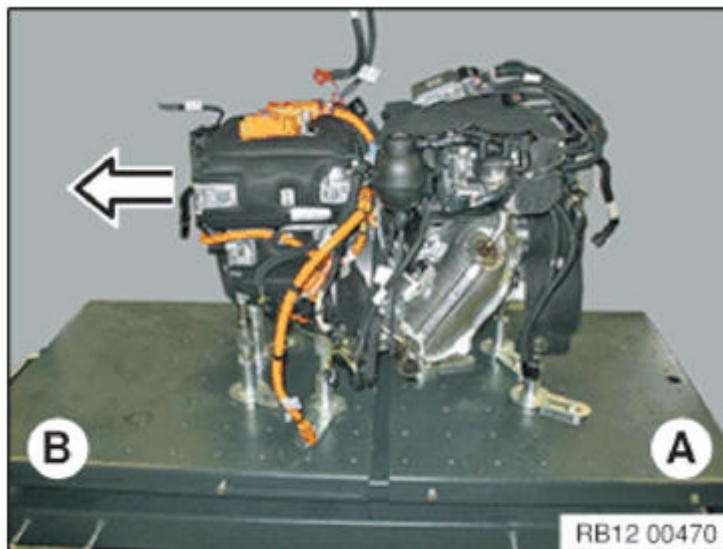
For alternating current rapid charging equipment (SA4U8): Feed out coolant hose (3).



**Fig. 50: Detaching Coolant Hose**

Courtesy of BMW OF NORTH AMERICA, INC.

Move table lift plate (B) in direction of arrow.



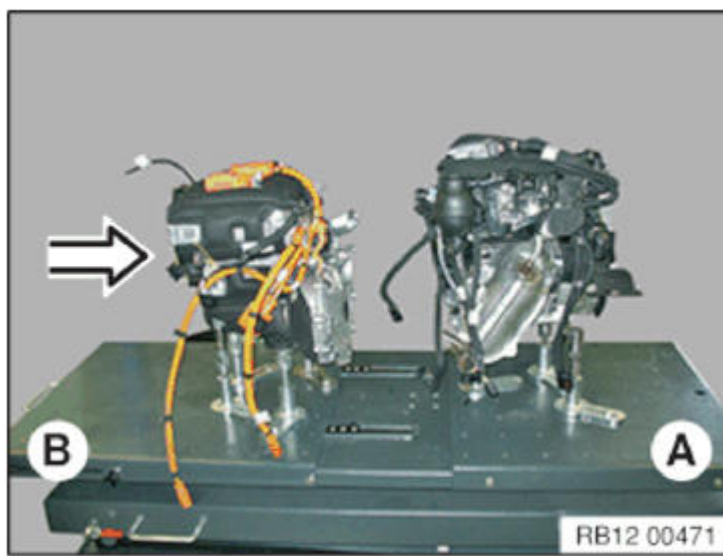
**Fig. 51: Moving Table Lift Plate**

Courtesy of BMW OF NORTH AMERICA, INC.

**INSTALLATION:**

Move table lift plate (B) in direction of arrow.





**Fig. 52: Moving Table Lift Plate**

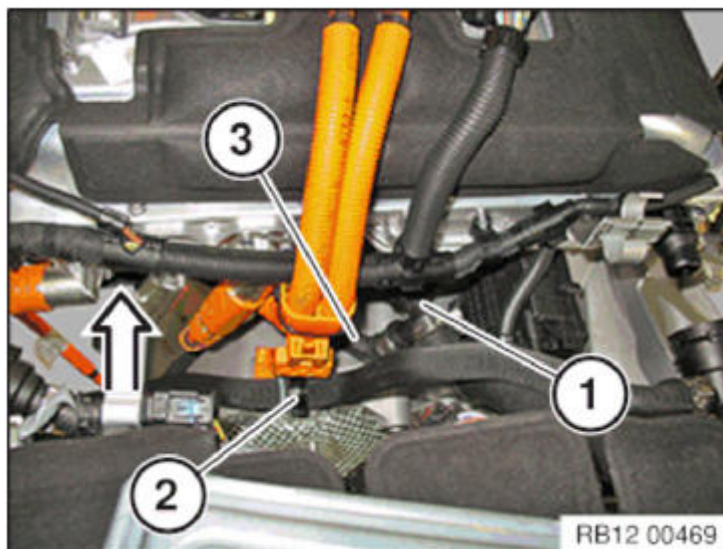
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Pull apart slightly for better accessibility of electrical machine with electrical machine electronics of range extender.

For alternating current rapid charging equipment (SA4U8): Feed in coolant hose (3).

For alternating current rapid charging equipment (SA4U8): Attach coolant hose (2).

Connect coolant hose (1) and lock.

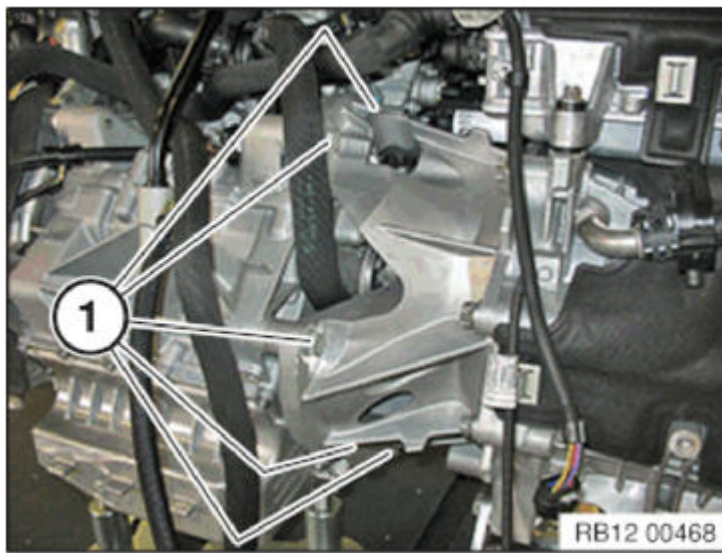


**Fig. 53: Detaching Coolant Hose**

Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down screws (1).

Tightening torque [27 00 2AZ](#).



**Fig. 54: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screw (1).

Tightening torque [27 00 2AZ](#) .

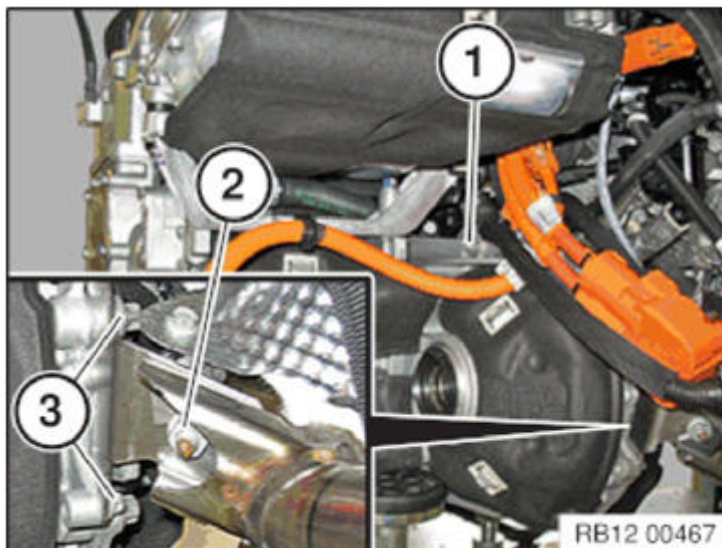
Feed in catalytic converter holder.

Tighten screws (3) of catalytic converter holder.

Tightening torque [18 30 7AZ](#) .

Tighten nut (2) on catalytic converter.

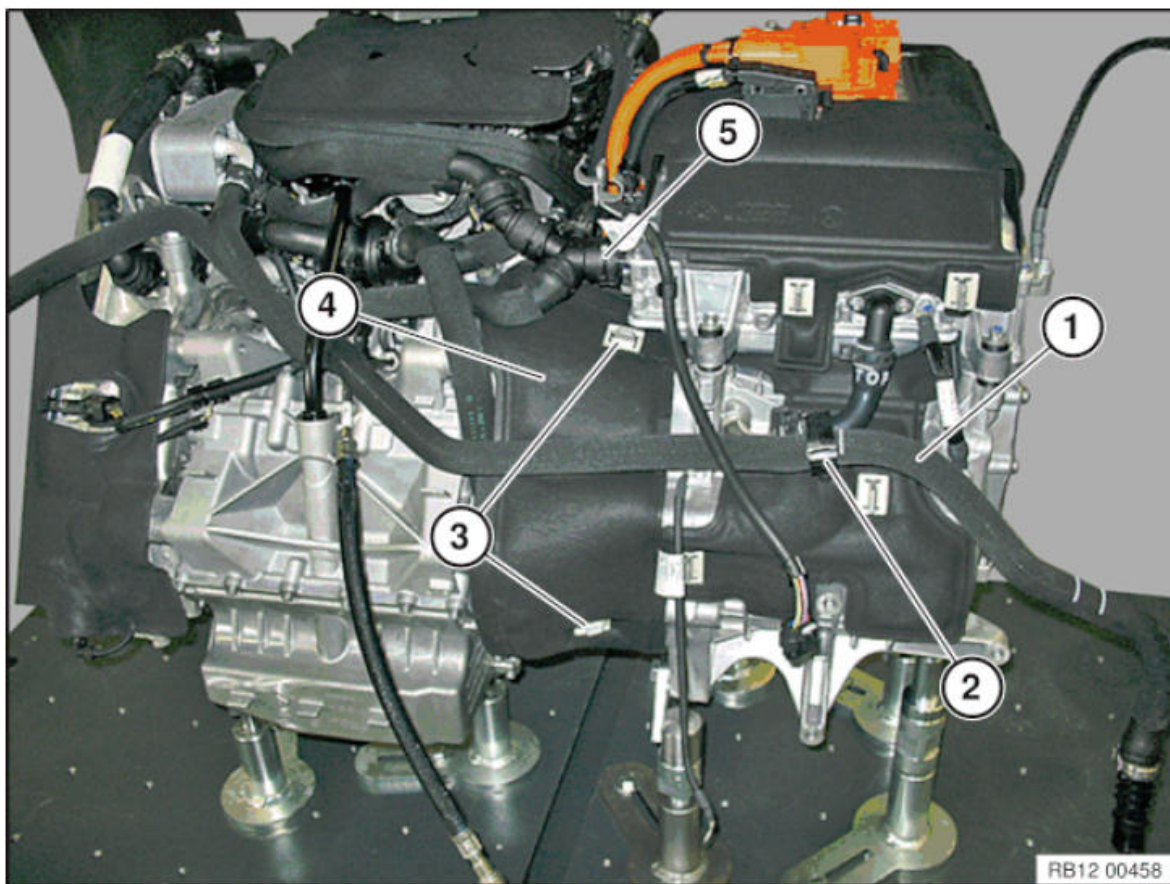
**NOTE:** Replace nut (2).



**Fig. 55: Identifying Screws And Nut**

Courtesy of BMW OF NORTH AMERICA, INC.

Tightening torque [18 30 2AZ](#) .



**Fig. 56: Identifying Coolant Hose, Retaining Clip, Clamps And Sound Insulation**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect coolant hose (5) and lock.

Feed in and position sound insulation (4).

IMPORTANT: Clamps (3) must be replaced.

Mount clamps (3) on sound insulation (4).

Clip coolant hose (1) into retaining clip (2).

**Required follow-up work:**

- Install **COMPLETE DRIVE UNIT** .

**LOWER SECTION OF CRANKCASE**

**11 11 010 REMOVING AND INSTALLING LOWER SECTION OF CRANKCASE (W20)**

**Special tools required:**

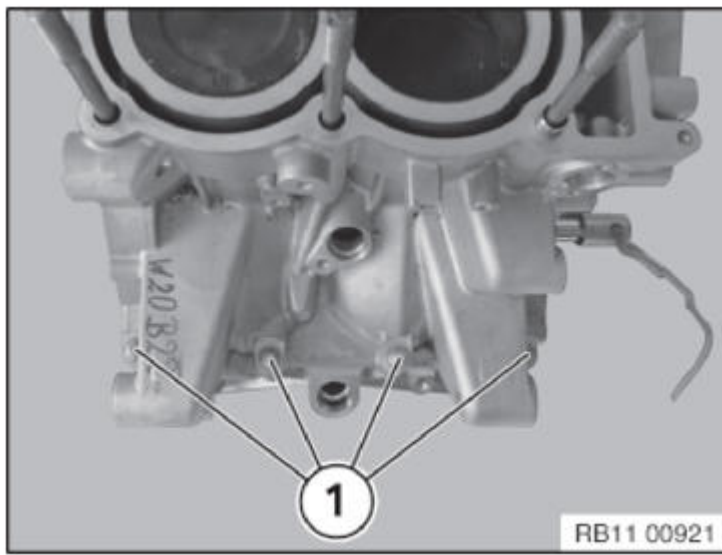
- 11 4 470

**Required preliminary work!**

- Remove **COMPLETE DRIVE UNIT (RANGE EXTENDER)**.
- Remove **ENGINE FROM DRIVE UNIT**.
- Remove **COOLANT PUMP**.
- Remove **OIL SUMP**.
- Remove oil dipstick **GUIDE TUBE**.

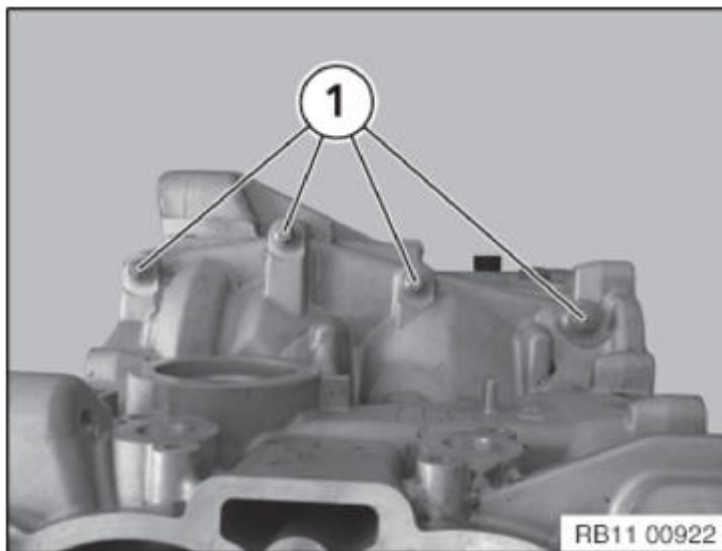
Release screws (1).





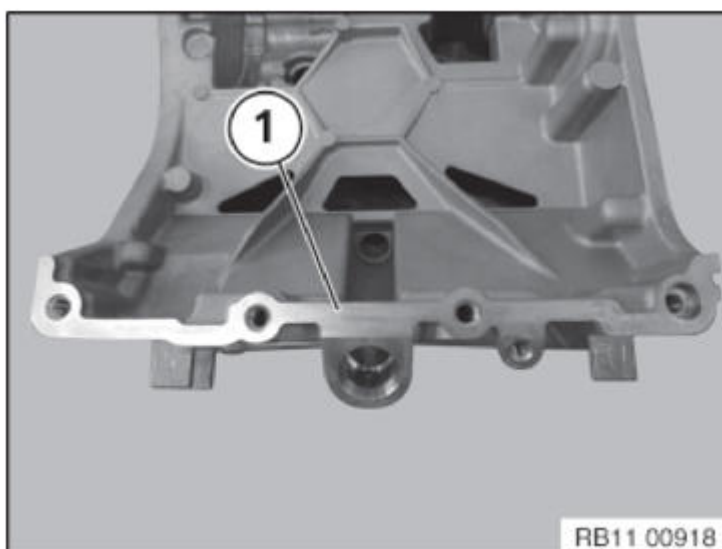
**Fig. 57: Identifying Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).



**Fig. 58: Identifying Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean sealing surfaces (1) on housing halves with special tool 11 4 470.



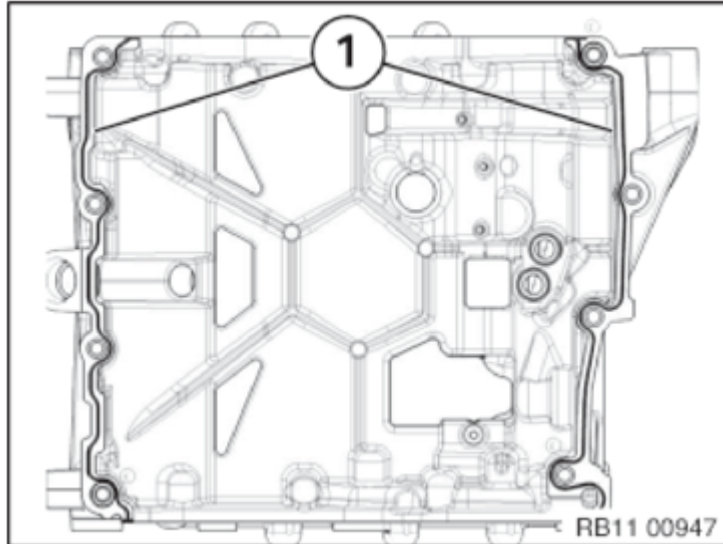
**Fig. 59: Identifying Housing Halves Sealing Surfaces**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply sealing bead in area (1).

*Installation note:*

Use sealing compound [1.7](#).

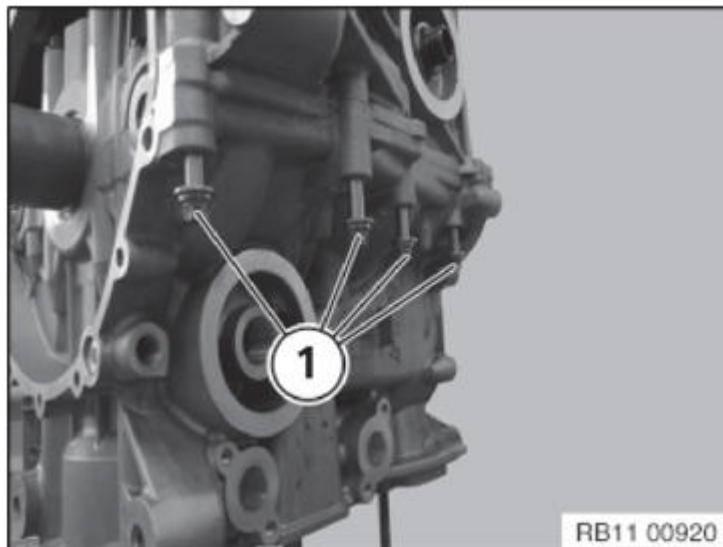
Apply sealing bead approx. 1 to 1.3 mm.



**Fig. 60: Identifying Sealing Bead Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

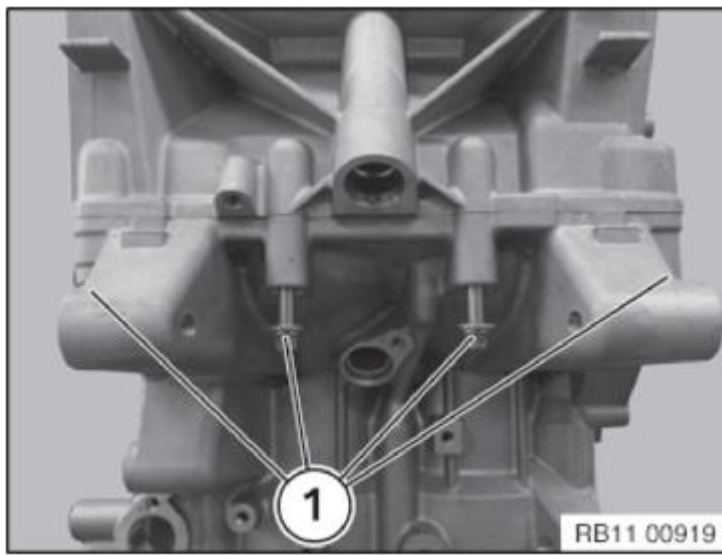
Join housing halves.

Insert bolts (1).



**Fig. 61: Identifying Bolts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert bolts (1).

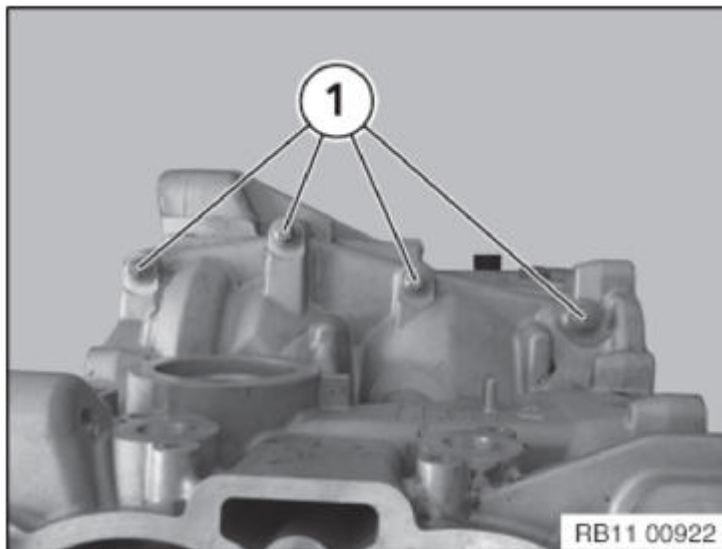


**Fig. 62: Identifying Bolts**

Courtesy of BMW OF NORTH AMERICA, INC.

Secure screws (1).

Tightening torque: [11 11 3AZ](#) .



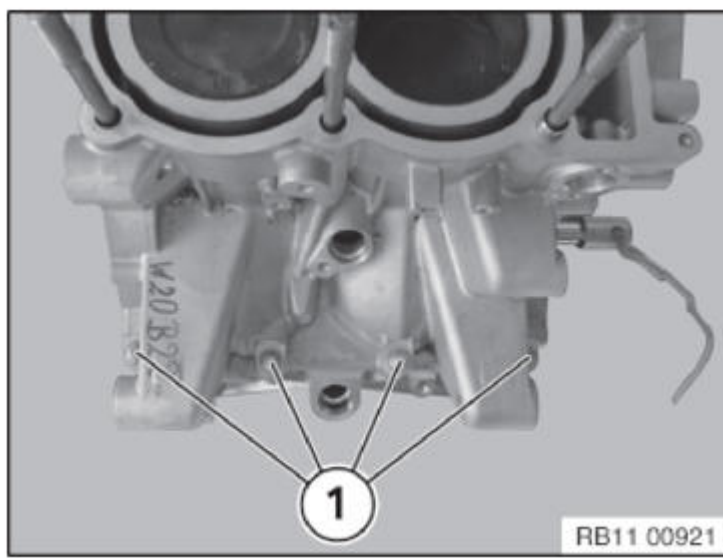
**Fig. 63: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Secure screws (1).

Tightening torque: [11 11 3AZ](#) .





**Fig. 64: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

## **CYLINDER HEAD WITH COVER**

### **11 12 100 REMOVING AND INSTALLING CYLINDER HEAD (W20)**

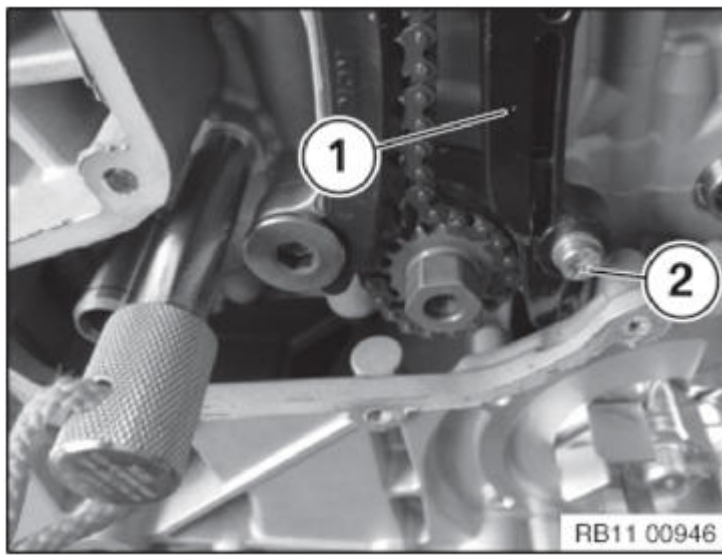
**IMPORTANT:** **Lightly** oil washer on the contact surfaces (both sides).  
Check length of stud bolt.

*Necessary preliminary tasks:*

- Drain **ENGINE OIL** .
- Remove **EXHAUST SYSTEM** .
- Remove **COMPLETE DRIVE UNIT (RANGE EXTENDER)**.
- Remove **ENGINE FROM DRIVE UNIT**.
- Drain coolant. See **DRAINING COOLING CIRCUIT (HIGH-TEMPERATURE COOLING SYSTEM)** and **DRAINING COOLING CIRCUIT (LOW TEMPERATURE COOLING SYSTEM)** .
- Remove intake **PLENUM**.
- Detach coolant hoses from cylinder head.
- Remove **GEAR BOX LID**.
- Remove intake and exhaust camshaft. See **INTAKE CAMSHAFT** and **EXHAUST CAMSHAFT**.

Release screw (2).

Guide rail (1) must be loose for cylinder head disassembly and installation.



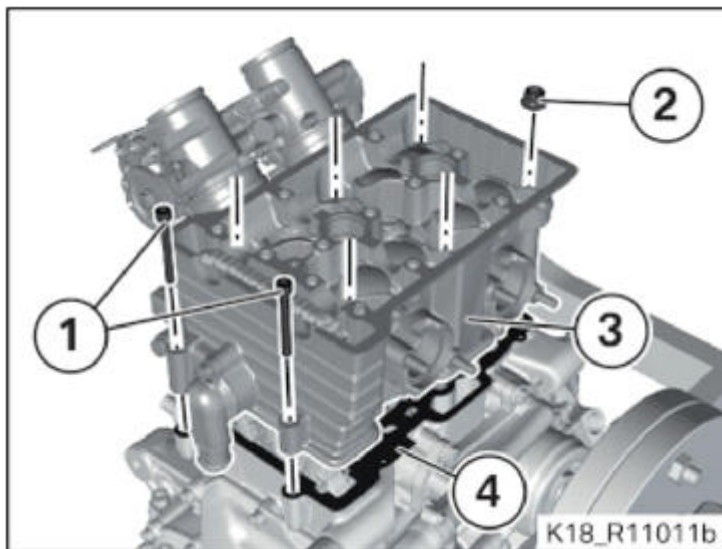
**Fig. 65: Identifying Guide Rail And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Unscrew nuts (2).

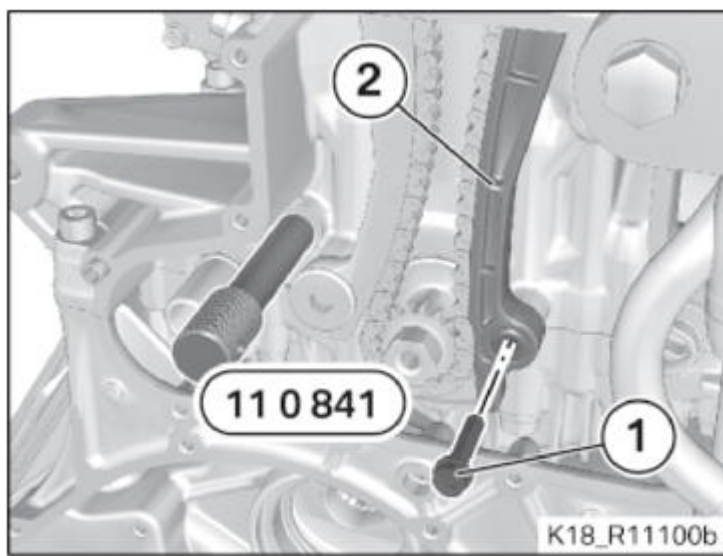
Remove cylinder head.

Renew cylinder head gasket (4).



**Fig. 66: Identifying Cylinder Head Screws, Nuts And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

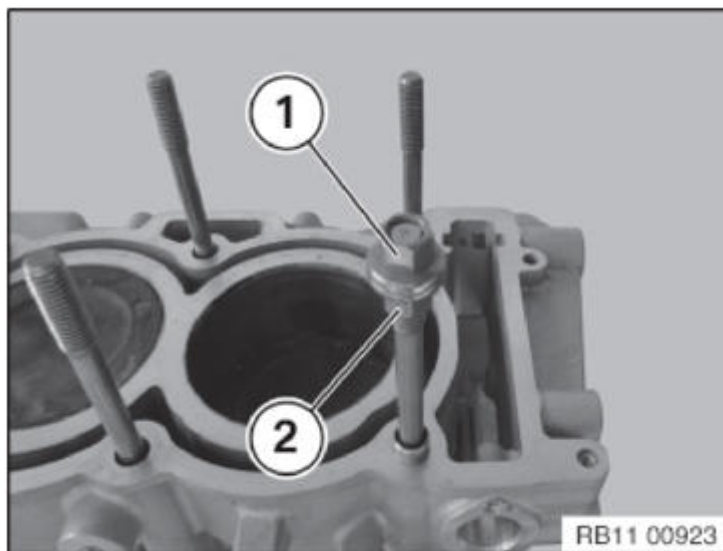
Remove guide rail (2) upwards.



**Fig. 67: Removing Guide Rail With Special Tool (11 0 841).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove stud bolts to clean the sealing surface if necessary.

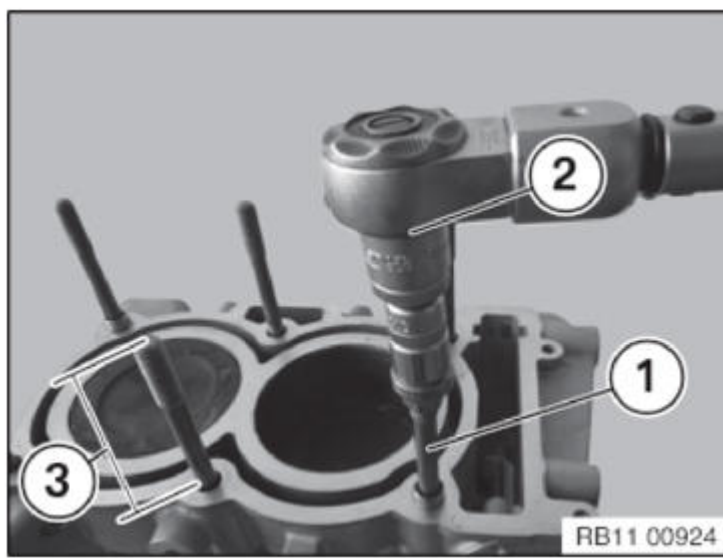
Secure stud bolts with cylinder head nuts (1 and 2).



**Fig. 68: Identifying Cylinder Head Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Check that length of the stud bolts (3) is 77 mm.

Adjust stud bolts (1) with reversible ratchet (2).

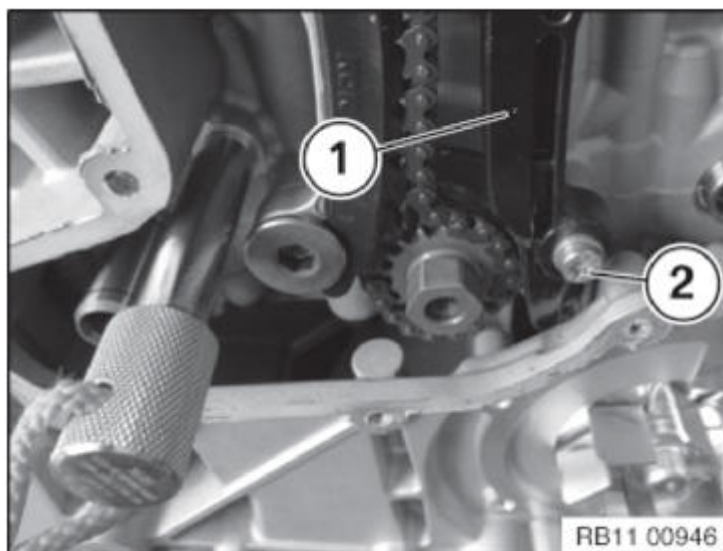


**Fig. 69: Adjusting Stud Bolts With Reversible Ratchet**  
Courtesy of BMW OF NORTH AMERICA, INC.

Replace **CYLINDER HEAD GASKET**.

Insert guide rail (1).

Do not secure guide rail (1) yet.

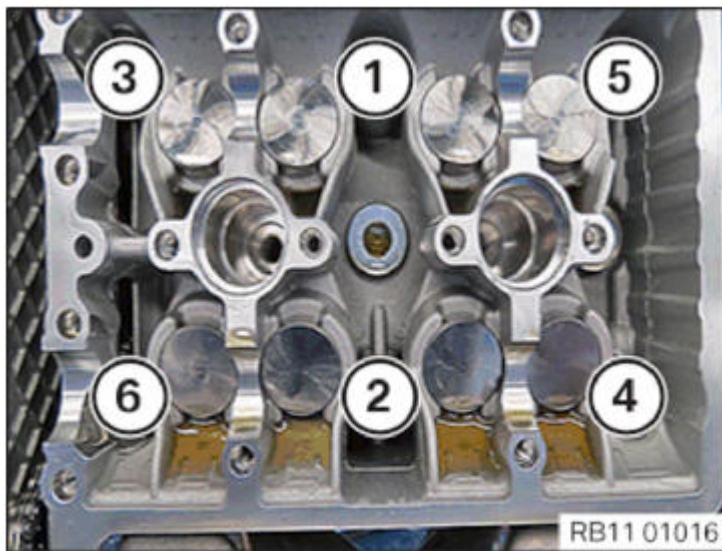


**Fig. 70: Identifying Guide Rail And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position cylinder head.

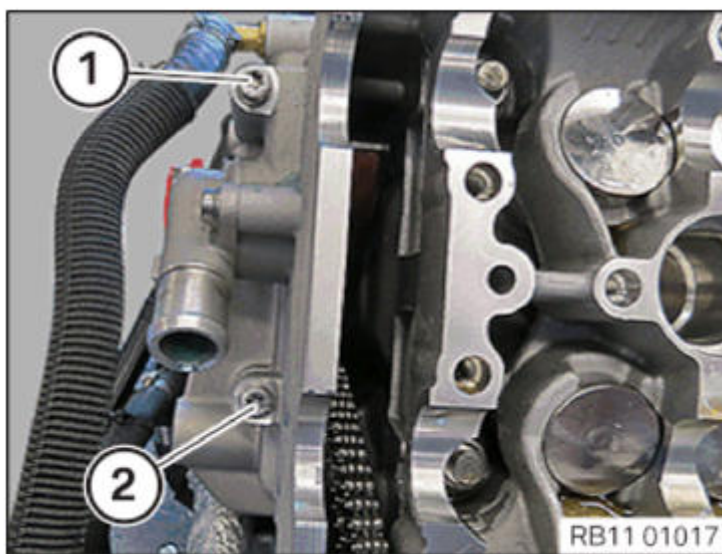
Secure nuts in sequence 1 to 6.

Tightening torque **11 12 1AZ** .



**Fig. 71: Cylinder Head Nuts Tightening Sequence**  
 Courtesy of BMW OF NORTH AMERICA, INC.

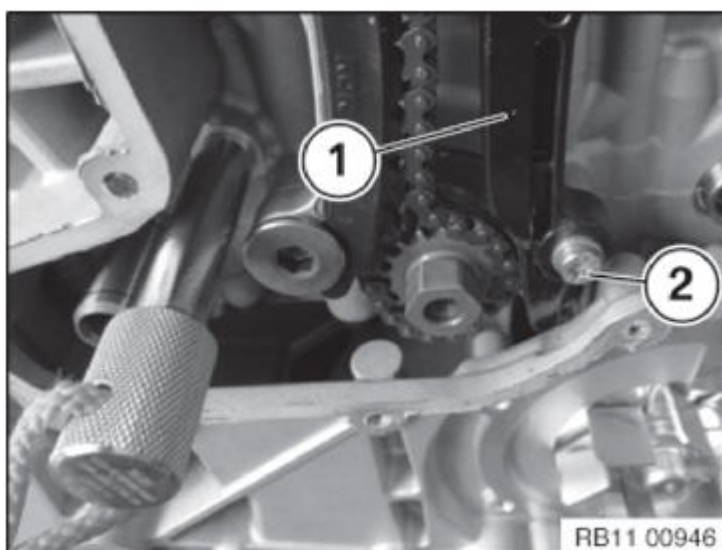
Tightening torque [11 12 2AZ](#) .



**Fig. 72: Identifying Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Attach guide rail (1) with screw (2).

Tightening torque: [11 31 2AZ](#) .





**Fig. 73: Identifying Guide Rail And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install camshafts. See [INTAKE CAMSHAFT](#) and [EXHAUST CAMSHAFT](#).

Adjust [VALVE CLEARANCE](#).

Assemble engine.

Checking oil level:

- Park vehicle on a horizontal surface.

The following engine oils may be used:

BMW engine oil "Longlife-01 FE" SAE 0W-30, part # 83 21 2 405 945

BMW engine oil "Longlife-01" SAE 5W-30, part # 83 21 2 405 947

**NOTE:** For gasoline-powered engines, BMW "Longlife-04..." engine oils are only approved for the European region including Norway, Switzerland and Liechtenstein.

**Service Function:**

1. 01 Drive.
2. Range extender digital engine electronics.
3. Range extender service start.

Carry out leak test.

**11 12 000 REMOVING AND INSTALLING/SEALING CYLINDER HEAD COVER (W20)**

**Special tools required:**

- 83 30 2 298 505
- 81 31 2 353 954

**IMPORTANT:** Service function consists of two checks, both the checks must be executed, to guarantee tightness of engine.

*Necessary preliminary tasks:*

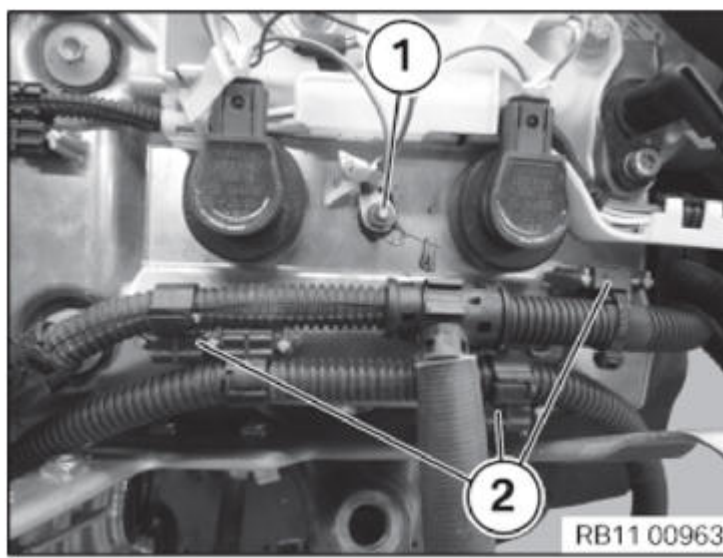
- Remove [IGNITION COILS](#) .
- Remove [INTAKE PLENUM](#).
- Remove [FUEL INJECTION PIPE](#)

Slacken nut (1).

Lay ground strap to one side.

Disconnect all cable clips (2) at cylinder head cover.

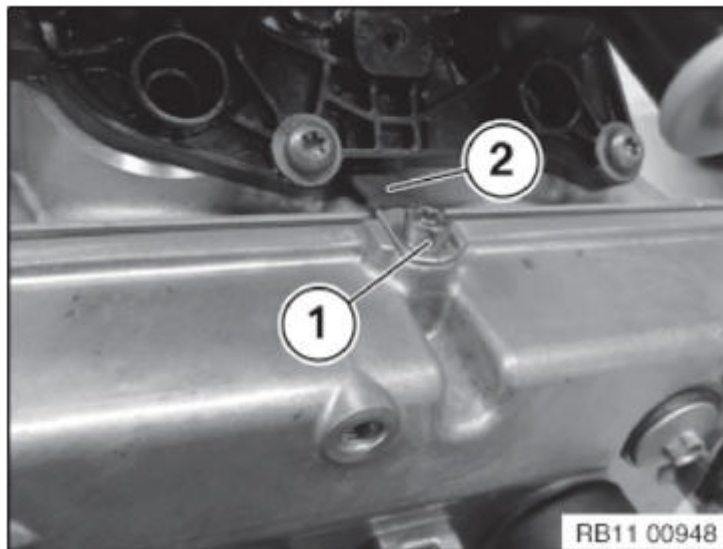




**Fig. 74: Identifying Ground Strap Nut And Cable Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) on cylinder head cover.

Unfasten ground strap (2).

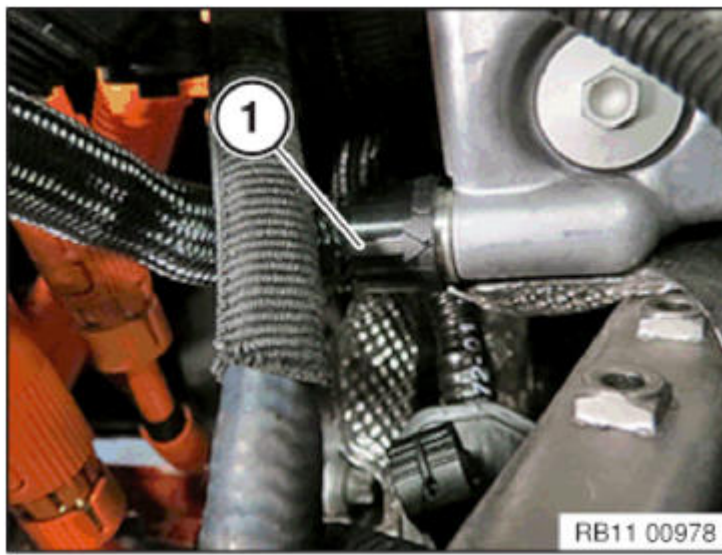


**Fig. 75: Identifying Cylinder Head Cover Screw And Ground Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release engine ventilation (1) at cylinder head cover.

*Installation note:*

Renew engine ventilation (1).

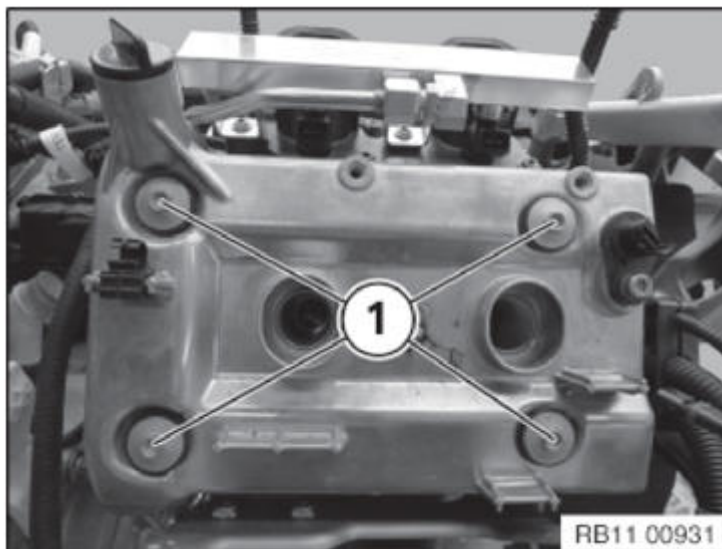


**Fig. 76: Identifying Engine Ventilation At Cylinder Head Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection at camshaft sensor.

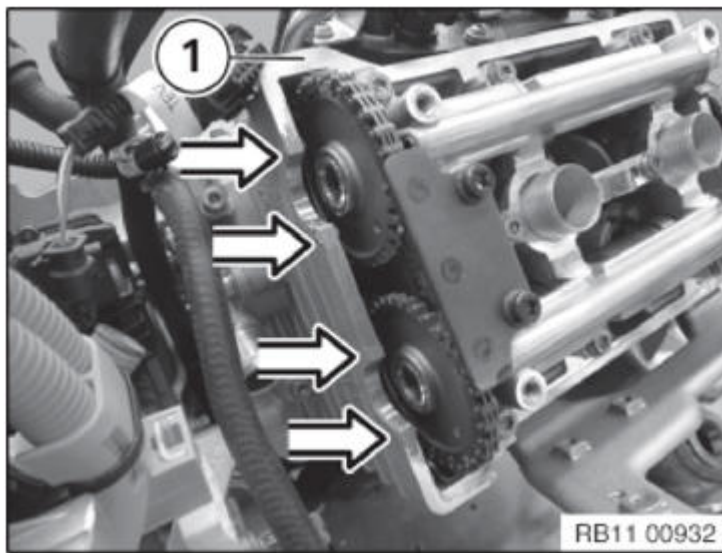
Release all screws (1).

Feed out cylinder head cover upwards.



**Fig. 77: Identifying Cylinder Head Cover Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

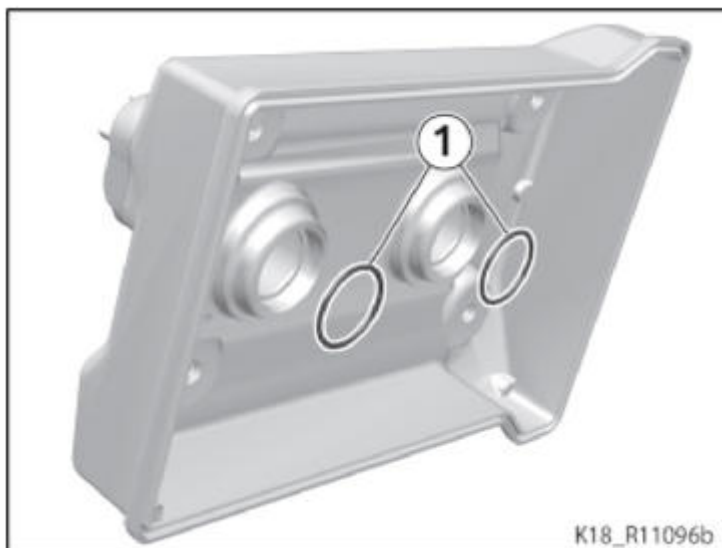
Clean the sealing surface (1) in the area, the half-moon section.



**Fig. 78: Locating Sealing Surface In Half-Moon Section Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Replace sealing rings (1).

Remove oil residue in cylinder head cover using a lint-free cloth to prevent moistening of thermal protection at exhaust manifold.



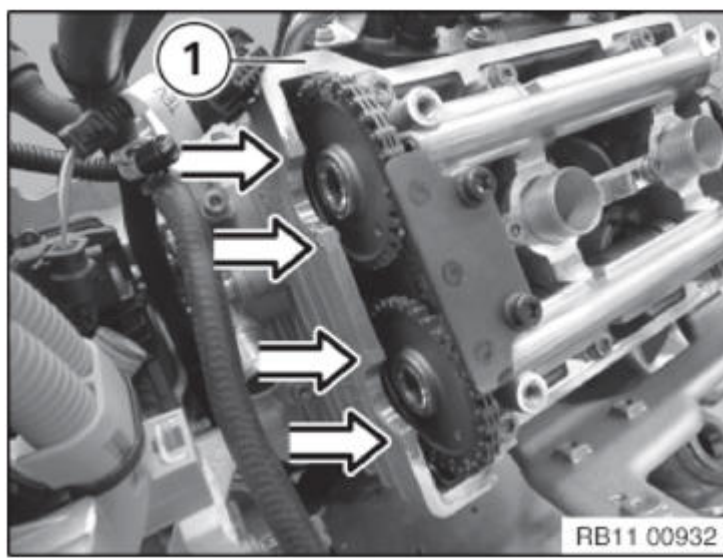
**Fig. 79: Identifying Sealing Rings**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace gasket.

Position gasket on cylinder head cover.

Thinly apply sealing compound [1.7](#) at corners in area (1) of half-moon sections.

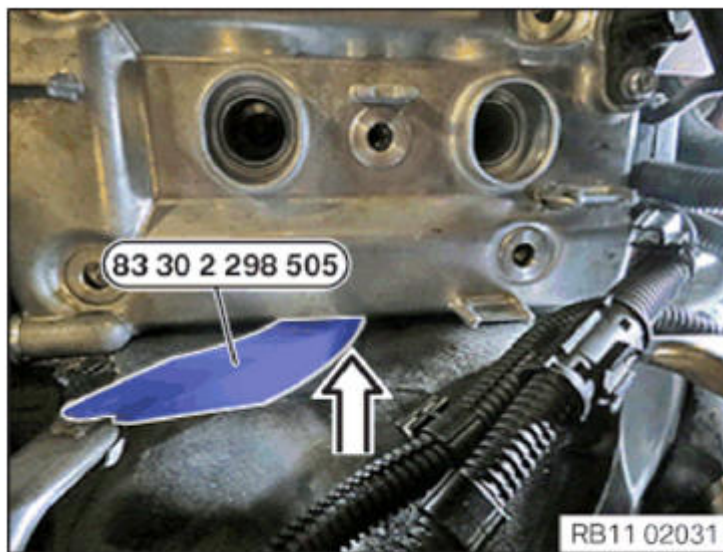


**Fig. 80: Locating Sealing Surface In Half-Moon Section Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Check cylinder head cover gasket .

Insert special tool 83 30 2 298 505 sideways on cylinder head between rear intake system cover and cylinder head cover.

Visual inspection of correct installation position of cylinder cap seal can be performed using an air gap.



**Fig. 81: Inserting Special Tool (83 30 2 298 505) Between Rear Intake System Cover And Cylinder Head Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage to gasket

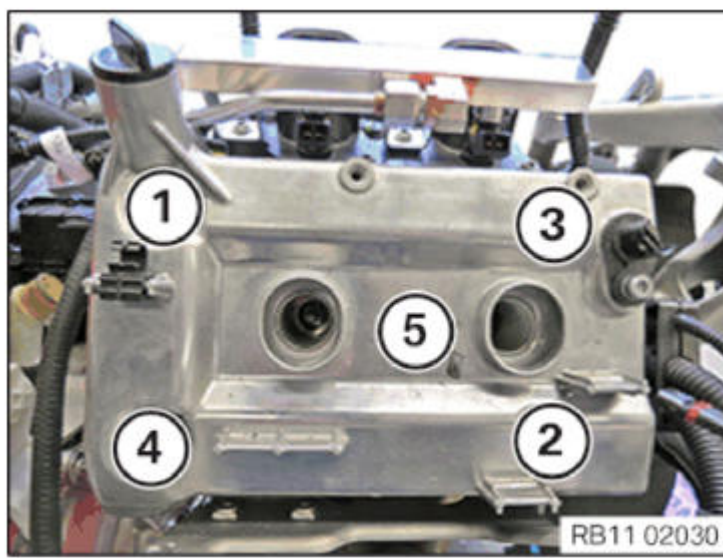
Carefully position cylinder head cover with new gasket.

Join collar bolts with new gasket.

Tighten collar bolts in sequence (1 to 5).

Tightening torque: **11 12 3AZ** .





**Fig. 82: Cylinder Head Collar Bolts Tightening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Engine leakage test.**

Prepare special tool 81 31 2 353 954.



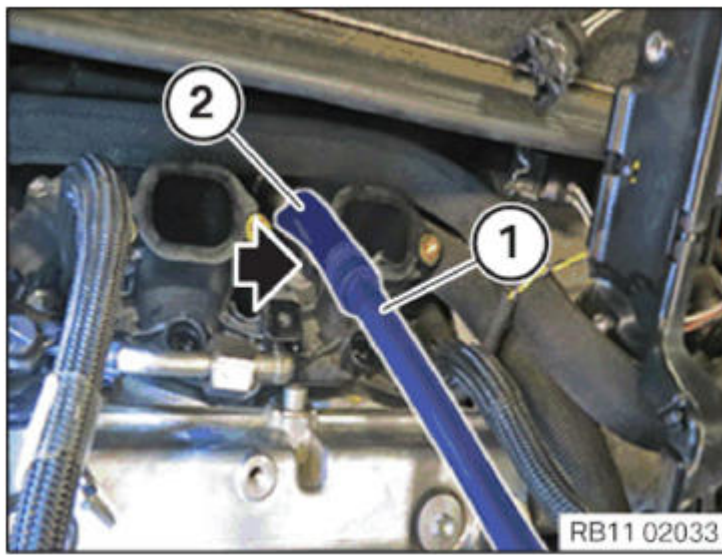
**Fig. 83: Preparing Special Tool (81 31 2 353 954)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove oil dipstick.

Insert pressure hose (1) from smoke-diagnosis system into the oil pipe (2).

Seal the opening on cylinder head cover and engine ventilation using appropriate caps.

Check engine for leak tightness using smoke diagnosis system.



**Fig. 84: Locating Pressure Hose**

Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Checking oil level:

**ENGINE INTERNAL PRESSURE** check.

- Park vehicle on a horizontal surface.

**Service Function:**

1. 01 Drive.
2. Range extender digital engine electronics.
3. Range extender service start.

Carry out leakage test for 20 min.

IMPORTANT: If there is an oil leak, the engine must be cleaned thoroughly.

If required, dismount engine for this.

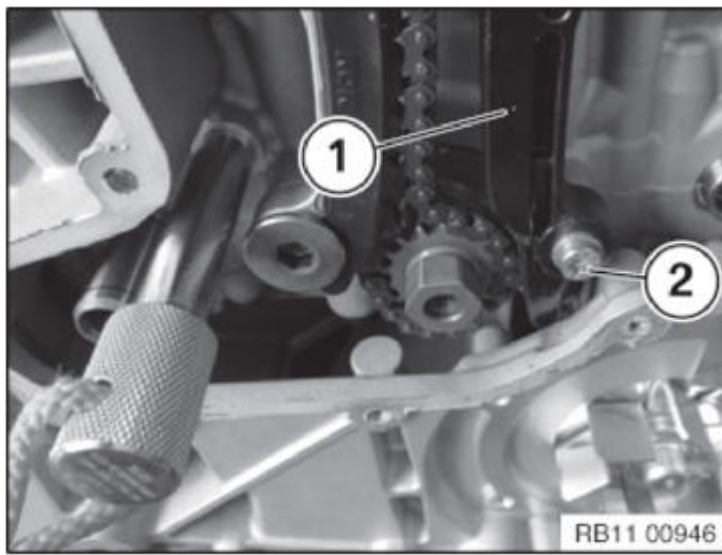
## **11 12 101 REPLACING CYLINDER HEAD GASKET (W20)**

*Necessary preliminary tasks:*

- Remove **CYLINDER HEAD**.
- Remove **GEAR CASE COVER**.
- Check cylinder head for deviation from flatness.

Remove guide rail (1) in upward direction.

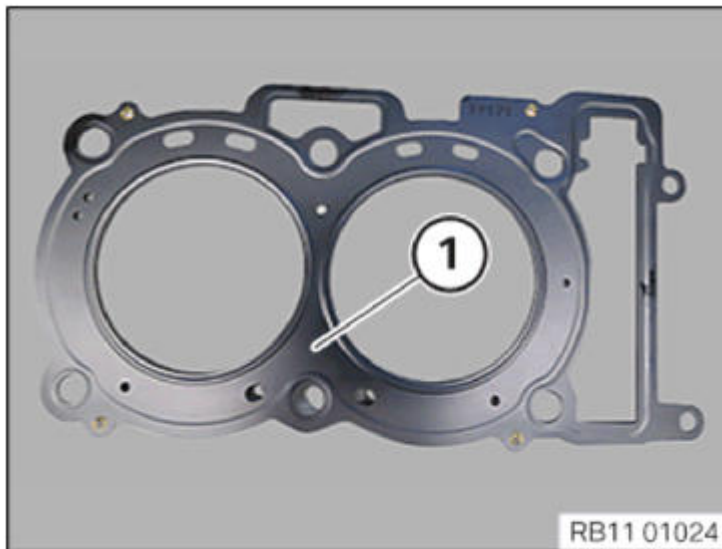




**Fig. 85: Identifying Guide Rail And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

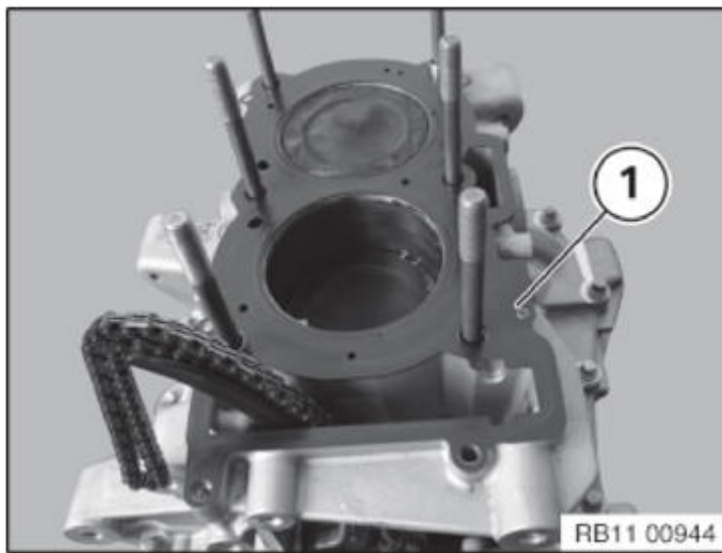
Replace beaded metal gasket (1).



**Fig. 86: Identifying Beaded Metal Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

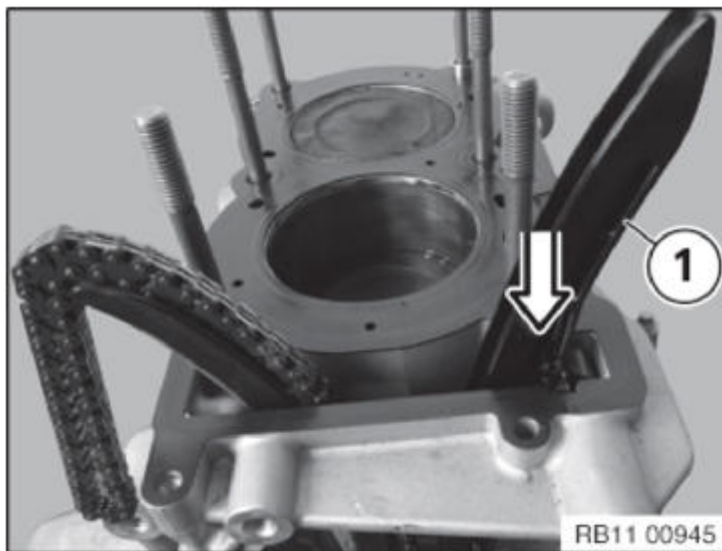
Place cylinder head gasket (1) in direction of arrow on engine block.

Secure new cylinder head gasket with fitting sleeves.



**Fig. 87: Identifying Cylinder Head Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

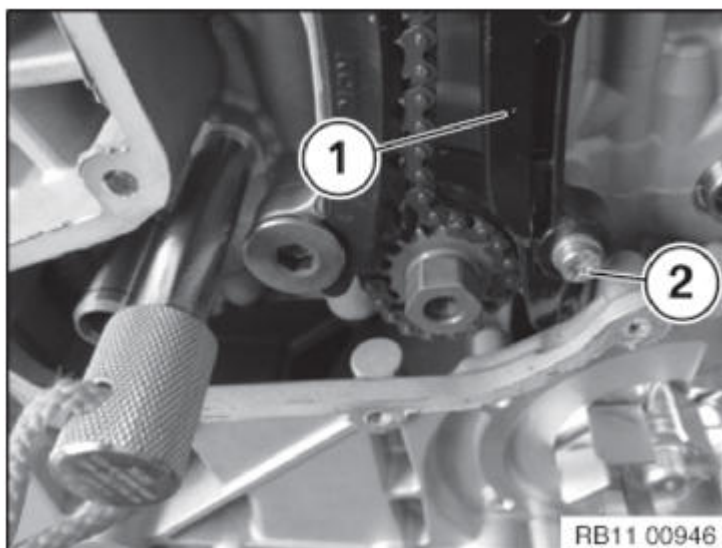
Slide in guide rail (1) in direction of arrow.



**Fig. 88: Inserting Guide Rail**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attach guide rail (1) with screw (2).

Tightening torque: [11 31 2AZ](#) .



Assemble engine.

## **OIL SUMP**

### **11 13 000 REMOVING AND INSTALLING, SEALING OR REPLACING OIL SUMP (W20)**

Special tools required:

- 11 4 470

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM** .
- Observe **SAFETY INFORMATION** for working with electric vehicles.
- Drain **ENGINE OIL** .

Necessary preliminary tasks:

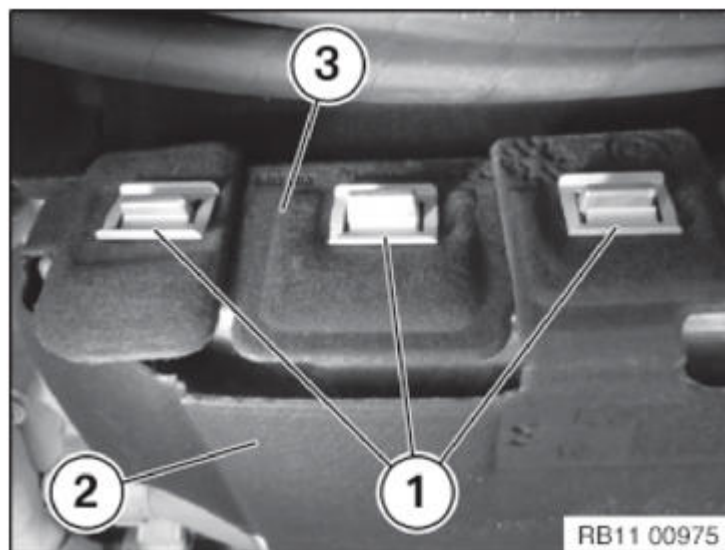
- Remove **UNDERBODY PANELLING** at rear.
- Remove **HORIZONTAL STRUT ON LEFT AND RIGHT** .

Release retaining clips (1).

Remove sound insulation (2).

Sound insulation (3) must be detached at top of crankcase.

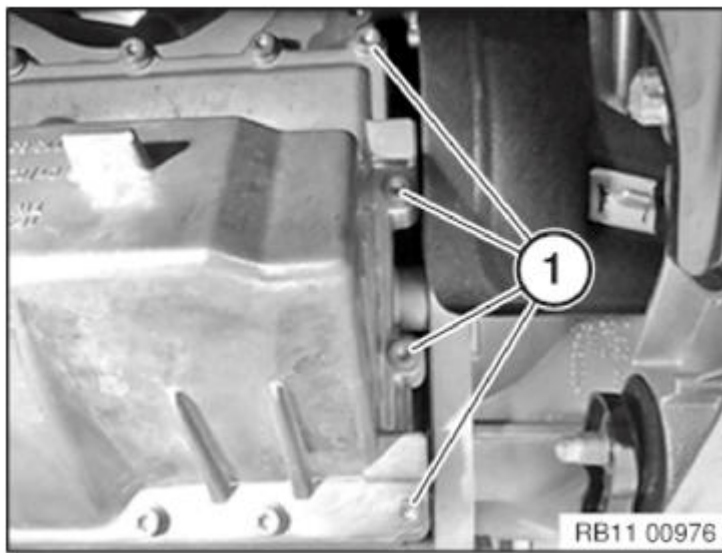
Feed out sound insulation (3) downward.



**Fig. 90: Identifying Sound Insulation And Retaining Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque: **11 13 1AZ** .



**Fig. 91: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) along line.

Disconnect oil sump with a suitable tool at lower section of crankcase.

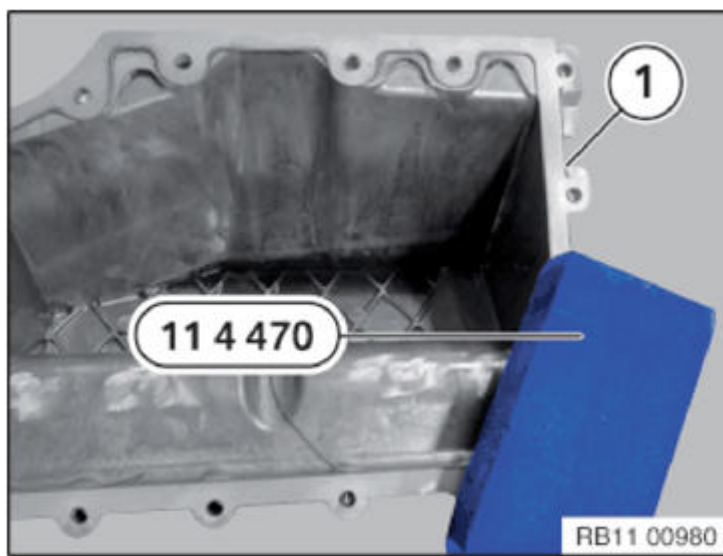
Tightening torque. [11 13 1AZ](#) .



**Fig. 92: Identifying Oil Sump Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Clean sealing surface (1) of oil sump and lower section of crankcase with special tool 11 4 470.

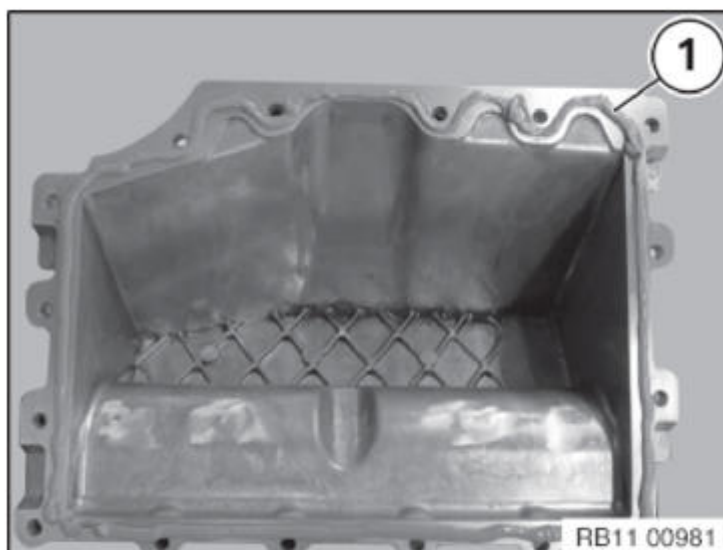


**Fig. 93: Cleaning Sealing Surface Of Oil Sump And Lower Section Of Crankcase With Special Tool (11 4 470)**

Courtesy of BMW OF NORTH AMERICA, INC.

Apply sealing bead (1) to oil sump, see illustration.

Sealing compound [1.7](#)



**Fig. 94: Identifying Oil Sump Sealing Bead Applying Area**

Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

The following engine oils may be used:

BMW engine oil "Longlife-01 FE" SAE 0W-30, part # 83 21 2 405 945

BMW engine oil "Longlife-01" SAE 5W-30, part # 83 21 2 405 947

**NOTE:** For gasoline-powered engines, BMW "Longlife-04..." engine oils are only approved for the European region including Norway, Switzerland and Liechtenstein.

## **HOUSING COVER**

### **11 14 122 REMOVING AND INSTALLING/RENEWING TIMING CASE COVER (W20)**

Special tools required:



- 11 4 470

**Necessary preliminary tasks:**

- Remove **DRIVE UNIT (RANGE EXTENDER)** .
- Remove **ENGINE FROM DRIVE UNIT**.

*Installation note:*

Ventilation lines must be renewed after releasing.

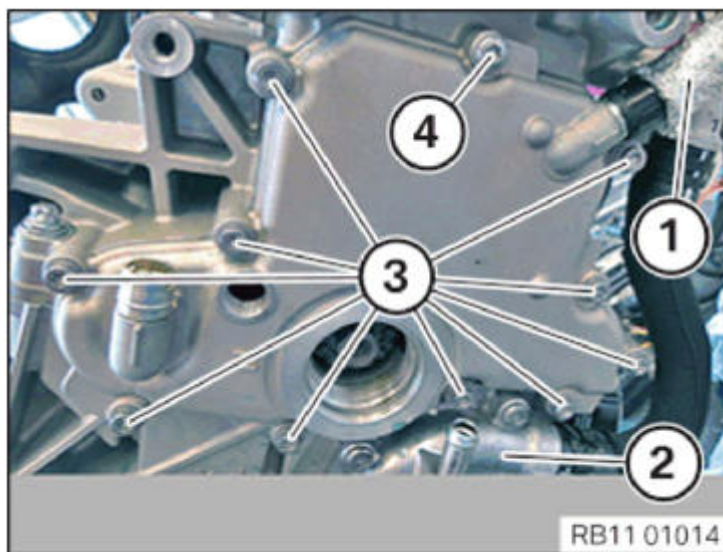
Release ventilation line (1).

Remove **COOLANT PUMP HOUSING**.

Release screws (3 and 4).

Tightening torque **11 14 3 AND 4AZ** .

Remove the timing case cover.



**Fig. 95: Identifying Coolant Pump Housing, Ventilation Line And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

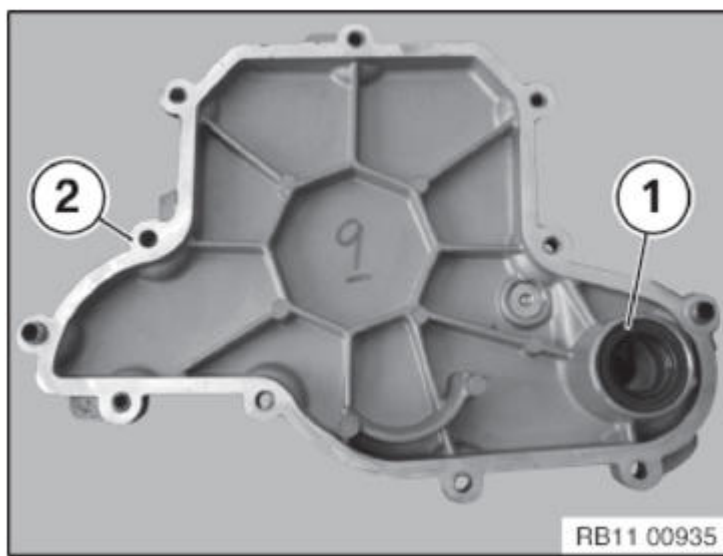
*Installation note:*

Replace radial shaft seal (1).

Clean sealing surface (2) with special tool 11 4 470.

Apply sealing bead with sealing compound **1.7**..





**Fig. 96: Identifying Radial Shaft Seal And Sealing Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Checking oil level:

- Park vehicle on a horizontal surface.

**Service Function:**

1. 01 Drive.
2. Range extender digital engine electronics.
3. Range extender service start.

Carry out leakage test for 20 min.

IMPORTANT: If there is an oil leak, engine must be cleaned thoroughly.

## **11 14 201 REMOVING AND INSTALLING/REPLACING GENERATOR LID (W20)**

**Special tools required:**

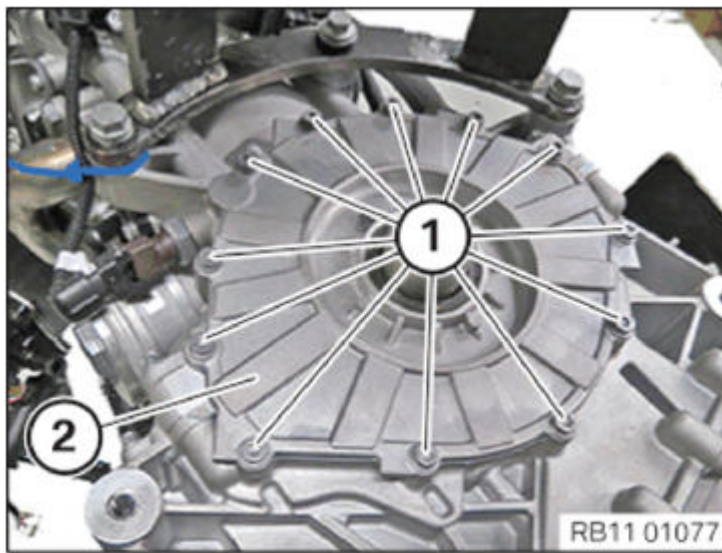
- 11 4 470

**Necessary preliminary tasks:**

- Remove **DRIVE UNIT (RANGE EXTENDER)** .
- Remove **ENGINE FROM DRIVE UNIT** .
- Remove **RANGE EXTENDER ELECTRIC MACHINE** .

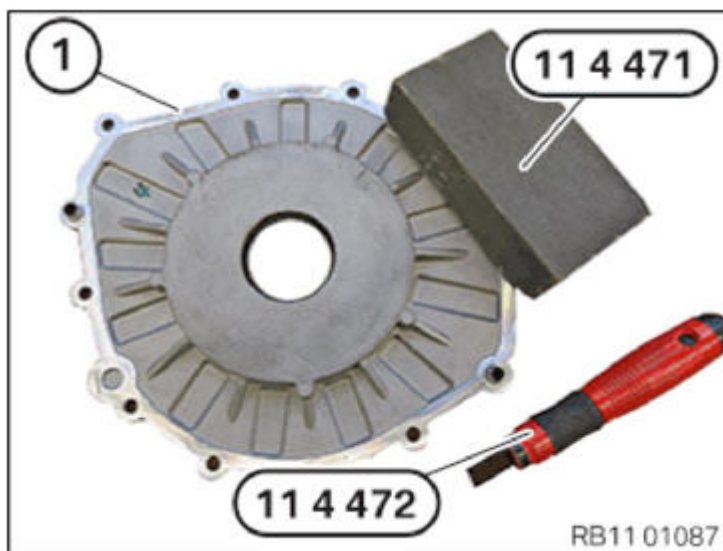
Release all screws (1).

Remove generator lid (2).



**Fig. 97: Identifying Generator Lid And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean sealing surface (1) on generator lid and sealing surface on crankcase with special tool 11 4 470.



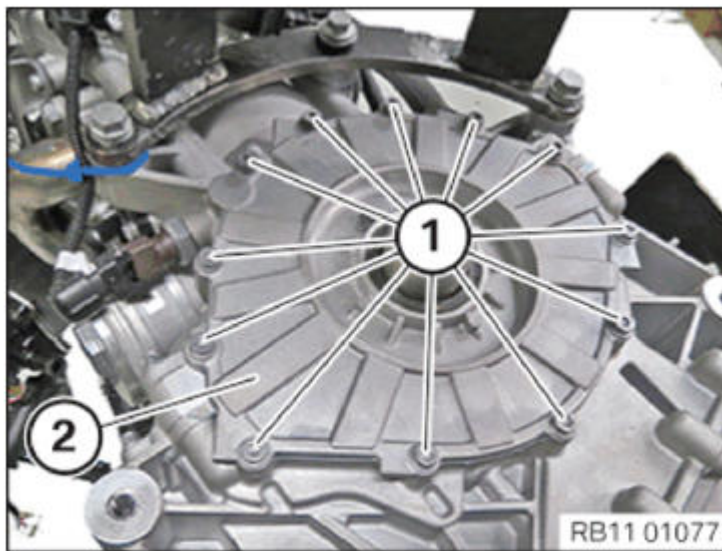
**Fig. 98: Cleaning Sealing Surface On Generator Lid And Sealing Surface On Crankcase With Special Tool (11 4 470).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply sealing bead with sealing compound [1.7](#).

Position generator lid (2) on crankcase.

Insert all bolts (1).

Tightening torque [11 14 3AZ](#) .



**Fig. 99: Identifying Generator Lid And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

### **11 14 202 REMOVING AND INSTALLING/REPLACING RADIAL SHAFT SEAL (W20)**

**Special tools required:**

- 11 4 470
- [23 4 100](#)

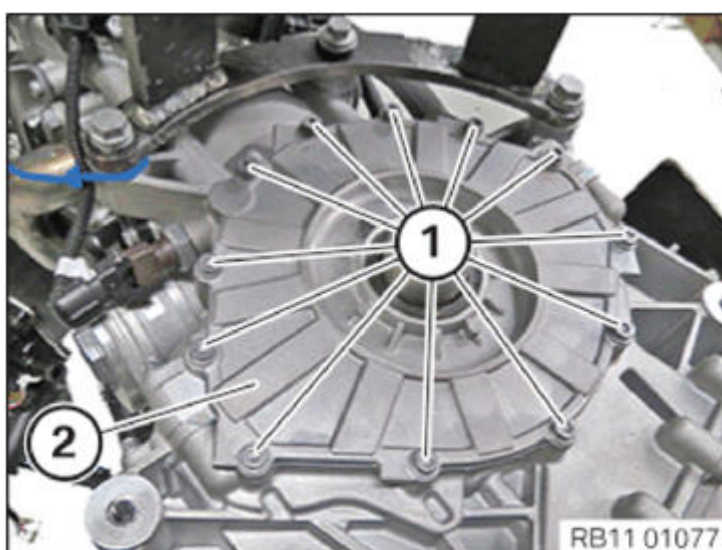
**Necessary preliminary work:**

- Remove [DRIVE UNIT \(RANGE EXTENDER\)](#) .
- Remove [ENGINE FROM DRIVE UNIT](#) .
- Remove [RANGE EXTENDER ELECTRIC MACHINE](#) .

Release all screws (1).

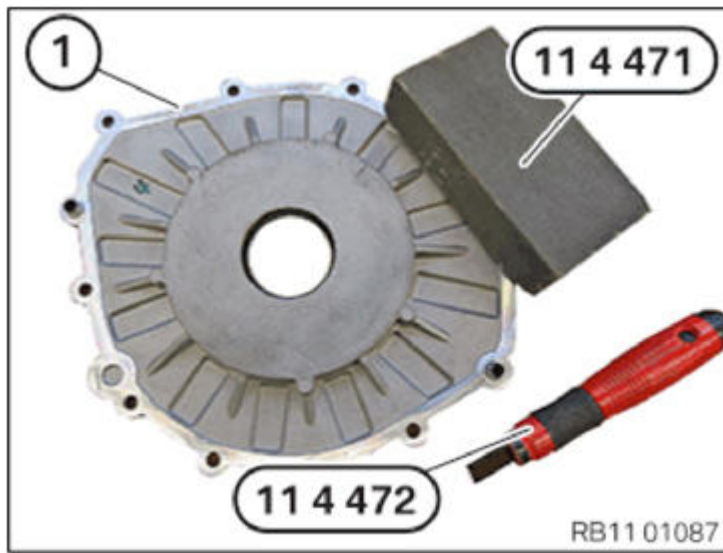
Tightening torque [11 14 3AZ](#) .

Remove generator lid (2).



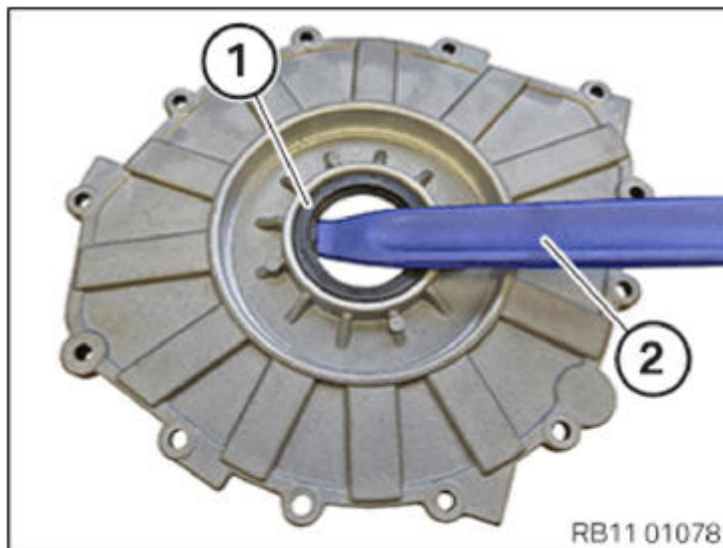
**Fig. 100: Identifying Generator Lid And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Clean sealing surface (1) on generator lid and sealing surface on crankcase with special tool 11 4 470.



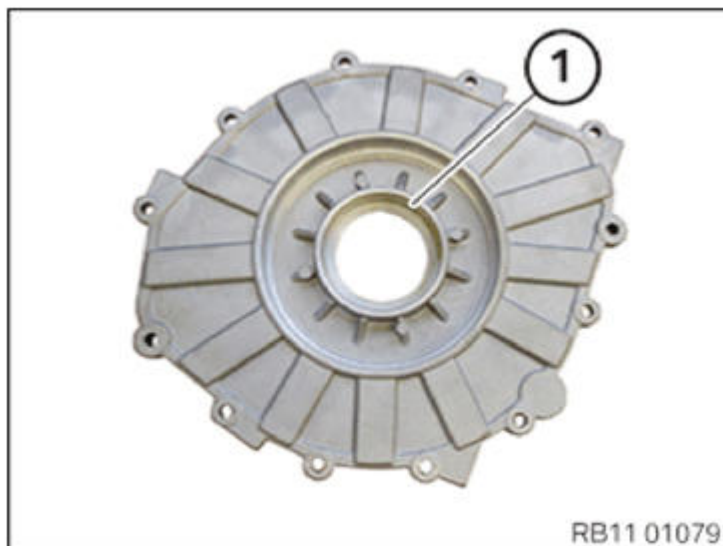
**Fig. 101: Cleaning Sealing Surface On Generator Lid And Sealing Surface On Crankcase With Special Tool (11 4 470).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove radial shaft seal (1) with a suitable mounting lever (2).



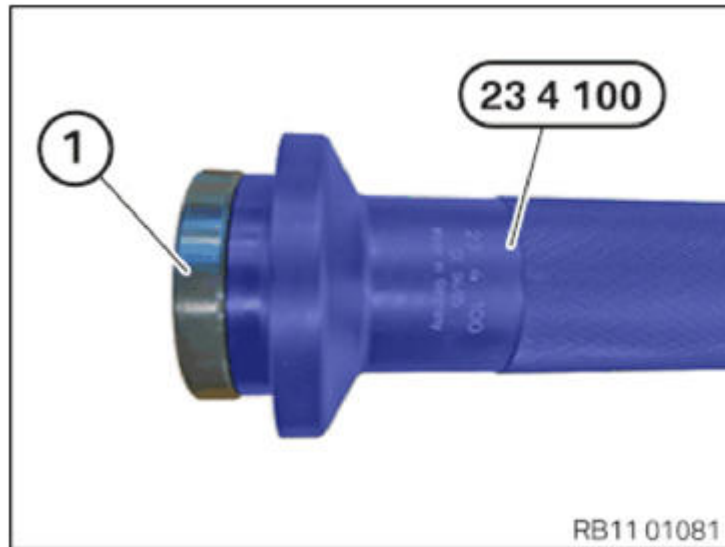
**Fig. 102: Removing Radial Shaft Seal With Suitable Mounting Lever**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check sealing surface (1) for damage.



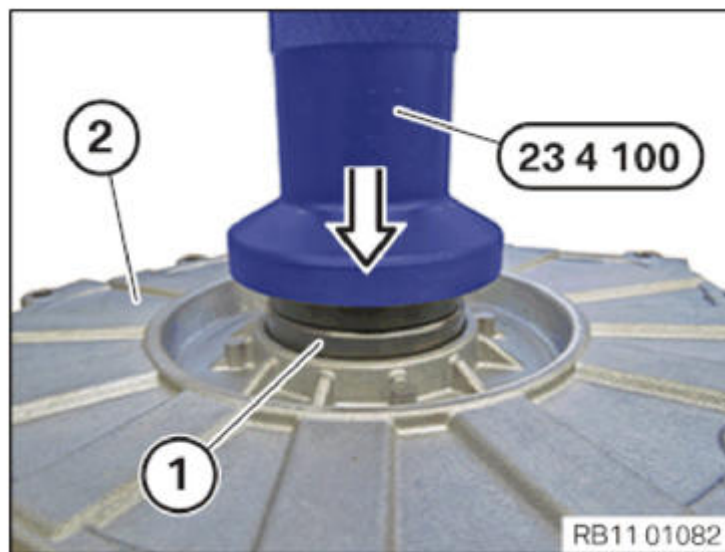
**Fig. 103: Identifying Sealing Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position sealing ring (1) on special tool [23 4 100](#) .



**Fig. 104: Positioning Sealing Ring On Special Tool (23 4 100)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press sealing ring (1) into generator lid (2) with special tool [23 4 100](#) in direction of arrow.



**Fig. 105: Pressing Sealing Ring Into Generator Lid With Special Tool (23 4 100)**  
Courtesy of BMW OF NORTH AMERICA, INC.

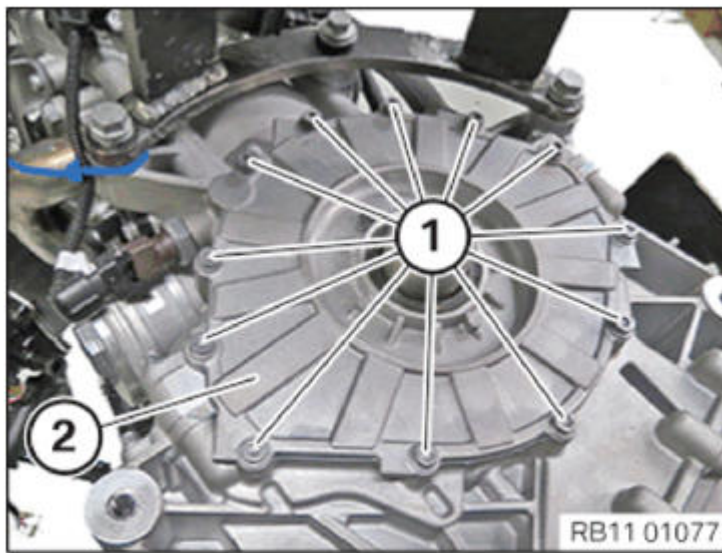
Apply sealing bead with sealing compound [1.7](#).

Position generator lid (2) on crankcase.

Insert all bolts (1).

Tightening torque [11 14 3AZ](#) .





**Fig. 106: Identifying Generator Lid And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

## **INTERNAL ENGINE PRESSURE**

### **11 15 510 MEASURING THE INTERNAL ENGINE PRESSURE (W20)**

Special tools required:

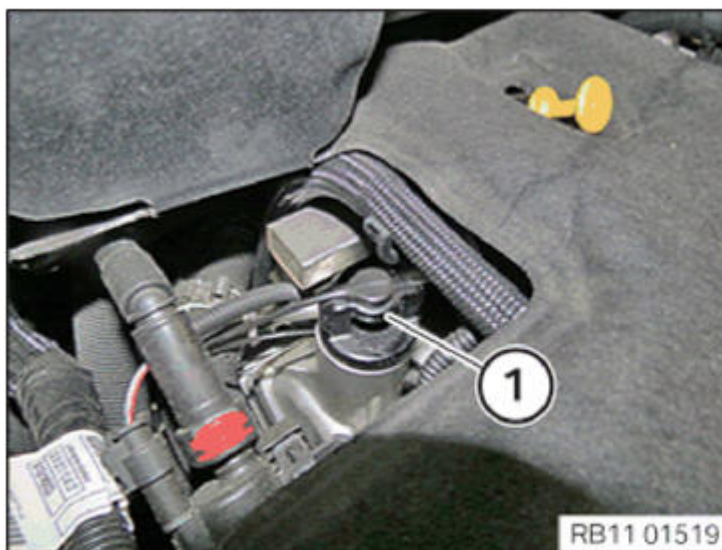
- [2 406 729](#)

*Necessary preliminary tasks:*

- Follow the diagnosis instruction for pressure testing.
- Check engine oil level.

Open oil filler cap (1).

Start engine and run at idle speed.



**Fig. 107: Identifying Oil Filler Cap**  
Courtesy of BMW OF NORTH AMERICA, INC.

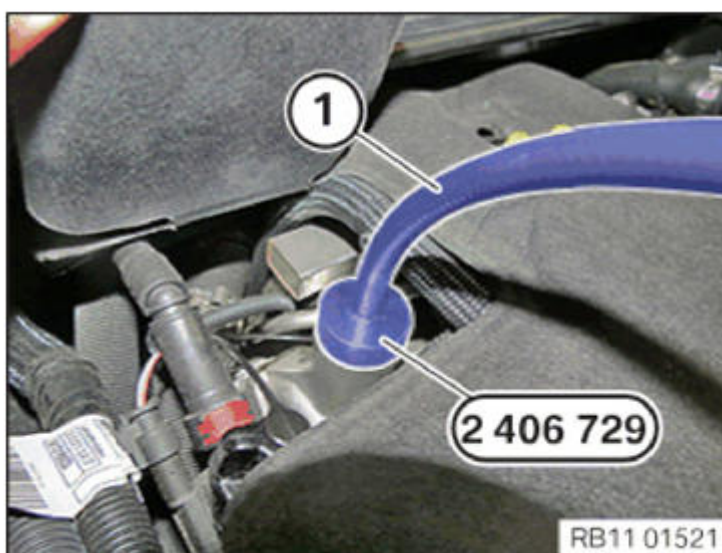
Screw special tool [2 406 729](#) in hand-tight.





**Fig. 108: Screwing Special Tool (2 406 7329)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect the pressure hose (1) with special tool [2 406 729](#) .



**Fig. 109: Connecting Pressure Hose With Special Tool (2 406 729)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect pressure hose (1) with the fuel pressure sensor to the Integrated Measurement Interface Box (IMIB).



Follow diagnosis instruction.

## **CRANKSHAFT WITH BEARING**

### **11 21 005 REMOVING AND INSTALLING/REPLACING CRANKSHAFT (W20)**

Special tools required:

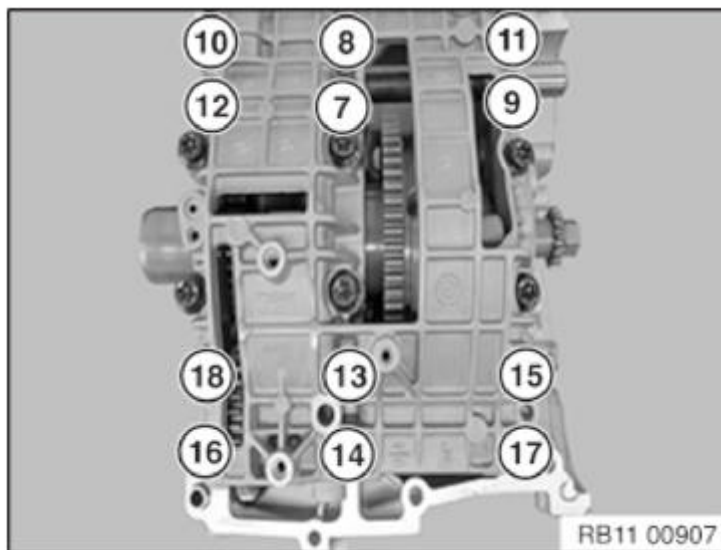
- **11 0 841**

IMPORTANT: Jointing torque and angle of rotation must be observed without fail (**risk of damage**) .

*Necessary preliminary tasks:*

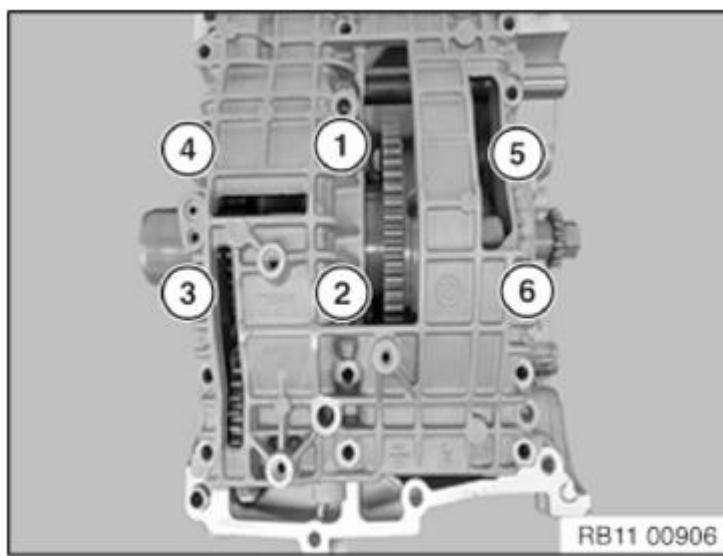
- Remove **DRIVE UNIT** .
- Mount **ENGINE ON ASSEMBLY STAND**.
- Remove **OIL SUMP**
- Remove **OIL PUMP**.
- Remove **LOWER SECTION OF CRANKCASE**.
- Remove camshafts. See **INTAKE CAMSHAFT** and **EXHAUST CAMSHAFT**.

Release all screws in sequence (18 to 7).



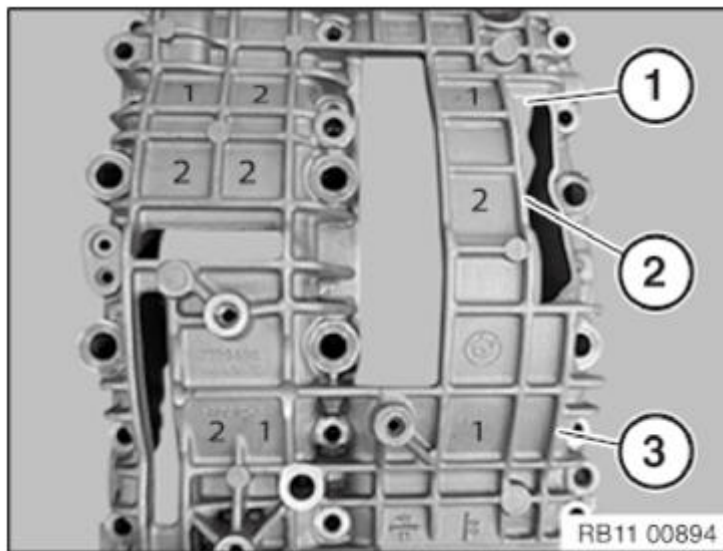
**Fig. 111: Crankshaft Screws Tightening Sequence**

Undo bolts in sequence (6 to 1).



**Fig. 112: Crankshaft Bolts Tightening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove bearing frame.



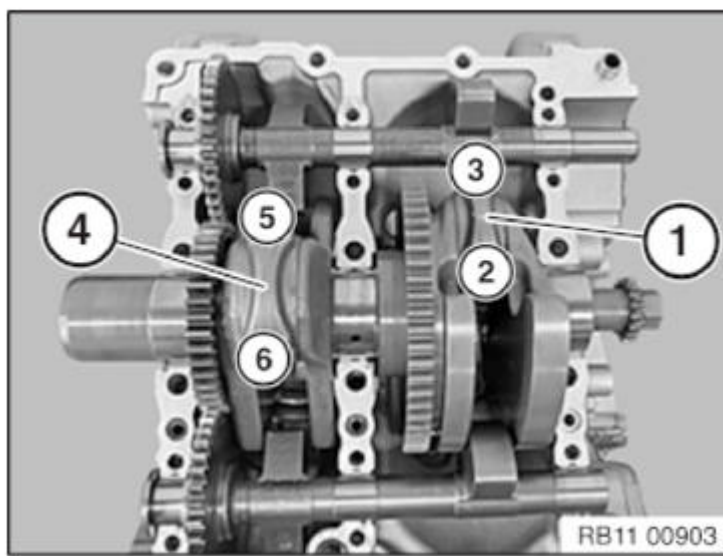
**Fig. 113: Identifying Bearing Frame Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release connecting rod bolts (2 and 3).

Remove connecting rod bearing cap (1).

Release connecting rod bolts (5 and 6).

Remove connecting rod bearing cap (4).



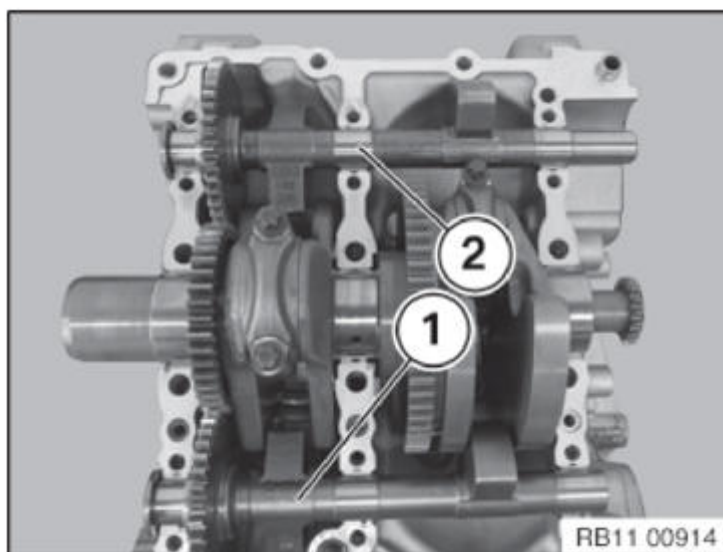
**Fig. 114: Identifying Connecting Rod Bearing Cap And Connecting Rod Bolts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove counterbalance shaft (1).

Remove counterbalance shaft (2).

*Installation note:*

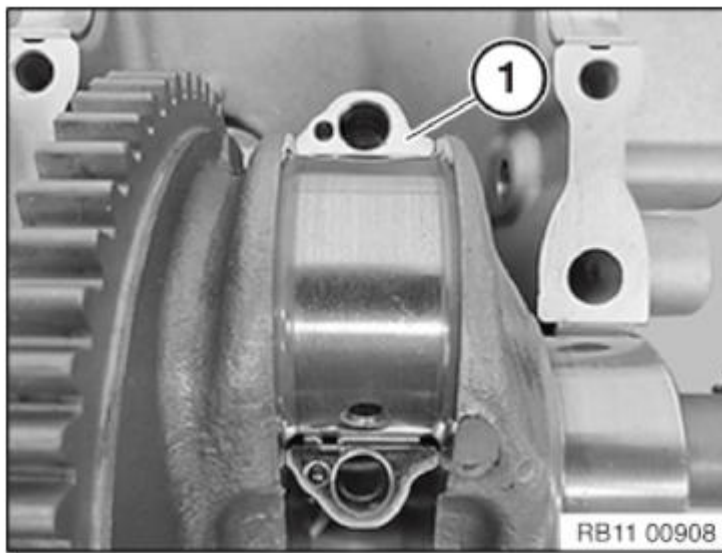
Counterbalance shaft (2) has a connection for the engine ventilation.



**Fig. 115: Identifying Counterbalance Shafts**  
Courtesy of BMW OF NORTH AMERICA, INC.

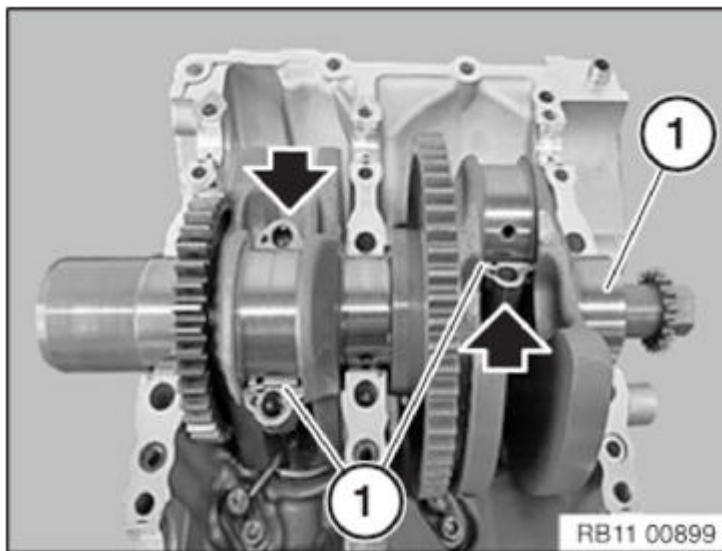
IMPORTANT: Risk of damage! At valves.

Press connecting rod (1) downwards slightly.



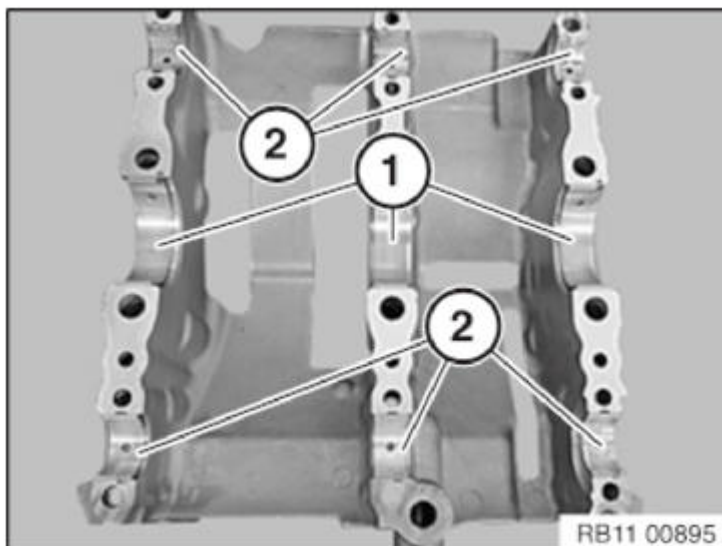
**Fig. 116: Identifying Connecting Rod**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lift out crankshaft (1).



**Fig. 117: Locating Connecting Rods**  
Courtesy of BMW OF NORTH AMERICA, INC.

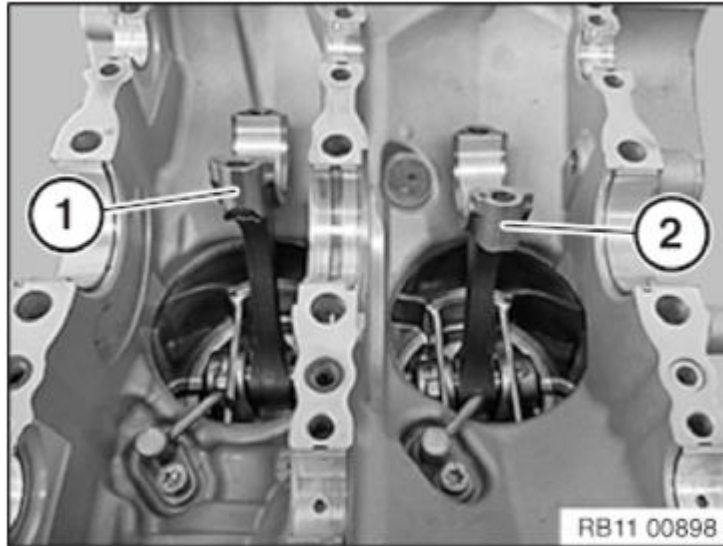
Pay attention to **BEARING CLASSIFICATION** (1 and 2).





**Fig. 118: Identifying Bearing Classification**  
Courtesy of BMW OF NORTH AMERICA, INC.

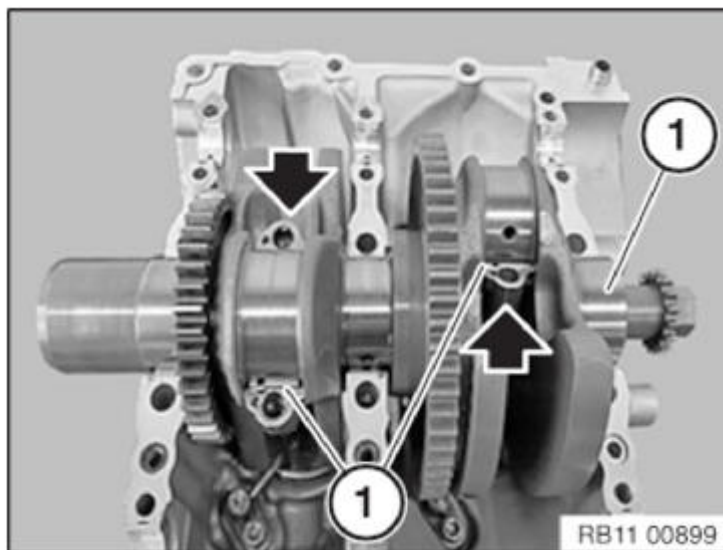
Secure connecting rod (1 and 2) with a second person for inserting the crankshaft.



**Fig. 119: Identifying Connecting Rods**  
Courtesy of BMW OF NORTH AMERICA, INC.

Secure connecting rods (2) in crankshaft (1).

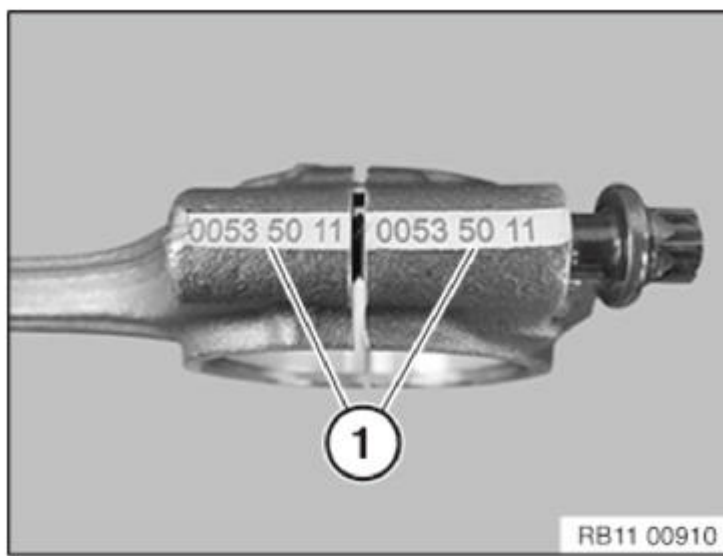
Insert crankshaft (1) in crankcase.



**Fig. 120: Locating Connecting Rods**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pay attention to **IDENTIFICATION** (1) on connecting rod base and connecting rod.





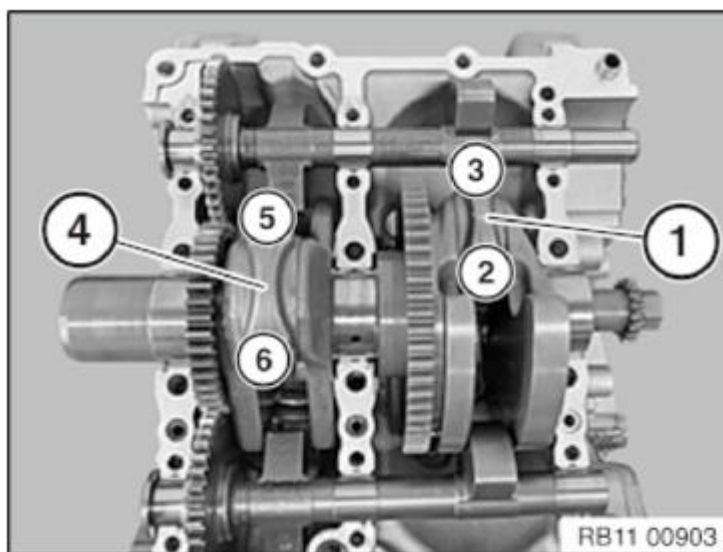
**Fig. 121: Identifying Connecting Rod Identification Number**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position connecting rod bearing cap (1 and 4) according to identification.

Secure connecting rod bolt (2) and 3).

Secure connecting rod bolt (5 and 6).

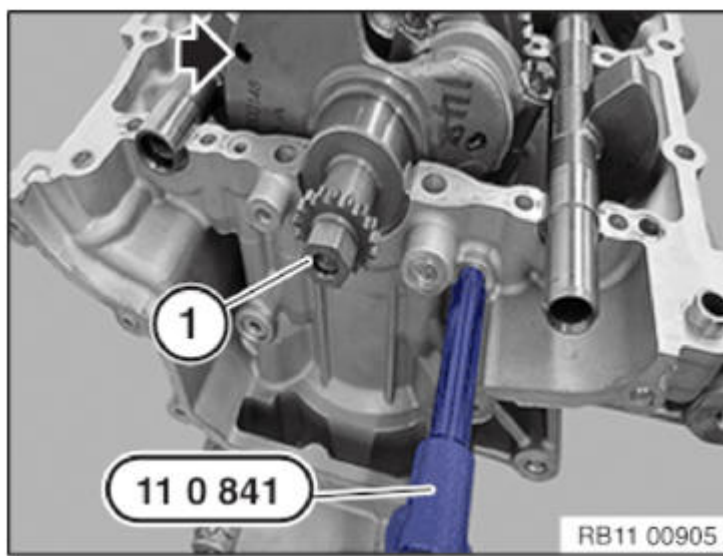
Tightening torque: [11 24 1AZ](#) .



**Fig. 122: Identifying Connecting Rod Bearing Cap And Connecting Rod Bolts**  
Courtesy of BMW OF NORTH AMERICA, INC.

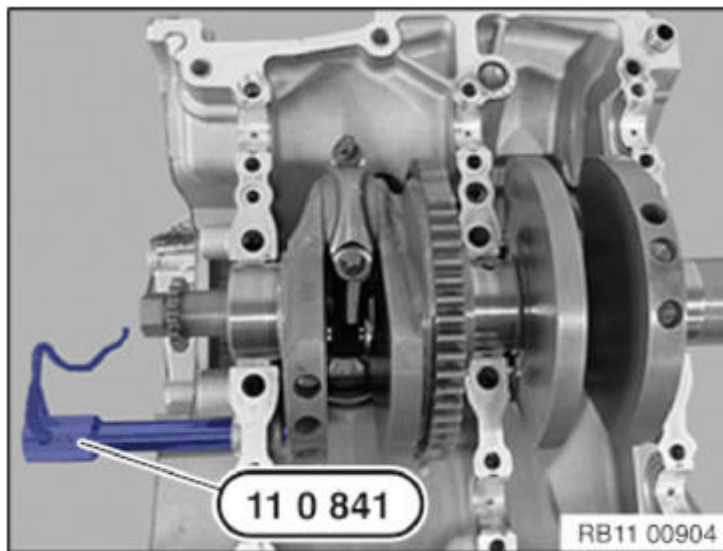
Assemble special tool [11 0 841](#) in crankcase.

Rotate crankshaft at the central bolt (1) until the bore hole (see arrow) of the crank arm is flush with the special tool [11 0 841](#) .



**Fig. 123: Assembling Special Tool (11 0 841) In Crankcase**  
Courtesy of BMW OF NORTH AMERICA, INC.

Secure crankshaft with special tool [11 0 841](#) .

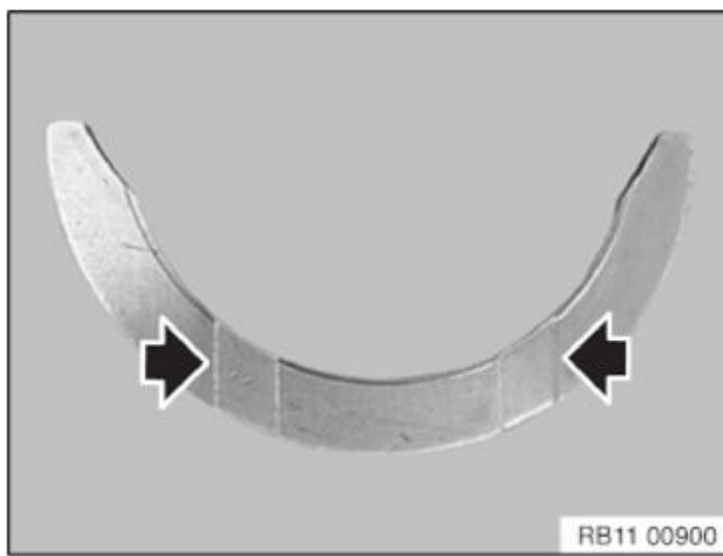


**Fig. 124: Securing Crankshaft With Special Tool (11 0841)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

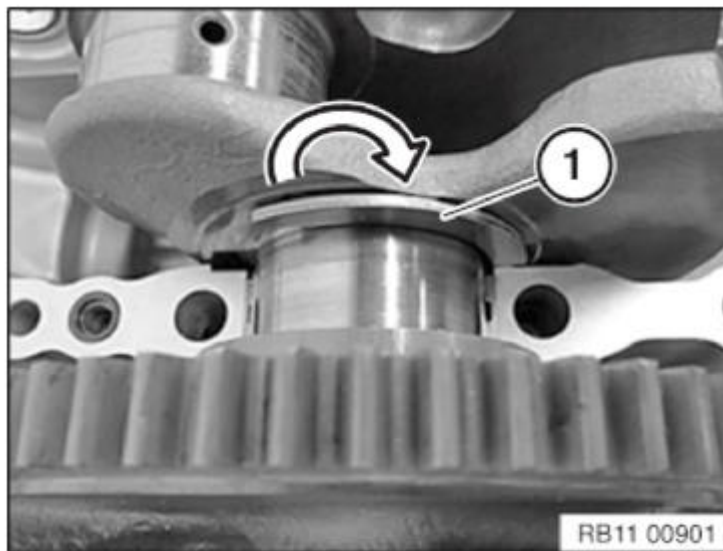
Observe recess of thrust washers.

Recesses must point outwards.



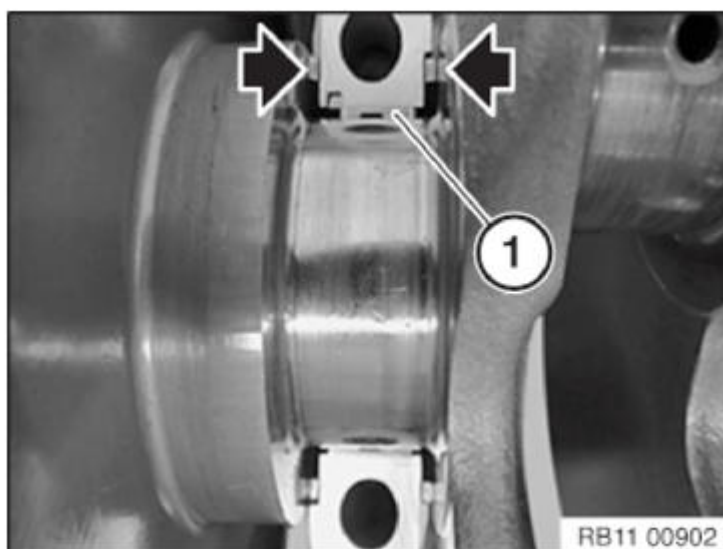
**Fig. 125: Locating Thrust Washers Recess**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw in thrust washer (1) in direction of arrow.



**Fig. 126: Screwing Thrust Washer**  
Courtesy of BMW OF NORTH AMERICA, INC.

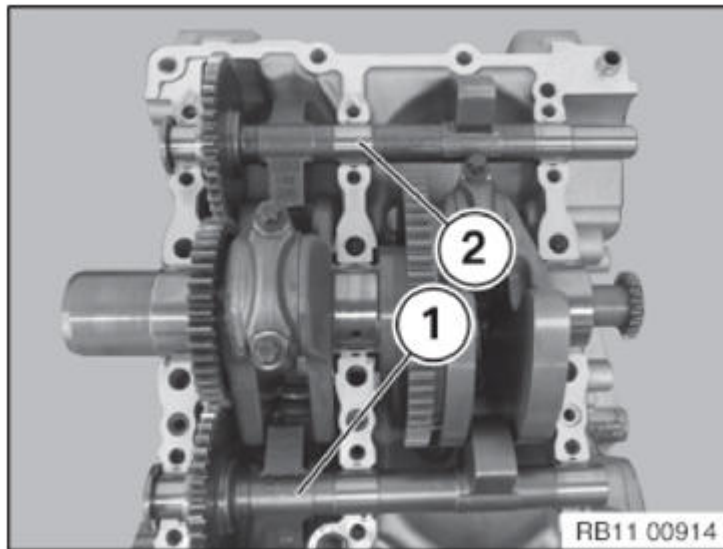
Insert both thrust washers flush to main bearing 2 (see illustration).



**Fig. 127: Locating Thrust Washers**  
Courtesy of BMW OF NORTH AMERICA, INC.

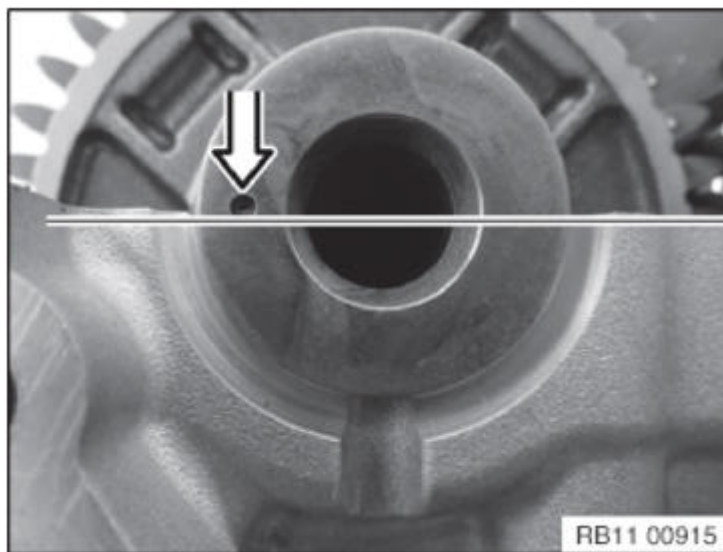
Insert counterbalance shaft (1 and 2).

Pay attention to **COUNTERBALANCE SHAFT BEARING CLASSIFICATIONS.**



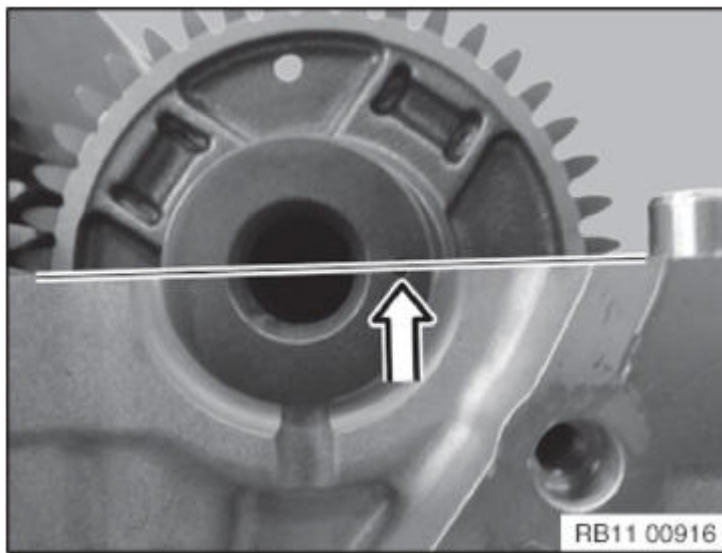
**Fig. 128: Identifying Counterbalance Shafts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert left counterbalance shaft so that bore hole for counterbalance shaft and the edge are aligned with the crankcase on the outside



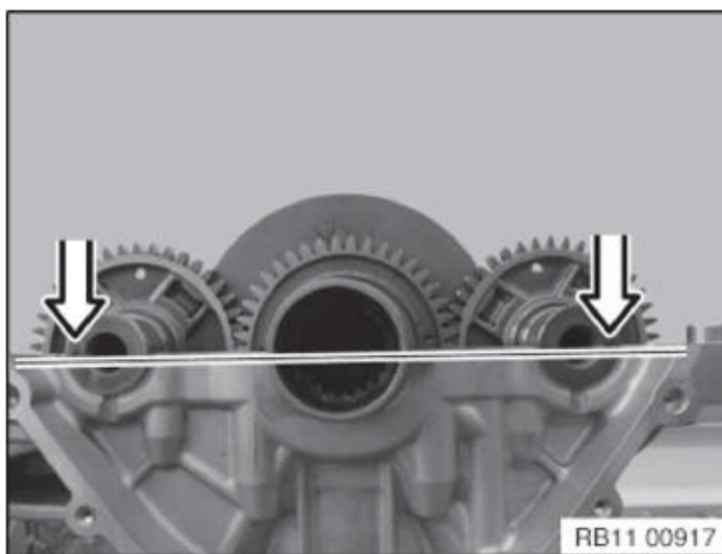
**Fig. 129: Aligning Left Counterbalance Shaft Bore Holes With Crankcase**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert right counterbalance shaft so that bore hole for counterbalance shaft and the edge are aligned with the crankcase on the outside



**Fig. 130: Aligning Right Counterbalance Shaft Bore Holes With Crankcase**  
Courtesy of BMW OF NORTH AMERICA, INC.

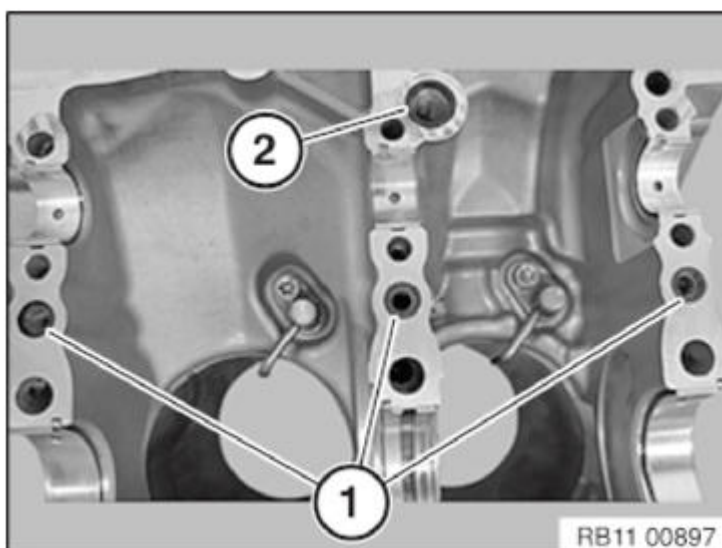
All identifications (bore holes) must be in line with the crankcase.



**Fig. 131: Aligning Bore Holes With Crankcase**  
Courtesy of BMW OF NORTH AMERICA, INC.

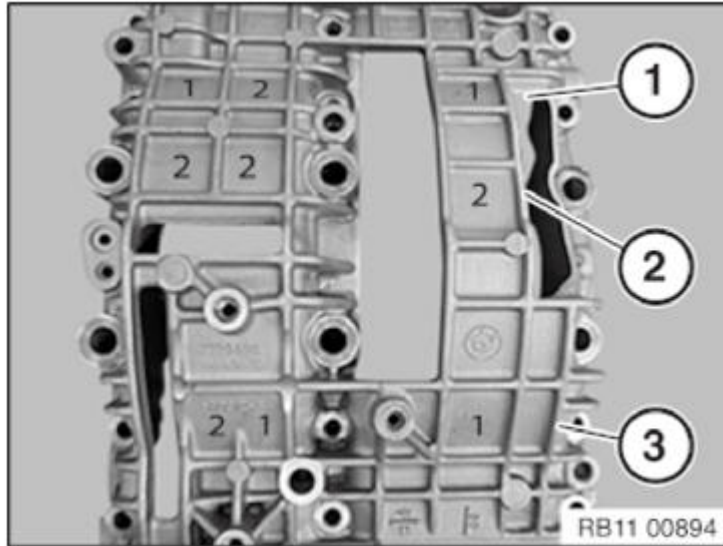
Insert all O-rings (1).

Insert O-ring (2).



**Fig. 132: Identifying O-Rings**  
Courtesy of BMW OF NORTH AMERICA, INC.

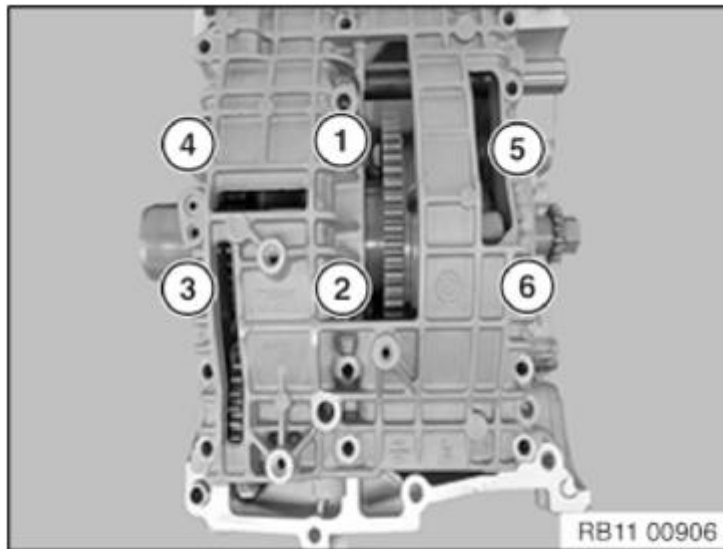
Position bearing frame on crankcase.



**Fig. 133: Identifying Bearing Frame Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws in sequent (1 to 6), observe tightening sequence.

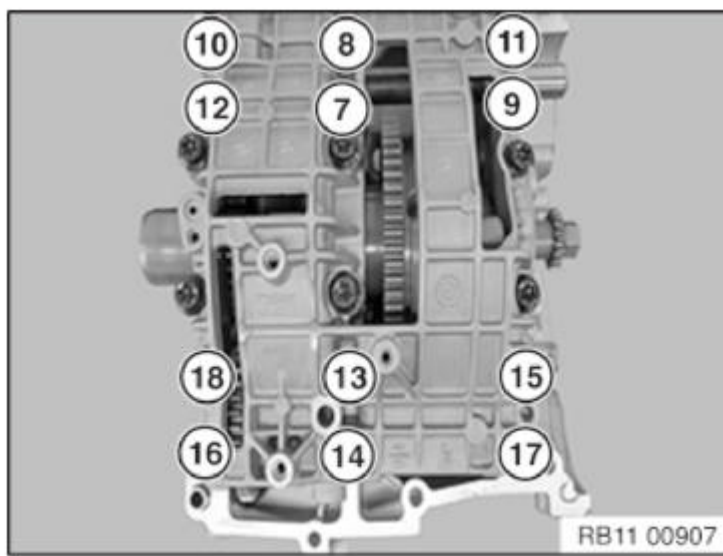
Tightening torque: **11 11 1AZ** .



**Fig. 134: Crankshaft Bolts Tightening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten all screws in sequence (7 to 18), observe tightening sequence.





**Fig. 135: Crankshaft Screws Tightening Sequence**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

**11 21 515 REPLACE TORSION SPLINED SHAFT (W20)**

**Special tools required:**

- [2 285 548](#)
- [2 286 315](#)

**Necessary preliminary tasks:**

- Mount [ENGINE ON ASSEMBLY STAND](#).

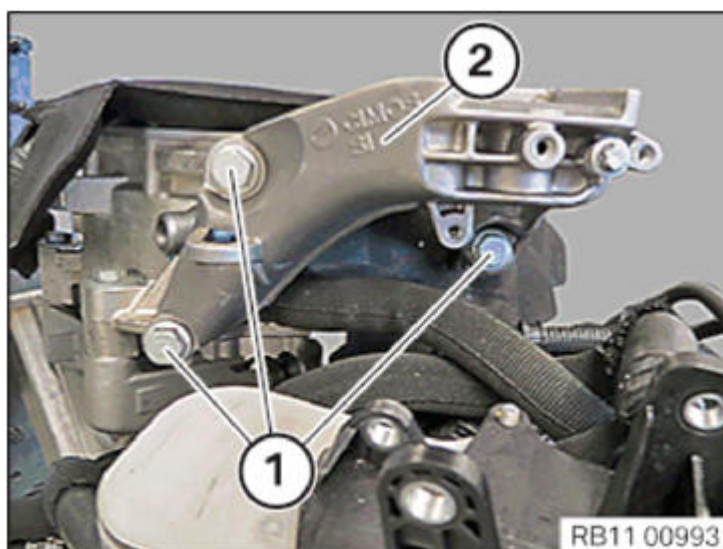
*Installation note:*

Once disassembled, a torsion splined shaft must not be reused.

Reset adaptation values after replacing the torsion splined shaft.

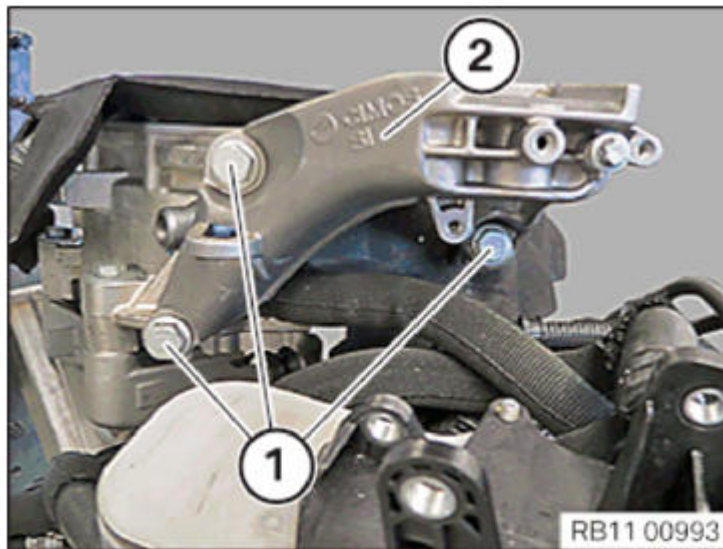
Risk of damage to engine and range extender electrical machine during operation.

Release screws (1) and take off engine support arm (2).



**Fig. 136: Identifying Engine Support Arm And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

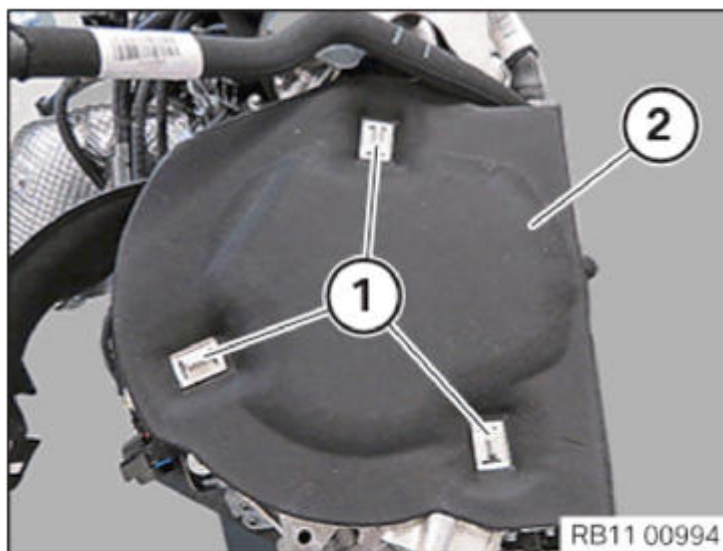
Release screws (1) and take off engine support arm (2).



**Fig. 137: Identifying Engine Support Arm And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

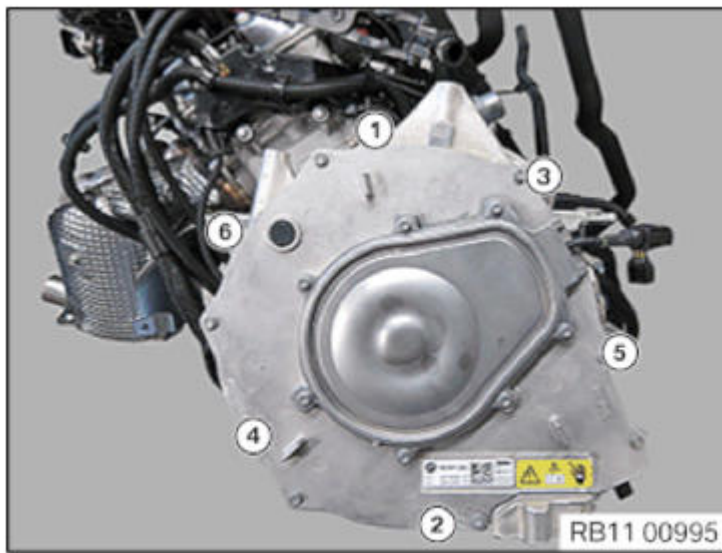
Lever out holding clamps (1).

Remove sound insulation (2).



**Fig. 138: Identifying Sound Insulation And Holding Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws in sequence (1 to 6).



**Fig. 139: Torsion Splined Shaft Screws Tightening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tool [2 285 548](#) M10 into bolting points (1, 4 and 5), hand-tight, as far as it will go.

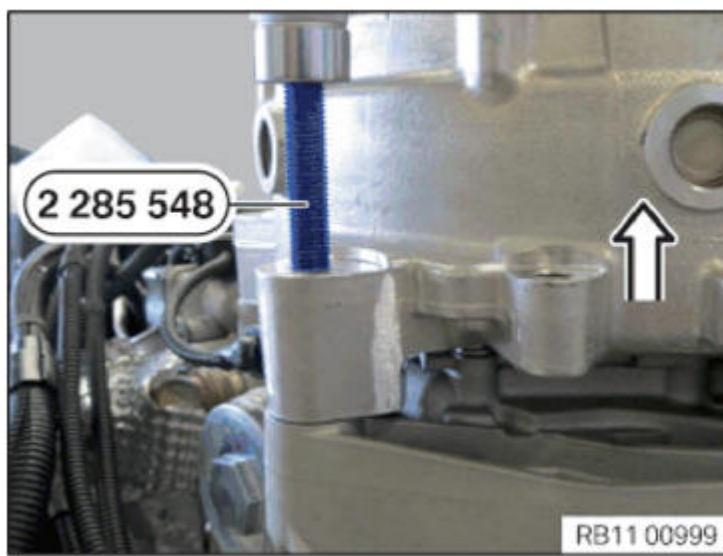


**Fig. 140: Screwing Special Tool (2 285 548) Into Bolting Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

To extract the range extender electrical machine, screw the special tool [2 285 548](#) into bolting points (1, 4 and 5).

Special tool

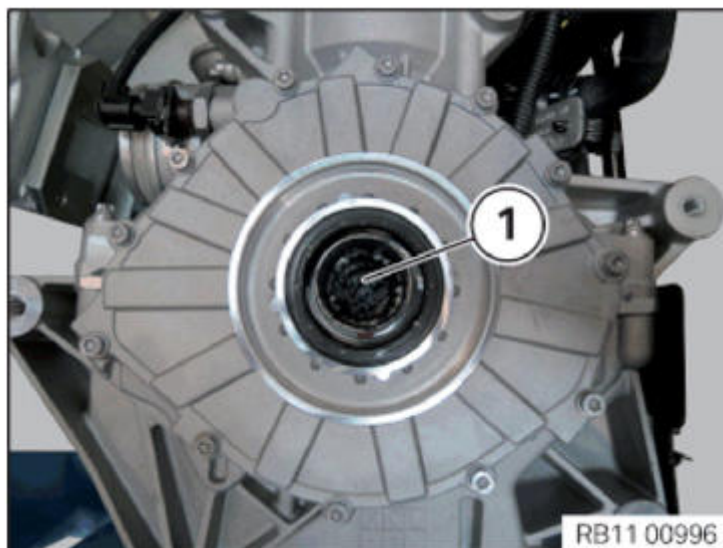
Uniformly pull off range extender electrical machine in 360° steps until the torsion splined shaft releases.



**Fig. 141: Pulling Off Range Extender Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check crankshafts and generator gearing for damage and if necessary clean metal residues (debris) on the tooth flanks.

Replace **RADIAL SHAFT SEAL**.



**Fig. 142: Identifying Radial Shaft Seal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Sealing sleeve (1) with clamping ring

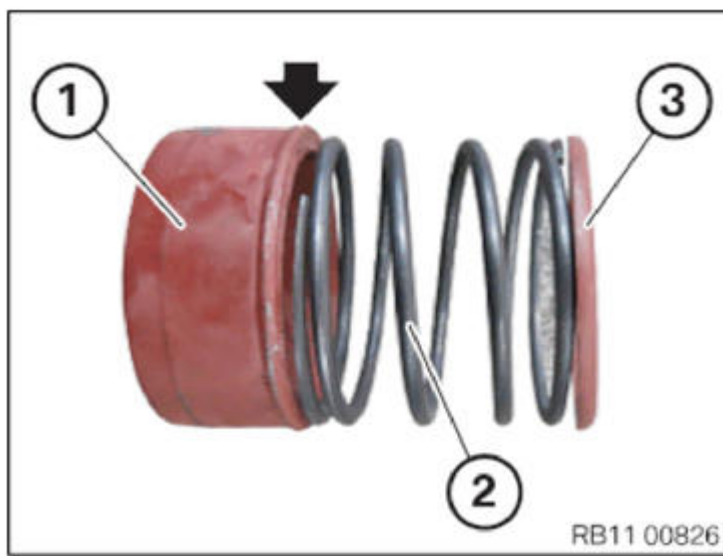
Length compensation spring (2)

Valve seat insert (3)

*Installation note:*

Always renew sealing sleeve (1) and valve seat insert (3).





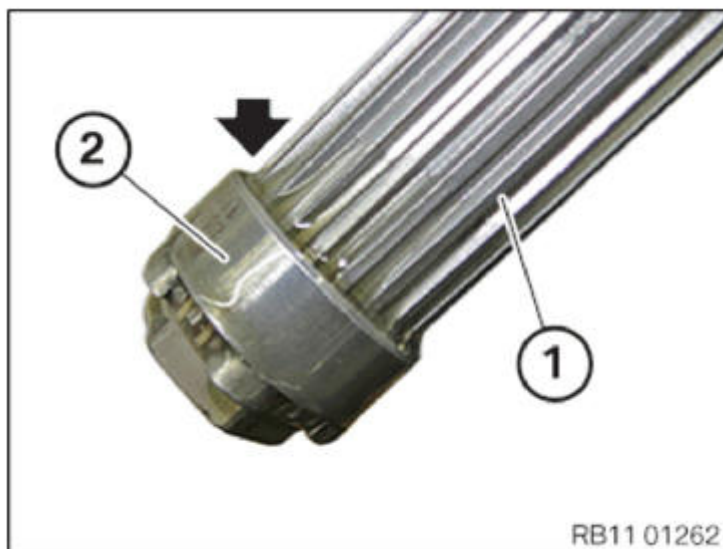
**Fig. 143: Locating Sealing Sleeve**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace torsion splined shaft (1).

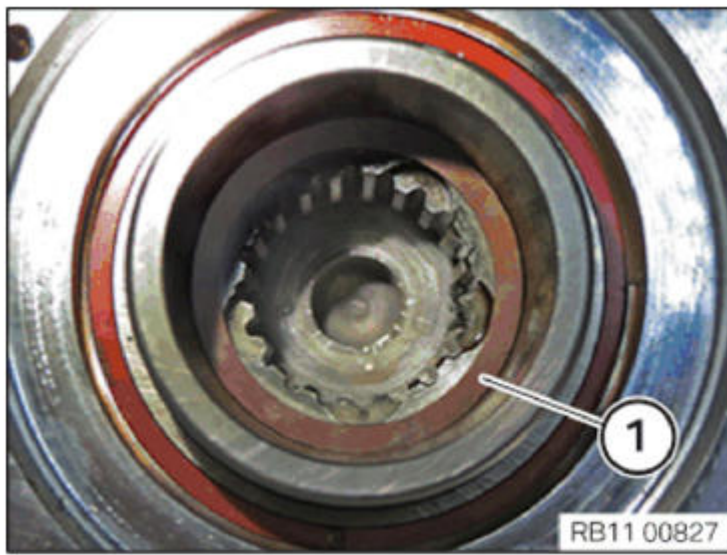
Coat torsion splined shaft (1) at both ends (2) with sufficient engine oil.



**Fig. 144: Locating Torsion Splined Shaft End**

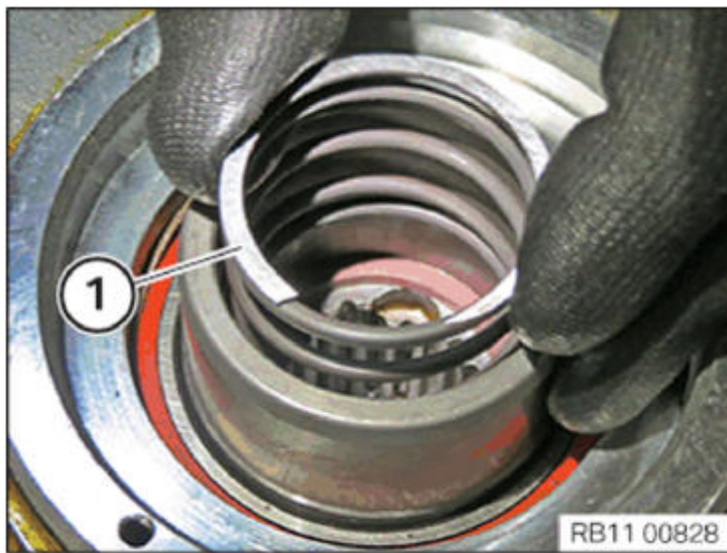
Courtesy of BMW OF NORTH AMERICA, INC.

Insert valve seat insert (1) in the alternator with the rounded area downwards.



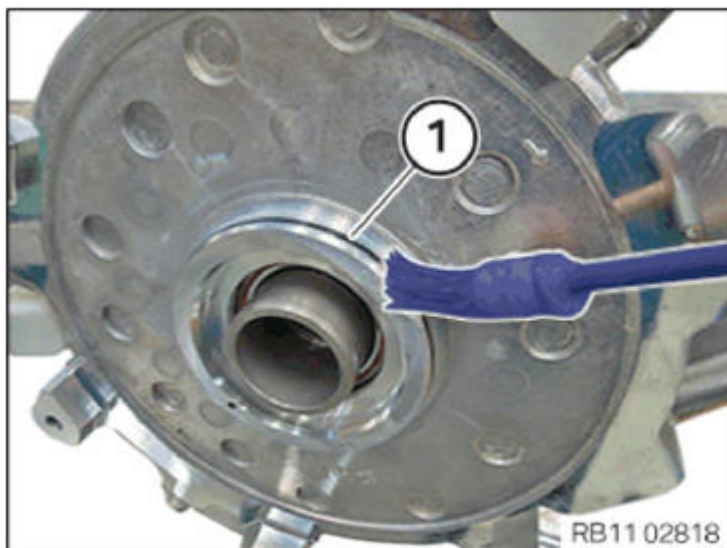
**Fig. 145: Identifying Valve Seat Insert**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert length compensation spring (1).



**Fig. 146: Inserting Length Compensation Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

Grease the O-ring on the alternator (1) with [4.9](#) grease.



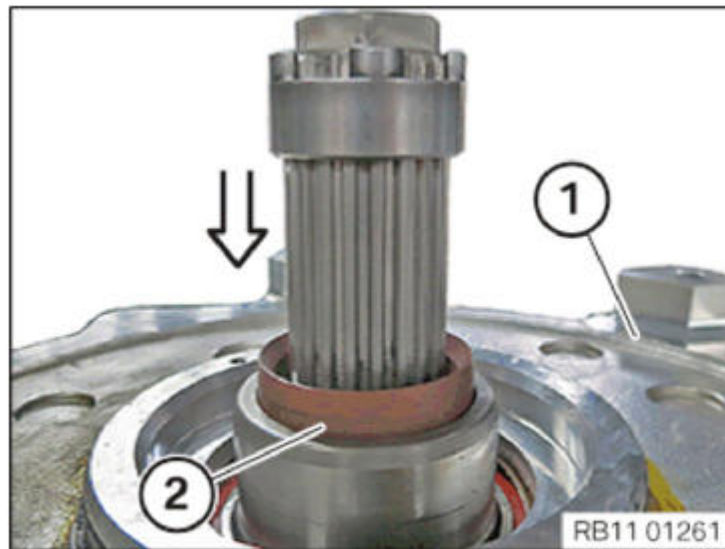


**Fig. 147: Greasing O-Ring On Alternator**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push sealing sleeve (2) and clamping ring down in the alternator (1).

Insert torsion splined shaft in direction of arrow.

During joining, position in such a way that the 5 crowns of the clamping sleeve match the 5 alternator shaft pockets.

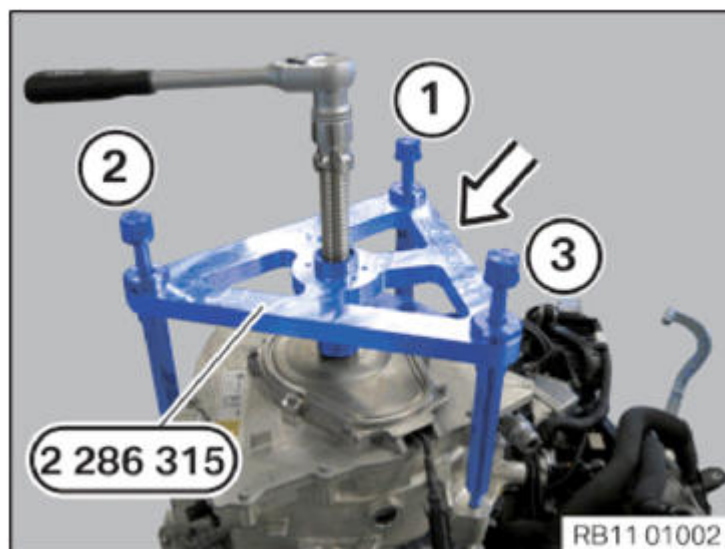


**Fig. 148: Pushing Sealing Sleeve And Clamping Ring Down In Alternator**  
Courtesy of BMW OF NORTH AMERICA, INC.

Mount range extender electrical machine and torsion splined shaft.

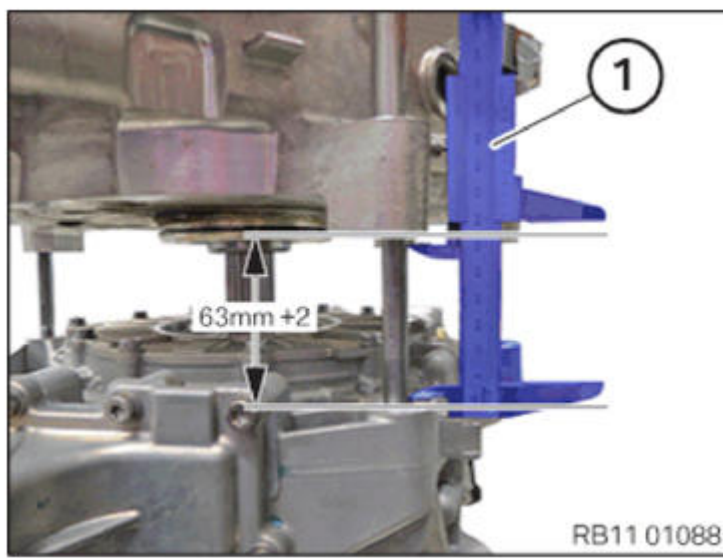
Position the range extender electrical machine during joining in such a way that the 5 crowns of the clamping sleeve match the 5 crankshaft pockets.

Align special tool [2 286 315](#) with notch on housing facing cylinder head and screw in at crankcase until hand-tight.



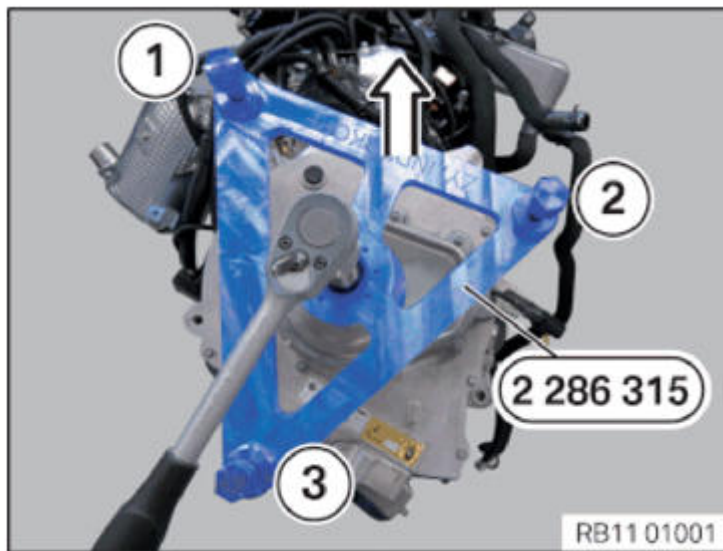
**Fig. 149: Aligning Special Tool (2 286 315) With Notch On Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Measure distance between both housing halves by means of a caliper gauge (1) **63 mm** and re-align the range extender electrical machine if necessary.



**Fig. 150: Measuring Distance Between Both Housing Halves With Caliper Gauge**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Screw in mounting bolts 1, 2 and 3 on engine block with 15 Nm.

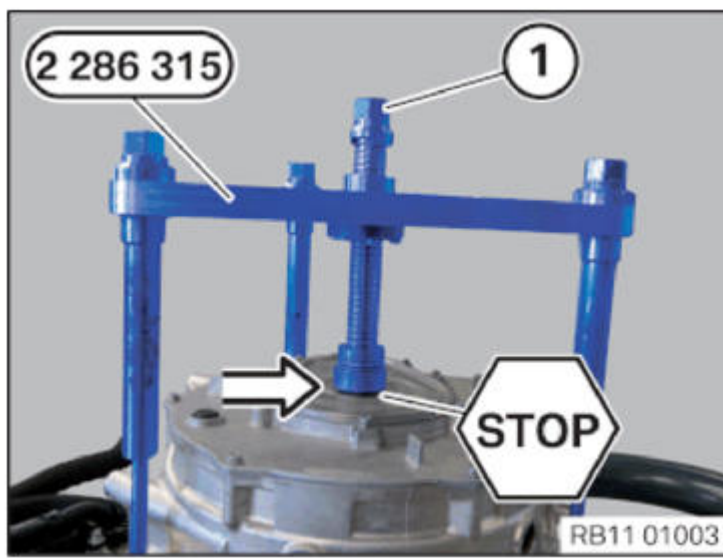


**Fig. 151: Screwing Mounting Bolts On Engine Block**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage! On range extender electrical machine.

Join engine and range extender electrical machine with a torque of **12.5 Nm** by means of special tool [2 286 315](#) to a distance of **5 mm** .

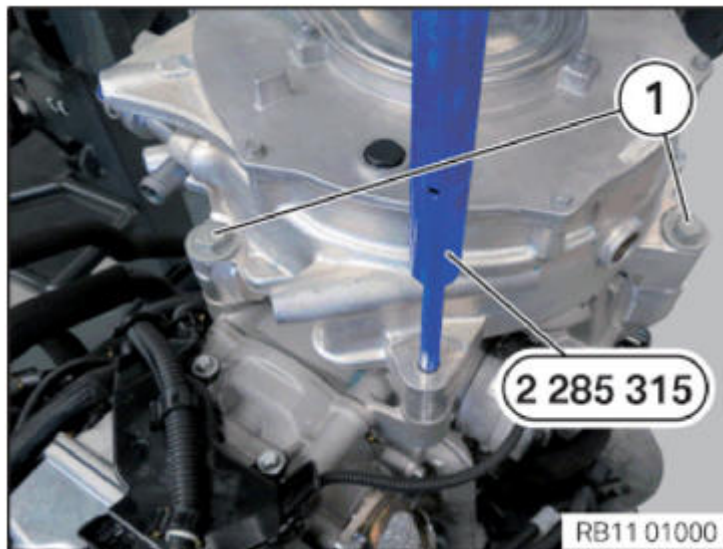
IMPORTANT: Connect range extender electrical machine to spindle (1) with special tool [2 286 315](#) with **MAXIMUM 7.5 Nm** , leaving no gap.



**Fig. 152: Joining Engine And Range Extender Electrical Machine Using Special Tool (2 286 315)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert 3 x screws (1) and tighten with 10 Nm.

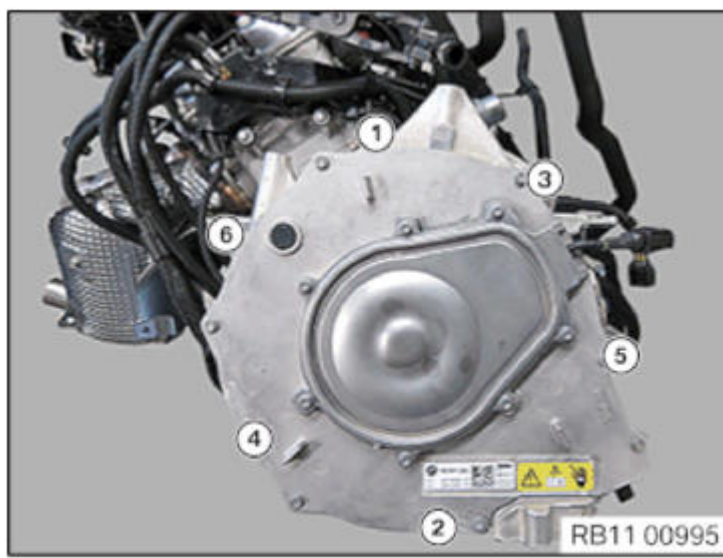
Remove special tool [2 286 315](#) .



**Fig. 153: Removing Special Tool (2 286 315)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws in sequence (1 to 6).

Tightening torque: [12 35 9AZ](#) .



**Fig. 154: Torsion Splined Shaft Screws Tightening Sequence**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Reset adaptation values.

**11 21 535 REPLACING ALL CRANKSHAFTS AND BEARING SHELLS OF THE COUNTERBALANCE SHAFT (W20)**

*Necessary preliminary tasks:*

- Remove bearing frame.

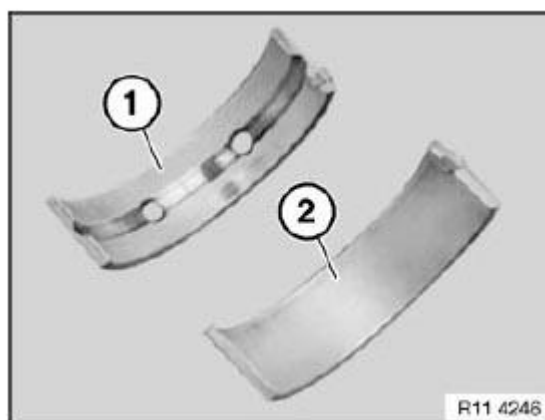
*Installation note:*

**The number and letter combination produces a bearing shell pairing.**

Bearing shell (1) with lubricating groove

Bearing shell (2) without lubricating groove.

IMPORTANT: Adhere to bearing position as specified in the table.



**Fig. 155: Identifying Bearing Shell With/Without Lubricant Groove**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Main bearing classification of crankcase, crankshaft:**

Code numbers 1, 2 or 3 are used for the upper section of the crank case.

For the respective bearing seat assignment (2), the code numbers

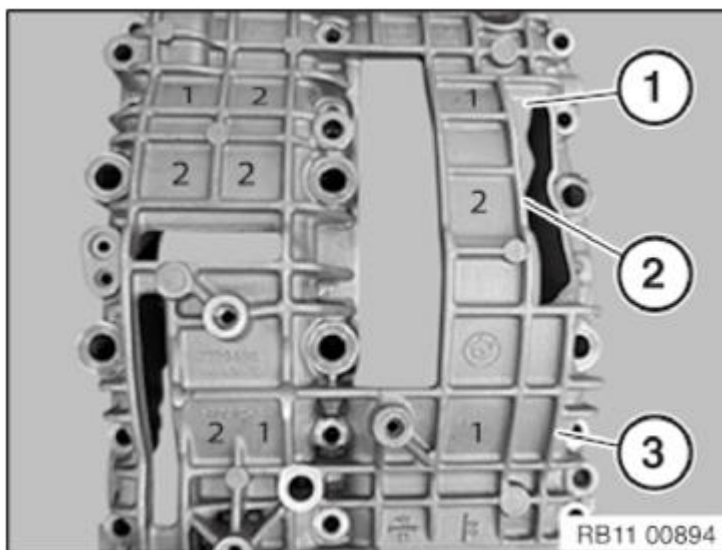
2 2 2 are printed on the bearing frame.

**Main bearing classification of crankcase, counterbalance shaft:**

Code numbers 1 or 2 are used for the upper section of the crank case.

For the respective bearing seat assignment (1), the code numbers 1 2 1 are printed on the bearing frame.

For the respective bearing seat assignment (3), the code numbers 2 1 1 are printed on the bearing frame.



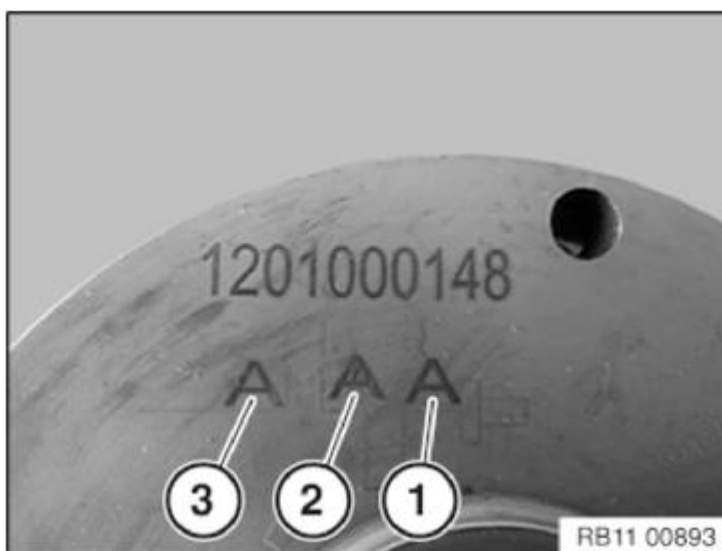
**Fig. 156: Identifying Bearing Frame Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**Main bearing classification of bearing frame, crankshaft:**

Crankshaft code letters A, B or C are used.

Bearing seat assignment 1 to 3; the first bearing position is located on the actuator drive.



**Fig. 157: Identifying Crankshaft Code Letters And Bearing Seat Assignment**

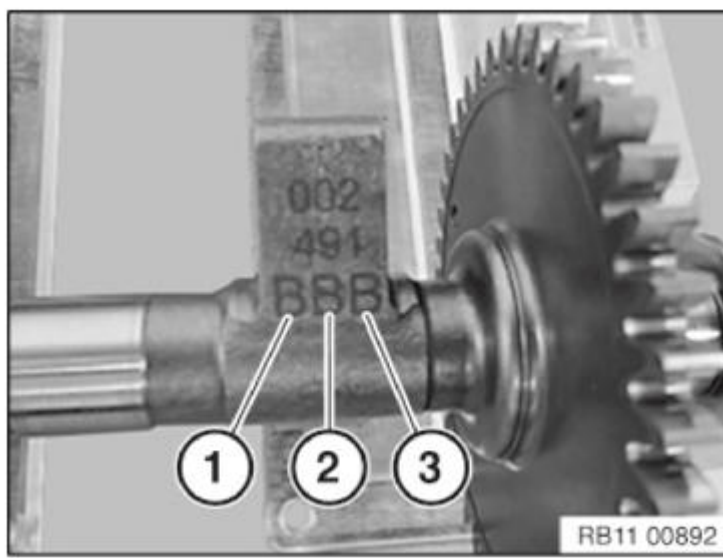
Courtesy of BMW OF NORTH AMERICA, INC.

**Counterbalance shaft bearing frame:**

Counterbalance shaft code letters A or B are used.

Bearing seat assignment 1 to 3; the first bearing position is located on the actuator drive side.





**Fig. 158: Identifying Counterbalance Shaft Code Letters And Bearing Seat Assignment**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

**The number and letter combination produces a bearing shell pairing.**

**IMPORTANT:** Engine damage will result if an insufficiently small radial clearance is determined. If a large radial clearance is determined, this can lead to noise in crankshaft drive.

**Code numbers on bearing frame:**

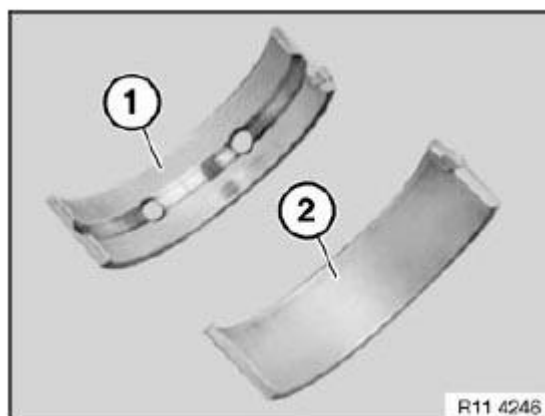
Code number **1** = bearing shell (1), yellow, with lubricating groove and without lubricating groove.

Code number **2** = bearing shell (1), brown, with lubricating groove and without lubricating groove.

Code number **3** = bearing shell (1), blue, with lubricating groove and without lubricating groove.

**Code letters on the crankshaft:**

Code letter **A** = bearing shell (2), blue, without lubricating groove.



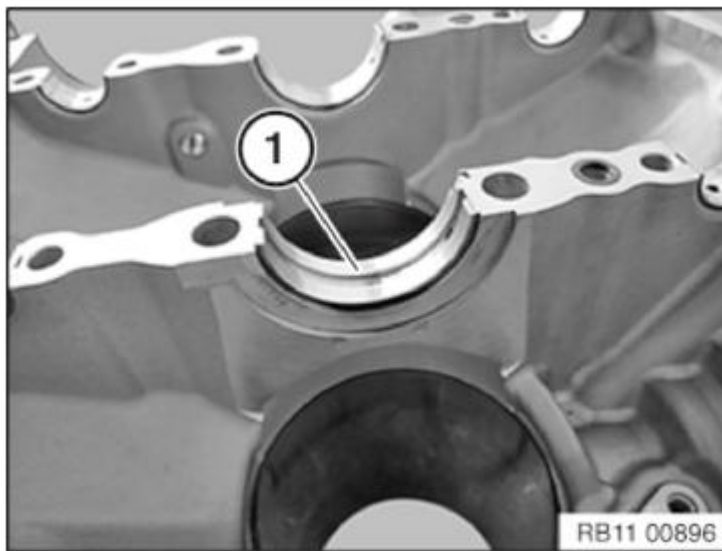
**Fig. 159: Identifying Bearing Shell With/Without Lubricant Groove**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Code letter **B** = bearing shell (2), brown, without lubricating groove.

Code letter **C** = bearing shell (2), yellow, without lubricating groove.

**IMPORTANT:** Bearing shell (1) with lubricating groove at bearing seat 2.





**Fig. 160: Identifying Bearing Shell**  
 Courtesy of BMW OF NORTH AMERICA, INC.

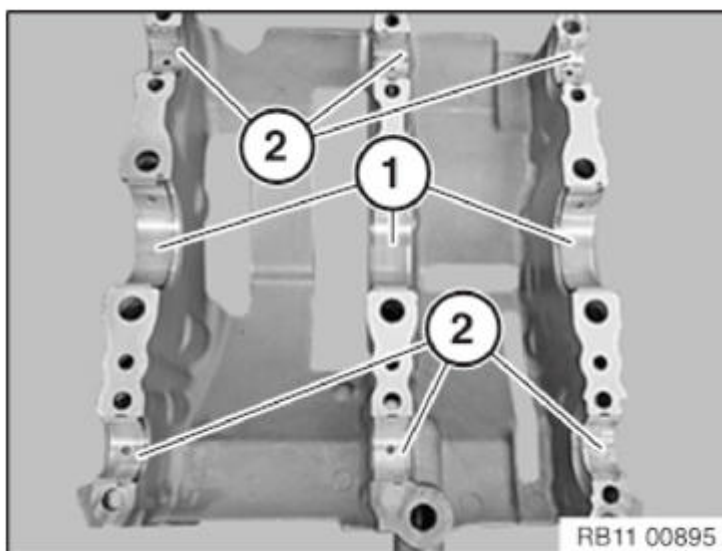
*Installation note:*

Bearing of crankshaft in crankcase (1) .

**Installation example: Crankshaft:**

Crankcase/bearing frame.

With code number **2** on the **bearing frame** and code letter **A** on the **crankshaft** , a bearing shell with the color **brown** is required for the **upper section of the crankcase** and a bearing shell with the color **blue** is required for the **bearing frame** .



**Fig. 161: Identifying Bearing Classification**  
 Courtesy of BMW OF NORTH AMERICA, INC.

For examples, see above.

Bearing 1: **2** and **A** in brown and blue.

Bearing 2: **2** and **A** the colors brown with lubricating groove and blue without lubricating groove.

Bearing 3: **2** and **A** in brown and blue.

**CRANKCASE AND BEARING FRAME DESCRIPTION**

(1/A) crankcase/yellow	(1/B) crankcase/yellow	(1/C) crankcase/yellow
(1/A) bearing frame/blue	(1/B) bearing frame/brown	(1/C) bearing frame/yellow

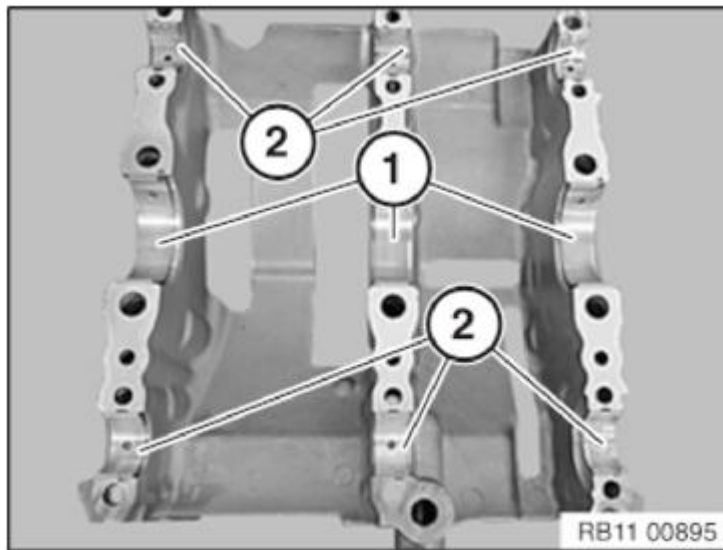
(1/A) crankcase/yellow	(1/B) crankcase/yellow	(1/C) crankcase/yellow
Â		
(2/A) crankcase/brown	(2/B) crankcase/brown	(2/C) crankcase/brown
(2/A) bearing frame/blue	(2/B) bearing frame/brown	(2/C) bearing frame/yellow
Â		
(3/A) crankcase/blue	(3/B) crankcase/blue	(3/C) crankcase/blue
(3/A) bearing frame/blue	(3/B) bearing frame/brown	(3/C) bearing frame/yellow

### Installation example: Counterbalance shafts

Crankcase/bearing frame.

*Installation note:*

Bearing of counterbalance shafts in crankcase (2) .



**Fig. 162: Identifying Bearing Classification**

Courtesy of BMW OF NORTH AMERICA, INC.

With code number **1** on the **bearing frame** and code letter **B** on the **counterbalance shaft** , a bearing shell with the color **red** is required for the **upper section of the crankcase** and a bearing shell with the color **red** is required for the **bearing frame** .

For examples, see above.

Bearing 1: **1** and **B** in red and red.

Bearing 2: **2** and **B** in blue and red.

Bearing 3: **1** and **B** in red and red.

Bearing 1: **2** and **B** in blue and red.

Bearing 2: **1** and **B** in red and red.

Bearing 3: **1** and **B** in red and red.

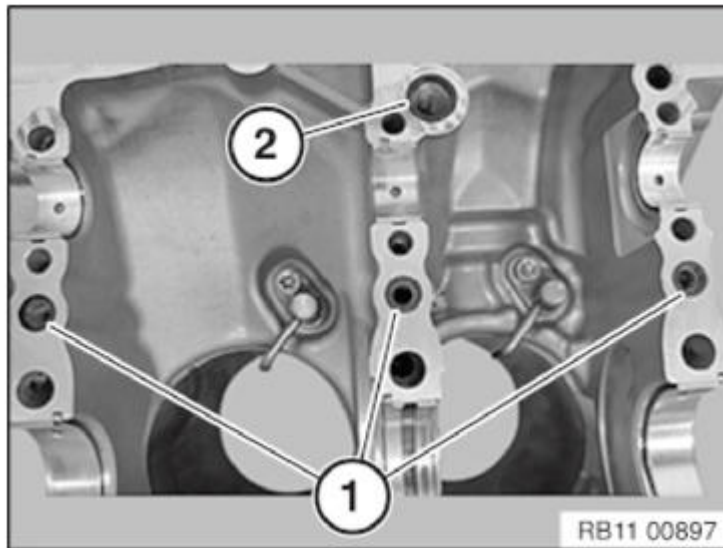
### CRANKCASE AND BEARING FRAME DESCRIPTION

(1/A) crankcase/blue	(1/B) crankcase/red
(1/A) bearing frame/red	(1/B) bearing frame/red
Â	
(2/A) crankcase/blue	(2/B) crankcase/blue
(2/A) bearing frame/blue	(2/B) bearing frame/red

IMPORTANT: Internal leakage, O-rings must always be replaced.

Insert O-rings (1).

Insert O-ring (2).

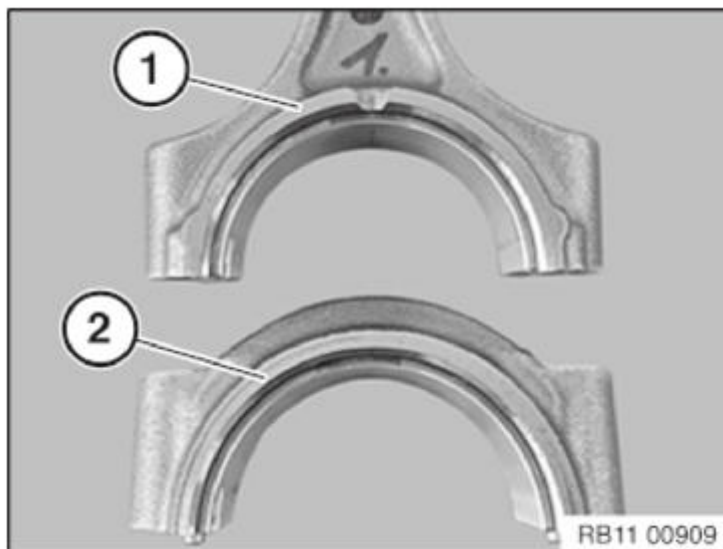


**Fig. 163: Identifying O-Rings**

Courtesy of BMW OF NORTH AMERICA, INC.

Insert connecting rod (1), brown.

Insert connecting rod bearing cap (2), blue.

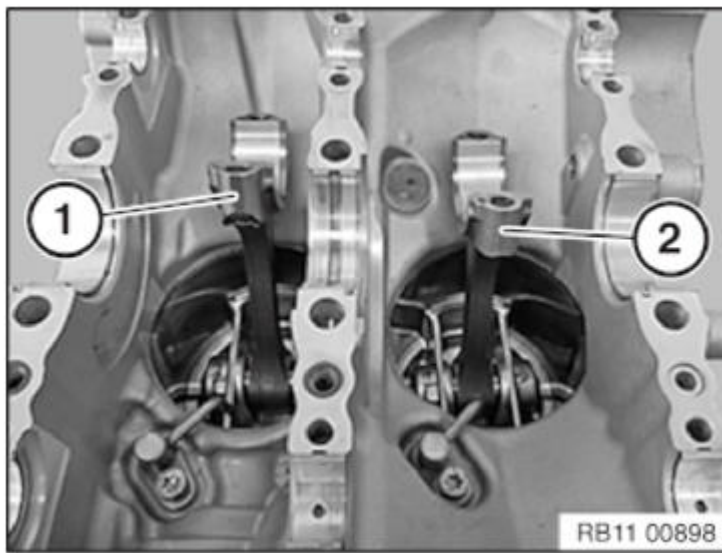


**Fig. 164: Identifying Connecting Rod And Bearing Cap**

Courtesy of BMW OF NORTH AMERICA, INC.

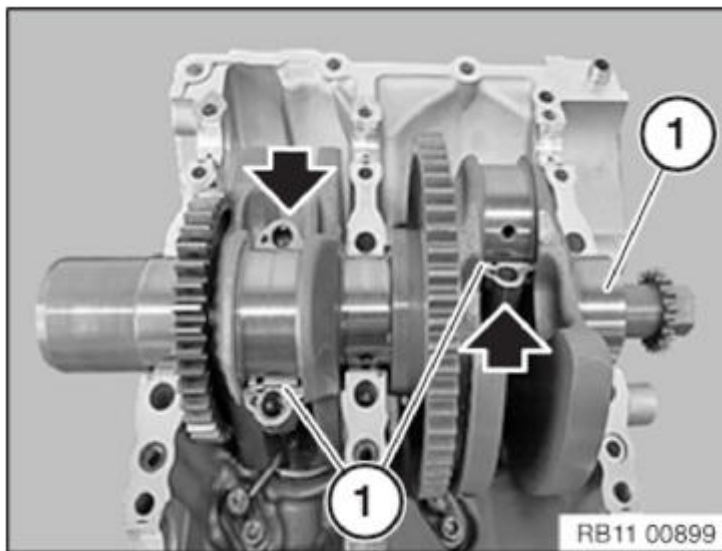
Coat all bearing positions with engine oil.

IMPORTANT: Have another person hold the connecting rods (1 and 2), risk of damage!



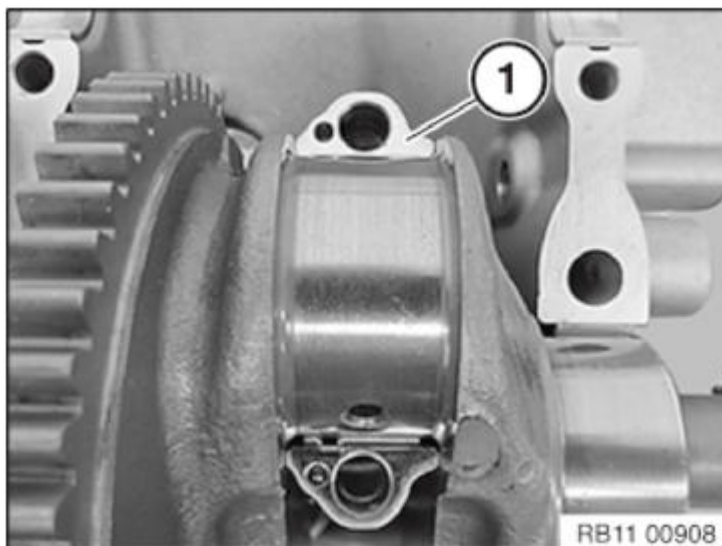
**Fig. 165: Identifying Connecting Rods**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert crankshaft (1), position connecting rod (2).



**Fig. 166: Locating Connecting Rods**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position connecting rod (1) on crankpin of crankshaft in a form-fit manner.



**Fig. 167: Identifying Connecting Rod**  
Courtesy of BMW OF NORTH AMERICA, INC.

Mount **CONNECTING ROD AND BEARING FRAME**.

Assemble engine.

## **CONNECTING ROD BEARING SHELLS**

### **11 24 571 REPLACING ALL CONNECTING ROD BEARING SHELLS (W20)**

**Special tools required:**

- 00 9 120

*Necessary preliminary tasks:*

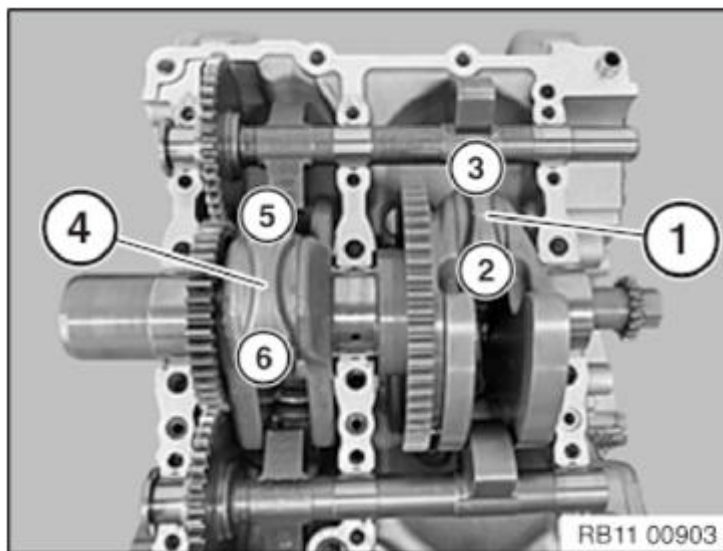
- Remove **CRANKSHAFT WITH COUNTERBALANCE SHAFTS**.

Release connecting rod bolts (2 and 3).

Remove connecting rod bearing cap (1).

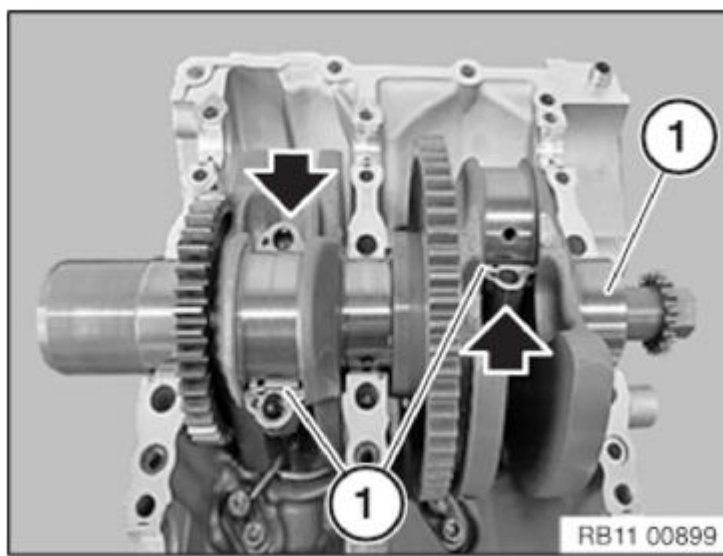
Release connecting rod bolts (5 and 6).

Remove connecting rod bearing cap (4).



**Fig. 168: Identifying Connecting Rod Bearing Cap And Connecting Rod Bolts**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Risk of damage** to cylinder wall and to crankshaft.  
**IMPORTANT:** Gently release connecting rod from crankshaft.  
Lift out crankshaft (1).



**Fig. 169: Locating Connecting Rods**

Courtesy of BMW OF NORTH AMERICA, INC.

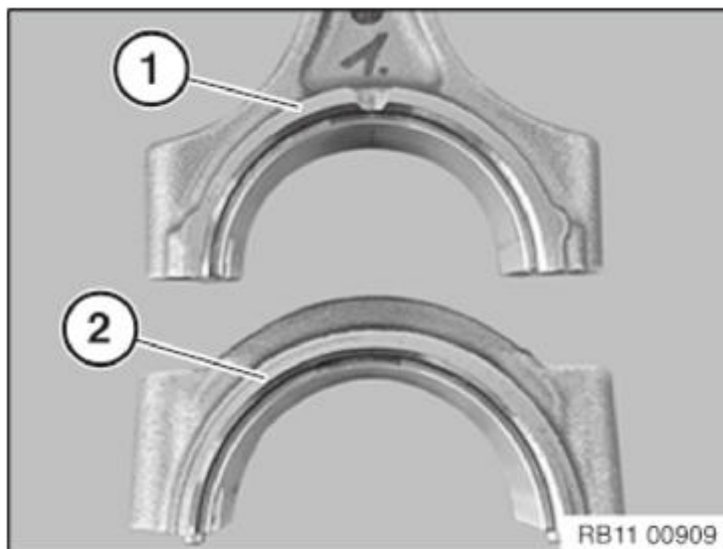
*Installation note:*

Pay attention to guide lugs during installation.

Insert conrod bearing shells (1 and 2).

Connecting rod (1) bearing shell color **brown** .

Connecting rod bearing cap (2) bearing shell color **blue** .



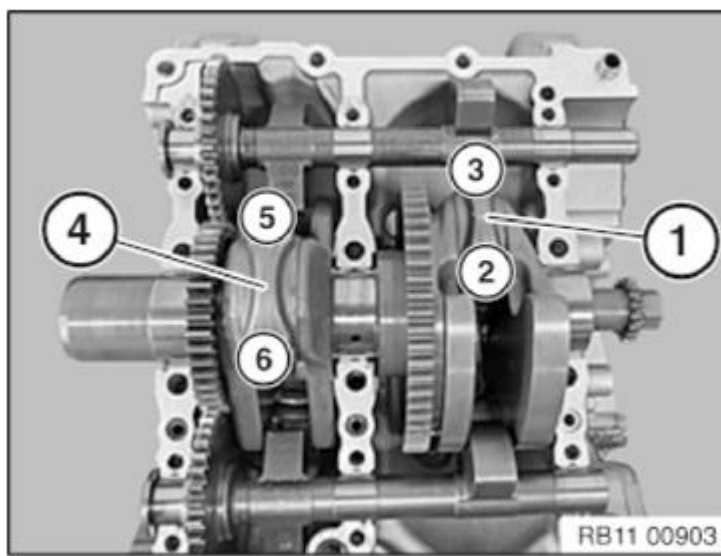
**Fig. 170: Identifying Connecting Rod And Bearing Cap**

Courtesy of BMW OF NORTH AMERICA, INC.

Tighten all connecting rod bolts with special tool 00 9 120.

Tightening torque [11 24 1AZ](#) .





**Fig. 171: Identifying Connecting Rod Bearing Cap And Connecting Rod Bolts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

## PISTON WITH RINGS AND PIN

### 11 25 530 REMOVING AND INSTALLING/REPLACING ALL PISTONS (W20)

Special tools required:

- 11 5 721 See [115721 BUSH](#) or [115721 BUSH](#)

**WARNING:** Safety goggles must be worn when performing repair work on the piston pin circlip.

If pistons, connecting rods and bearing shells are reused, they must be reinstalled in the same places.

Piston and gudgeon pins are paired and must not be fitted individually.

**IMPORTANT:** Individual connecting rod replacement is not permitted; they are classified by weight class.

Connecting rods and connecting rod bearing caps are marked with the same pairing letters; mixing them up will result in engine damage.

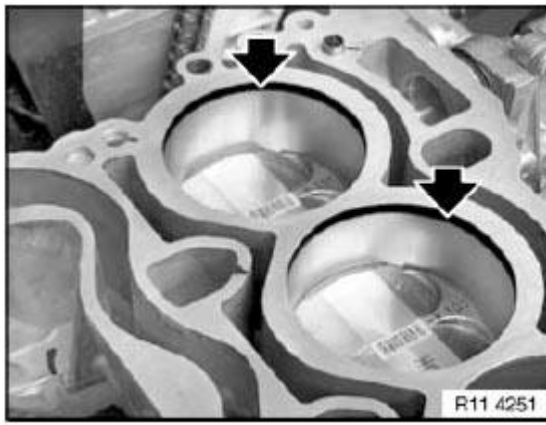
*Necessary preliminary tasks:*

- Remove [COMPLETE DRIVE UNIT \(RANGE EXTENDER\)](#).
- Remove [ENGINE FROM DRIVE UNIT](#).
- Mount engine on [ASSEMBLY STAND](#).
- Remove [INTAKE PLENUM](#).
- Remove [CYLINDER HEAD](#).
- Remove [OIL SUMP](#).
- Remove [OIL PUMP](#).
- Remove [LOWER SECTION OF CRANKCASE](#).

**NOTE:** In event of heavy oil carbon residue:

Carefully remove oil carbon residue from cylinder wall.

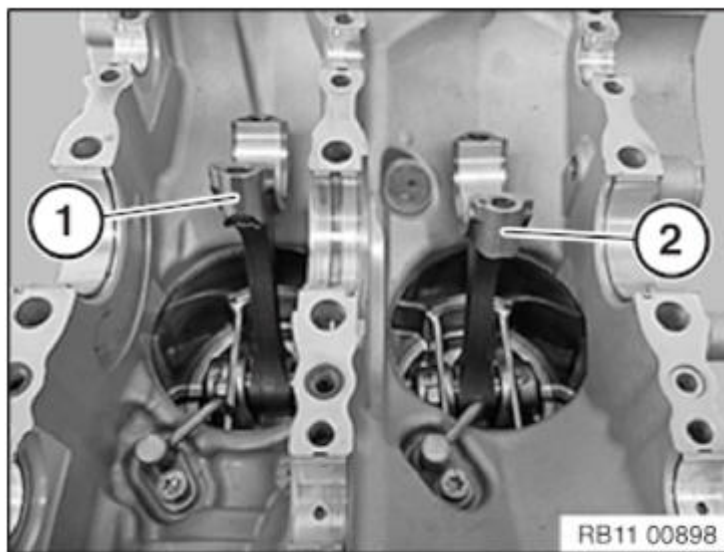
**NOTE:** Illustration shows N46 engine.



**Fig. 172: Locating Oil Carbon Residue On Cylinder Wall**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: **OIL SPRAY NOZZLE** (2) must not be maladjusted or bent.

Press out pistons downwards with connecting rod (1 and 2).

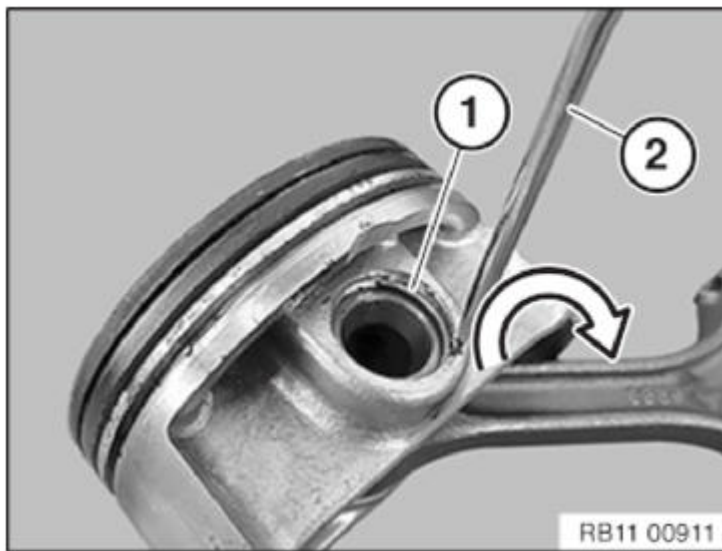


**Fig. 173: Identifying Connecting Rods**  
Courtesy of BMW OF NORTH AMERICA, INC.

**WARNING:** Safety goggles must be worn for the next operation.

**WARNING:** Safety goggles must be worn.

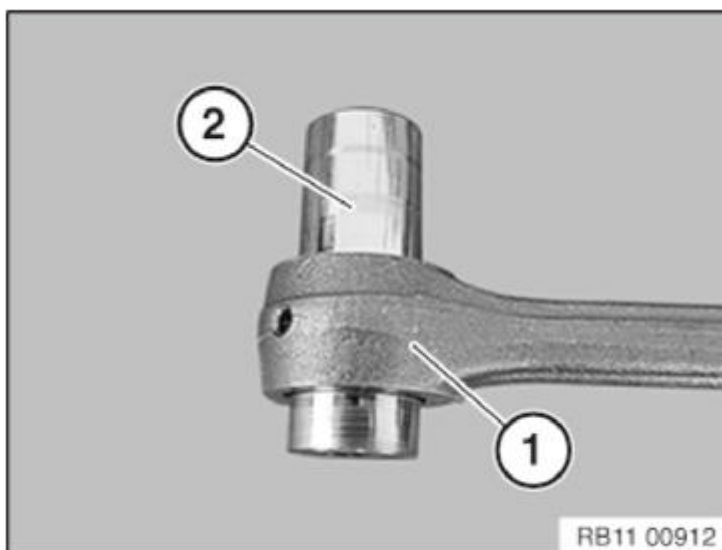
Lever out gudgeon pin circlip (1) with screwdriver (2) in direction of arrow.



**Fig. 174: Levering Out Gudgeon Pin Circlip With Screwdriver**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

The gudgeon pin (2) must be able to be pressed through the bush (1) by hand with little force and must not display any significant play.

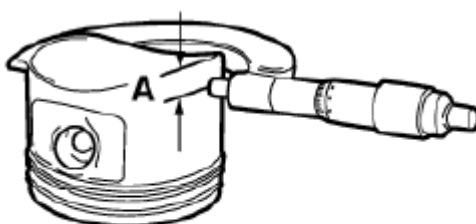


**Fig. 175: Identifying Gudgeon Pin And Bush**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Measuring **PISTON INSTALLATION CLEARANCE** :

Measure piston diameter with micrometer at measuring point A from lower edge of piston and offset at 90° to the axis of the gudgeon pin.

Piston diameter at measuring point A.



**Fig. 176: Measuring Piston Diameter Using Micrometer**  
Courtesy of BMW OF NORTH AMERICA, INC.

Adjust micrometer to cylinder bore of engine block. Set internal measuring device on micrometer to zero. Measure bottom, center and top of cylinder bore in direction of travel and direction of rotation.

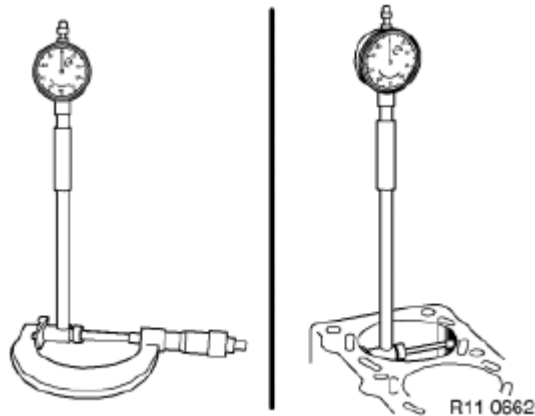
Diameter of cylinder bore.

Piston installation clearance.

For diameter of cylinder bore, piston installation clearance, and permissible total wear tolerance, see **ENGINE BLOCK/CYLINDER CRANKCASE** and **PISTONS WITH RINGS/PINS**.

*Installation note:*

**If necessary, replace piston.**



**Fig. 177: Measuring Cylinder Bore Diameter**  
Courtesy of BMW OF NORTH AMERICA, INC.

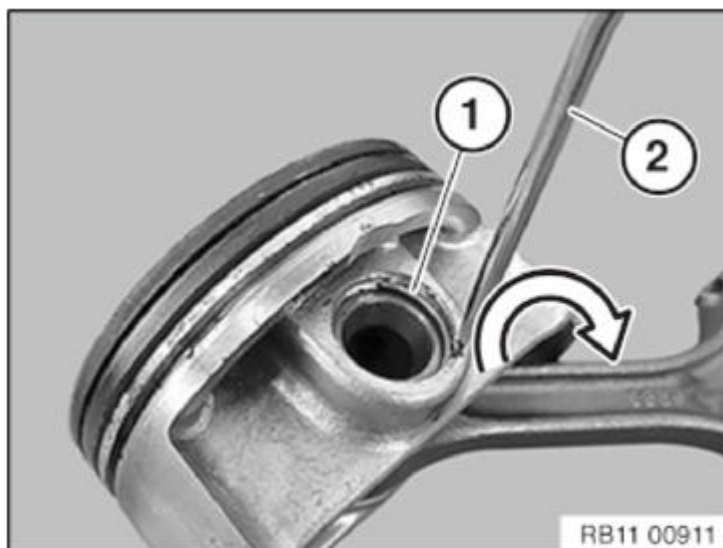
*Installation note:*

Observe installation position of gudgeon pin circlip (1).

The opening points upwards to the piston crown.

Coat piston and piston rings with oil.

Install all **BEARING SHELLS**.

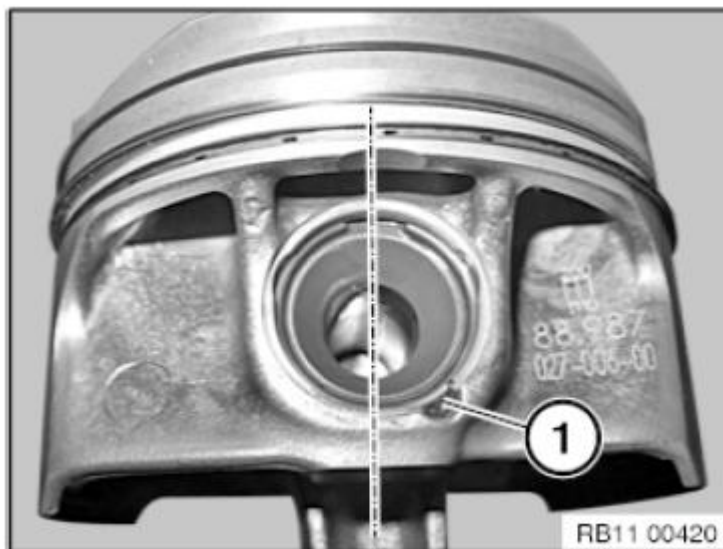


**Fig. 178: Levering Out Gudgeon Pin Circlip With Screwdriver**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Piston circlip (1) is correctly installed when the opening points upwards.

See illustration.



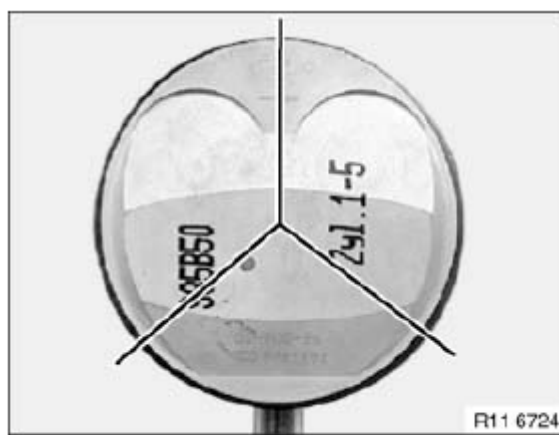
**Fig. 179: Identifying Piston Circlip Installed Position**

Courtesy of BMW OF NORTH AMERICA, INC.

Lightly coat pistons and piston rings with oil.

Offset the contact points of the piston rings by approx.  $120^{\circ}$  to each other but do not position above the gudgeon pin boss.

**NOTE:** Illustration shows S85 engine.



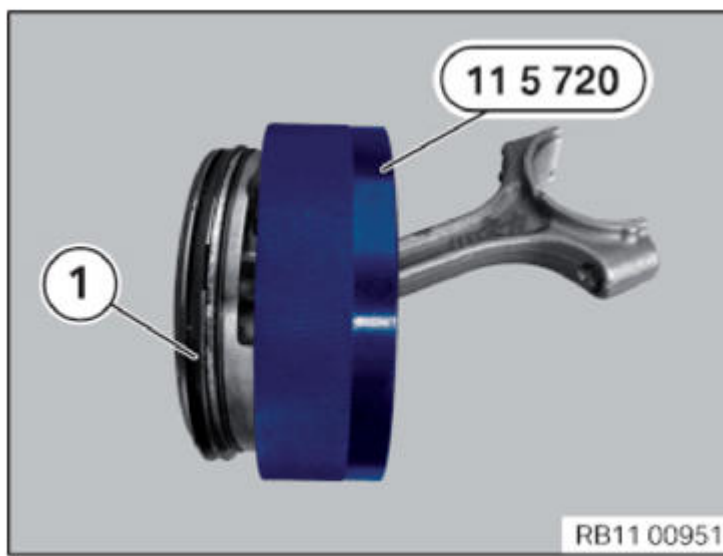
**Fig. 180: Identifying Piston Rings Contact Points**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Heavily oil special tool 11 5 721 See [115721 BUSH](#) or [115721 BUSH](#) and piston rings for installation in cylinder.

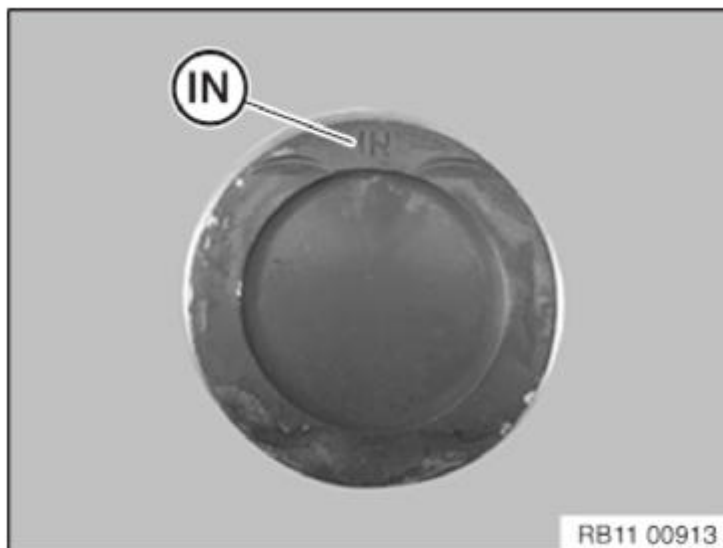
Preassemble special tool 11 5 721 See [115721 BUSH](#) or [115721 BUSH](#) on piston with connecting rod.



**Fig. 181: Preassembling Special Tool (11 5 720) On Piston With Connecting Rod**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

The identification (IN) points to the intake side.



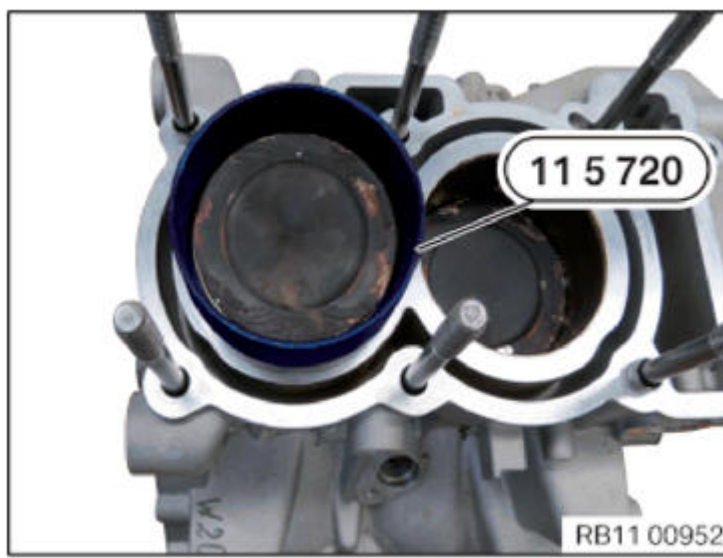
**Fig. 182: Identifying Identification (IN) Points To Intake Side**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully guide in piston with connecting rod in cylinder, risk of damage to cylinder  
IMPORTANT: wall.

Risk of damage to oil spray nozzle.

Align piston and special tool **11 5 721** See **115721 BUSH** or **115721 BUSH** on same plane as cylinder.



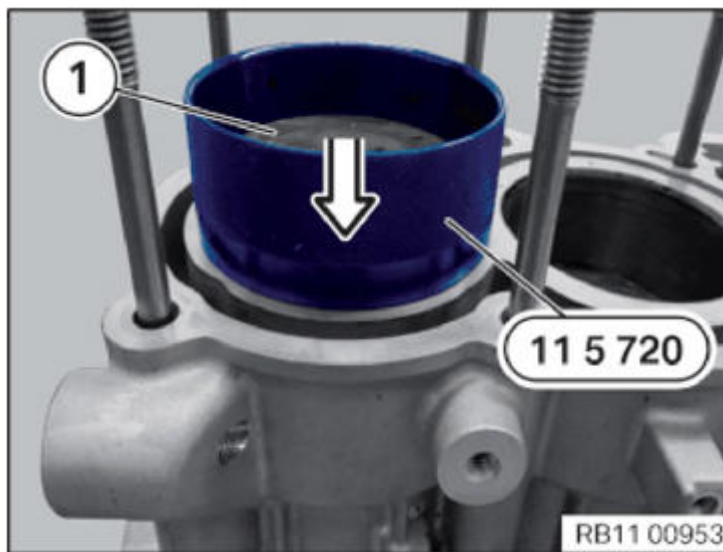


**Fig. 183: Aligning Piston And Special Tool (11 5 720) On Same Plane As Cylinder**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Press in piston with connecting rod in cylinder in direction of arrow.

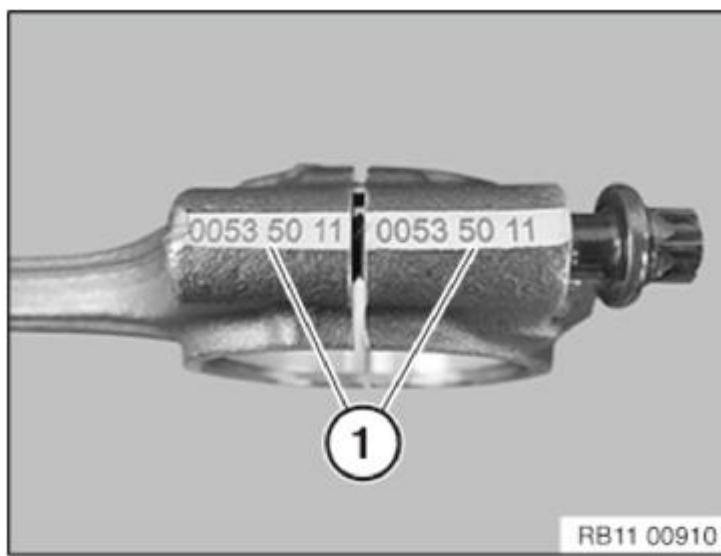
**IMPORTANT:** Risk of breakage of piston rings.  
 Press in piston in direction of arrow with finger pressure only, do not drive in.

Press in piston (1) via special tool 11 5 721 See [115721 BUSH](#) or [115721 BUSH](#) .



**Fig. 184: Pressing Piston With Special Tool**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Connecting rod and connecting rod bearing cap are marked with pairing letters (1) and must not be mixed up.  
 Mixing them up or incorrect assembly of the connecting rod bearing cap on the connecting rod will result in **engine damage** .

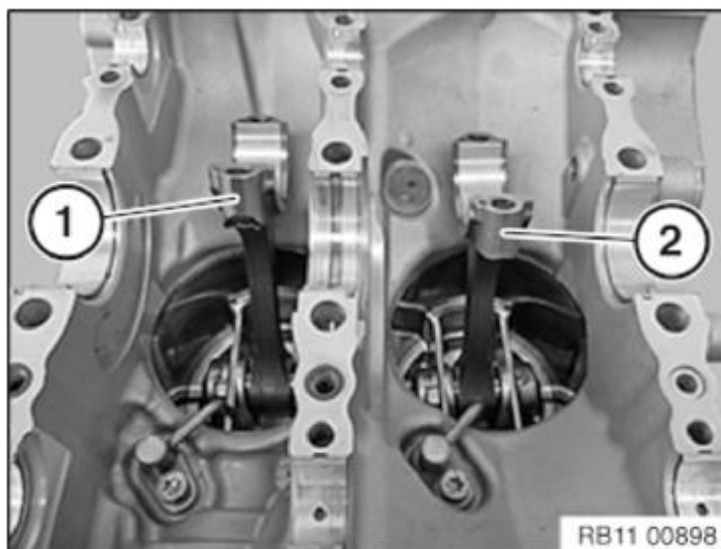


**Fig. 185: Identifying Connecting Rod Identification Number**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Prepare piston with connecting rod.

Install new connecting rod bolts (1).

Install **CRANKSHAFT WITH COUNTERBALANCE SHAFTS**.



**Fig. 186: Identifying Connecting Rods**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

## **CAMSHAFT**

### **11 31 505 ADJUSTING TIMING OF CAMSHAFT(S) (W20)**

**Special tools required:**

- 61 6 010
- **11 0 841**
- **11 0 842**

*Necessary preliminary tasks:*

- Remove **COMPLETE DRIVE UNIT (RANGE EXTENDER)**.
- Remove **ENGINE FROM DRIVE UNIT**.

- Remove **CYLINDER HEAD COVER**.
- Check **TIMING**.

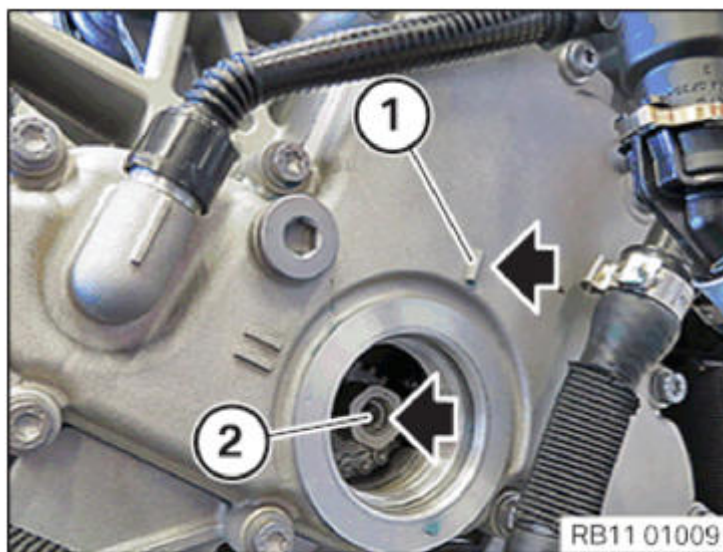
Release screw plug with special tool 61 6 010.



**Fig. 187: Releasing Screw Plug With Special Tool (61 6 010).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Rotate crankshaft at the central bolt (2) into TDC setting.

Mark (1) and mark on the crankshaft must align.

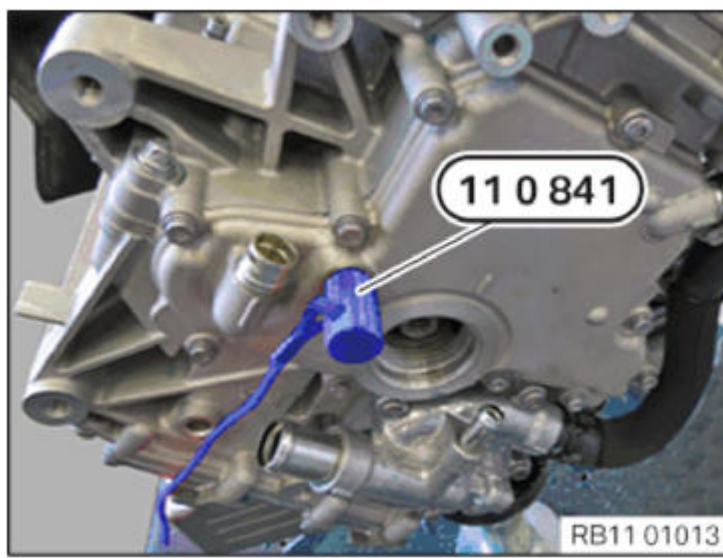


**Fig. 188: Locating Crankshaft Central Bolt And Mark**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Open screw plug.

Tightening torque: **11 14 5AZ** .

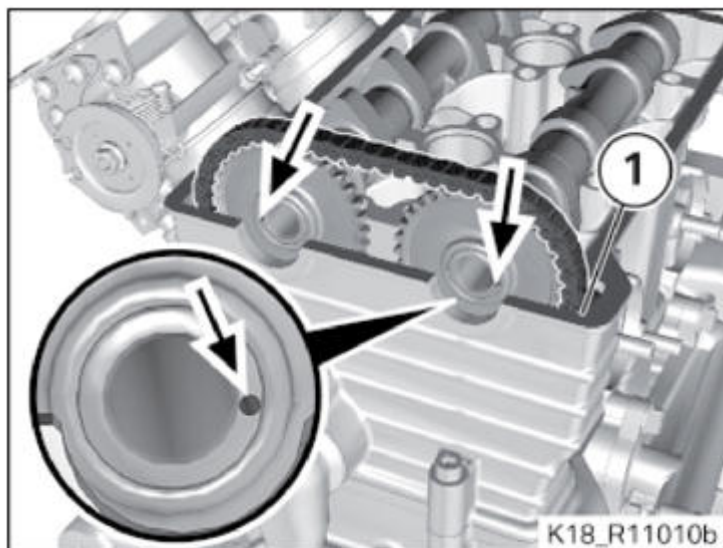
Screw in special tool **11 0 841** in the crankcase and block the crankshaft.



**Fig. 189: Blocking Crankshaft Using Special Tool (11 0 8 4 1).**  
Courtesy of BMW OF NORTH AMERICA, INC.

In the TDC firing position at cylinder 1, the marks point outward parallel to the cylinder head lower face.

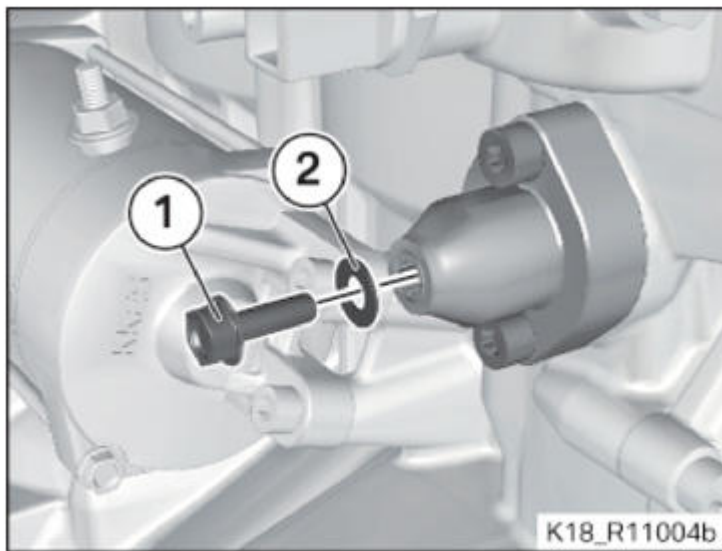
If the marks are offset, the camshafts must be readjusted.



**Fig. 190: Locating Camshafts Marks**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) on the chain tensioner.





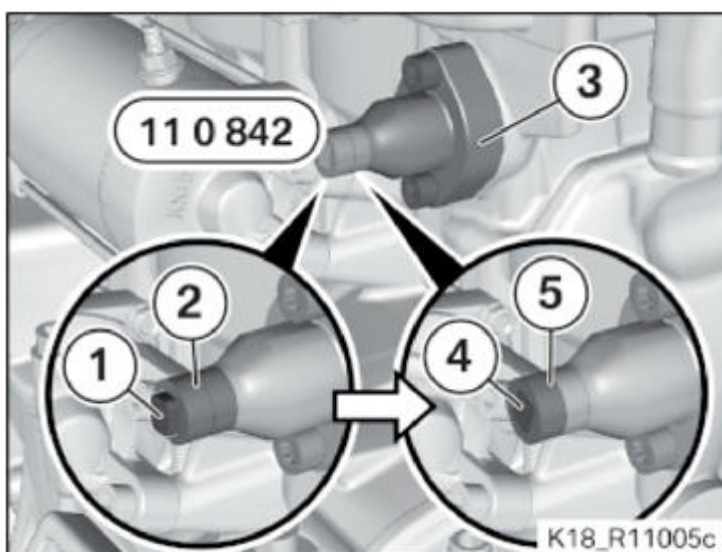
**Fig. 191: Identifying Chain Tensioner Screw**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Prepare special tool [11 0 842](#) .

Pull out stop (1) on the special tool [11 0 842](#) and twist 90°.

Screw preloaded special tool [11 0 842](#) into the chain tensioner at both knurled screws.

Once the special tool [11 0 842](#) is screwed in, twist the stop (1) 90° until it locks.



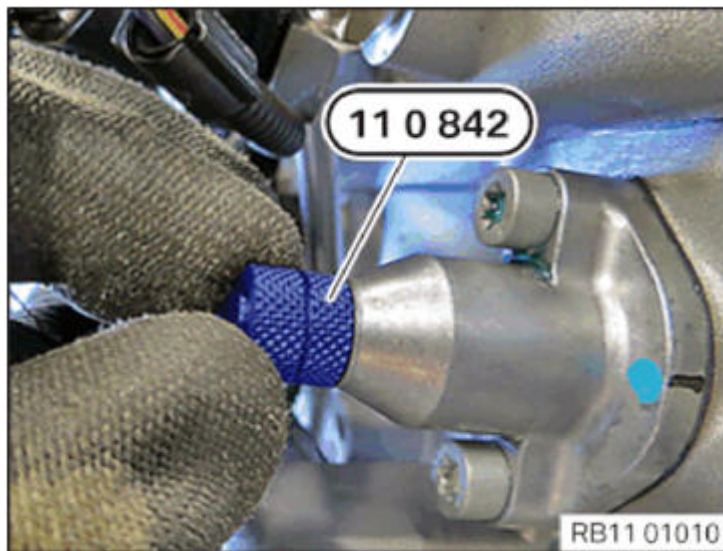
**Fig. 192: Screwing Preloaded Special Tool (11 0 842) Into Chain Tensioner**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Twist the knurled screw clockwise in 120° steps (1 rotation) until the retaining pin preloads the chain tensioner.



**Fig. 193: Twisting Knurled Screw Clockwise**  
Courtesy of BMW OF NORTH AMERICA, INC.

The tensioning rail is tension-free at the timing chain.



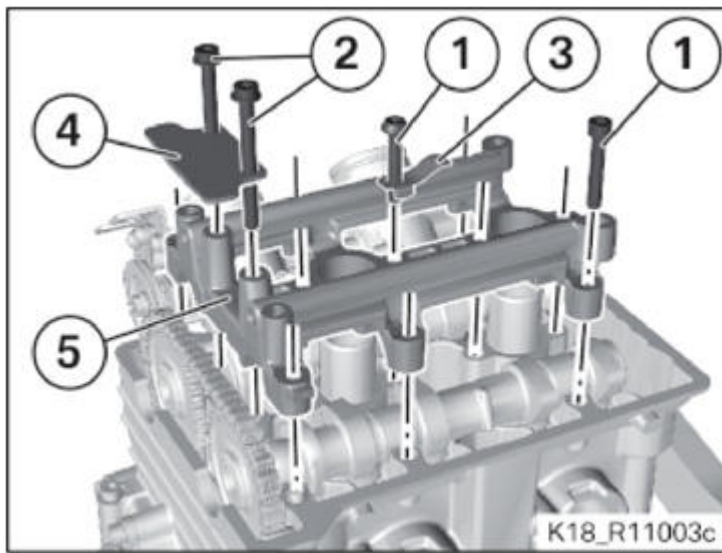
**Fig. 194: Inserting Special Tool (11 0 842)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (2) and remove top tensioning rail (4).

Release all screws (1).

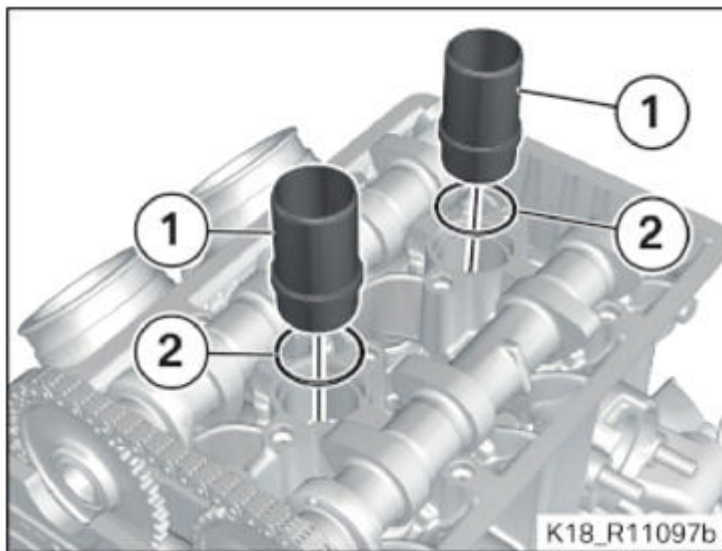
Remove bearing bracket (5).





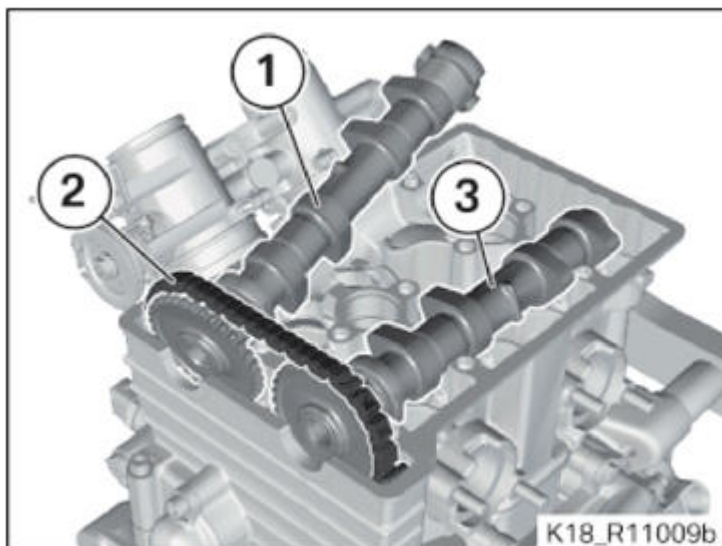
**Fig. 195: Identifying Tensioning Rail, Bearing Bracket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull off spark plug shafts (1) upwards.



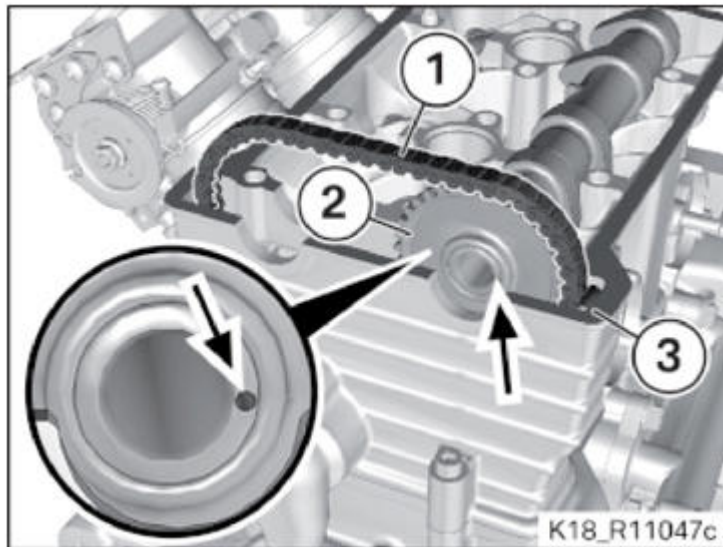
**Fig. 196: Identifying Spark Plug Shafts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lift intake camshaft (1) and disengage it from the (2) sprocket chain.



**Fig. 197: Identifying Intake Camshaft And Sprocket Chain**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lift exhaust camshaft (2) and disengage it from the (1) sprocket chain.



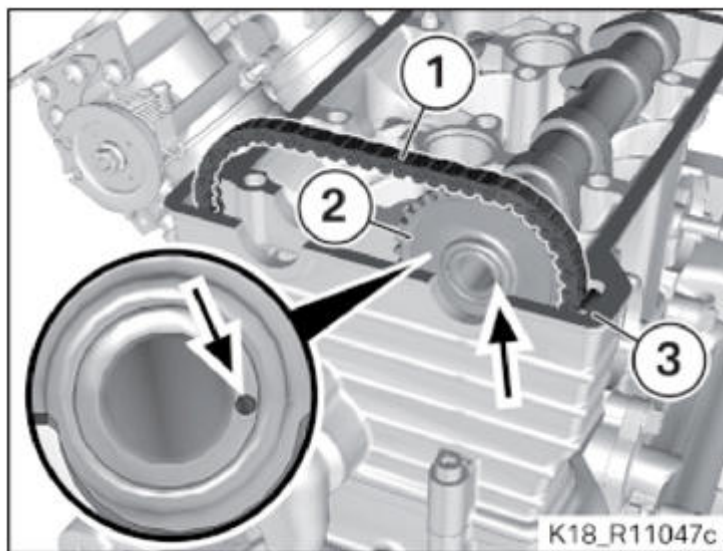
**Fig. 198: Identifying Camshaft And Sprocket Chain**  
Courtesy of BMW OF NORTH AMERICA, INC.

Adjust valve timing.

Lift sprocket chain (1) and maintain tension.

Align camshaft (2) with the mark at the edge of the cylinder head.

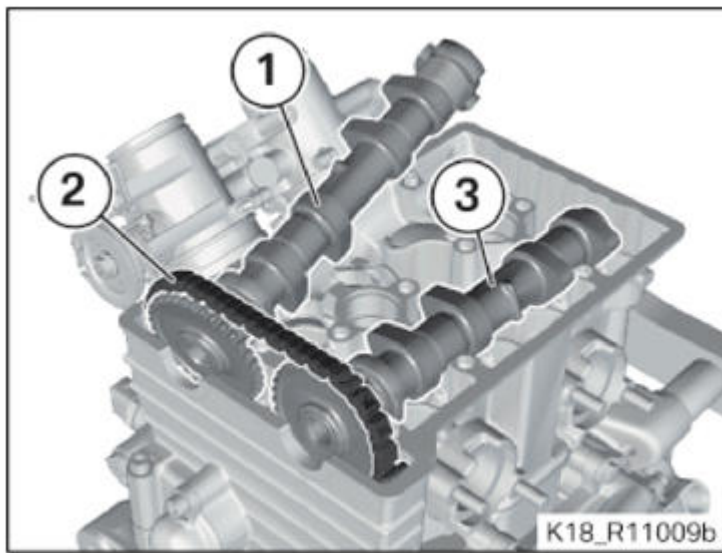
Insert exhaust camshaft (2) in position.



**Fig. 199: Identifying Camshaft And Sprocket Chain**  
Courtesy of BMW OF NORTH AMERICA, INC.

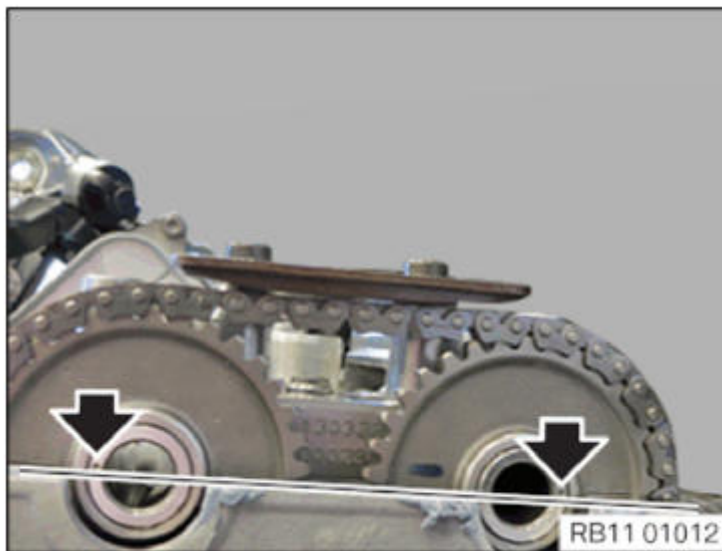
Engage intake camshaft (1) in the sprocket chain (2).

Position intake camshaft (1) in the cylinder head.



**Fig. 200: Identifying Intake Camshaft And Sprocket Chain**  
Courtesy of BMW OF NORTH AMERICA, INC.

Marks of the two camshafts must be positioned on the outer sides parallel to the cylinder head surface.

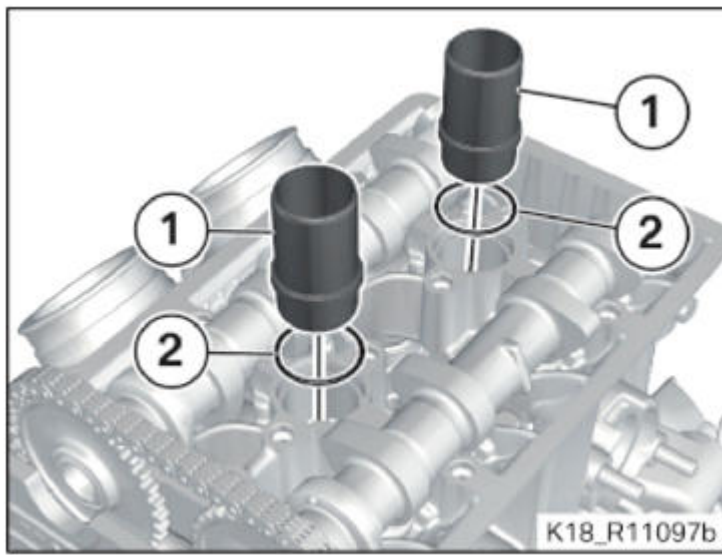


**Fig. 201: Locating Camshaft Marks**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace O-rings (2).

Lightly oil O-rings (2) and push in spark plug shafts (1) in the cylinder head until reaching limit position.



**Fig. 202: Identifying Spark Plug Shafts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

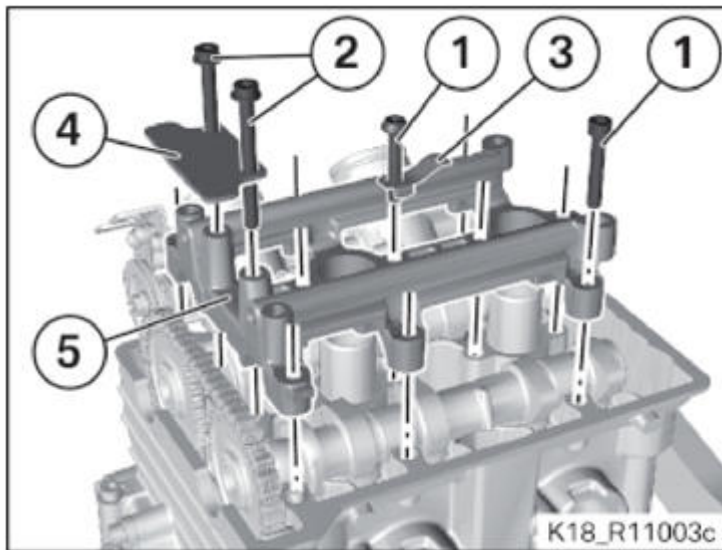
Position bearing bracket (5) on the cylinder head.

Insert bolts (1).

Tightening torque: [11 31 1AZ](#) .

Secure top guide rail (4) with screws (2).

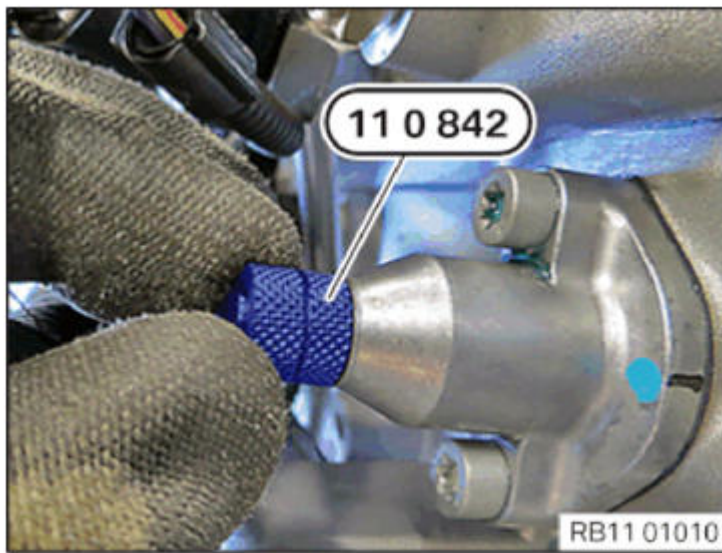
Tightening torque: [11 31 6AZ](#) .



**Fig. 203: Identifying Tensioning Rail, Bearing Bracket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool [11 0 842](#) .

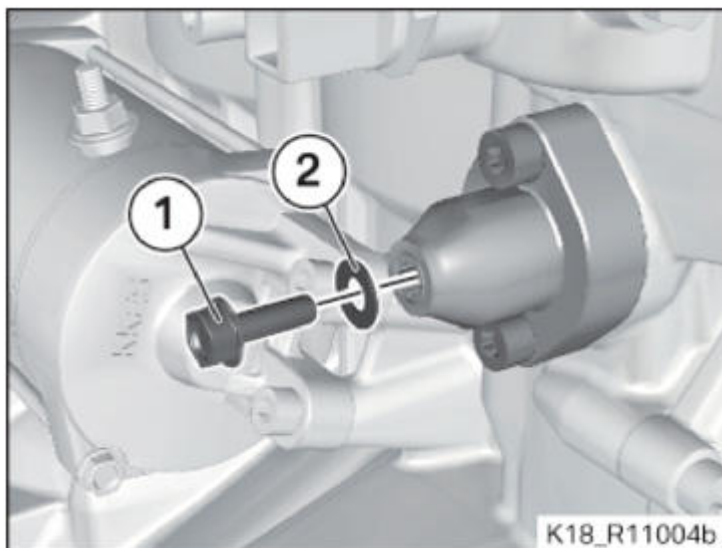




**Fig. 204: Inserting Special Tool (11 0 842)**  
Courtesy of BMW OF NORTH AMERICA, INC.

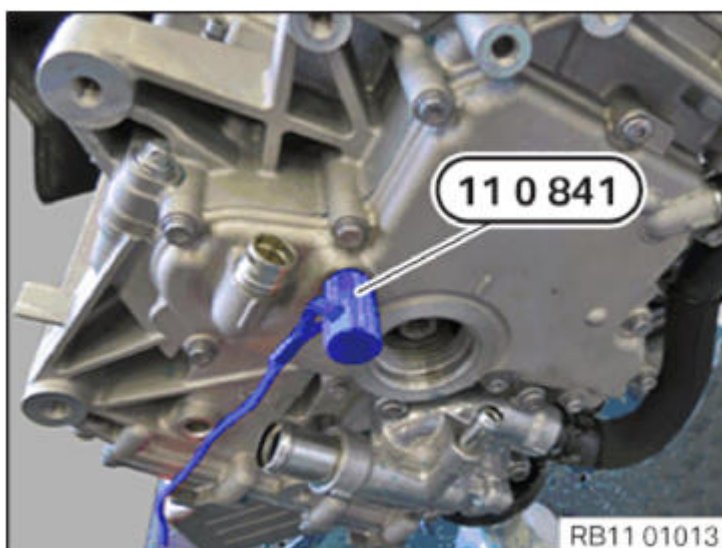
Release screw (1).

Tightening torque: [11 31 4AZ](#) .



**Fig. 205: Identifying Chain Tensioner Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

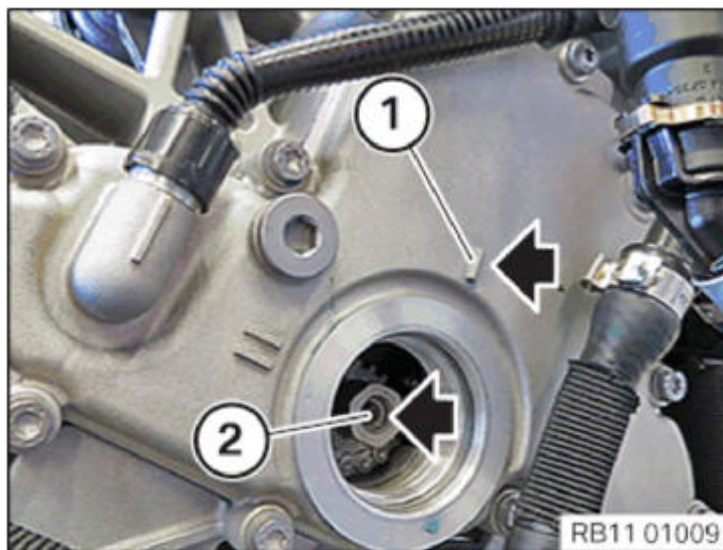
Remove special tool [11 0 841](#) from crankcase.



**Fig. 206: Blocking Crankshaft Using Special Tool (11 0 841)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Rotate crankshaft 360° at central bolt.

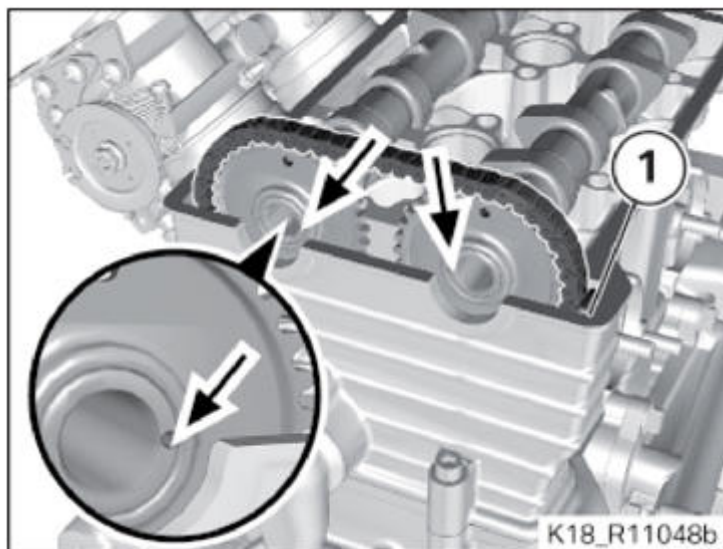
Mark (1) and mark (2) on the crankshaft must align.



**Fig. 207: Locating Crankshaft Central Bolt And Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Marks of the two camshafts must be positioned on the inner sides parallel to the cylinder head surface (1).



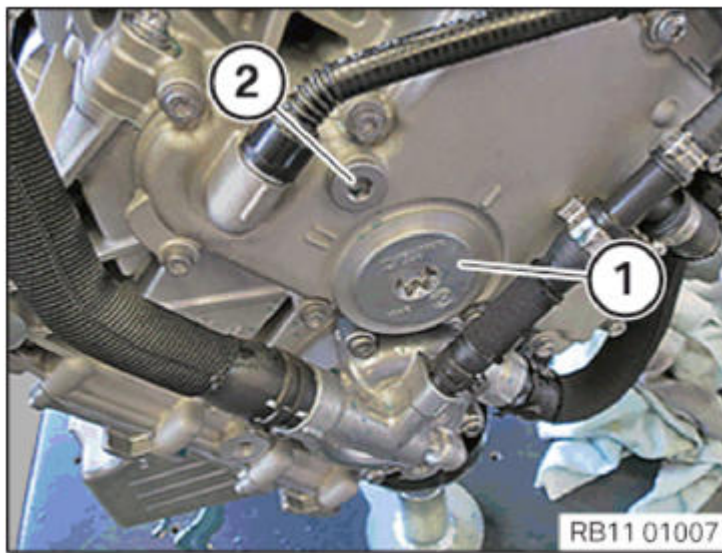
**Fig. 208: Locating Camshafts Marks**  
Courtesy of BMW OF NORTH AMERICA, INC.

Close screw plugs (1 and 2).

Tightening torque: [11 14 5AZ](#) .

Tightening torque: [11 14 6AZ](#) .





**Fig. 209: Identifying Screw Plugs**

Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

### **11 31 005 CHECKING CAMSHAFT TIMING (W20)**

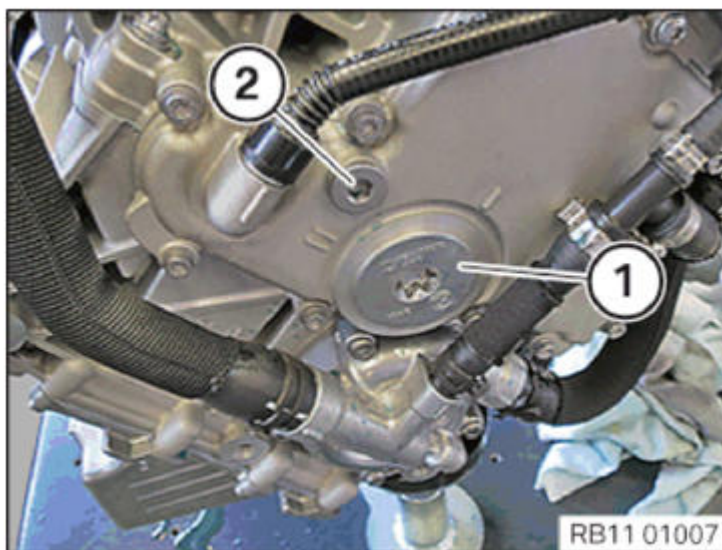
**Special tools required:**

- 61 6 010
- **11 0 841**

*Necessary preliminary tasks:*

- Remove **COMPLETE DRIVE UNIT (RANGE EXTENDER)**.
- Remove **ENGINE FROM DRIVE UNIT.**
- Remove **CYLINDER HEAD COVER.**

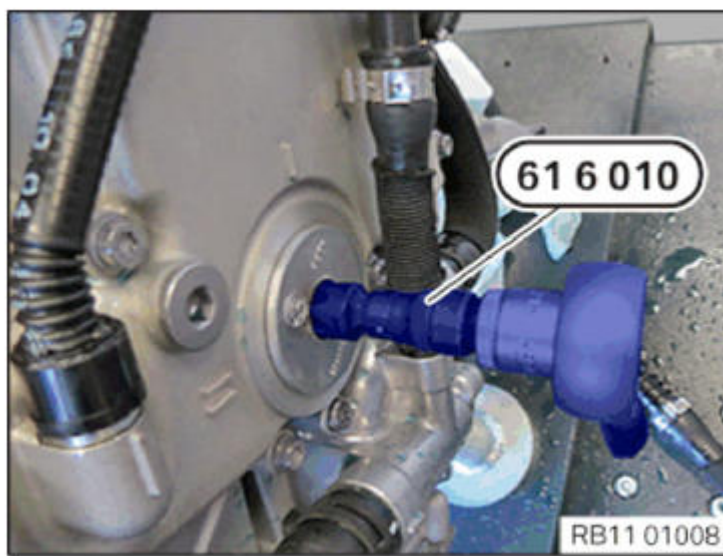
Remove screw plugs (1 and 2).



**Fig. 210: Identifying Screw Plugs**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw plug with special tool 61 6 010.

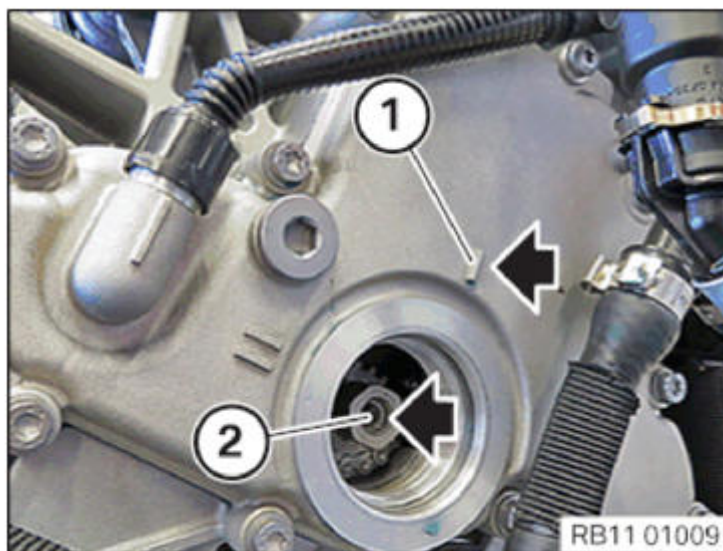


**Fig. 211: Releasing Screw Plug With Special Tool (61 6 010)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Rotate crankshaft at the central bolt (2) into TDC setting.

Tightening torque: [11 14 6AZ](#) .

Mark (1) and mark on the crankshaft must align.

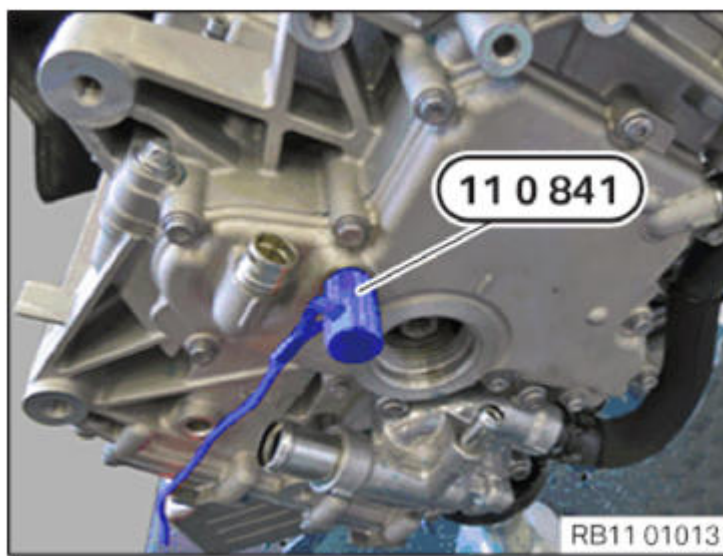


**Fig. 212: Locating Crankshaft Central Bolt And Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open screw plug.

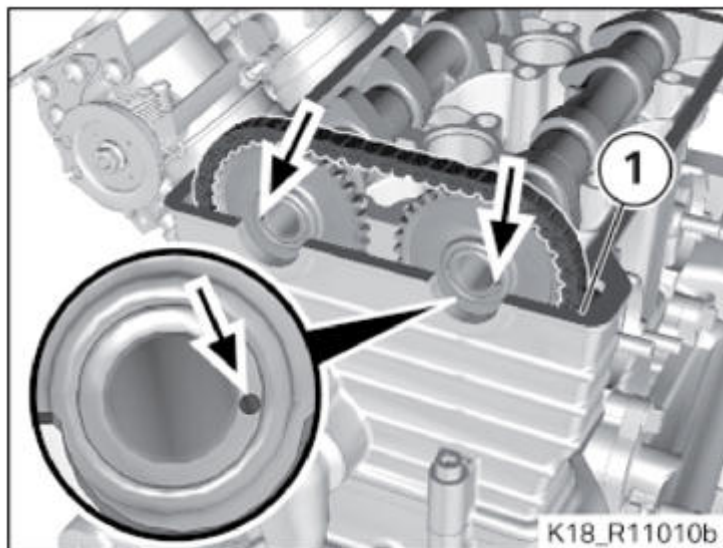
Tightening torque: [11 14 5AZ](#) .

Screw in special tool [11 0 841](#) in the crankcase and block the crankshaft.



**Fig. 213: Blocking Crankshaft Using Special Tool (11 0 841)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

In the TDC firing position at cylinder 1, the marks point outward parallel to the cylinder head lower face.



**Fig. 214: Locating Camshafts Marks**  
 Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, adjust **VALVE TIMING**.

Assemble engine.

### **11 31 028 REMOVING AND INSTALLING/REPLACING EXHAUST CAMSHAFT (W20)**

#### **Special tools required:**

- 61 6 010
- **11 0 841**

#### *Necessary preliminary tasks:*

- Remove **COMPLETE DRIVE UNIT (RANGE EXTENDER)**.
- Remove **ENGINE FROM DRIVE UNIT**.
- Remove **CYLINDER HEAD COVER**.

Release screw plug with special tool 61 6 010.



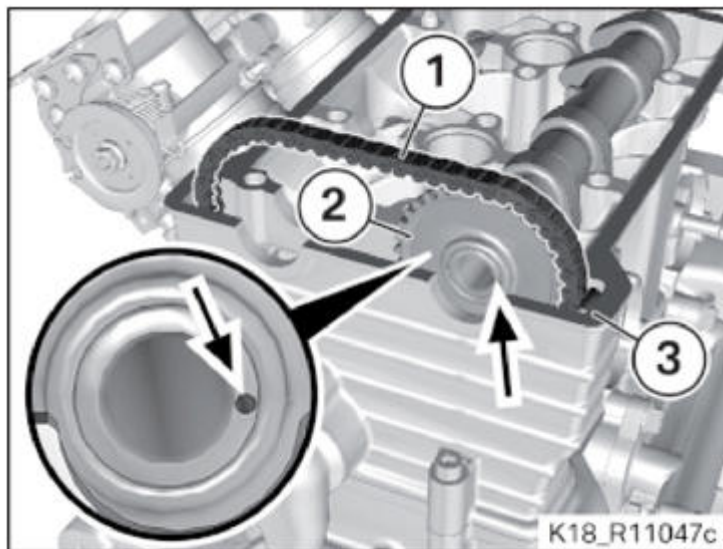
Tightening torque: [11 14 6AZ](#) .



**Fig. 215: Releasing Screw Plug With Special Tool (61 6 010).**  
Courtesy of BMW OF NORTH AMERICA, INC.

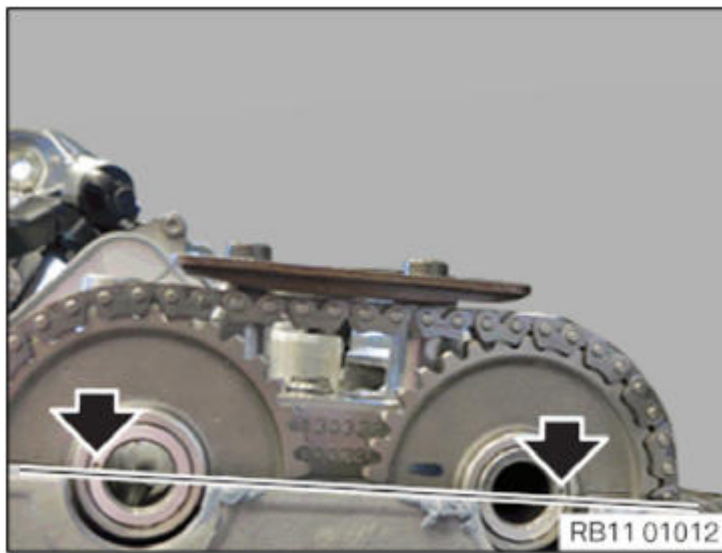
Engage exhaust camshaft (2) in the sprocket chain (1).

Position exhaust camshaft (2) in the cylinder head (3).



**Fig. 216: Identifying Camshaft And Sprocket Chain**  
Courtesy of BMW OF NORTH AMERICA, INC.

Marks of the two camshafts must be positioned on the outer sides parallel to the cylinder head lower face.



**Fig. 217: Locating Camshaft Marks**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace O-rings (2).

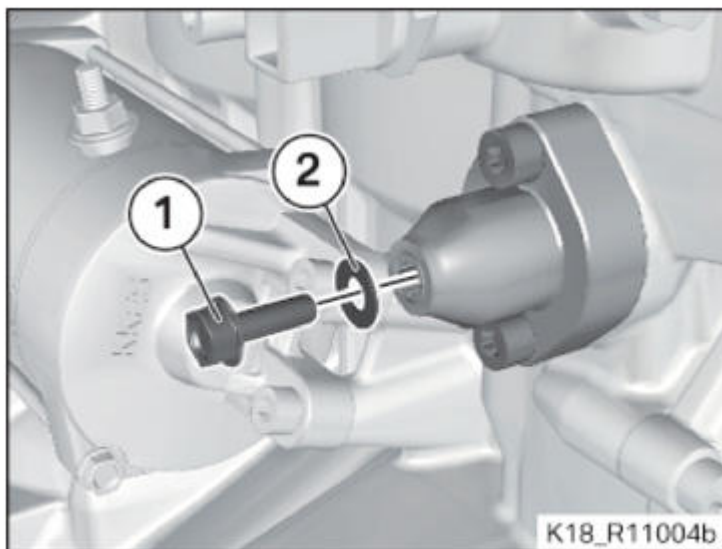
Lightly oil O-rings (2) and push in spark plug shafts (1) in the cylinder head until reaching limit position.

*Installation note:*

Renew gasket.

Insert screw (1).

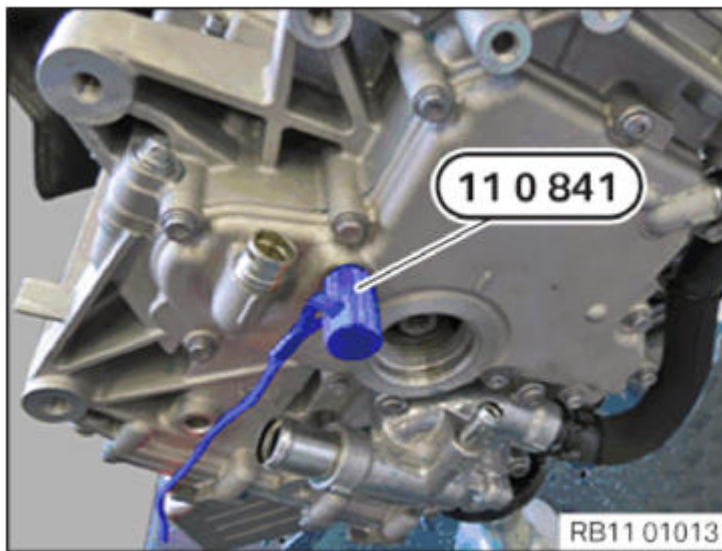
Tightening torque: [11 31 4AZ](#) .



**Fig. 218: Identifying Chain Tensioner Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

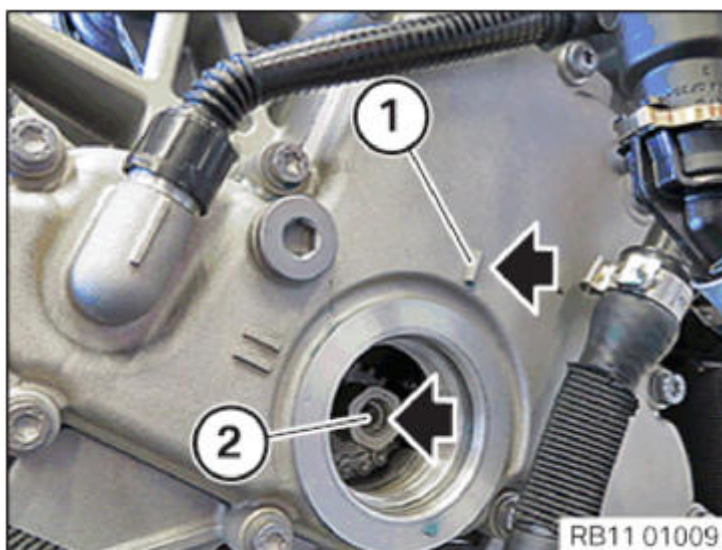
Remove special tool [11 0 841](#) from crankcase.



**Fig. 219: Blocking Crankshaft Using Special Tool (11 0 841).**  
Courtesy of BMW OF NORTH AMERICA, INC.

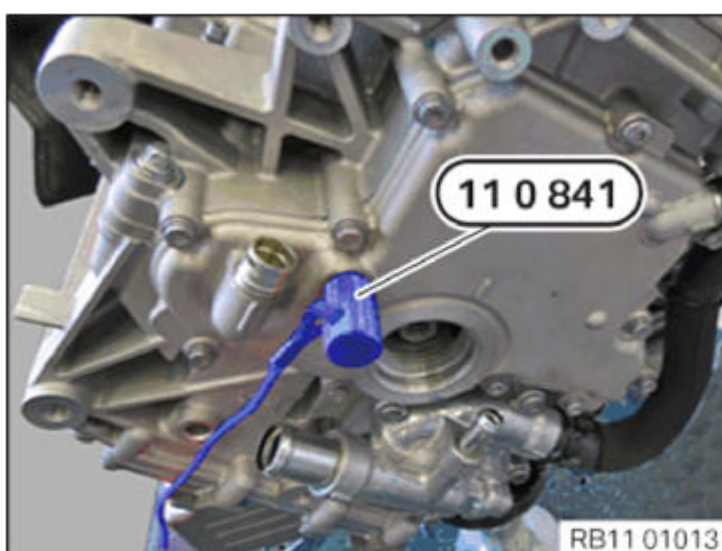
Rotate crankshaft 360° at central bolt.

Mark (1) and mark (2) on the crankshaft must align.



**Fig. 220: Locating Crankshaft Central Bolt And Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw in special tool **11 0 841** in the crankcase and block the crankshaft.





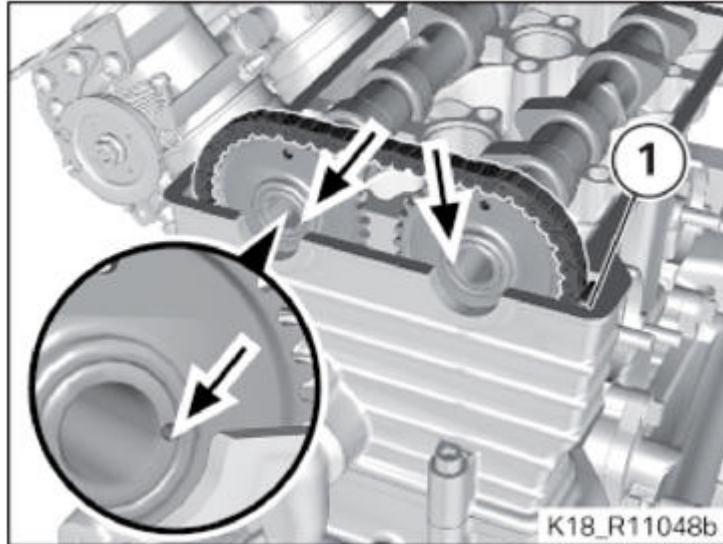
**Fig. 221: Blocking Crankshaft Using Special Tool (11 0 841)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Marks of the two camshafts must be positioned on the inner sides parallel to the cylinder head surface.

Secure bearing cap of camshaft bearing.

Tightening torque: **11 31 1AZ**



**Fig. 222: Locating Camshafts Marks**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

### **11 31 096 REMOVING AND INSTALLING/REPLACING CHAIN TENSIONER (W20)**

*Necessary preliminary tasks:*

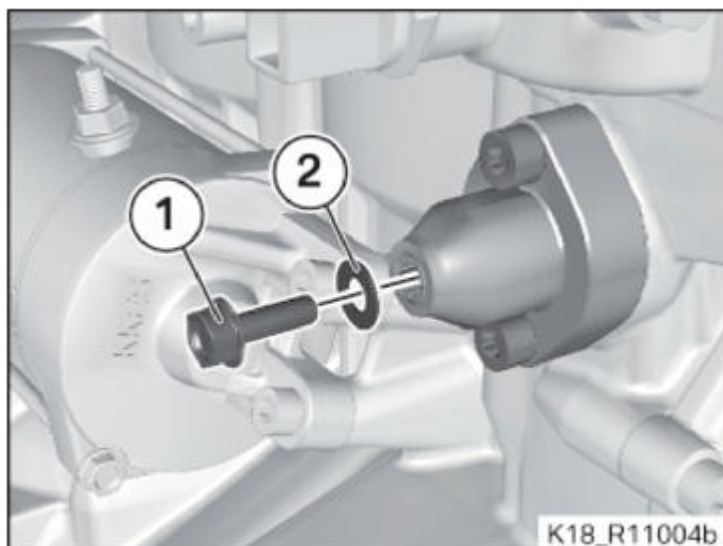
- Remove **DRIVE UNIT (RANGE EXTENDER)**

Open screw plug (1).

Tightening torque **11 31 4AZ** .

*Installation note:*

Replace sealing ring (2).



Assemble engine.

## **11 31 025 REMOVING AND INSTALLING/REPLACING INTAKE CAMSHAFT (W20)**

### **Special tools required:**

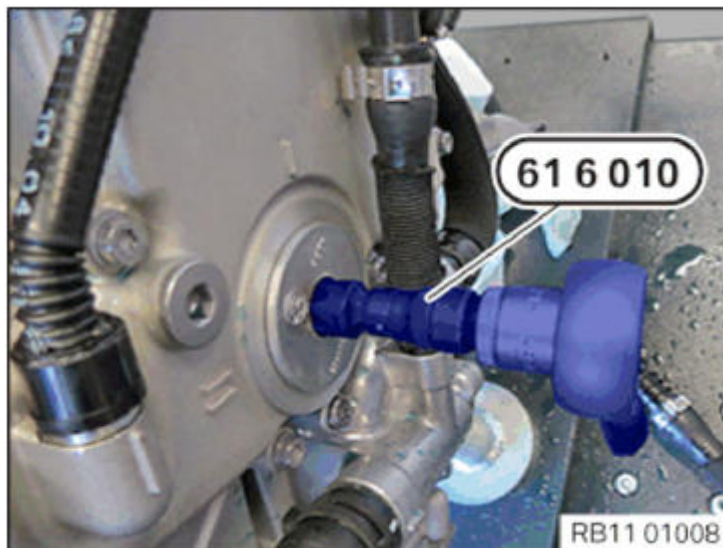
- 11 4 481
- 61 6 010
- [11 0 841](#)
- [11 0 842](#)

*Necessary preliminary tasks:*

- Remove [COMPLETE DRIVE UNIT \(RANGE EXTENDER\)](#).
- Remove [ENGINE FROM DRIVE UNIT](#).
- Remove [CYLINDER HEAD COVER](#).

Release screw plug with special tool 61 6 010.

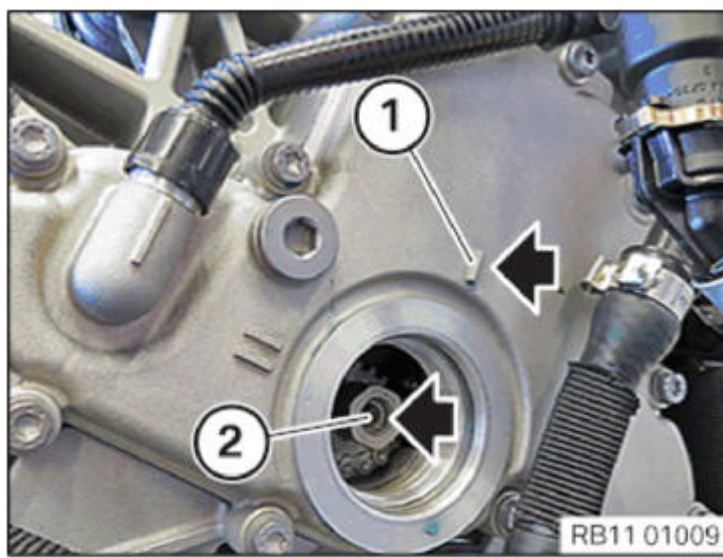
Tightening torque: [11 14 6AZ](#) .



**Fig. 224: Releasing Screw Plug With Special Tool (61 6 010)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Rotate crankshaft at the central bolt (2) into TDC setting.

Mark (1) and mark on the crankshaft (2) must align.

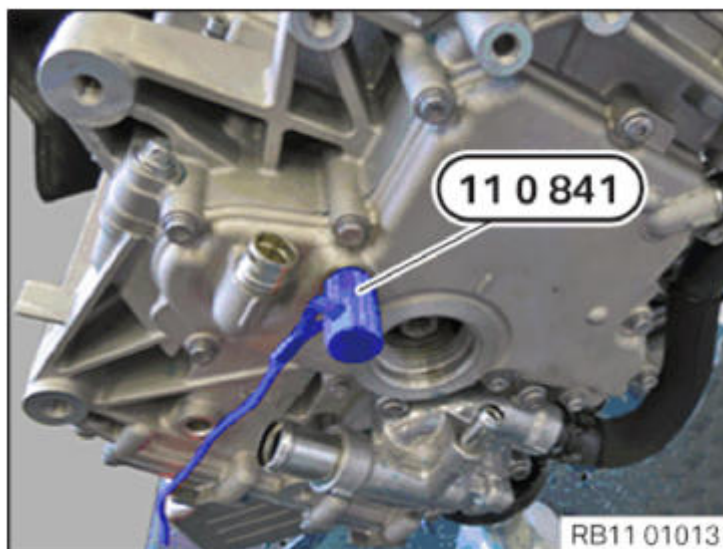


**Fig. 225: Locating Crankshaft Central Bolt And Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open screw plug.

Tightening torque: [11 14 5AZ](#) .

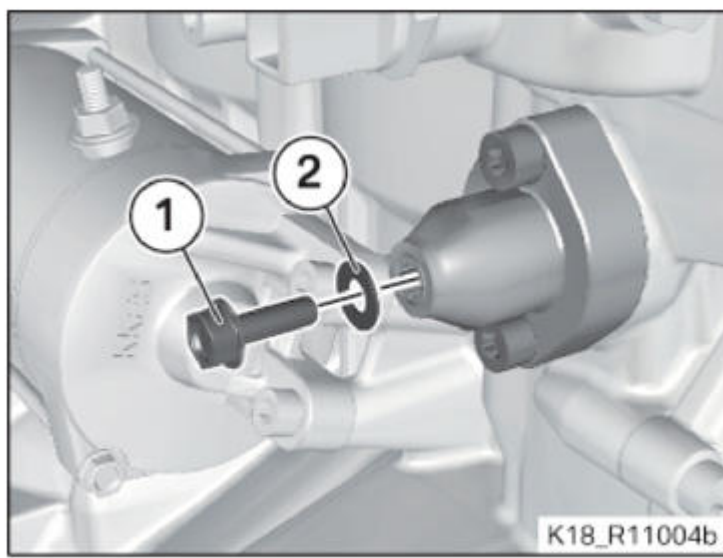
Screw in special tool [11 0 841](#) in the crankcase and block the crankshaft.



**Fig. 226: Blocking Crankshaft Using Special Tool (11 0 841)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque: [11 31 4AZ](#) .



**Fig. 227: Identifying Chain Tensioner Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Prepare special tool [11 0 842](#) .

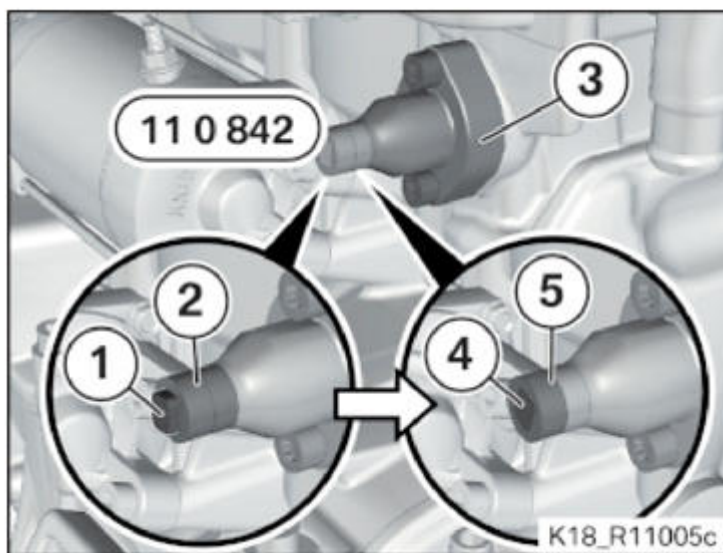
Pull out stop (1) on the special tool [11 0 842](#) and twist 90°.

Screw preloaded special tool [11 0 842](#) into the chain tensioner at both knurled screws.

Once the special tool [11 0 842](#) is screwed in, twist the stop (1) 90° until it locks.

Twist the knurled screw (4) clockwise in 120° steps (1 rotation) until the retaining pin preloads the chain tensioner.

The tensioning rail is tension-free at the timing chain.



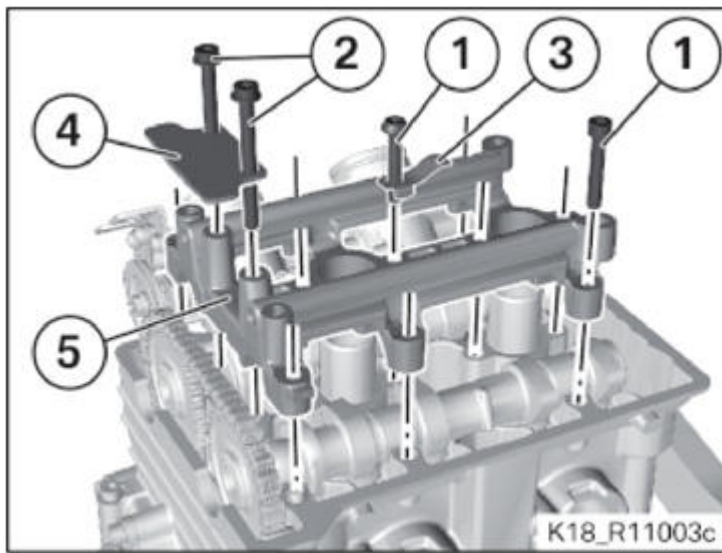
**Fig. 228: Screwing Preloaded Special Tool (11 0 842) Into Chain Tensioner**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (2) and remove top tensioning rail.

Release all screws (1).

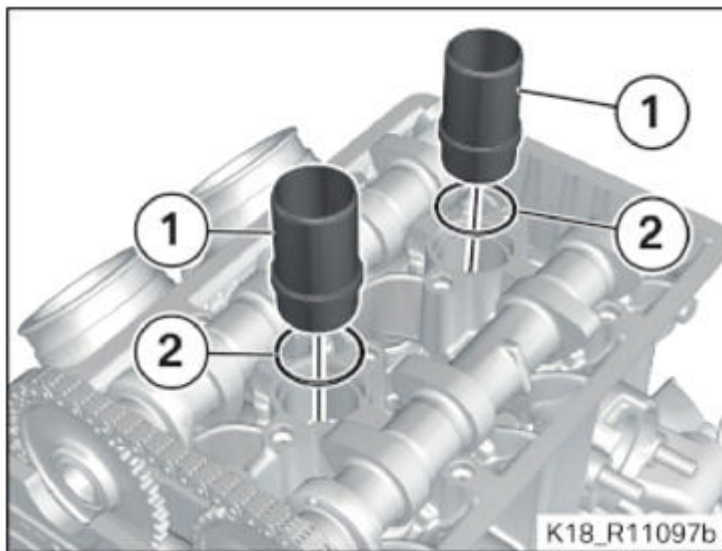
Remove bearing bracket (5).





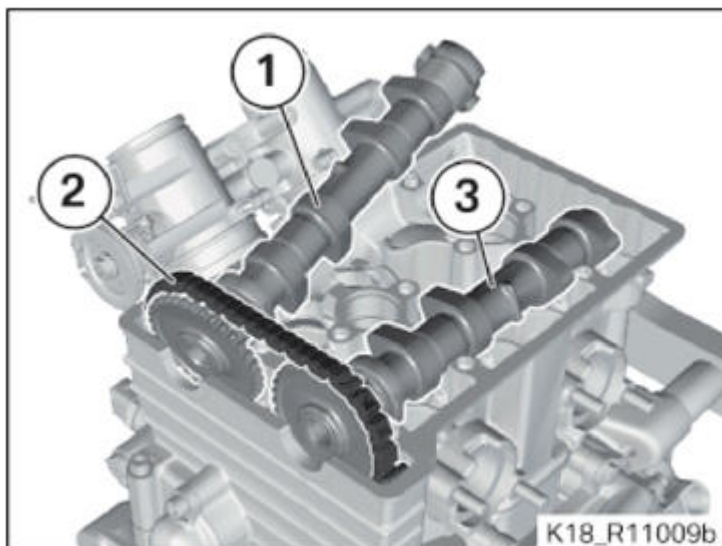
**Fig. 229: Identifying Tensioning Rail, Bearing Bracket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull off spark plug shafts (1) upwards.



**Fig. 230: Identifying Spark Plug Shafts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Lift intake camshaft (1) and disengage it from the (2) sprocket chain.

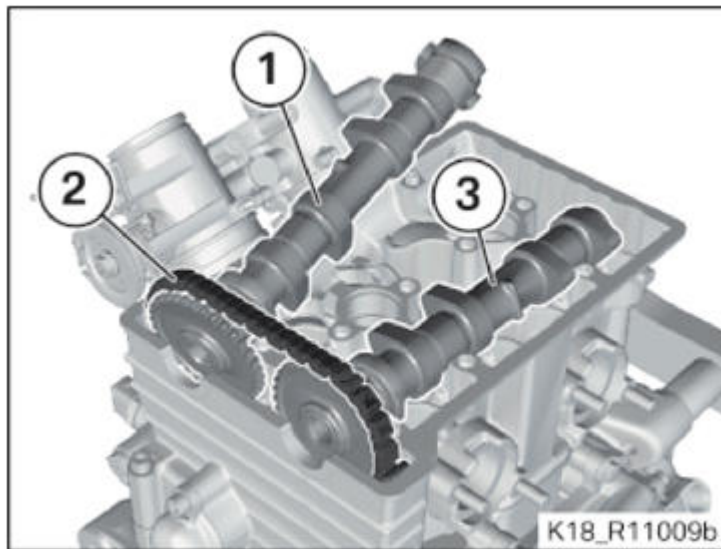


**Fig. 231: Identifying Intake Camshaft And Sprocket Chain**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

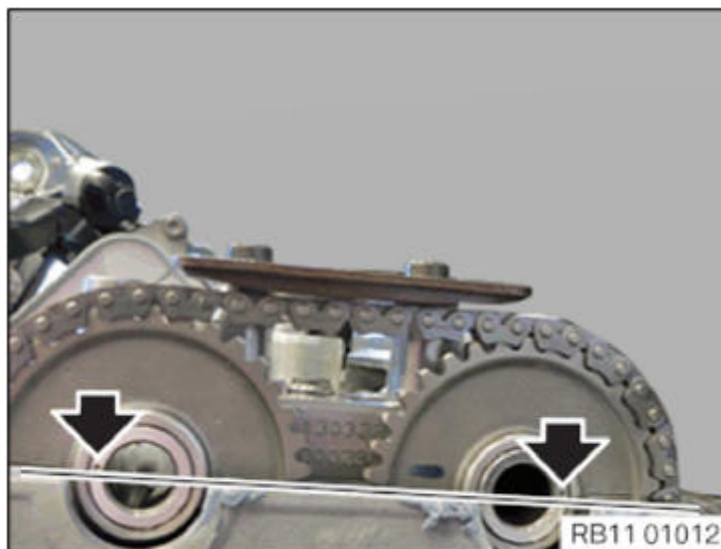
Engage intake camshaft (1) in the sprocket chain (2).

Position intake camshaft (1) in the cylinder head.



**Fig. 232: Identifying Intake Camshaft And Sprocket Chain**  
Courtesy of BMW OF NORTH AMERICA, INC.

Marks of the two camshafts must be positioned on the outer sides parallel to the cylinder head surface.



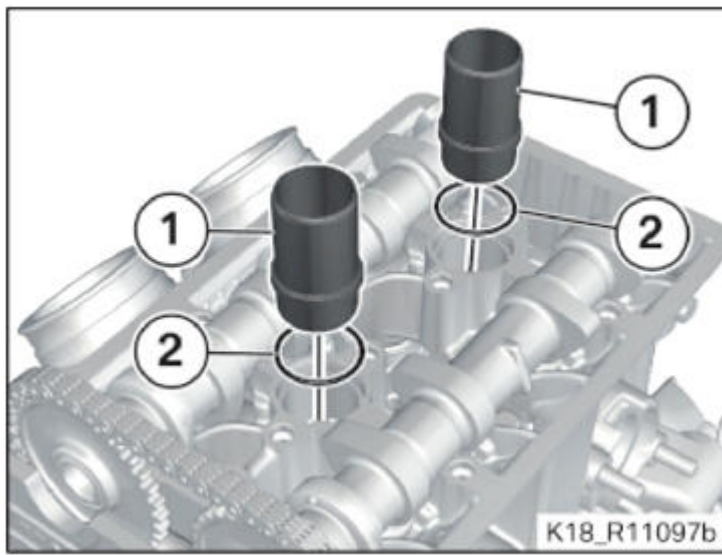
**Fig. 233: Locating Camshaft Marks**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace O-rings (2).

Lightly oil O-rings (2) and push in spark plug shafts (1) in the cylinder head until reaching limit position.





**Fig. 234: Identifying Spark Plug Shafts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

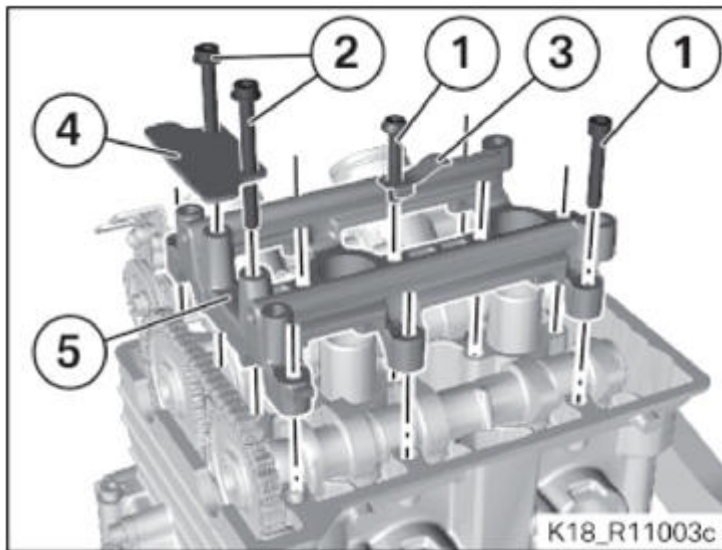
Position bearing bracket (5) on the cylinder head.

Insert bolts (1).

Tightening torque: [11 31 1AZ](#) .

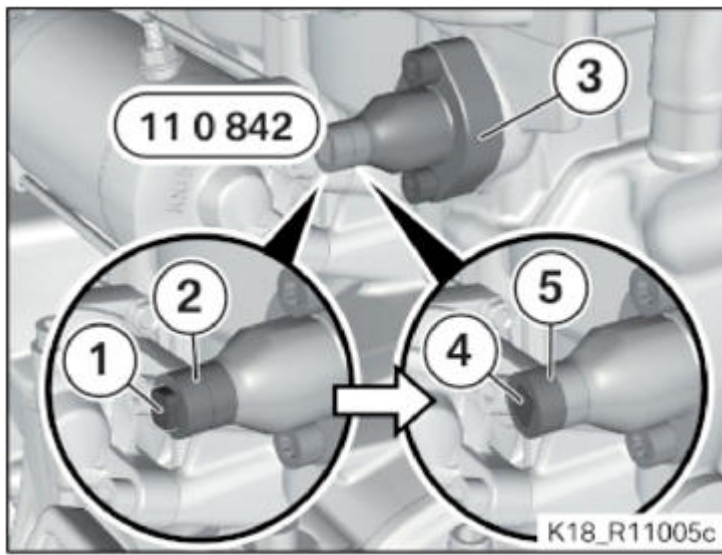
Secure top guide rail (4) with screws (2).

Tightening torque: [11 31 6AZ](#) .



**Fig. 235: Identifying Tensioning Rail, Bearing Bracket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove special tool [11 0 842](#) .



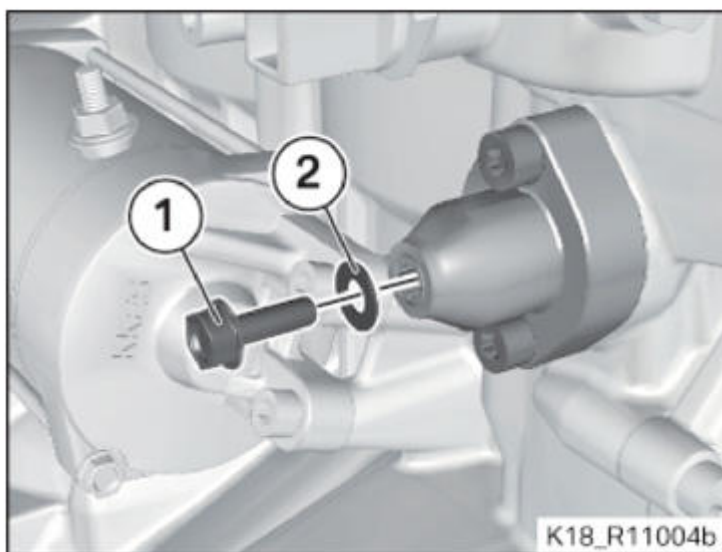
**Fig. 236: Screwing Preloaded Special Tool (11 0 842) Into Chain Tensioner**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace gasket.

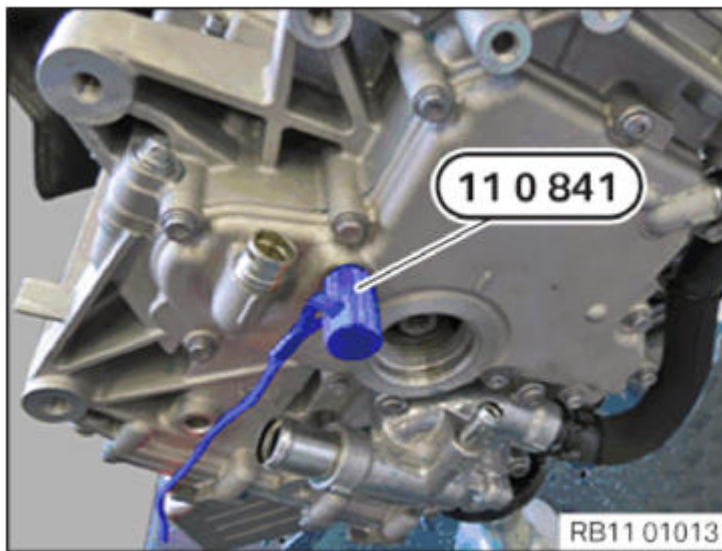
Insert screw (1).

Tightening torque: [11 31 4AZ](#) .



**Fig. 237: Identifying Chain Tensioner Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

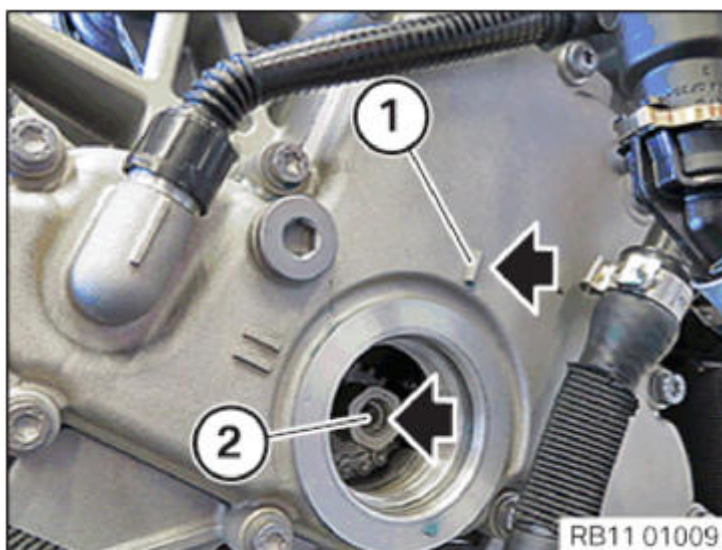
Remove special tool [11 0 841](#) from crankcase.



**Fig. 238: Blocking Crankshaft Using Special Tool (11 0 841)**  
Courtesy of BMW OF NORTH AMERICA, INC.

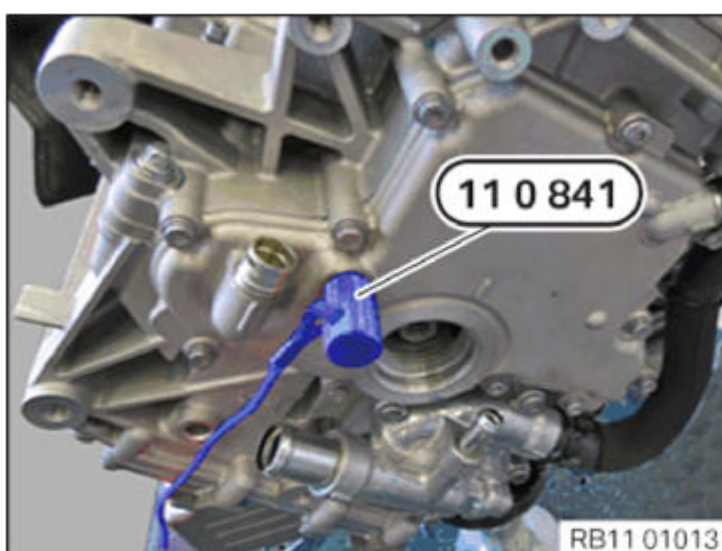
Rotate crankshaft 360° at central bolt.

Mark (1) and mark (2) on the crankshaft must align.



**Fig. 239: Locating Crankshaft Central Bolt And Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

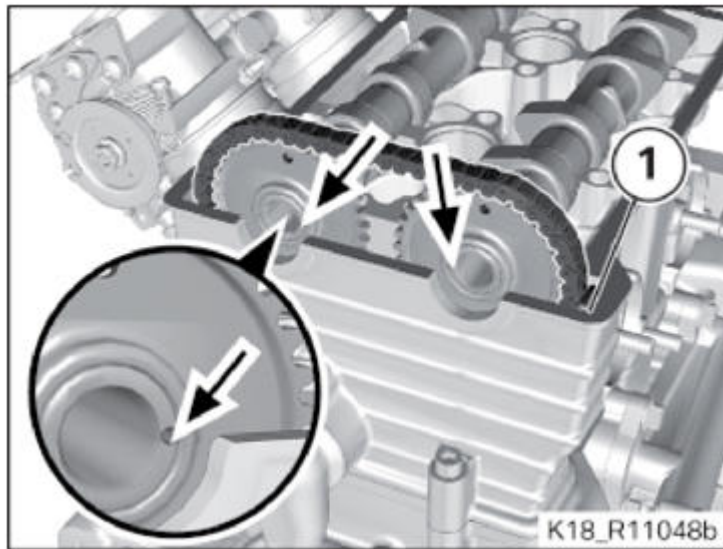
Screw in special tool **11 0 841** in the crankcase and block the crankshaft.



**Fig. 240: Blocking Crankshaft Using Special Tool (11 0 841)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Marks of the two camshafts must be positioned on the inner sides parallel to the cylinder head surface.



**Fig. 241: Locating Camshafts Marks**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

**11 31 051 REPLACE TIMING CHAIN WITH TENSIONING RAIL (W20)**

**Special tools required:**

- **11 0 841**

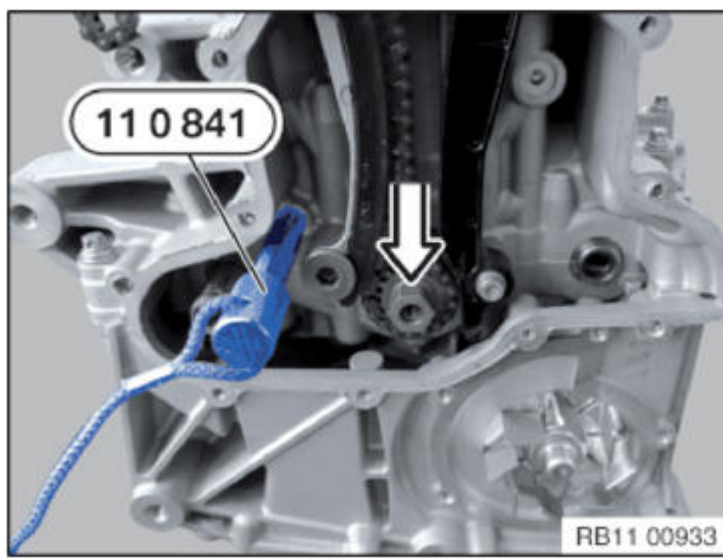
*Necessary preliminary tasks:*

- Remove **COMPLETE DRIVE UNIT (RANGE EXTENDER)**.
- Remove **ENGINE FROM DRIVE UNIT**.
- Remove **GEAR CASE COVER**.
- Remove **CYLINDER HEAD**.

Rotate crankshaft at hexagon head; when the mark on the crankshaft (see arrow) points up, the special tool **11 0 841** can be screwed in.

Block crankshaft with special tool **11 0 841** .





**Fig. 242: Blocking Crankshaft With Special Tool (11 0 841).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

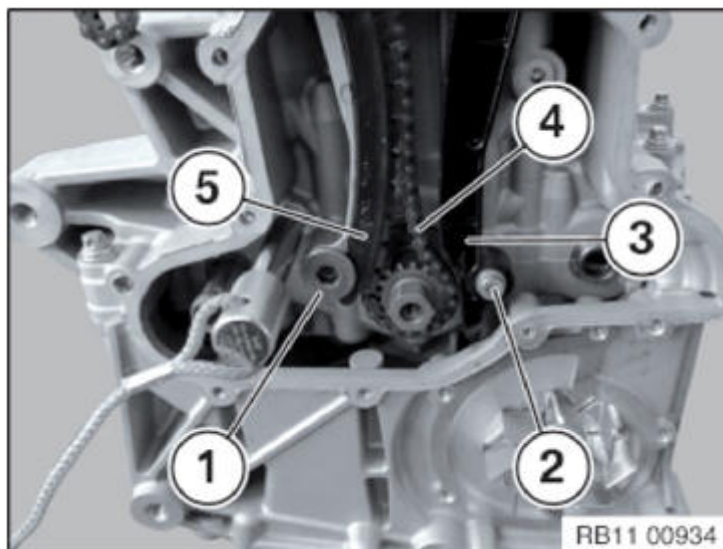
Release screw (2).

Remove guide rail (3) upwards.

Release screw (1).

Remove tensioning rail (5).

Remove timing chain (4).



**Fig. 243: Identifying Guide Rail, Tensioning Rail, Timing Chain And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

## **VALVES WITH SPRINGS**

### **11 34 004 ADJUST VALVE CLEARANCE (W20)**

**Special tools required:**

- 11 4 480

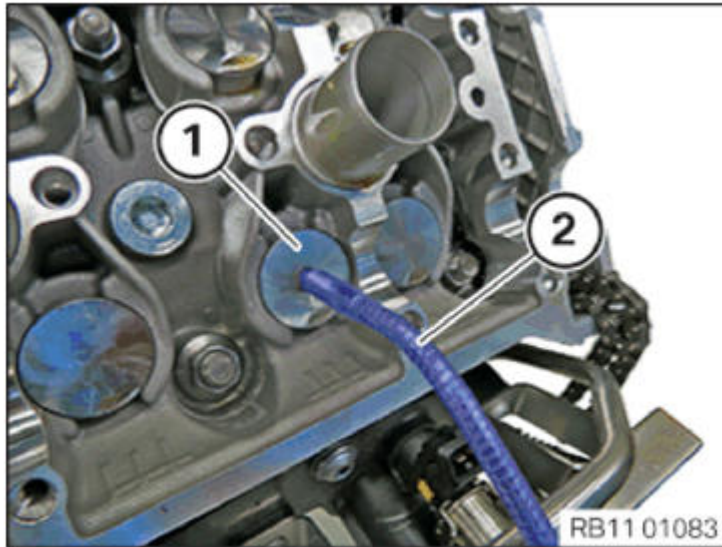
*Necessary preliminary tasks:*

- Check **VALVE CLEARANCE**.

- Remove camshafts. See [INTAKE CAMSHAFT](#) and [EXHAUST CAMSHAFT](#).

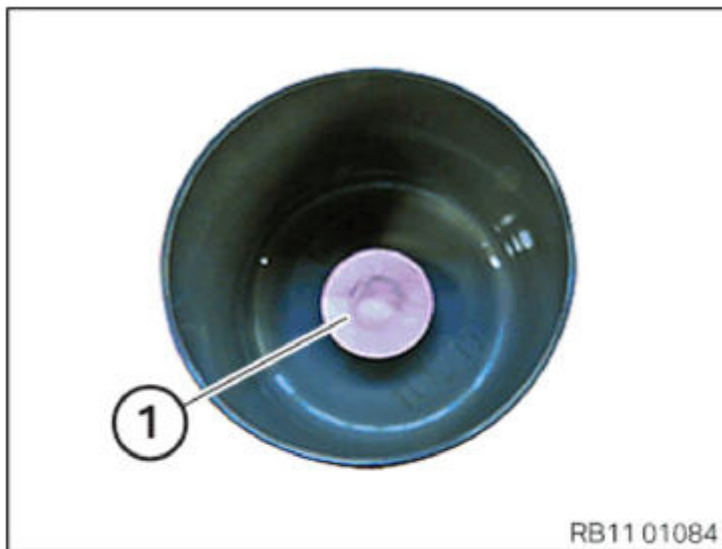
Remove bucket tappets (1) by means of a magnet (2).

Set down bucket tappets on special tool 11 4 480 in a tidy and orderly fashion.



**Fig. 244: Removing Bucket Tappets With Magnet**  
Courtesy of BMW OF NORTH AMERICA, INC.

Compensating plate (1) is removed with the magnet.



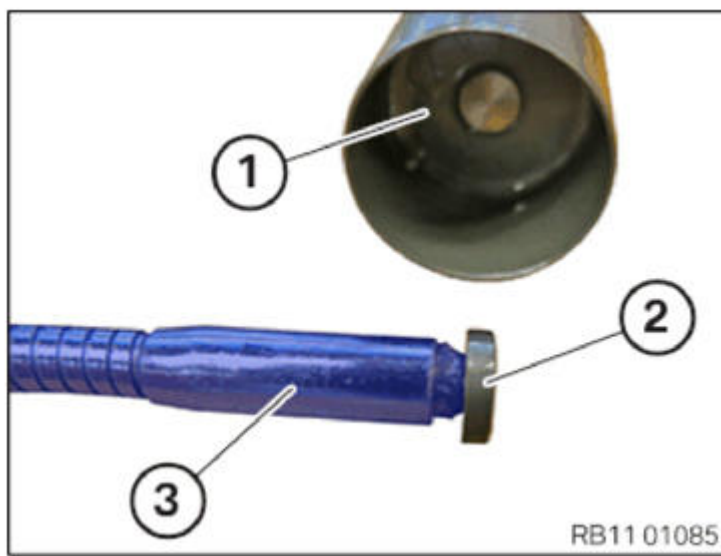
**Fig. 245: Identifying Compensating Plate**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove compensating plate (2) with a magnet (3) from the bucket tappet (1).

*Installation note:*

Determine compensating plate (2) according to ID code.

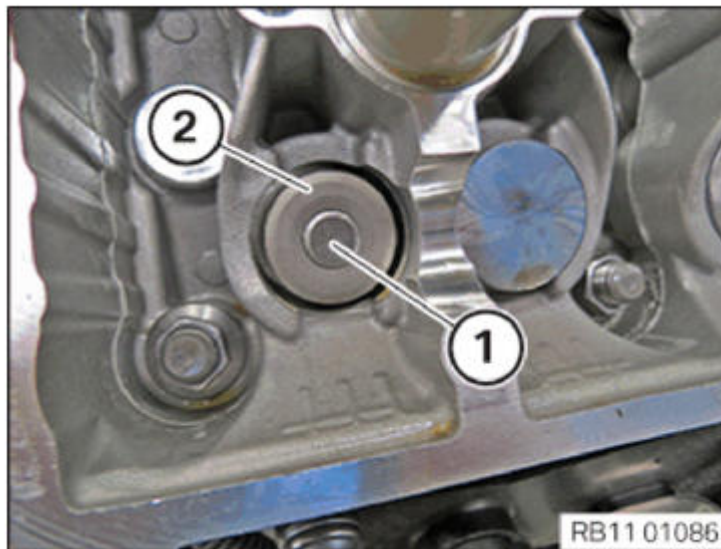




**Fig. 246: Identifying Bucket Tappet, Compensating Plate And Magnet**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Insert compensating plate (1) on the valve head (2) with the ID code facing up.

Position set bucket tappet over valve head.



**Fig. 247: Identifying Compensating Plate And Valve Head**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Check **VALVE CLEARANCE** and adjust if necessary.

**11 34 002 CHECKING VALVE CLEARANCE (W20)**

**Special tools required:**

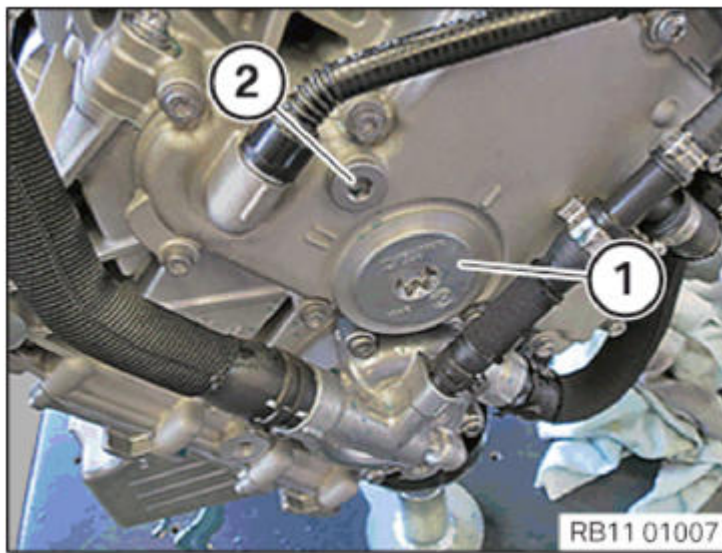
- 61 6 010
- 11 3 160

*Necessary preliminary tasks:*

- Remove **RANGE EXTENDER DRIVE UNIT** .
- Remove **ENGINE FROM DRIVE UNIT**.

Screw plug (1) for access to crankshaft.

Disconnect crankshaft access screw plug (2).



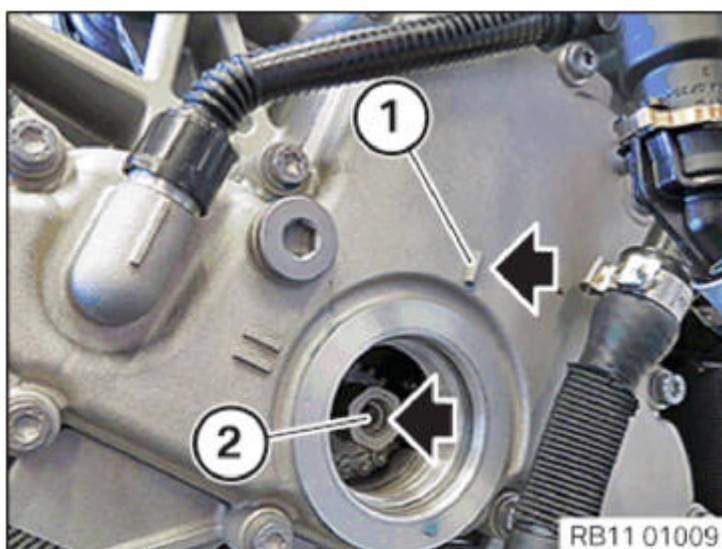
**Fig. 248: Identifying Screw Plugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open screw plug with special tool 61 6 010.



**Fig. 249: Releasing Screw Plug With Special Tool (61 6 010)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Twist crankshaft (2) in direction of engine rotation at hexagon head.



**Fig. 250: Locating Crankshaft Central Bolt And Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

Measure valve clearance with special tool 11 3 160 and note down.

Adjust **VALVE CLEARANCE**.



**Fig. 251: Measuring Valve Clearance With Special Tool (11 3 160)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

**11 34 715 REMOVING AND INSTALLING/REPLACING ALL VALVE SPRINGS (W20)**

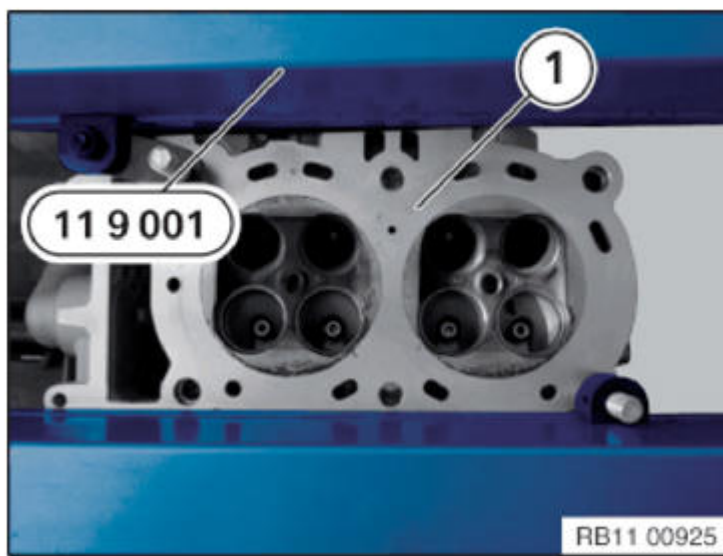
**Special tools required:**

- 11 9 001
- 11 9 008
- 11 9 006
- 11 8 840
- 11 4 482

*Necessary preliminary tasks:*

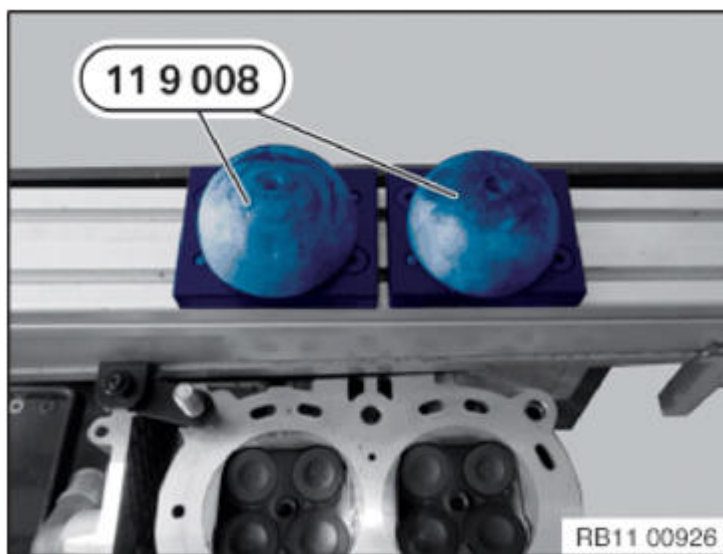
- Remove camshafts. See **INTAKE CAMSHAFT** and **EXHAUST CAMSHAFT**.
- Remove **CYLINDER HEAD**.

Mount cylinder head (1) on special tool 11 9 001.



**Fig. 252: Mounting Cylinder Head On Special Tool (11 9 001)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

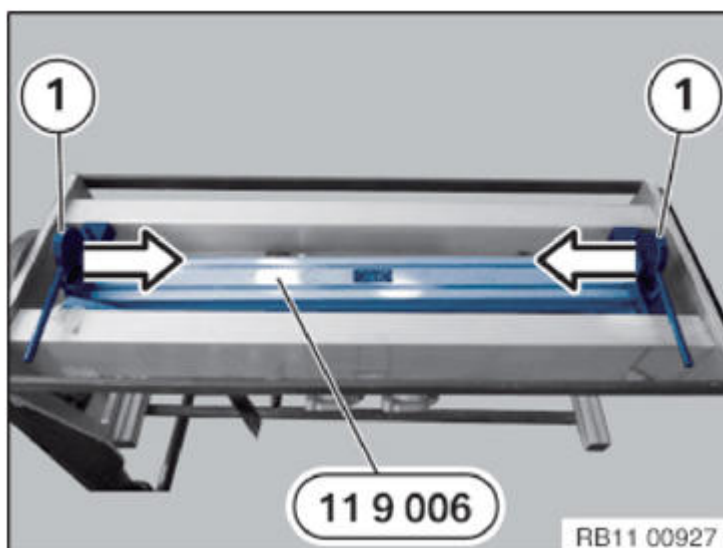
Align special tool 11 9 008 on particular combustion chamber.



**Fig. 253: Aligning Special Tool (11 9 008) On Combustion Chamber**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Position special tool 11 9 006 on cylinder head.

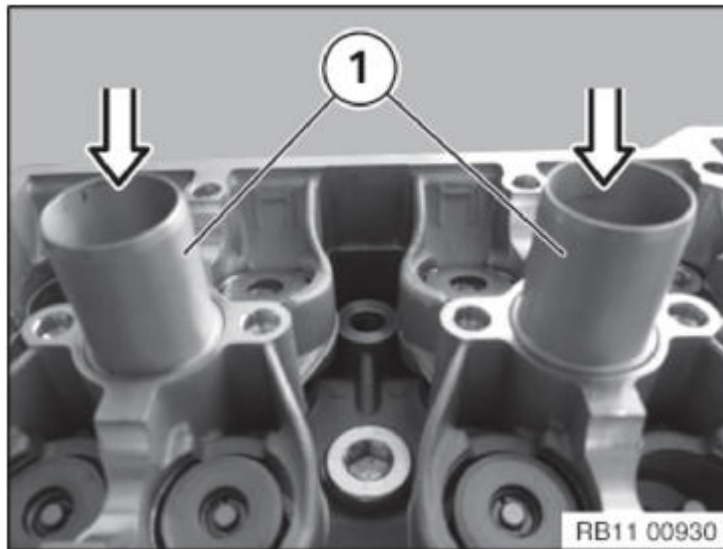
Slide lock (1) inwards and preload with eccentric shaft.





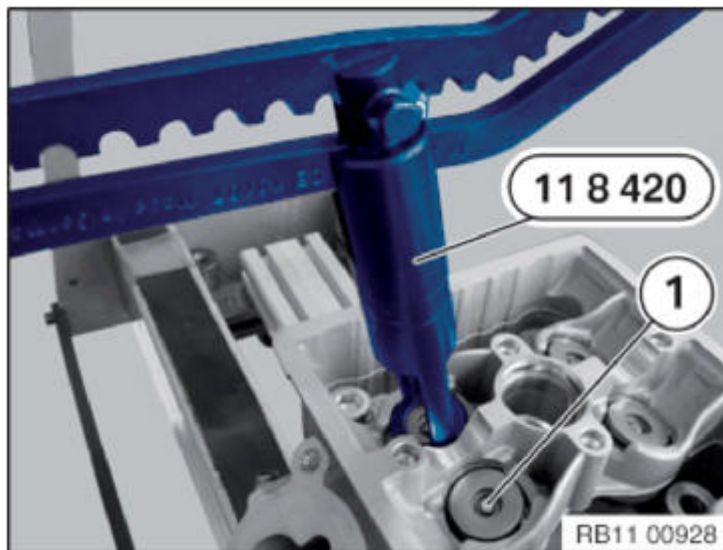
**Fig. 254: Positioning Special Tool (11 9 006) On Cylinder Head**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull off spark plug tubes (1) upwards.



**Fig. 255: Pressing Spark Plug Tubes**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press down **valve springs** with special tool 11 8 840.



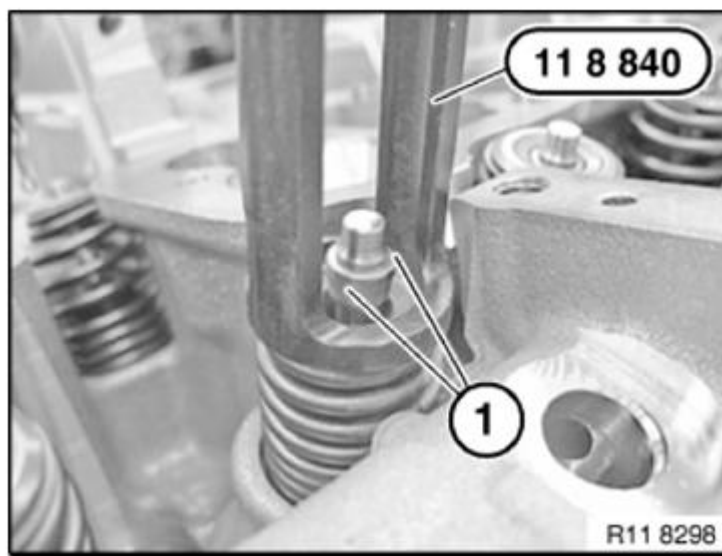
**Fig. 256: Pressing Down Valve Springs With Special Tool (11 8 840)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove valve key (1) with a magnet.

Remove valve spring with spring cups.

If individual components are to be reused, they must be placed in neat order in special tool 11 4 482.

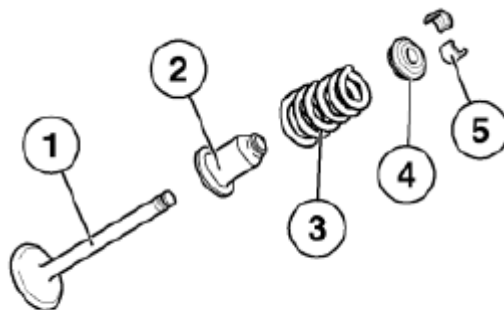
Illustration shows N54 engine.



**Fig. 257: Identifying Special Tool (11 8 840) And Valve Key**  
Courtesy of BMW OF NORTH AMERICA, INC.

Arrangement:

1. Valve
2. Valve stem seal
- Valve spring cup, bottom
3. Valve spring
4. Valve spring cup, top
5. Valve keys



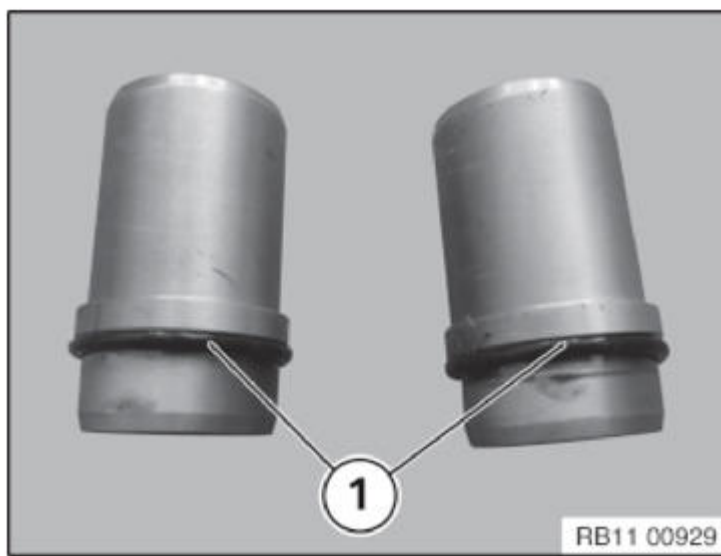
R11 4170

**Fig. 258: Identifying Valve, Stem Seal, Spring And Valve Keys**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace O-rings (1) on spark plug tube.



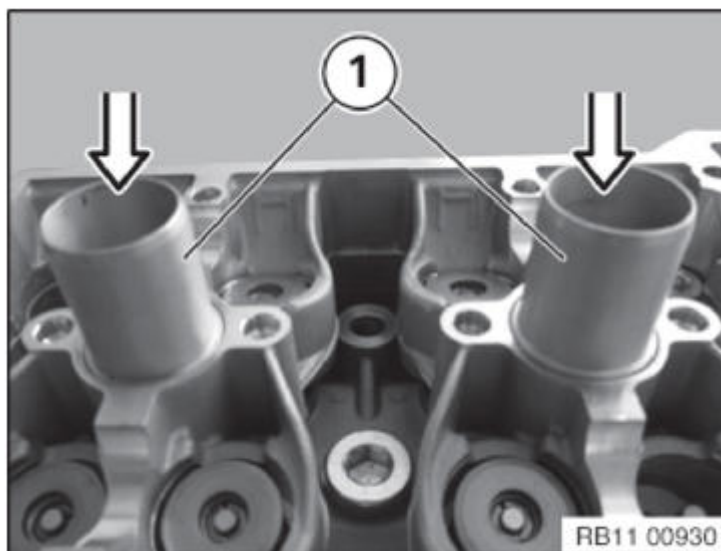


**Fig. 259: Identifying O-Rings On Spark Plug Tube**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Lightly coat O-rings with engine oil.

Press in spark plug tubes (1) in direction of arrow.



**Fig. 260: Pressing Spark Plug Tubes**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

## **11 34 552 REMOVING AND INSTALLING/REPLACING ALL VALVES (W20)**

**Special tools required:**

- 11 4 481
- 11 8 420

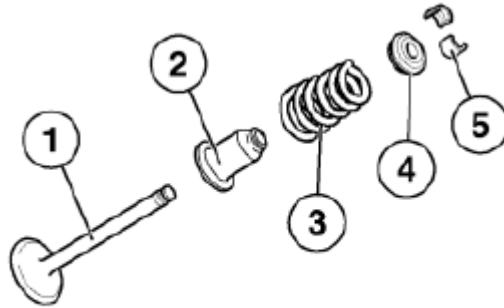
*Necessary preliminary tasks:*

- Remove **RANGE EXTENDER DRIVE UNIT (REX)**.
- Remove **CYLINDER HEAD**.
- Remove **VALVE SPRINGS**.
- Remove **VALVE STEM SEALS**.

Arrangement:

1. Intake valve 5 mm dia.
2. Valve stem seal
3. Spring cup.
4. Valve spring
5. Upper spring cup
6. Valve keys

If the valves are to be reused, they must be placed in neat order in special tool 11 4 481.



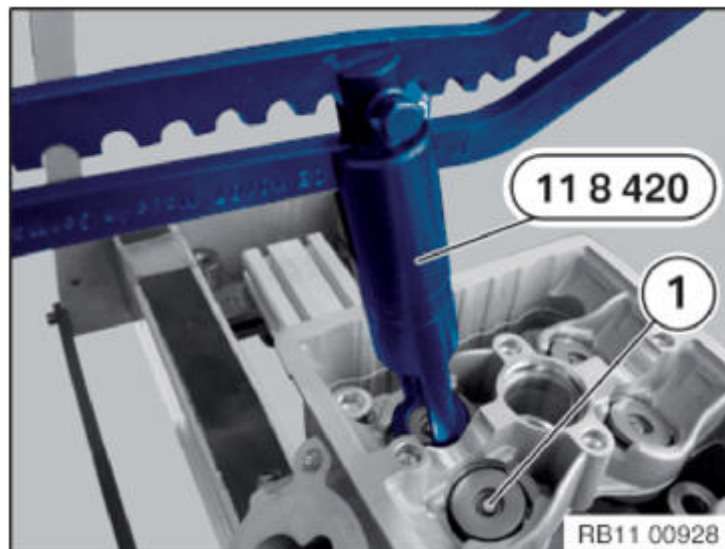
R11 4170

**Fig. 261: Identifying Valve, Stem Seal, Spring And Valve Keys**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press down valve spring with special tool 11 8 420.

Remove valve keys with a magnet.

Place valves and valve springs on special tool 11 4 481 in order.



**Fig. 262: Pressing Down Valve Springs With Special Tool (11 8 840)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

### **11 34 560 REPLACING ALL VALVE STEM SEALS (W20)**

**Special tools required:**

- 11 1 480

*Necessary preliminary tasks:*

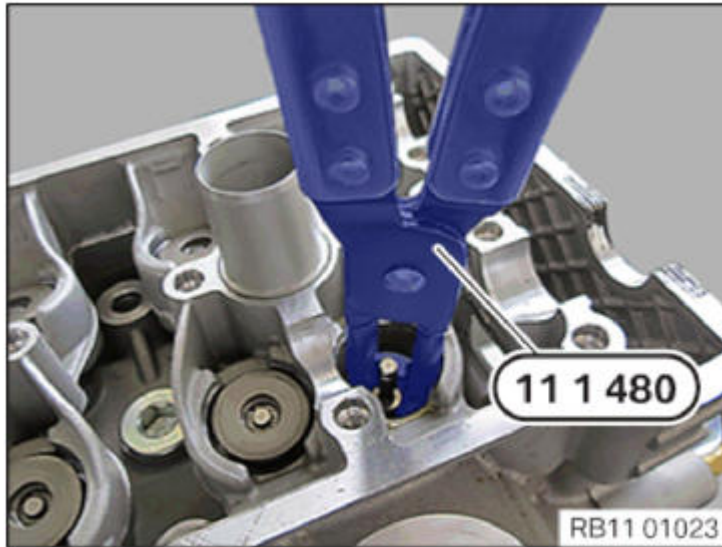
- Remove camshafts. See **INTAKE CAMSHAFT** and **EXHAUST CAMSHAFT**.
- Remove **CYLINDER HEAD**.

Detach valve stem seal from valve stem by turning and simultaneously pulling special tool 11 1 480.

*Installation note:*

Press on new valve stem seal with a suitable tool.

Insert all **VALVES**.



**Fig. 263: Detaching Valve Stem Seal From Valve Stem Using Special Tool (11 1 480)**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Assemble engine.

## **ENGINE OIL PRESSURE**

### **11 40 000 CHECKING ENGINE OIL PRESSURE (W20)**

**Special tools required:**

- 11 4 050
- 11 4 310
- 2 212 823

The oil pressure can only be checked and measured with the diagnosis system.  
 Diagnosis path:

- IMPORTANT:**
- Power train
  - Range extender electrical machine
  - Range extender electrical machine digital engine electronics
  - Engine oil
  - Oil pressure switch

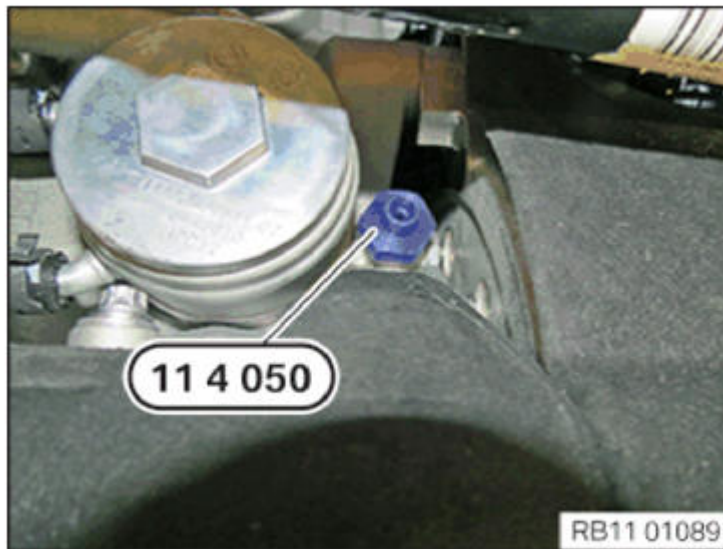
*Necessary preliminary tasks:*

- Connect BMW diagnosis system to vehicle.
- Remove **OIL PRESSURE SWITCH**.

Screw in special tool 11 4 050 with new sealing ring.

Screw the pressure sensor (1) hand tight.

Apply light coating of oil to sealing ring at pressure sensor (1) 100 bar.

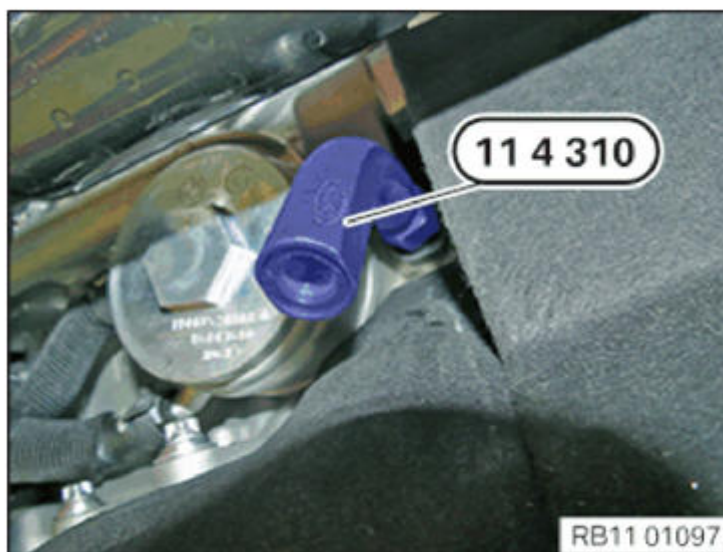


**Fig. 264: Screwing Special Tool (11 4 050) With Sealing Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tool 11 4 310 on to special tool 11 4 050.

Screw the pressure sensor (1) hand tight.

Apply light coating of oil to sealing ring at pressure sensor (1) 100 bar.



**Fig. 265: Screwing Special Tool (11 4 310) On To Special Tool (11 4 050)**  
Courtesy of BMW OF NORTH AMERICA, INC.

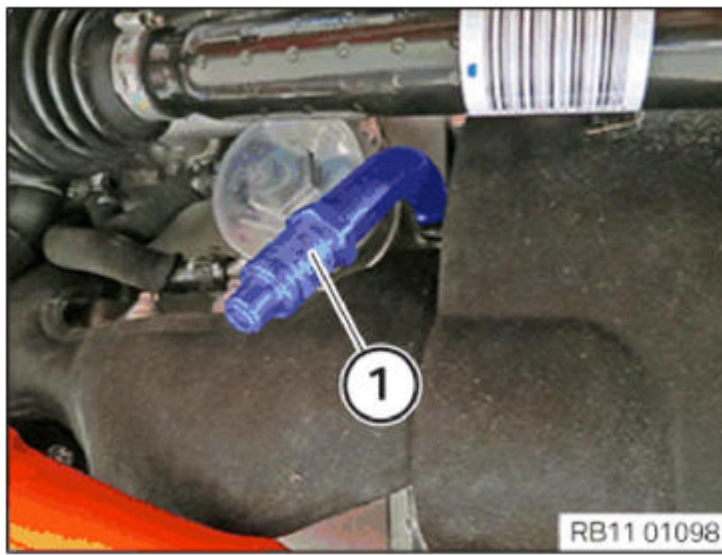
**Measure the engine oil pressure with diagnosis system.**

Order number for special tool: Screw 2 212 823 to oil filter housing.

Special tool 11 4 310 on special tool, order number: 2 212 823.

Hand-tighten the 100 bar pressure sensor (1) on the special tool 11 4 310.

Connect line of IMIB (Integrated Measurement Interface Box) to pressure sensor (1) 100 bar.



**Fig. 266: Identifying Pressure Sensor**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Start the engine in compliance with diagnosis instructions.

## **OIL PUMP WITH FILTER AND DRIVE**

### **11 41 000 REMOVING AND INSTALLING/REPLACING OIL PUMP (W20)**

*Necessary preliminary tasks:*

- Remove **COMPLETE DRIVE UNIT (RANGE EXTENDER)**.
- Remove **ENGINE FROM DRIVE UNIT**.
- Removing **OIL SUMP**.
- Remove **LOWER SECTION OF CRANKCASE**.

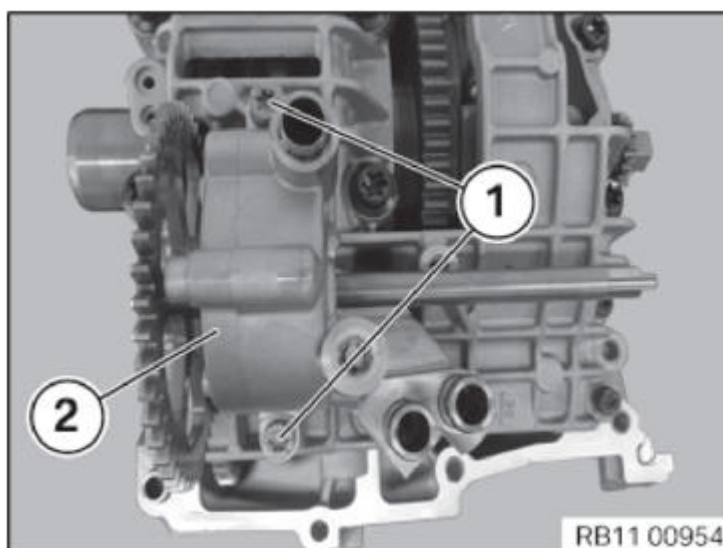
Release screws (1).

Remove oil pump (2).

Tightening torque: **11 41 1AZ** .

*Installation note:*

Replace all O-rings.



**Fig. 267: Identifying Oil Pump And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.



Assemble engine.

## OIL SPRAY NOZZLES

### 11 42 320 REMOVING AND INSTALLING/REPLACING OIL SPRAY NOZZLES (W20)

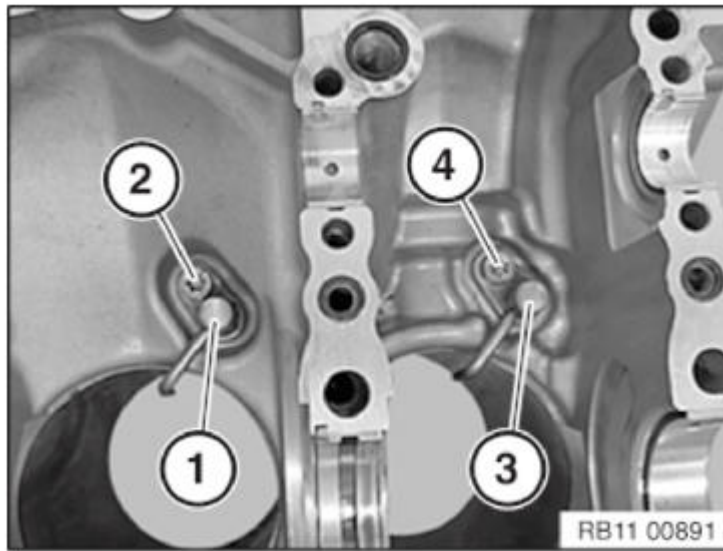
*Necessary preliminary tasks:*

- Remove **CRANKSHAFT**.

Loosen screws (2 and 4).

Remove oil spray nozzles (1 and 3).

Tightening torque: **11 11 2AZ** .



**Fig. 268: Identifying Oil Spray Nozzles And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

## GUIDE TUBE FOR DIPSTICK

### 11 43 000 REMOVING AND INSTALLING/REPLACING GUIDE TUBE FOR DIPSTICK (W20)

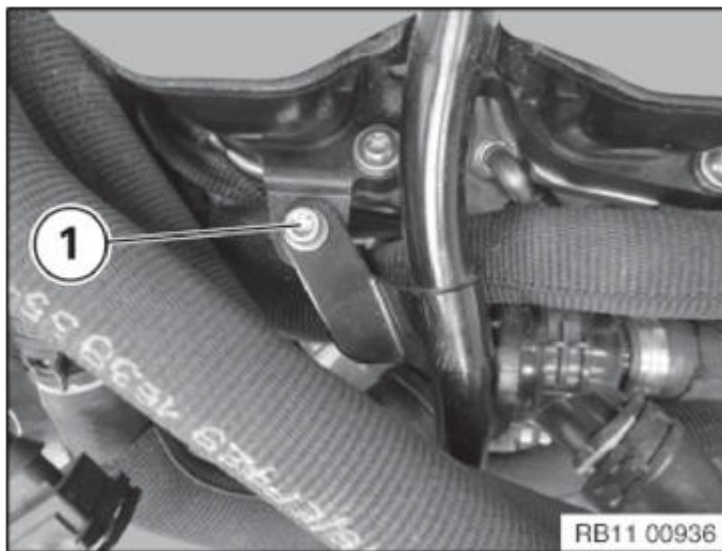
*Necessary preliminary tasks:*

- Remove **DRIVE UNIT** .

Release screw (1).

Tightening torque: **11 43 1AZ** .



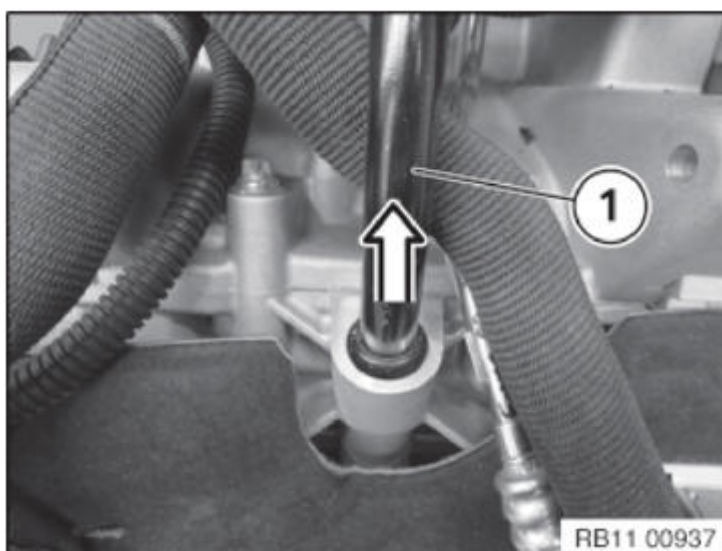


**Fig. 269: Identifying Guide Tube Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove guide tube (1) in an upward direction.

*Installation note:*

Replace O-ring (1).



**Fig. 270: Removing Guide Tube**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Check oil level, correcting if necessary.

The following engine oils may be used:

BMW engine oil "Longlife-01 FE" SAE 0W-30, part # 83 21 2 405 945

BMW engine oil "Longlife-01" SAE 5W-30, part # 83 21 2 405 947

**NOTE:** For gasoline-powered engines, BMW "Longlife-04..." engine oils are only approved for the European region including Norway, Switzerland and Liechtenstein.

## **OIL COOLER**

## 11 44 000 REMOVING AND INSTALLING/REPLACING OIL-TO-WATER HEAT EXCHANGER (W20)

**WARNING:** Risk of scalding!  
Only perform this repair work on an engine that has cooled down.

### Recycling:

Catch and dispose of drained coolant.

Observe country-specific waste disposal regulations.

*Necessary preliminary tasks:*

- Remove BOTH REAR STRUTS .
- Drain coolant. See [DRAINING COOLING CIRCUIT \(HIGH-TEMPERATURE COOLING SYSTEM\)](#) and [DRAINING COOLING CIRCUIT \(LOW TEMPERATURE COOLING SYSTEM\)](#) .

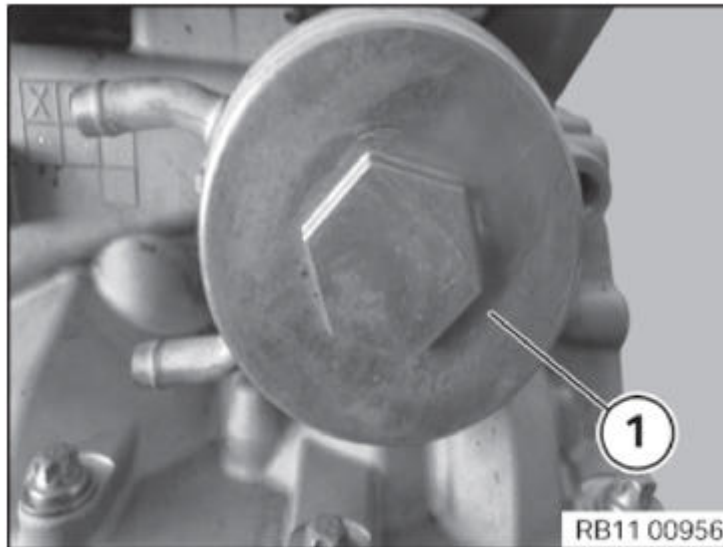
Release coolant hose (1).

Unfasten screws (2).

Tightening torque: [11 42 3AZ](#) .

*Installation note:*

Replace all gaskets.

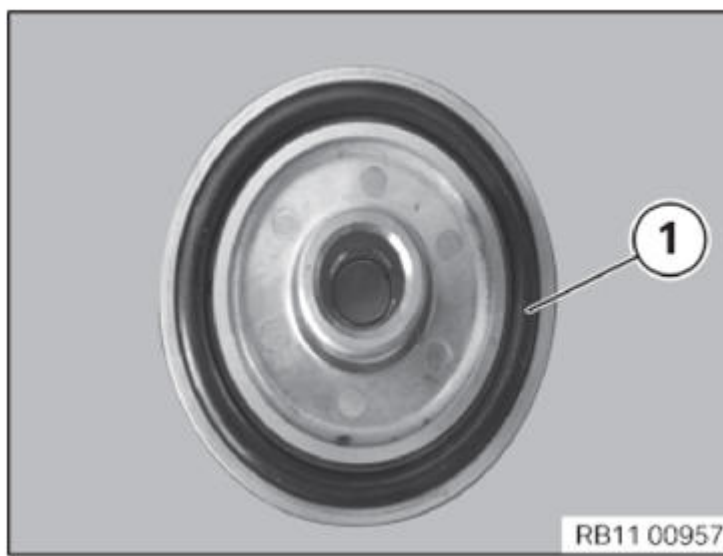


**Fig. 271: Identifying Coolant Hose**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace O-ring (1).

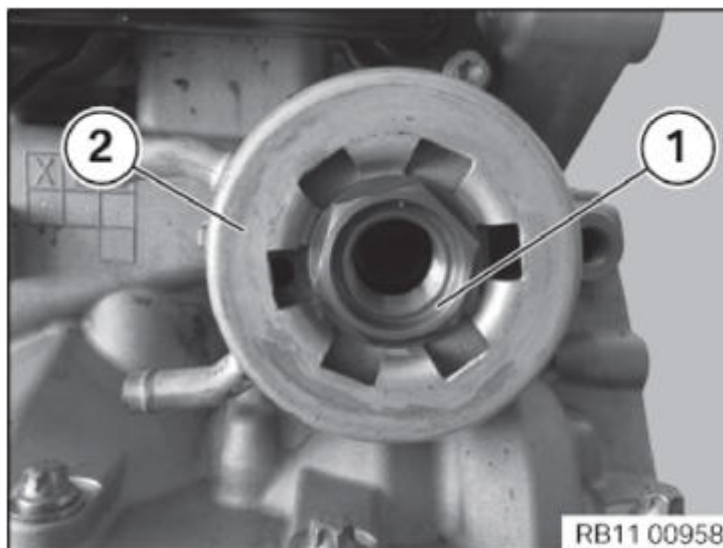


**Fig. 272: Identifying O-Ring**

Courtesy of BMW OF NORTH AMERICA, INC.

Release banjo bolt (1) and remove oil-to-water heat exchanger (2).

Tightening torque [11 42 2AZ](#) .



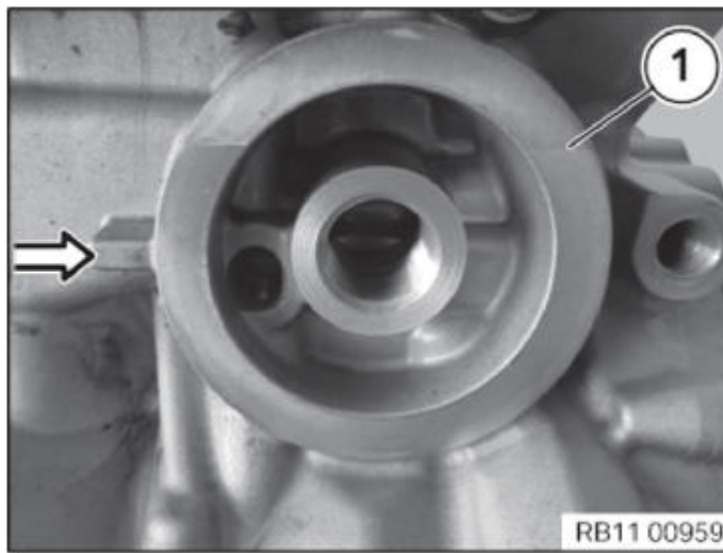
**Fig. 273: Identifying Banjo Bolt And Oil-To-Water Heat Exchanger**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Pay attention to retaining pin on engine block (see arrow).

Clean sealing surface (1).

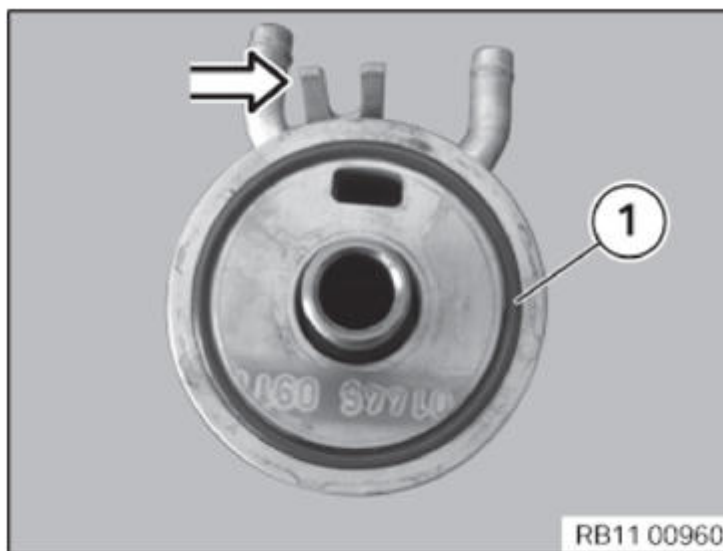


**Fig. 274: Identifying Sealing Surface And Retaining Pin**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace O-ring (1).

Pay attention to retaining pin on oil-to-water heat exchanger (see arrow).



**Fig. 275: Identifying O-Ring And Oil-To-Water Heat Exchanger Retaining Pin**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

*Installation note:*

**BLEEDING INSTRUCTION** must be observed without fail.

## **WATER PUMP WITH DRIVE**

### **11 51 000 REMOVING AND INSTALLING/REPLACING COOLANT PUMP (W20)**

Special tools required:

- **17 2 050**
- **2 288 154**
- 11 4 470
- 24 5 420

## Recycling:

Catch and dispose of drained coolant in a suitable collecting vessel.

Observe country-specific waste disposal regulations.

*Necessary preliminary tasks:*

- Completely remove **DRIVE UNIT (RANGE EXTENDER)** .
- Remove **ENGINE FROM DRIVE UNIT**.
- Remove **OIL SUMP**.

Remove surge plates from crankcase.

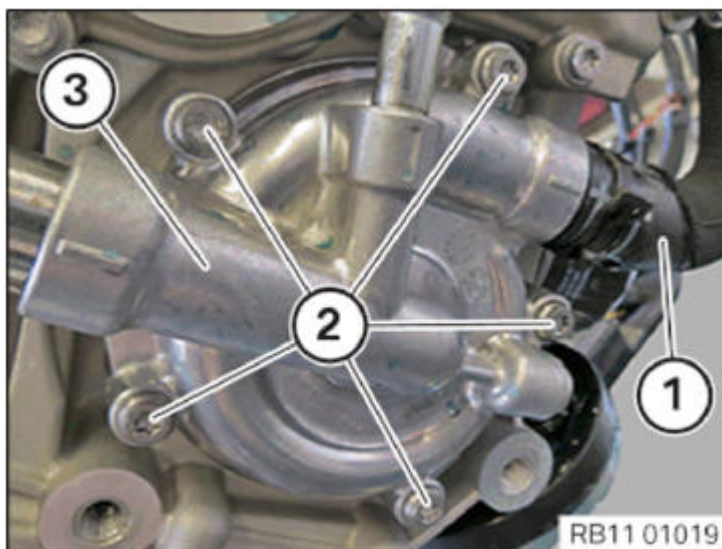


**Fig. 276: Identifying Surge Plates On Crankcase**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release coolant hoses (1) by means of special tool **17 2 050** .

Unfasten screws (2).

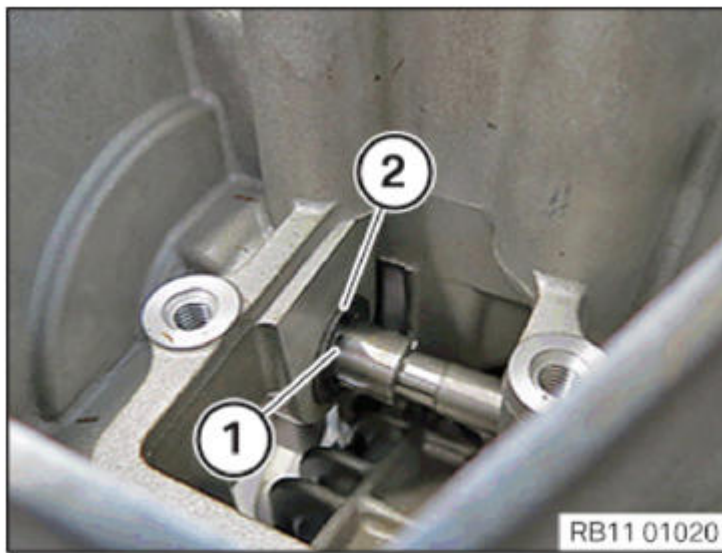
Remove housing (3) of coolant pump.



**Fig. 277: Identifying Coolant Pump Housing, Coolant Hoses And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

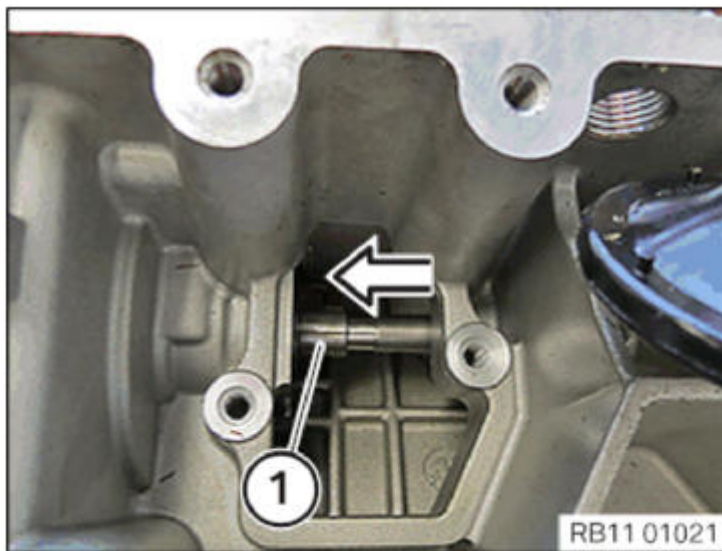
Release circlip (1) by means of special tool **2 288 154** .





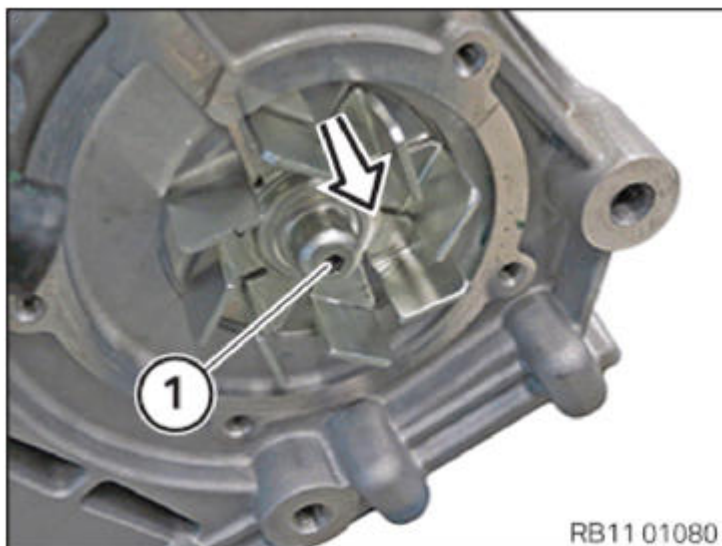
**Fig. 278: Releasing Circlip With Special Tool (2 288 154)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press out impeller (1) in direction of arrow.



**Fig. 279: Pressing Out Impeller**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull off coolant pump wheel (1) with shaft in direction of arrow.

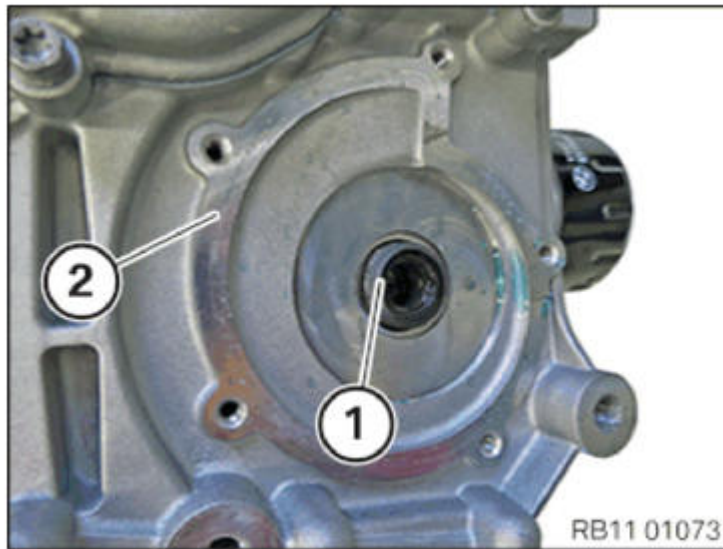




**Fig. 280: Pulling Out Coolant Pump Wheel With Shaft**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove sealing ring (1) coolant by means of an adequate tool.

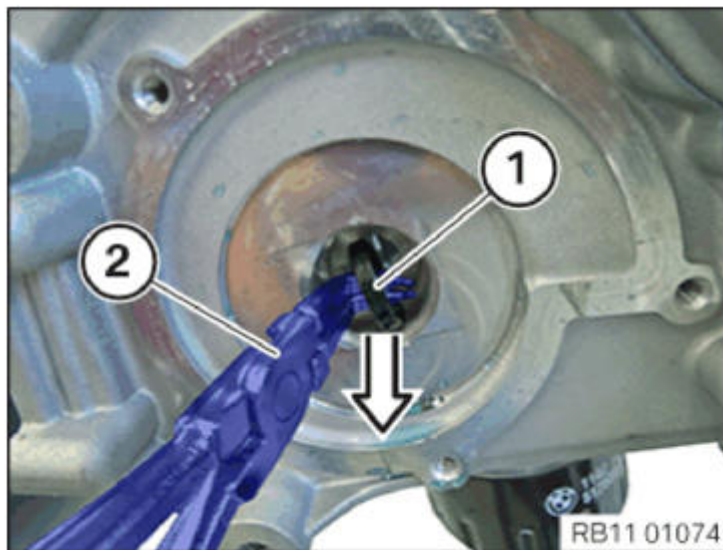
Clean sealing surface (2) with special tool 11 4 470.



**Fig. 281: Identifying Sealing Surface And Sealing Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage to sealing surface crankcase.

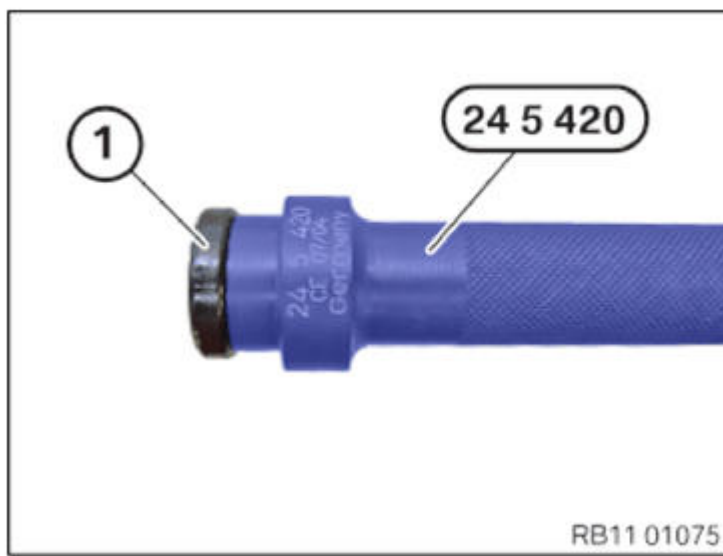
Remove sealing ring (1) crankcase (oil) by means of angled pliers (2) in direction of arrow.



**Fig. 282: Removing Sealing Ring With Pliers**  
Courtesy of BMW OF NORTH AMERICA, INC.

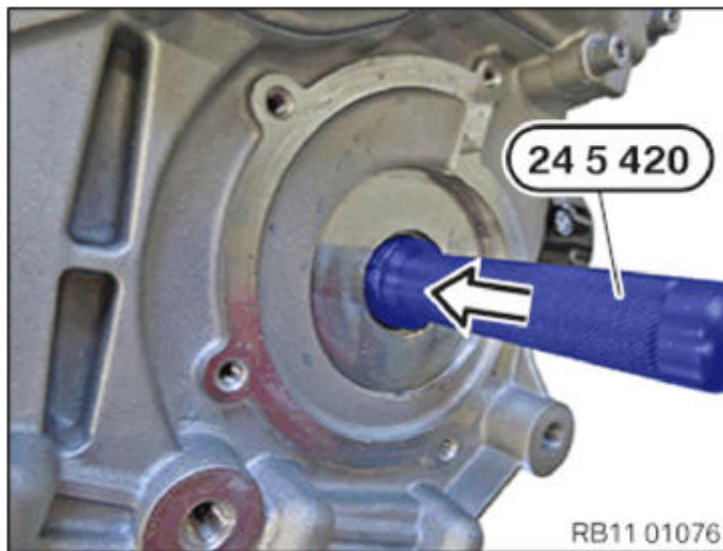
Position the input shaft seal (1) on special tool 24 5 420.

Check installed direction.



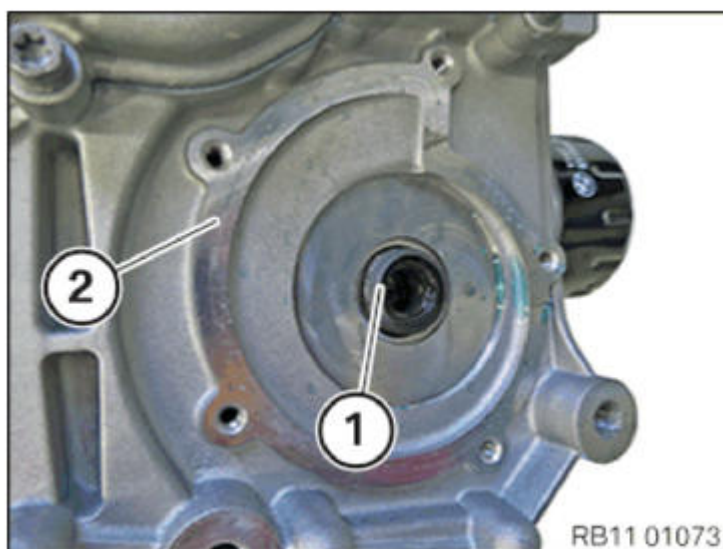
**Fig. 283: Positioning Input Shaft Seal On Special Tool (24 5 420).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press in shaft seal by means of special tool 24 5 420 to the limit position in the crankcase.



**Fig. 284: Pressing Shaft Seal Into Crankcase With Special Tool (24 5 420).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press in sealing ring (1) coolant by means of an adequate tool.



*Installation note:*

Bleeding instructions must be observed without fail. See [DRAINING/REFILLING](#) or [BLEEDING/FILLING WITH VACUUM FILLING UNIT](#) .

Assemble engine.

## **INTAKE MANIFOLD**

### **11 61 008 REMOVING AND INSTALLING INTAKE NECK (W20)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

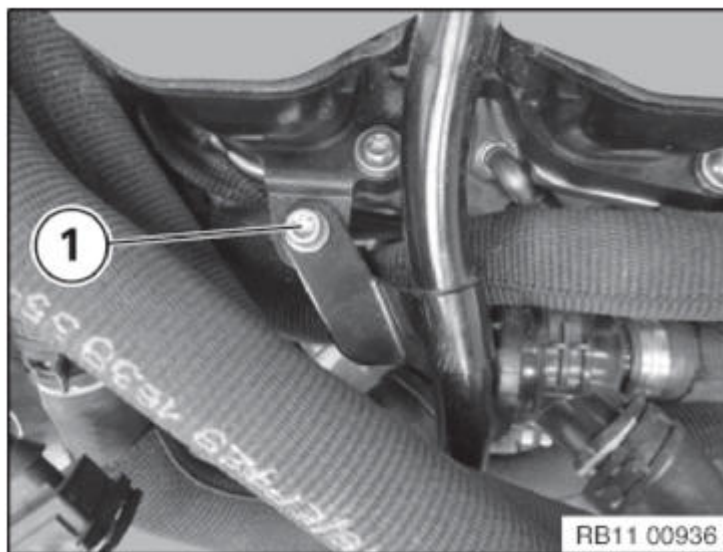
- De-energize the [HIGH-VOLTAGE SYSTEM](#) .
- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

*Necessary preliminary tasks:*

- Remove [INTAKE PLENUM](#).

Release screw (1).

Tightening torque: [11 43 1AZ](#) .

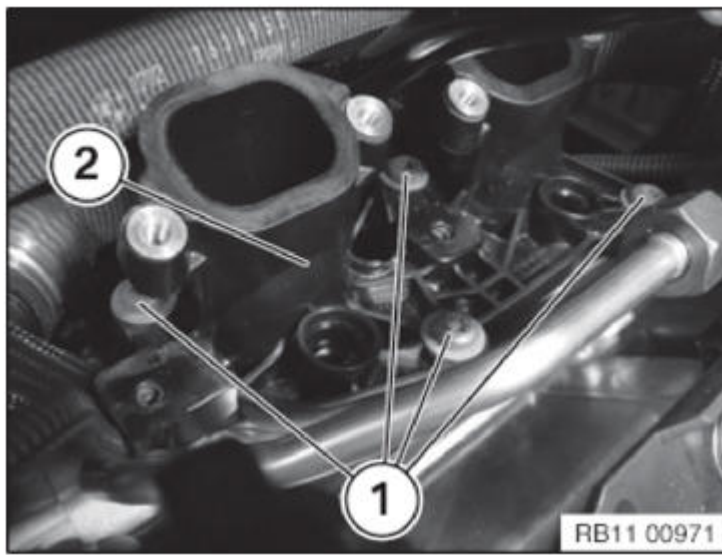


**Fig. 286: Identifying Guide Tube Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Remove intake neck.

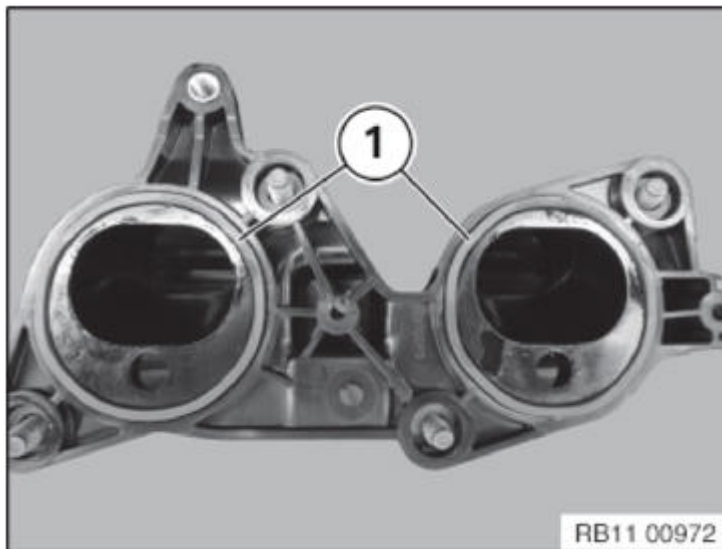
Tightening torque: [11 61 2AZ](#) .



**Fig. 287: Identifying Intake Neck Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace sealing rings (1).



**Fig. 288: Identifying Sealing Rings**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace all gaskets.

Assemble engine.

### **11 61 050 REMOVING AND INSTALLING INTAKE PLENUM (W20)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM** .
- Observe **SAFETY INFORMATION** for handling electric vehicles.

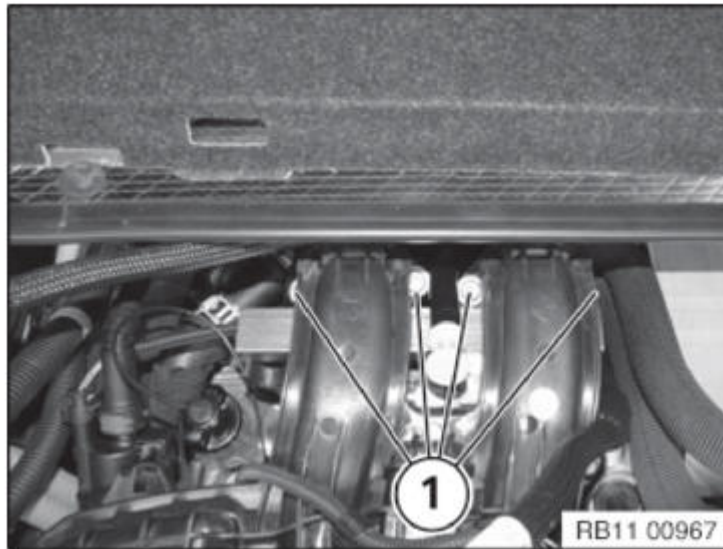
*Necessary preliminary tasks:*



- Disconnect **BATTERY EARTH LEAD** .
- Partly release **THROTTLE BODY** .

Release screws (1).

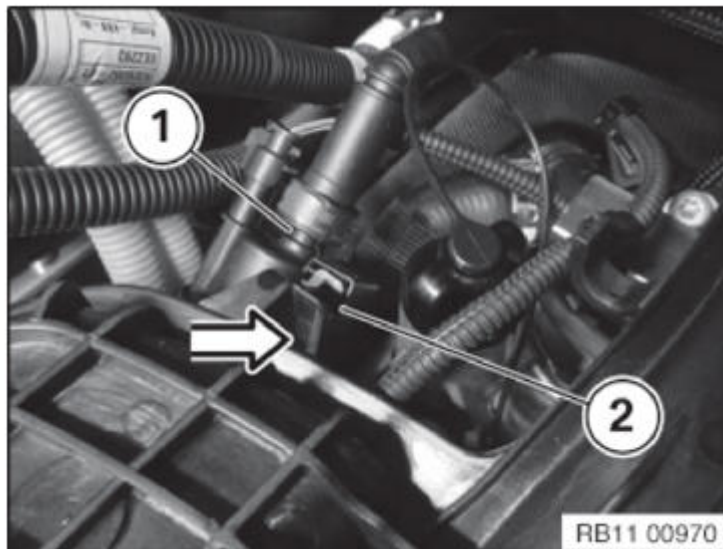
Tightening torque: **11 61 1AZ** .



**Fig. 289: Identifying Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release tank vent valve (1) from holder (2) in direction of arrow.



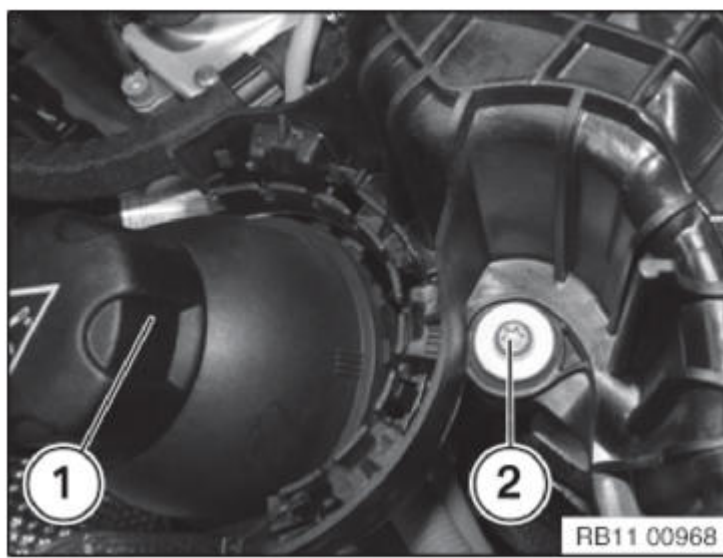
**Fig. 290: Releasing Tank Vent Valve From Holder**

Courtesy of BMW OF NORTH AMERICA, INC.

Unclip expansion tank (1) carefully from bracket at intake system.

Release screw (2).

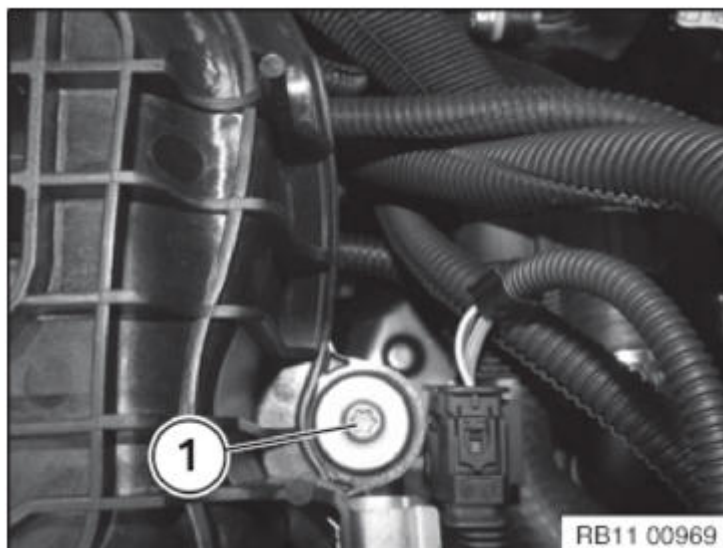
Tightening torque: **11 61 3AZ** .



**Fig. 291: Identifying Expansion Tank And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque: [11 61 3AZ](#) .



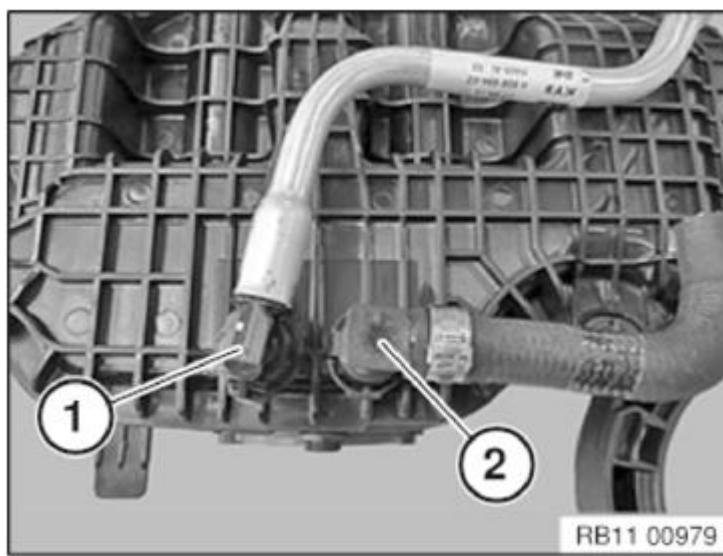
**Fig. 292: Identifying Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and pull off tank ventilation line at connecting element (1).

Unlock and pull off engine ventilation line at connecting element (2).

Illustration shows the removed intake plenum.





**Fig. 293: Identifying Tank Ventilation Line And Engine Ventilation Line Connecting Elements**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace all gaskets.

Assemble engine.

## **EXHAUST MANIFOLD**

### **18 40 040 REMOVING AND INSTALLING, SEALING/REPLACING EXHAUST MANIFOLD (I01)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**WARNING:** Risk of burning!  
Only perform this repair work on an engine that has cooled down.

**Necessary preliminary tasks:**

- Remove the **CATALYTIC CONVERTER** .

Unscrew nuts (1).

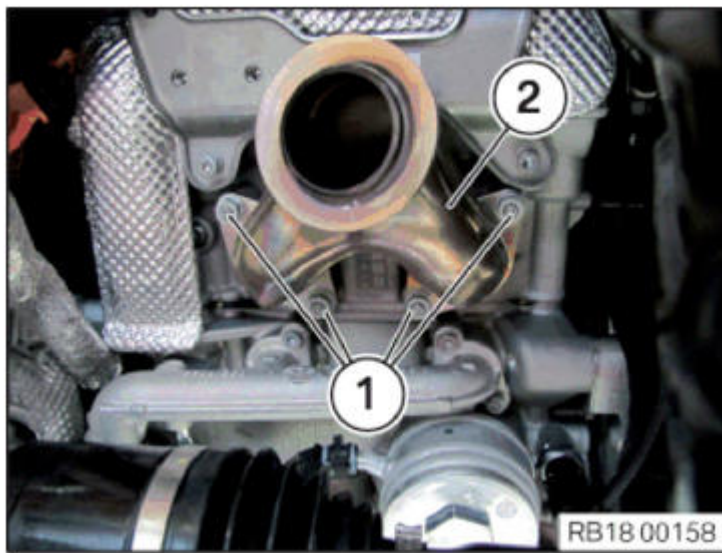
Tightening torque **18 30 8AZ** .

Remove exhaust manifold (2) from cylinder head.

*Installation note:*

Clean connection points.

Replace gaskets.



**Fig. 294: Identifying Exhaust Manifold And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Check exhaust system for leak tightness.

## **EMISSION CONTROL, OXYGEN SENSOR**

### **11 78 510 REPLACING OXYGEN CONTROL SENSORS (W20)**

**Special tools required:**

- 11 4 260

**WARNING:** Risk of burning!  
Only carry out this repair work when the exhaust system has cooled down.

*Installation note:*

The threads of new oxygen control sensors are already coated with Never Seez Compound.

If a oxygen control sensor is to be reused, apply a thin and even coating of Never Seez compound to the thread only.

The part of the lambda control sensor which projects into the exhaust system branch (sensor ceramics) must **not** be cleaned and **not** coated with lubricant.

*Necessary preliminary tasks:*

- Remove **INTAKE PLENUM**.

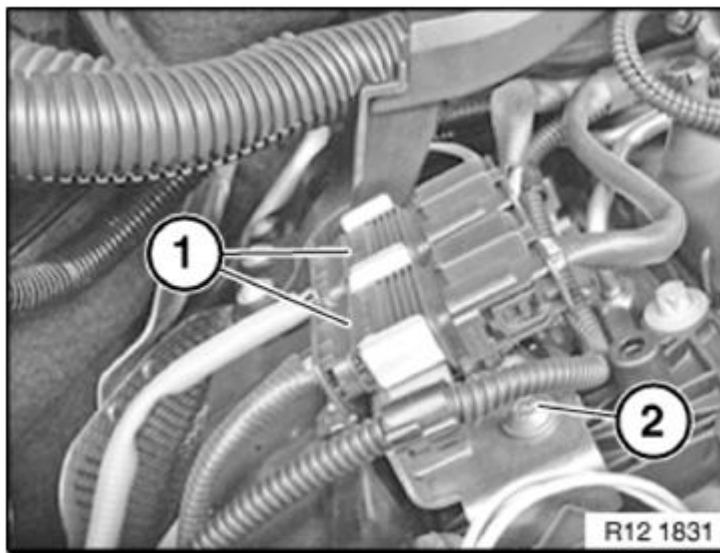
Disconnect plug connection on oxygen control sensor (1).

*Installation note:*

Protective sleeve color of oxygen control sensor = black.

Protective sleeve color of oxygen monitoring sensor = grey.

Illustration shows N20 engine.



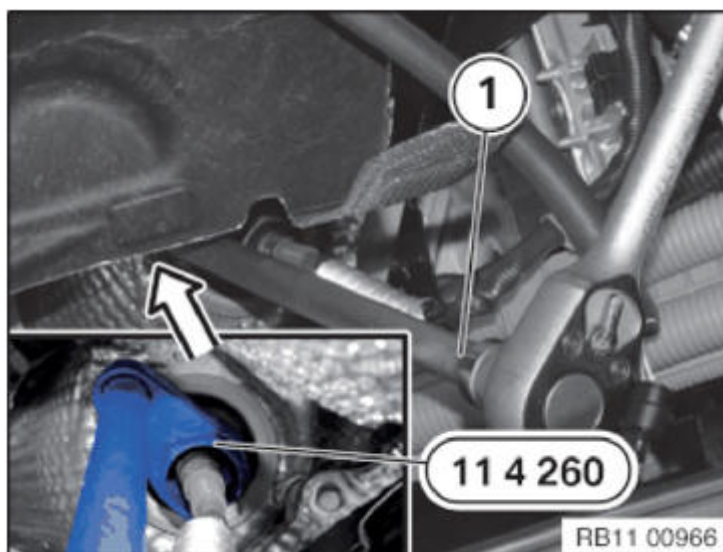
**Fig. 295: Identifying Oxygen Control Sensor Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

Release oxygen control sensor with special tool 11 4 260 and with a suitable extension (1).

Tightening torque [11 78 1AZ](#) .

**IMPORTANT:** When using special tool 11 4 260, it is essential to reduce the prescribed tightening torque by 3 Nm.



**Fig. 296: Releasing Oxygen Control Sensor With Special Tool (11 4 260) And Suitable Extension**

Courtesy of BMW OF NORTH AMERICA, INC.

Reassemble the vehicle.

Check function of DME.

### **11 78 545 REPLACING OXYGEN MONITORING SENSORS (W20)**

**Special tools required:**

- 11 4 260

**WARNING:**

**Risk of burning!**

**Only carry out this repair work when the exhaust system has cooled down.**

*Necessary preliminary tasks:*

- Remove INTAKE PLENUM.

*Installation note:*

The threads of new lambda monitoring sensors are already coated with Never Seez Compound.

If a lambda monitoring sensor is to be reused, apply a thin and even coating of Never Seez Compound to the thread only.

The part of the lambda monitoring sensor which projects into the exhaust system branch (sensor ceramics) must **not** be cleaned and **not** coated with lubricant.

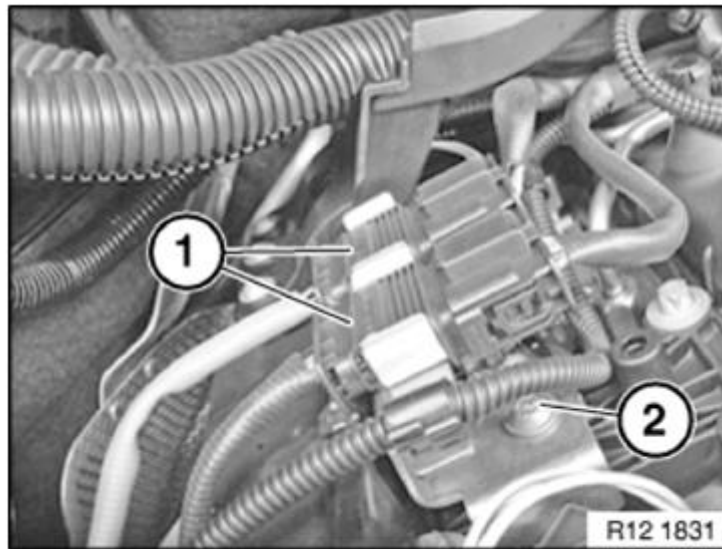
Disconnect plug connection on lambda monitoring sensor (1).

*Installation note:*

Protective sleeve color of oxygen control sensor = black.

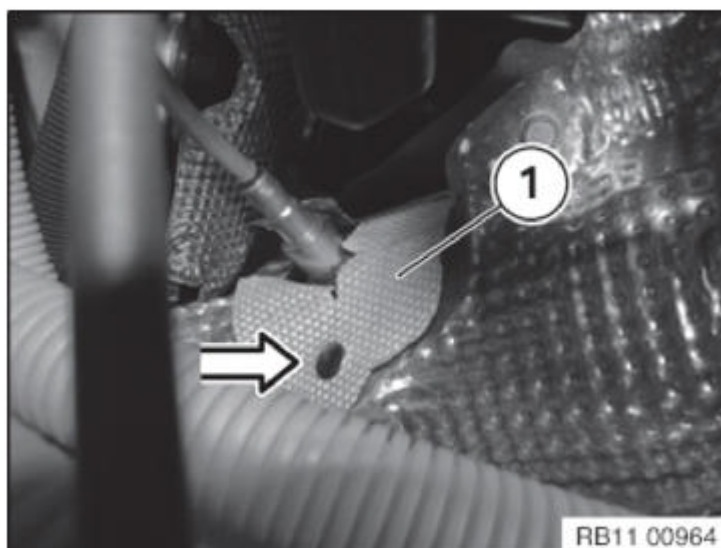
Protective sleeve color of oxygen monitoring sensor = grey.

Illustration shows N20 engine.



**Fig. 297: Identifying Oxygen Control Sensor Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release and remove insulation (1) on push-button.

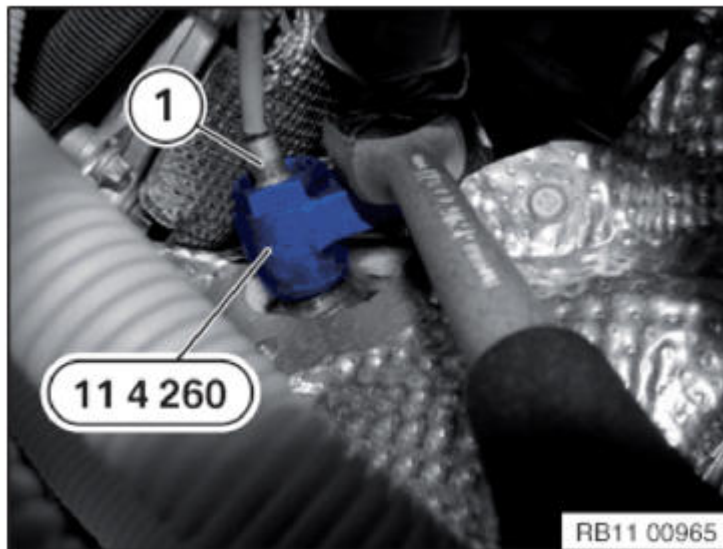


**Fig. 298: Removing Insulation On Push-Button**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release oxygen monitoring sensor (1) with special tool 11 4 260.

Tightening torque [11 78 2AZ](#) .

**IMPORTANT:** When using special tool 11 4 260, it is essential to reduce the prescribed tightening torque by 3 Nm.



**Fig. 299: Releasing Oxygen Monitoring Sensor With Special Tool (11 4 260).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Reassemble the vehicle.

Check function of DME.

---

[Back To Article](#)

## ENGINE

Engine - Special Tools - Only I3 Models With Range Extender - i3

## ENGINE

### 2406729 ADAPTER AM

**NOTE:** For measuring the engine compartment pressure.

#### Storage Location

A36

#### SI number

01 14 15 (259)



**Fig. 1: Identifying Adapter (2406729).**

Courtesy of BMW OF NORTH AMERICA, INC.

### 2357744 ADAPTER AM

In conjunction with: 110220 = 0490613

**NOTE:** For compression testing.

#### Storage Location

B36

#### SI number

01 03 14 (070)





**Fig. 2: Identifying Adapter (2357744)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2158850 ADAPTER MP**

In conjunction with: Diagnostic auxiliary device 81290426464

**NOTE:** Adapter for connecting the diagnostic auxiliary device to the Integrated Measurement Interface Box.

**SI number**

02 10 09 (613)



**Fig. 3: Identifying Adapter (2158850)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**117521 BUSH MECHANICAL TOOL**

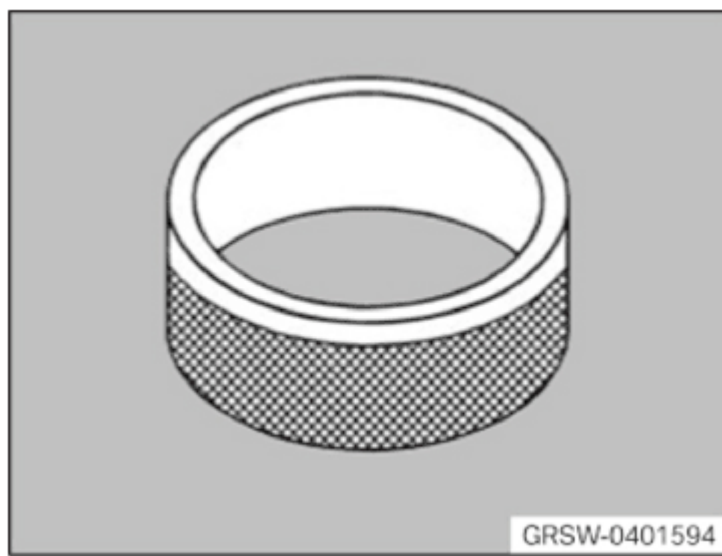
**NOTE:** For the piston installation.

**Storage Location**

C35

**SI number**

01 03 14 (070)



**Fig. 4: Identifying Bush (117521)**

Courtesy of BMW OF NORTH AMERICA, INC.

**115721 BUSH AM**

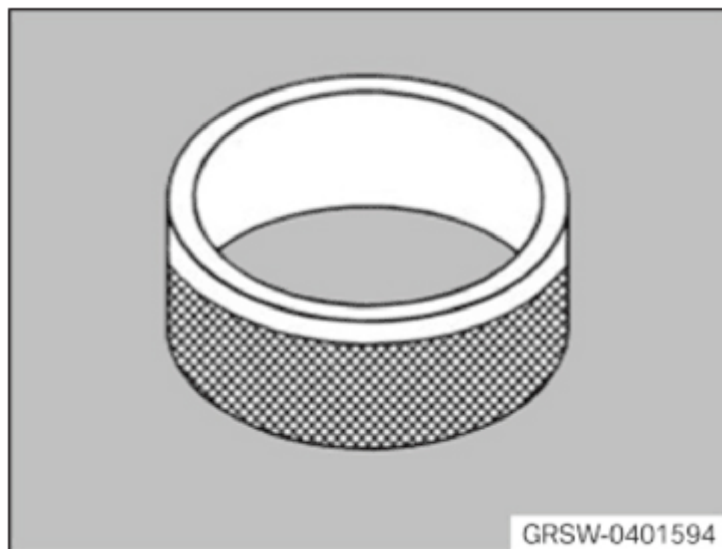
**NOTE:** For the piston installation.

**Storage Location**

C35

**SI number**

01 03 14 (070)



**Fig. 5: Identifying Bush (115721)**

Courtesy of BMW OF NORTH AMERICA, INC.

**115721 BUSH MECHANICAL TOOL**

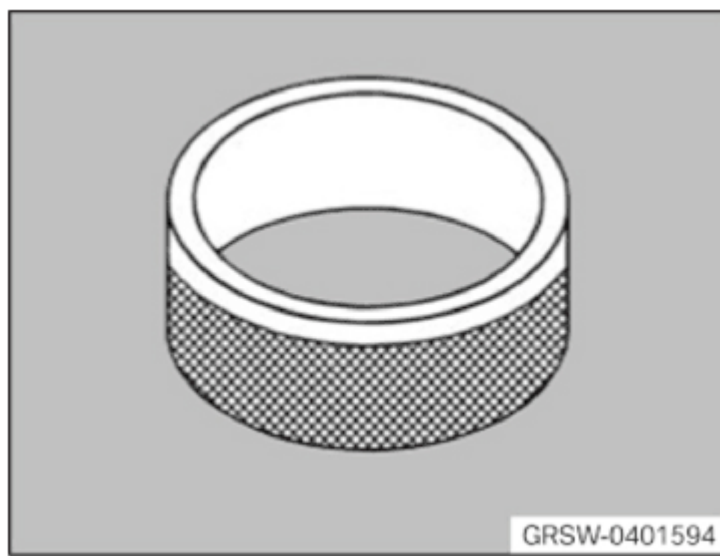
**NOTE:** For the piston installation.

**Storage Location**

C35

**SI number**

01 03 14 (070)



**Fig. 6: Identifying Bush (115721)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2166582 COMPRESSION TESTER MP**

**NOTE:** Electronic compression pressure-measuring device used for measurements on gasoline and diesel engines. The device's measuring range is 0-50 bar.

SI number

08 15 09 (579)



**Fig. 7: Identifying Compression Tester (2166582)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2358037 FOIL MINIMUM SET: MECHANICAL TOOLS AM**

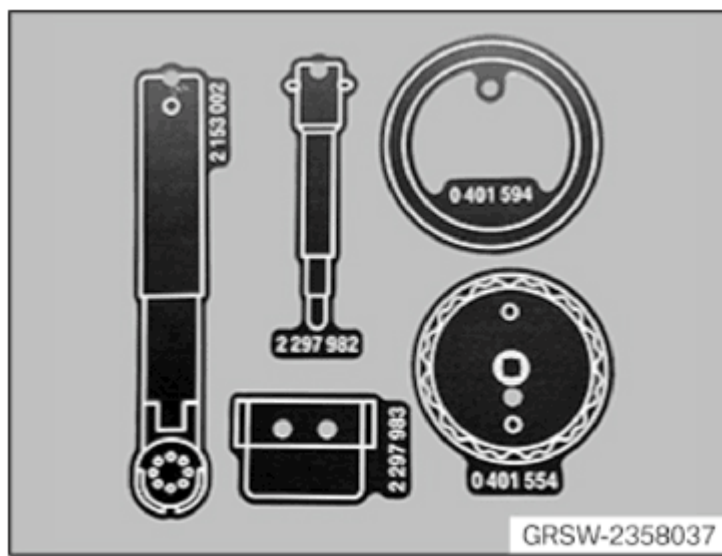
**NOTE:** This set is required for storing special tools with part numbers 0 401 554, 0 401 594, 2 297 982, 2 297 983 and 2 153 002

Storage Location

Individual

SI number

01 03 14 (070)



**Fig. 8: Identifying Foil (2358037)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2286315 DEVICE AM**

**NOTE:** For installation of the alternator on the engine.

**Storage Location**

Individual

**SI number**

01 03 14 (070)



**Fig. 9: Identifying Device (2286315)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355719 EXTRACTOR AM**

**NOTE:** Removal and installation of engine supporting bearing I03. Applies to: BMW i Aftersales.

**Storage Location**

B35

B36

**SI number**

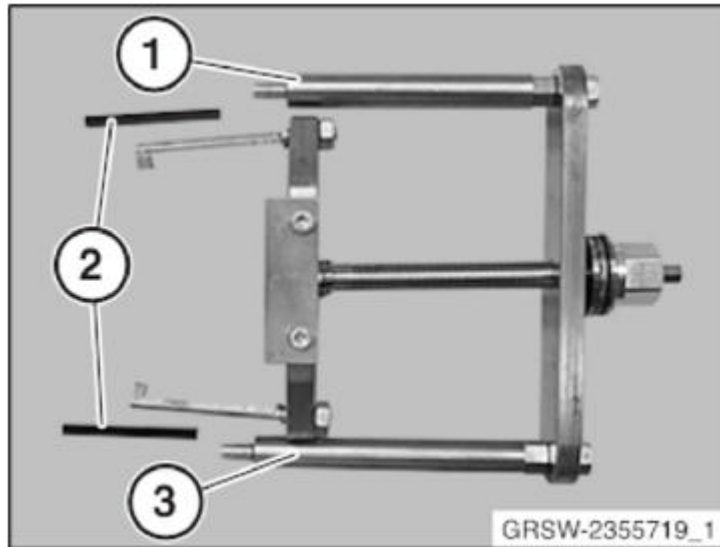
01 14 13 (972)

Consisting of:

3 = [2355721](#) Support

**NOTE:** Support length 134mm. Not available separately. Available only as complete tool set 83 30 2 355 719.

1 = [2355720](#) Support



**Fig. 10: Identifying Extractor (2355719)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Support (123 mm in length). Not available separately. Available only as complete tool set 83 30 2 355 719.

2 = [2355722](#) Pin

**NOTE:** Set of pins = 2 pieces. Not available separately. Available only as complete tool set 83 30 2 355 719.

**2286313 FIXTURE AM**

In conjunction with: 002300 = 0495187; 002320 = 0495196

**NOTE:** For mounting engine on the assembly stand.

**Storage Location**

Individual

**SI number**

01 03 14 (070)



**Fig. 11: Identifying Fixture (2286313).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2353954 LEAK DETECTOR MP**

**NOTE:** "BMW Smoke diagnosis tester" leak detector for the tightness diagnosis of closed systems such as fuel tanks, intake air passages, etc.. (1) "BMW Smoke diagnosis tester", (2) "UltraTracer", (3) cylinder with pressure reducer, (4) diverse adapter, (5) coupling kit for compressed air connection, (6) torch with white and UV light including special glasses, (7) power pack note: (2) "UltraTracer".

**Storage Location**

Alternatively

**SI number**

02 11 13 (958)



**Fig. 12: Identifying Leak Detector (2353954).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**110841 LOCATING STUD MECHANICAL TOOL**

**NOTE:** For disconnecting the crankshaft at TDC.

**Storage Location**



B36

SI number

01 03 14 (070)



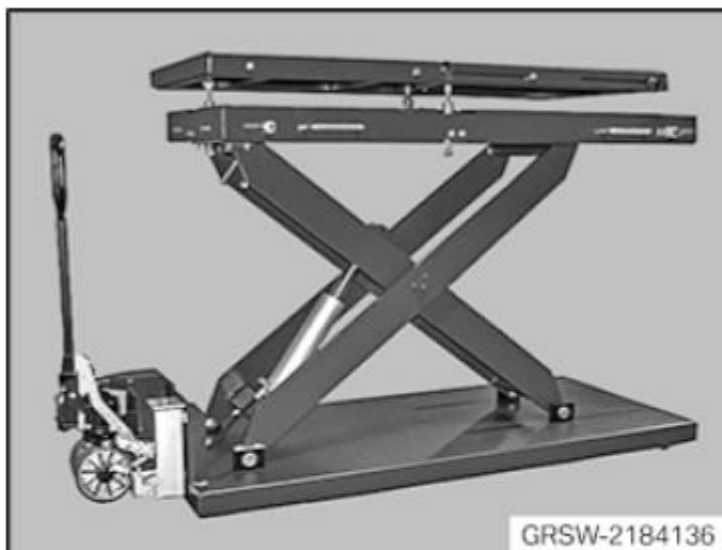
**Fig. 13: Identifying Locating Stud (110841)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2184136 MOBILE EQUIPMENT TABLE LIFT AM**

**NOTE:** Table lift MHT 1200

SI number

06 01 10 (649)



**Fig. 14: Identifying Mobile Equipment Table Lift (2184136)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**114661 OIL FILTER WRENCH MECHANICAL TOOL**

**NOTE:** For removal and installation of the oil filter element.

Storage Location

C35

SI number



**Fig. 15: Identifying Oil Filter Wrench (114661)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355722 PIN AM**

**NOTE:** Set of pins = 2 pieces. Not available separately. Available only as complete tool set 83 30 2 355 719.

**2288154 PLIERS AM**

**NOTE:** Circlip pliers with limit position for disassembly and installation of water pump.

**Storage Location**

C36

**SI number**

01 03 14 (070)



**Fig. 16: Identifying Pliers (2288154)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2285548 REMOVAL AID AM**

**NOTE:** For disassembly (disconnection) of the alternator from the engine.

**Storage Location**

C36

**SI number**

01 03 14 (070)



**Fig. 17: Identifying Removal Aid (2285548)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**118580 SOCKET WRENCH MINIMUM SET: MECHANICAL TOOLS**

**NOTE:** (wrench socket Torx T60) For removing and installing cylinder head (outside diameter 13.5 mm).

**Storage Location**

A20

B20

**SI number**

01 20 06 (299)



**Fig. 18: Identifying Socket Wrench (118580)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355721 SUPPORT AM**

**NOTE:** Support length 134mm. Not available separately. Available only as complete tool set 83 30 2 355 719.

### 2355720 SUPPORT AM

**NOTE:** Support (123 mm in length). Not available separately. Available only as complete tool set 83 30 2 355 719.

### 110842 TENSIONING TOOL MECHANICAL TOOL

**NOTE:** Pretensioning of timing chain tensioner when removing/installing camshafts.

#### Storage Location

C35

#### SI number

01 03 14 (070)



**Fig. 19: Identifying Tensioning Tool (110842)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### 0428212 TESTER MP

**NOTE:** For localization of component defects in the charging system.

#### SI number

02 13 06 (324)



**Fig. 20: Identifying Tester (0428212)**

Courtesy of BMW OF NORTH AMERICA, INC.

**0426464 TESTER MP**

**NOTE:** For localization of component defects in the charging system.



**Fig. 21: Identifying Tester (0426464)**

Courtesy of BMW OF NORTH AMERICA, INC.

**0402559 USE AM**

**NOTE:** for aluminum thread repair on the N52-magnesium crankcase

SI number

08 01 05 (177)



**Fig. 22: Identifying Use (0402559).**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

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## ENGINE

### Engine - Technical Data - Only I3 Models With Range Extender - i3

## CONNECTING RODS AND BEARINGS

### 11 24 CONNECTING RODS AND BEARINGS

#### CONNECTING RODS AND BEARINGS W20 B13 SPECIFICATION

Conrod bush: Inner diameter	mm	18.006... 18.017
Connecting rod: Inner diameter	mm	48.000... 48.016
Running clearance between conrod bush and gudgeon pin	mm	0.006... 0.025
Wear limit	mm	0.05

## COUNTERBALANCE SHAFT AND BEARING

### 11 27 COUNTERBALANCE SHAFT AND BEARING

#### COUNTERBALANCE SHAFT AND BEARING SPECIFICATION

Diameter of the counterbalance shaft	mm	19.090... 20.008
Side clearance, counterbalance shafts	mm	0.20... 0.40
Radial clearance of counterbalance shafts	mm	0.02... 0.05
Radial clearance of counterbalance shafts (wear limit)	mm	0.070

## CRANKSHAFT AND BEARINGS

### CONNECTING ROD BEARINGS

#### CONNECTING ROD BEARINGS SPECIFICATION

Diameters of conrod bearing journals	mm	41.984... 42.000
Side clearance connecting rod/wrist pin Radial clearance of conrod bearings	mm	0.130... 0.312 0.035... 0.075
Radial clearance of conrod bearings (wear limit)	mm	0.080

### CRANKSHAFT MAIN BEARINGS

#### CRANKSHAFT MAIN BEARINGS SPECIFICATION

Diameters of main journals	mm	41.990... 42.008
Â	Code letter A	41.990... 41.995
	Code letter B	41.996... 42.001
	Code letter C	42.002... 42.008
Radial play of main bearings	mm	0.027... 0.047
Radial play of main bearings (wear limit)	mm	0.070
Axial play of crankshaft	mm	0.09... 0.280
Axial play of crankshaft (wear limit)	mm	0.30

## CYLINDER HEAD AND LID

### 11 12 CYLINDER HEAD AND LID

#### CYLINDER HEAD AND LID SPECIFICATION

Cylinder head	mm	101.00
Inner diameter of installed valve guide	mm	5.000... 5.012
Running clearance between valve and valve guide	Â	Â

Intake	mm	0.025... 0.047
Exhaust	mm	0.033... 0.060
Maximum running clearance between valve and valve guide	Å	Å
Wear limit: Intake	mm	0.08
Wear limit: Exhaust	mm	0.10
Valve clearance: Intake (max. engine temperature 35Å°)	mm	0.16... 0.24
Valve clearance: Exhaust (max. engine temperature 35Å°)	mm	0.24... 0.32

## ENGINE BLOCK

### 11 11 ENGINE BLOCK, CYLINDER CRANKCASE

#### ENGINE BLOCK AND CYLINDER CRANKCASE W20/B13 SPECIFICATION

Bore hole Å <sup>(1)</sup>	mm	79.015... 79.025
Permitted out-of-round of cylinder bore <sup>(1)</sup>	mm	0.005
Permitted conicity of cylinder bore <sup>(1)</sup>	mm	0.01
Permissible total wear tolerance between piston and cylinder (engine operated)	mm	0.10
(1) New condition		

## ENGINE IN GENERAL

### 11 00 ENGINE IN GENERAL

#### ENGINE IN GENERAL W20 COOPER SPECIFICATION

Cylinder	Å	2
Bore hole	mm	77.0
Stroke	mm	85.8
Effective displacement	cm <sup>3</sup>	598
Compression ratio	:1	11
Idle speed	1/min	%
Nominal speed	1/min	2400
Max. permissible engine speed	1/min	%
Compression pressure	bar	8...12
Compression pressure (maximum difference between cylinders)	bar	3

## OIL SUPPLY

### 11 40 OIL SUPPLY

#### OIL SUPPLY SPECIFICATION

Oil grades and consumption: see <a href="#">ENGINE OILS</a>	Å	Å
Filling capacity, oil change with oil filter element	Liter	2.60

## PISTONS, RINGS, AND PINS

### 11 25 PISTONS RINGS PINS

#### PISTONS AND RINGS AND PINS SPECIFICATION

Piston and pin are paired to each other - replace together only.	Å	Å
Measuring point "A" (position)	mm	9
Piston diameter at measuring point "A"	Å	Å
Original (new dimension)	mm	78.960... 78.980

Piston running clearance	mm	0.035... 0.065
Permissible total wear tolerance between piston and cylinder (engine operated)	mm	0.10

## VALVES AND SPRINGS

### 11 34 VALVES/SPRINGS

#### VALVES AND SPRINGS SPECIFICATION

Valve clearance at max. 35°C coolant temperature	mm	mm
Intake	mm	0.16... 0.24
Exhaust	mm	0.24... 0.32
Stem diameter	mm	mm
Intake	mm	4.966... 4.970
Exhaust	mm	4.966... 4.970

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## ENGINE

### Engine - Tightening Torques - Only I3 Models With Range Extender - i3

## CAMSHAFT

### 11 31 CAMSHAFT

#### TIGHTENING TORQUE SPECIFICATION - CAMSHAFT

Å	Type	Thread	Tightening specifications	Dimension
1AZ Camshaft bearing cap to cylinder head	W20	M6x35	Insert bolts dry.	10 Nm
2AZ Guide rail to crankcase	W20	M6x30	Å	10 Nm
3AZ Tensioning rail to crankcase	W20	Å	Å	20 Nm
4AZ Screw plug, chain tensioner	W20	M6x25	Replace seal	9 Nm
5AZ Chain tensioner to cylinder head	W20	M6	Replace seal	10 Nm
6AZ Chain guide to cylinder head, top	W20	M6x60	Å	10 Nm

## CASE COVERS

### 11 14 CASE COVERS

#### TIGHTENING TORQUE SPECIFICATION - CASE COVERS

Å	Type	Thread	Tightening specifications	Dimension
1AZ Control drive cover to engine block	W20	M6x25	Å	10 Nm
2AZ Control drive cover to engine block	W20	M6x30	Å	10 Nm
3AZ Alternator cover to engine block	W20	M6x20	Å	10 Nm
4AZ Alternator cover to engine block	W20	M6x25	Å	10 Nm
5AZ Screw plug, control drive cover	W20	M16x1.5	Replace sealing ring.	28 Nm
6AZ Screw plug, crankshaft	W20	Å	Replace sealing ring.	25 Nm

## CONNECTING RODS AND BEARINGS

### 11 24 CONNECTING RODS AND BEARINGS

#### TIGHTENING TORQUE SPECIFICATION - CONNECTING RODS AND BEARINGS

Å	Type	Thread	Tightening specifications	Dimension
1AZ Connecting rod bolts	W20	M8x1	Replace, wash and oil screws 1. Jointing torque 2. Jointing torque 3. Angle of rotation	5 Nm 20 Nm 90 Å°

## COOLANT PUMP WITH DRIVE

### 11 51 COOLANT PUMP WITH DRIVE

#### TIGHTENING TORQUE SPECIFICATION - COOLANT PUMP WITH DRIVE

Å	Type	Thread	Tightening specifications	Dimension
1AZ Coolant pump to crankcase lower section	W20	M6x1	Replace seal	10 Nm
2AZ Screw plug to coolant pump	W20	M10x1	Replace sealing ring	15 Nm

## CYLINDER HEAD WITH CYLINDER HEAD COVER

## 11 12 CYLINDER HEAD WITH CYLINDER HEAD COVER

### TIGHTENING TORQUE SPECIFICATION - CYLINDER HEAD WITH CYLINDER HEAD COVER

Â	Type	Thread	Tightening specifications	Dimension
1AZ Cylinder head nuts	W20	M10	Â	Â
			Jointing torque	30 Nm
			1. Angle of rotation	90 Â°
			2. Angle of rotation	90 Â°
2AZ Cylinder head bolt	W20	M6x50	Â	10 Nm
3AZ Cylinder head cover to cylinder head.	W20	M6	Â	10 Nm
4AZ Ground strap to cylinder head cover/engine block.	W20	M6x12	Â	10 Nm

## EMISSIONS CONTROL, CONTROL SENSOR/MONITORING SENSOR

### 11 78 EMISSIONS CONTROL, CONTROL SENSOR/MONITORING SENSOR

### TIGHTENING TORQUE SPECIFICATION - EMISSIONS CONTROL, CONTROL SENSOR AND MONITORING SENSOR

Â	Type	Thread	Tightening specifications	Dimension
1AZ Control sensor	W20	M18 x 1.5	Universal oxygen sensor ADV	50 Nm
2AZ Monitor sensor	W20	M18 x 1.5	LSF 4.2	50 Nm
3AZ Bracket, oxygen sensor, to cylinder head	W20	M6 x 16	Â	10 Nm

## ENGINE BLOCK

### 11 11 ENGINE BLOCK

### TIGHTENING TORQUE SPECIFICATION - ENGINE BLOCK

Â	Type	Thread	Tightening specifications	Dimension
1AZ Bearing frame to crankcase upper part	W20	Â	Replace all bolts.	Â
Â		M9x1.25	1. Jointing torque	3 Nm
		M6x60	2. Jointing torque	3 Nm
		M9x1.25	3. Jointing torque	18 Nm
		M6x60	4. Jointing torque	10 Nm
		M9x1.25	5. Angle of rotation	90 Â°
2AZ Oil spray nozzles to engine block	W20	M6x16	Â	10 Nm
3AZ Crankcase lower section to crankcase upper part	W20	M8x50	Â	23 Nm
4AZ Oil cooler connection to crankcase lower section	W20	Â	Â	35 Nm
5AZ Oil drain plug to crankcase lower section	W20	M16x1.5	Renew the sealing ring.	28 Nm
6AZ Oil filter element to crankcase lower section	W20	Â	Â	11 Nm
7AZ Oil drain plug on lower section of the crankcase	W20	M12x1.5	Coat the screw with Loctite 360Â°.	11 Nm

## EXHAUST MANIFOLD

### 11 62 EXHAUST MANIFOLD

**TIGHTENING TORQUE SPECIFICATION - EXHAUST MANIFOLD**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Exhaust manifold to cylinder head	W20	M8	Replace all seals	15 Nm

**INTAKE PLENUM****11 61 INTAKE PLENUM****TIGHTENING TORQUE SPECIFICATION - INTAKE PLENUM**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Intake plenum to intake neck.	W20	M6x25	Â	10 Nm
2AZ Intake neck to cylinder head.	W20	M6	Â	10 Nm
3AZ Intake plenum to holder	W20	M6x28	Â	10 Nm

**OIL FILTER AND LINES****11-42 OIL FILTER AND LINES****TIGHTENING TORQUE SPECIFICATION - OIL FILTER AND LINES**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Oil filter to crankcase.	W20	Â	Â	11 Nm
2AZ Oil cooler connection for engine oil cooler to crankcase.	W20	M20 x 1.5	O-ring lightly oiled	35 Nm
3AZ End cover to engine oil cooler	W20	M20 x 1.5	O-ring lightly oiled	20 Nm
4AZ Oil filter oil cooler connection to crankcase	W20	M20 x 1.5	Â	35 Nm

**OIL GUIDE TUBE****11 43 OIL GUIDE TUBE****TIGHTENING TORQUE SPECIFICATION - OIL GUIDE TUBE**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Oil guide tube to intake neck	W20	M6x16	Â	10 Nm

**OIL PUMP WITH STRAINER AND MOTOR****11 41 OIL PUMP WITH STRAINER AND MOTOR****TIGHTENING TORQUE SPECIFICATION - OIL PUMP WITH STRAINER AND MOTOR**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Oil pump to bearing frame	W20	M6 x 30	Â	10 Nm
2AZ Intake snorkel to crankcase lower section	W20	M6 x 20	Â	10 Nm
3AZ Cover plate to crankcase lower section	W20	M6 x 16	Â	10 Nm

**OIL SUMP****11 13 OIL SUMP****TIGHTENING TORQUE SPECIFICATION - OIL SUMP**

Â	Type	Thread	Tightening specifications	Dimension
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Â	Type	Thread	Tightening specifications	Dimension
1AZ Oil sump (aluminum) to crankcase lower section	W20	M6x25	Â	10 Nm
2AZ Oil drain plug to crankcase, lower section	W20	M16x1.5	Renew the sealing ring.	28 Nm

## STANDARD SCREW CONNECTION

### 11 00 STANDARD SCREW CONNECTION

#### TIGHTENING TORQUE SPECIFICATION - STANDARD SCREW CONNECTION

Â	Type	Thread	Tightening specifications	Dimension
1AZ Screws and nuts	W20	M5	Â	5 Nm Â± 0.5
2AZ Screws and nuts	W20	M6	Â	8 Nm Â± 1
3AZ Screws and nuts	W20	M7	Â	13 Nm Â± 2
4AZ Screws and nuts	W20	M8	Â	19 Nm Â± 3
5AZ Screws and nuts	W20	M10	Â	38 Nm Â± 5
6AZ Screws and nuts	W20	M12	Â	66 Nm Â± 5
7AZ Hose clamp, WAF 5	W20	Â	Â	1.0 to 1.5 Nm
8AZ Hose clamp, WAF 7	W20	Â	Â	2.5 up to 3.5 Nm

## ENGINE

### Engine And Gearbox Suspension - Repair - i3

## ENGINE AND TRANSMISSION MOUNTING

### 22 11 161 REMOVING AND INSTALLING TRANSMISSION MOUNTING BRACKET (VEHICLES WITH RANGE EXTENDER)

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**IMPORTANT:** If the mounting bracket or the screw connection of the support bearing is broken, it is absolutely mandatory to follow the [REPAIR INSTRUCTIONS](#).

#### Necessary preliminary tasks:

- Remove [HEAT EXCHANGER](#)
- Remove HORIZONTAL STRUT on the left or right
- The drive unit **must** be supported by a lift throughout the entire procedure while the transmission mounting bracket is being removed and installed.

Release screw (1).

*Installation note:*

Replace screw.

Tightening torque [27 00 7AZ](#).



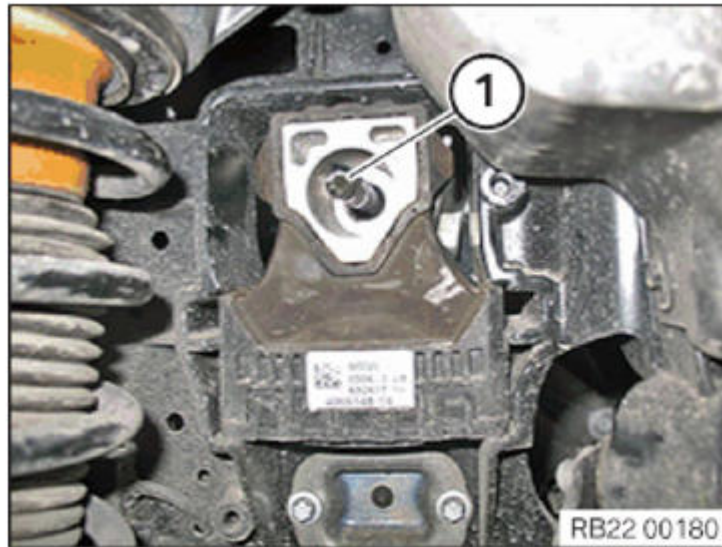
**[Fig. 1: Identifying Range Extender Transmission Mounting Bracket Screw](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

**IMPORTANT:** During installation, the bore holes of support bearing and transmission mounting

bracket must **absolutely** fall in line precisely.

For alignment of bore holes use a suitable tool (1), for example drill with 11 mm diameter shank.

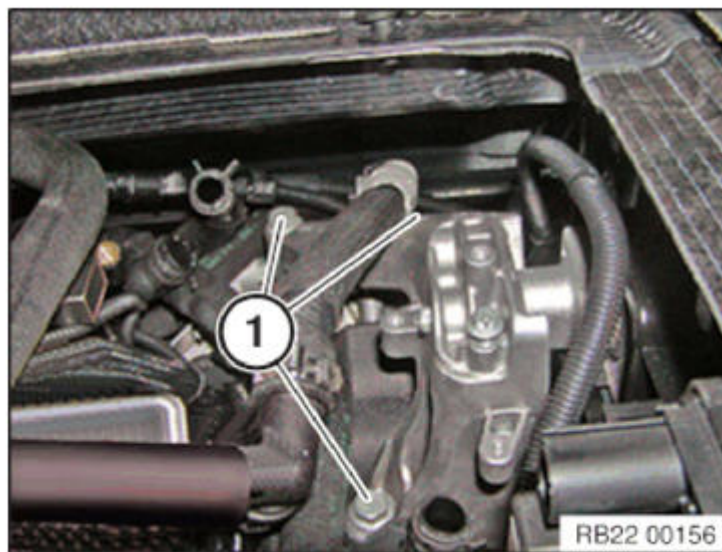


**Fig. 2: Identifying Transmission Mounting Bracket Bore Hole**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

*Installation note:*

Tightening torque **27 00 4AZ** .



**Fig. 3: Identifying Range Extender Transmission Mounting Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **22 11 169 REMOVING AND INSTALLING/REPLACING ANTI-ROLL BAR LINK I01/I01 RANGE EXTENDER**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

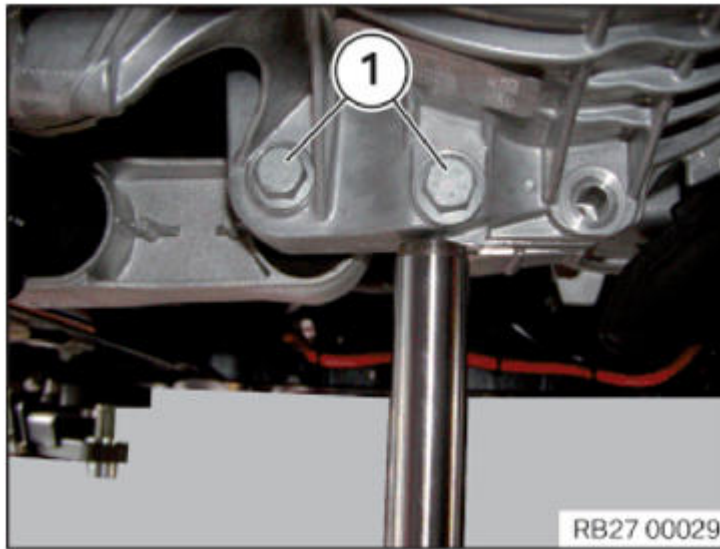
- Observe **SAFETY INFORMATION** for working with electric vehicles.

Necessary preliminary tasks:

- Remove HORIZONTAL STRUT on left or right
- The drive unit **must** be supported by a lift throughout the entire procedure while the transmission mounting bracket is being removed and installed.

Release screw (1).

Tightening torque [27 00 10AZ](#) .

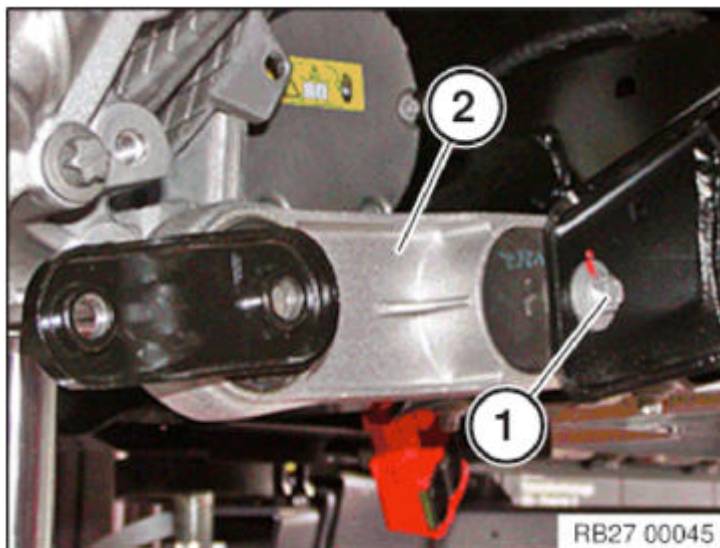


**Fig. 4: Identifying Anti Roll Bar Link Range Extender Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Remove anti-roll bar link (2).

Tightening torque [27 00 10AZ](#) .



**Fig. 5: Identifying Anti-Roll Bar Link And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**22 11 165 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT SUPPORT BEARING I01/I01 RANGE EXTENDER**

Special tools required:

- [2 355 719](#)

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.
- The drive unit must be supported by a lift throughout the entire procedure while the support bearing is being removed and installed.

**IMPORTANT:** If the screw connection of the support bearing is broken, it is absolutely mandatory to follow the **REPAIR INSTRUCTIONS**.

**Necessary preliminary tasks:**

- Remove **REAR SPRING STRUT**
- Remove **REAR WHEEL ARCH COVER**

Release screw (1).

*Installation note:*

Replace screw.

Right support bearing:

Tightening torque **27 00 6AZ AND 7AZ**.

Left support bearing:

Tightening torque **27 00 8AZ**.



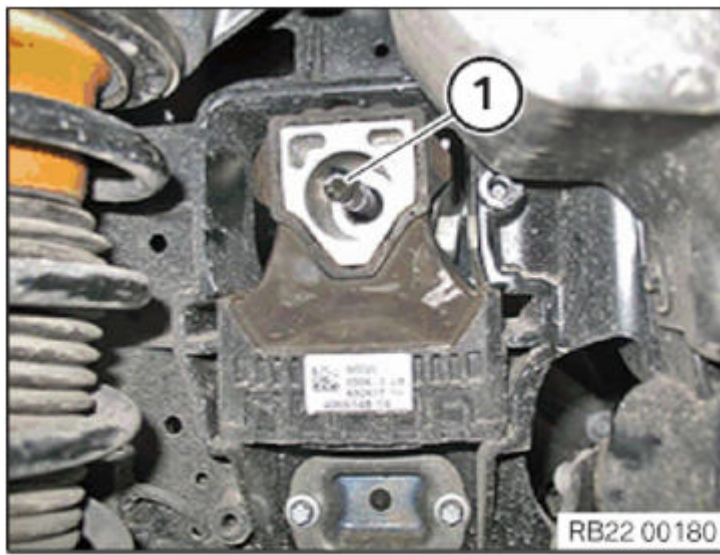
**Fig. 6: Identifying Range Extender Transmission Mounting Bracket Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

**IMPORTANT:** During installation, the bore holes of support bearing and transmission mounting bracket must **absolutely** fall in line precisely.

For alignment of bore holes use a suitable tool (1), for example drill with 11 mm diameter shank.





**Fig. 7: Identifying Transmission Mounting Bracket Bore Hole**

Courtesy of BMW OF NORTH AMERICA, INC.

The guide plate (2) is not needed to remove and install support bearing.  
IMPORTANT: Release screws (1).  
Remove panel (2).



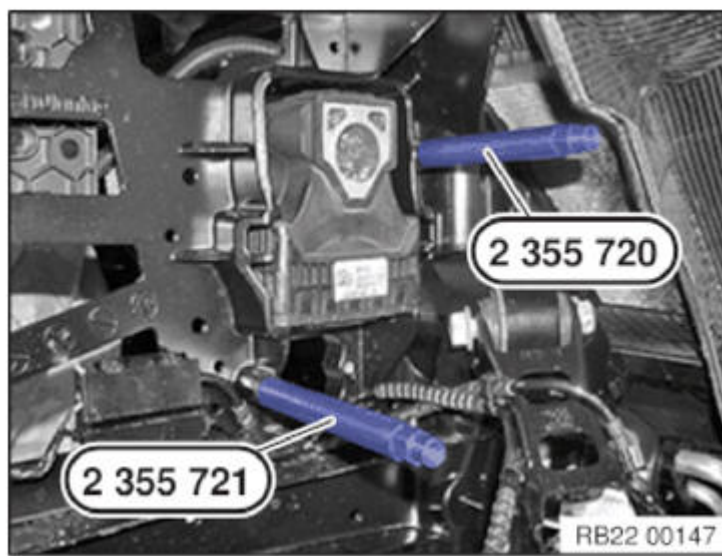
**Fig. 8: Identifying Guide Plate And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Screw supports 2 355 720/721 of special tool [2 355 719](#) into frame.

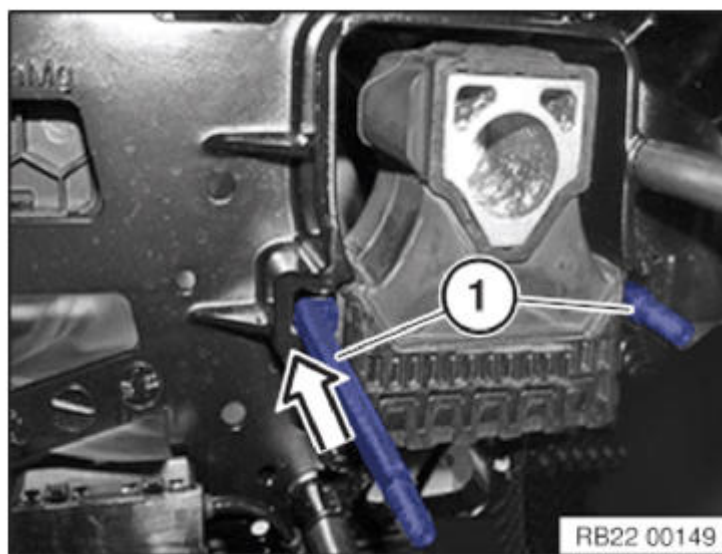
IMPORTANT: The thread is cut through the supports into the frame.  
The supports have different lengths.





**Fig. 9: Screwing Special Tool (2 355 720) Supports Into Frame**  
Courtesy of BMW OF NORTH AMERICA, INC.

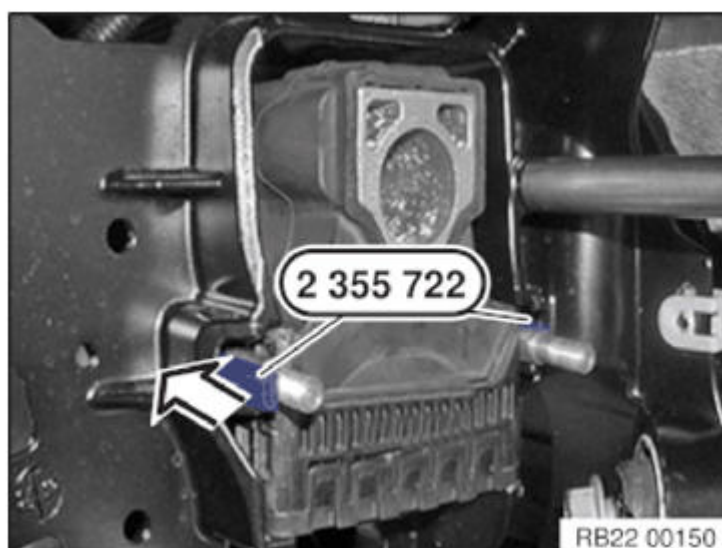
Slide in draw hook (1) next to support bearing on the left and right until it engages.



**Fig. 10: Installing Draw Hook**  
Courtesy of BMW OF NORTH AMERICA, INC.

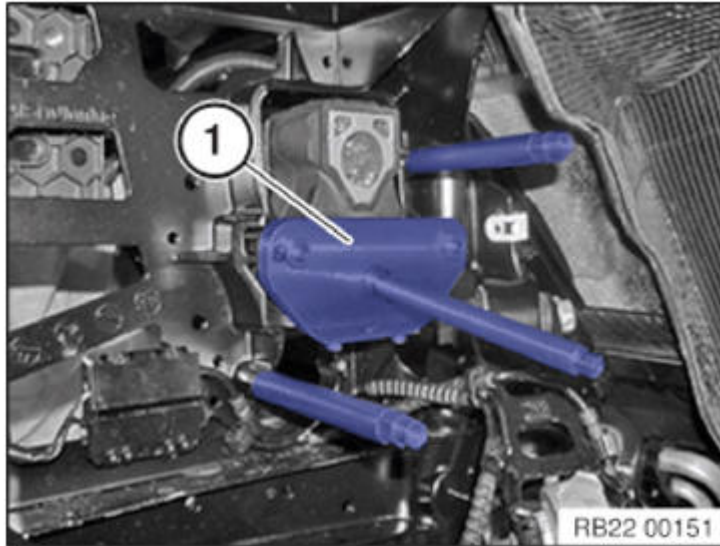
Push in spacer pins 2 355 722 of special tool [2 355 719](#) next to the draw hook.

IMPORTANT: The flat side of the spacer pins must face the draw hooks.



**Fig. 11: Pushing Special Tool (2 355 719) Spacer Pins**  
Courtesy of BMW OF NORTH AMERICA, INC.

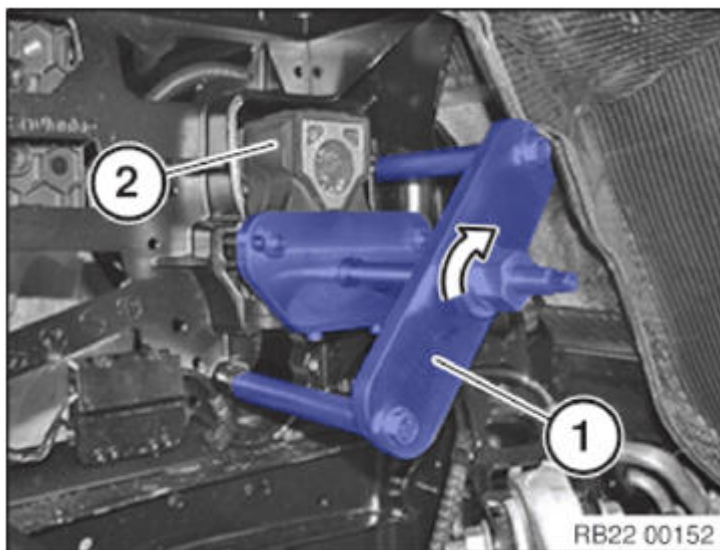
Mount draw plate with spindle (1) of special tool [2 355 719](#) .



**Fig. 12: Mounting Special Tool (2 355 719) Spindle**  
Courtesy of BMW OF NORTH AMERICA, INC.

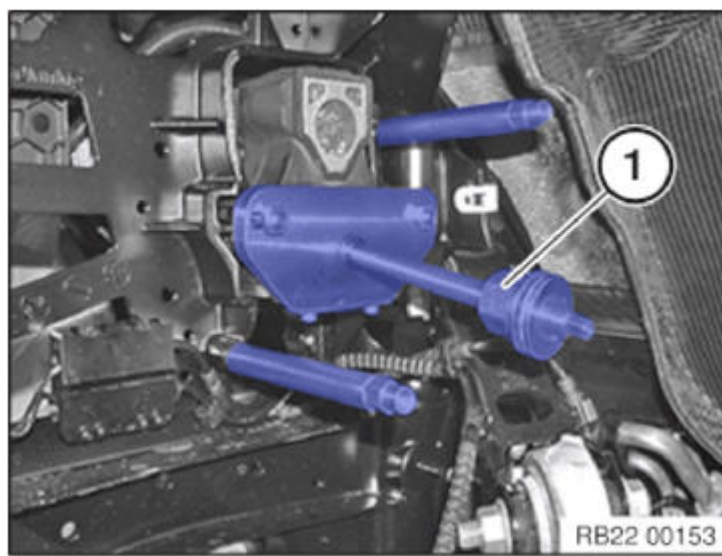
Mount pressure plate (1) with nut of special tool [2 355 719](#) .

Pull out support bearing (2).



**Fig. 13: Mounting Pressure Plate With Special Tool (2 355 719) Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

To press in the support bearing, mount nut (1) on spindle.

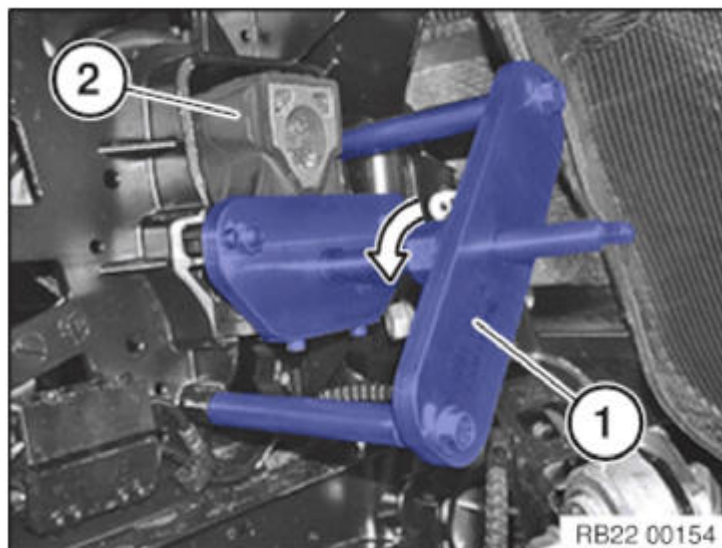


**Fig. 14: Mounting Spindle Nut**

Courtesy of BMW OF NORTH AMERICA, INC.

Mount pressure plate (1) of special tool [2 355 719](#) .

Press in support bearing (2).



**Fig. 15: Mounting Special Tool (2 355 719) Pressure Plate**

Courtesy of BMW OF NORTH AMERICA, INC.

## **22 11 155 REMOVING AND INSTALLING/REPLACING MOUNTING BRACKET OF ELECTRICAL MACHINE (VEHICLES WITH RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**IMPORTANT:** If the mounting bracket or the screw connection of the support bearing is broken, it is absolutely mandatory to follow the [REPAIR INSTRUCTIONS](#) .

**Necessary preliminary tasks:**

- Remove complete drive unit. See [REMOVING AND INSTALLING COMPLETE DRIVE UNIT](#) or [REMOVING AND INSTALLING COMPLETE DRIVE UNIT \(VEHICLES WITH](#)

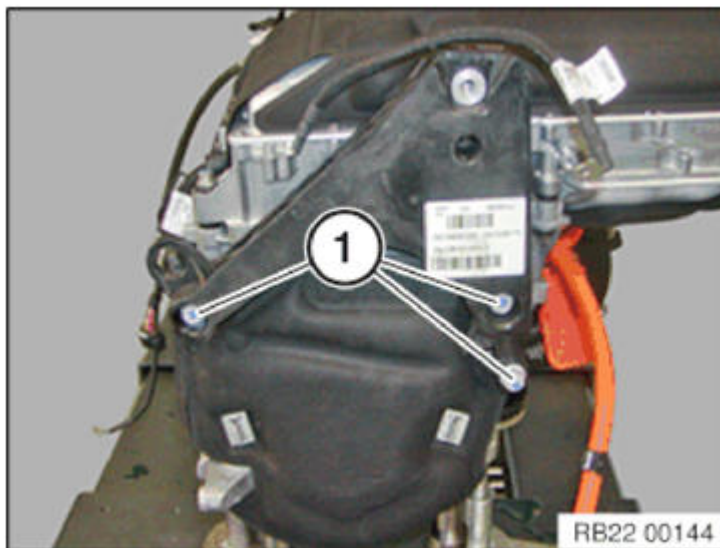
## RANGE EXTENDER).

Release screws (1).

Remove transmission mounting bracket.

*Installation note:*

Tightening torque 27 00 5AZ .



**Fig. 16: Identifying Transmission Mounting Bracket Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

## **22 11 160 REMOVING AND INSTALLING/REPLACING TRANSMISSION BEARING BLOCK I01**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe SAFETY INFORMATION for working with electric vehicles.

**IMPORTANT:** If the transmission mounting bracket or the screw connection of the support bearing is broken, it is absolutely mandatory to follow the REPAIR INSTRUCTIONS .

**Necessary preliminary tasks:**

- Remove HORIZONTAL STRUT on left or right
- The drive unit **must** be supported by a jack throughout the entire procedure while the transmission mounting bracket is being removed and installed.

Remove luggage compartment floor trim panel (1).

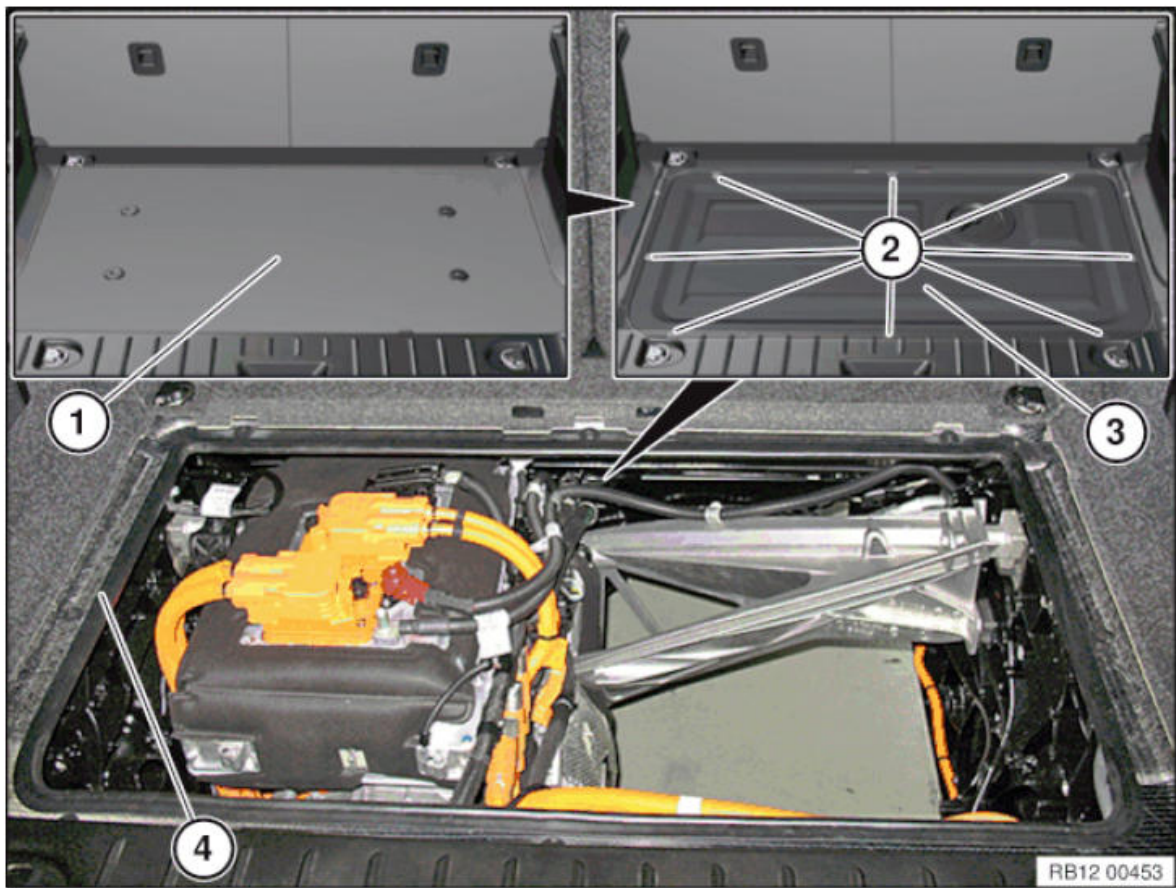
Release screws (2) and remove service cap (3) towards top.

Tightening torque 51 47 4AZ .

*Installation note:*

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.





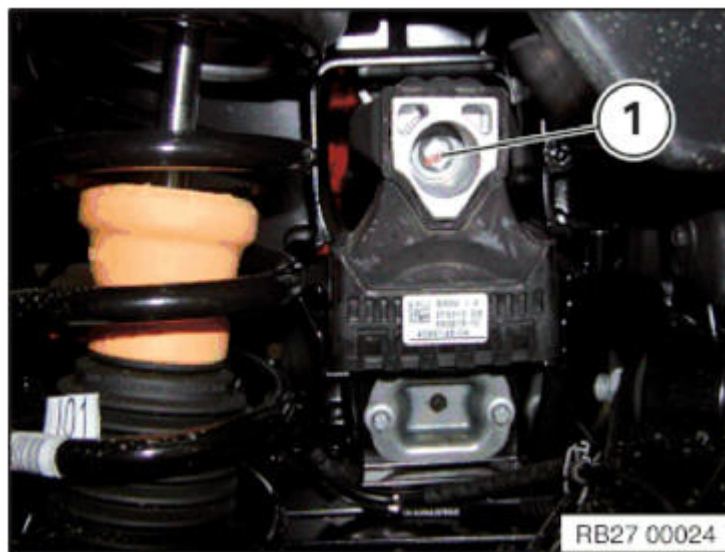
**Fig. 17: Identifying Luggage Compartment Floor Trim Panel, Screws, Service Cap And Gasket**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

*Installation note:*

Replace screw.

Tightening torque [27 00 6AZ](#) .

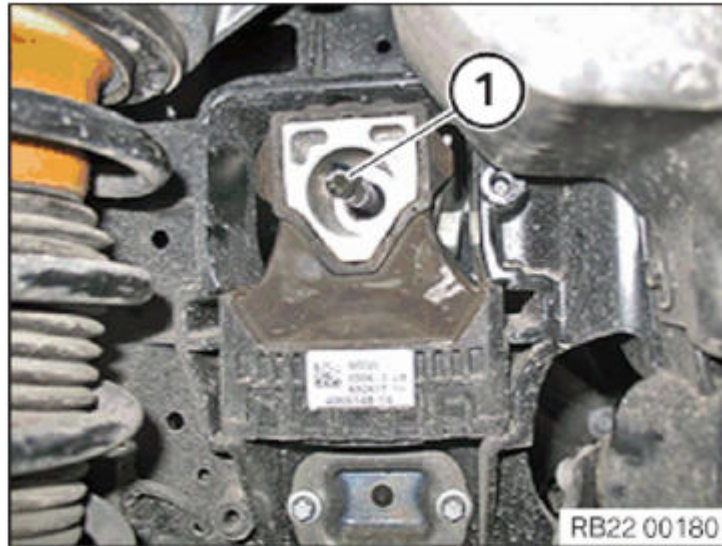


**Fig. 18: Identifying Transmission Bearing Block Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

IMPORTANT: During installation, the bore holes of support bearing and transmission mounting bracket **absolutely** must fall in line precisely.

For alignment of bore holes use a suitable tool (1), for example drill with 11 mm diameter shank.



**Fig. 19: Identifying Transmission Mounting Bracket Bore Hole**  
Courtesy of BMW OF NORTH AMERICA, INC.

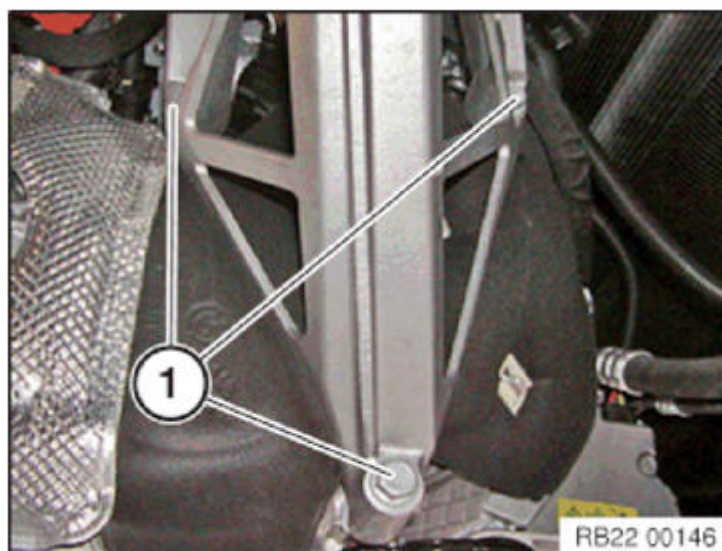
Release screws (1).

Remove transmission mounting bracket (2).

Tightening torque **27 00 3AZ** .

*Installation note:*

Screws must be replaced.



**Fig. 20: Identifying Transmission Mounting Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **22 11... REPAIR INSTRUCTIONS FOR BROKEN ENGINE MOUNTING BRACKET/ENGINE MOUNT SCREW CONNECTION**

**WARNING:** High-voltage system - danger to life!

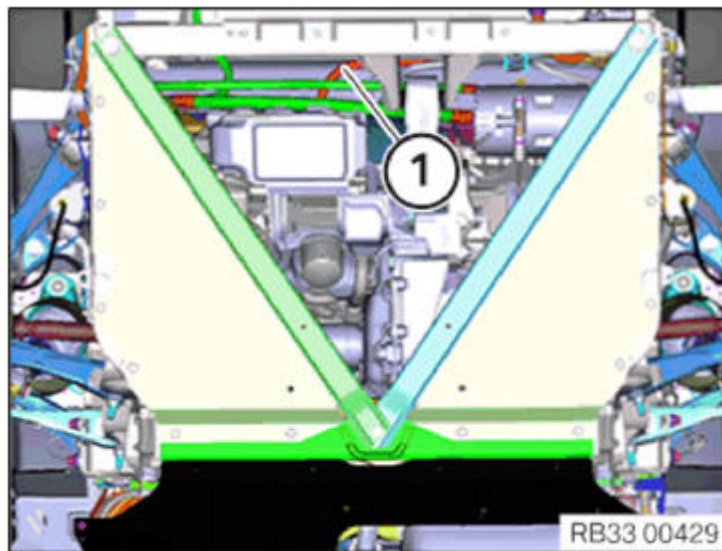
The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.



The following work must be performed when the engine mount screw connection or the engine mounting bracket is broken.

- Replace **LEFT AND RIGHT SUPPORT BEARINGS INCL. SCREW CONNECTION**
- Replace left and right mounting brackets. See **TRANSMISSION BEARING BLOCK I01**. Vehicles with range extender: see **MOUNTING BRACKET OF ELECTRICAL MACHINE (VEHICLES WITH RANGE EXTENDER)** and **TRANSMISSION MOUNTING BRACKET (VEHICLES WITH RANGE EXTENDER)**.
- Replace left and right output shaft. See **REPLACING LEFT OUTPUT SHAFT** and **REPLACING RIGHT OUTPUT SHAFT** .
- Replace **A/C LINES**
- Check the **HIGH-VOLTAGE CABLE** under the drive shaft sleeve and renew it in the event of damage
- Check the BRACING STRUT for paintwork damage and apply corrosion protection to potentially damaged areas of the paintwork
- Check **BATTERY VOLTAGE LINE** in the area of the iso-fix strip for damage and renew if necessary.
- Program the vehicle to integration level version I001-15-11-501 (from ISTA/P3.57.0)
- Check fuel lines (1) for damage. Replace damaged fuel lines.



**Fig. 21: Identifying Fuel Lines**

Courtesy of BMW OF NORTH AMERICA, INC.

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[Back To Article](#)

## ENGINE

Engine And Gearbox Suspension - Special Tools - All I3 Models - i3

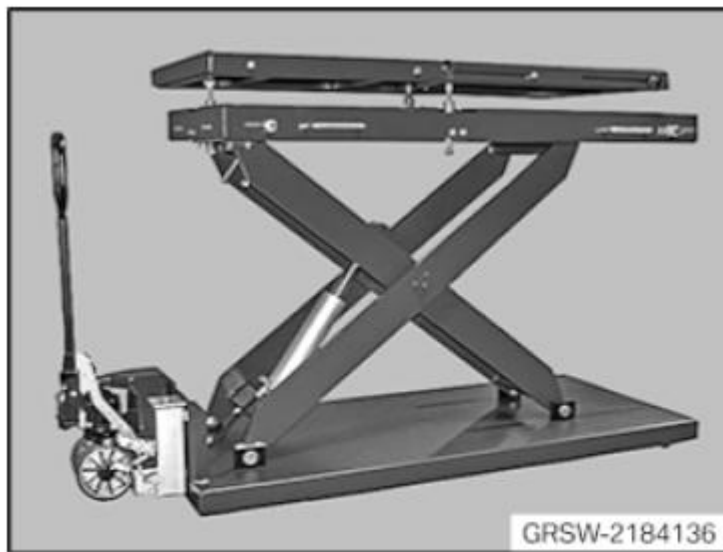
### ENGINE AND GEARBOX SUSPENSION

#### 2184136 MOBILE EQUIPMENT TABLE LIFT AM

**NOTE:** Table lift MHT 1200

SI number

06 01 10 (649)



**Fig. 1: Identifying Mobile Equipment Table Lift (2184136).**

Courtesy of BMW OF NORTH AMERICA, INC.

#### 0402559 USE AM

**NOTE:** for aluminum thread repair on the N52-magnesium crankcase

SI number

08 01 05 (177)





## ENGINE

### Engine Electrical System - Repair - All I3 Models - i3

## SAFETY AND GENERAL INFORMATION

### 61 00... SAFETY INFORMATION FOR HANDLING ELECTRIC/HYBRID VEHICLES

#### 1. *Qualification:*

All repair work on high-voltage components may **only be performed by specially trained personnel** (qualification: Work on high-voltage inherently safe vehicles) must be performed by qualified technicians. Each electric vehicle requires additional vehicle-specific training with training achievement controls.

Required training is offered by the BMW Training Academy.

#### 2. *Identification:*

Observe **warning notices** on high-voltage components. When replacing individual high-voltage components, check if warning stickers are present. Independently attaching warnings is only allowed on the locations provided for them. Use only approved and appropriately identified original new parts.

#### 3. *Rules of conduct/protective measures:*

- Note operating instructions for handling high-voltage battery units.
- Do not under any circumstances touch open high-voltage cables and high-voltage components on damaged vehicle before shutting down the high-voltage electrical system.
- In the event of damage (mechanical, thermal) transition metal oxides, carbon, electrolyte solvents and their products of decomposition may be released.

Damaged high-voltage battery units must be stored in an acid-resistant pan in a location in the open that is protected against the weather (sun, rain) and secured against unauthorized access. Do not inhale escaping gasses.

- Prevent escaping substances from entering drains, pits and the sewer system.
- Collect any material that is discharged and have it disposed of according to the work instruction, wear acid-resistant protective clothing when doing so.
- Notify the fire brigade if fire breaks out, clear the area immediately and make accident scene safe.

Attempt to extinguish the fire without putting persons in danger (suitable extinguishant: water and water foam).

- A cut 2nd emergency separation point must be repaired with a butt connector.

#### 4. *Measures before starting work:*

- Each job on the vehicle must be assigned by appropriately trained personnel. Before work is started, this electrician must place the vehicle in the operating condition required to perform the relevant activity. The qualified personnel's instructions and directions absolutely must be followed. **No work may be carried out without this qualified personnel being consulted first.**
- The readiness to drive must be ended before shutting off the voltage of the high-voltage system. The readiness to drive is ended when the driver is absent only under the following conditions:
  1. seat belt buckle unlocked **and**
  2. the driver's door is open **and**

3. no brake activated **and**
  4. no accelerator pressing **and**
  5. speed < 3 km/h (2 mph)
- Work on live high-voltage components is expressly prohibited. Before each operation on the high-voltage system, the system must be isolated from the power supply by qualified personnel (high-voltage safety connector Off) and secured against unauthorized return to service (padlock).
  - Before beginning work, it is mandatory to check that the equipment is de-energized and is protected against being energized again.

Work is only permitted to begin if:

1. Corresponding display in instrument cluster: **High-voltage system switched off**

When a high-voltage warning is active (indicator light, Check Control, etc.), it is essential to determine and eliminate the cause of this warning via the diagnosis system before continuing with any other work.

**If it cannot be definitively established that the equipment is de-energized**, work is not permitted to begin. **Danger to life!** Before work begins, a qualified electrician (1000 V DC) must verify that the system is de-energized using appropriate measuring devices and procedures.

**=> In this case, a qualified electrician or Technical Support must be contacted!**

- Do not carry out any work whatsoever on high-voltage components while the batteries are charging. Before starting work, disconnect the charging cable from the vehicle.
- The vehicle must not be charged and refuelled at the same time.
- No repair work may be carried out at the high-voltage system when a combustion engine is currently running.
- The coolant pump and electric fan can be switched on automatically when terminal 15 is switched on or the high-voltage battery unit is charging. The following preliminary work must be performed prior to working on the electric fan to prevent injuries caused by an automatically activated electric fan.
  1. Disconnect any connected charging cables.
  2. Switch off terminal 15.
  3. Disconnect high-voltage system from power.
  4. Disconnect plug connections from the electric fan.

*5. Measures during/after activities:*

- Identifiable mechanical damage to or tampering with high-voltage components must be reported immediately to the qualified personnel in charge.
- When carrying out any work on the high-voltage system, it is prohibited to drive externally all the drive train components (wheels, gearbox, drive shafts, etc.).
- Check all connectors and plug connections of the high-voltage components for damages after disconnecting them and/or before connecting them.
- High-voltage cables (orange coating) and their connectors and ferrules **may not** be repaired. If damaged, a cable must always be replaced completely.
- High-voltage cables must not be twisted or kinked. Crushed high-voltage cables must be replaced.
- After a bending operation, the resulting bend may only be returned to its original shape. To repeat bending at the same place is not permitted.
- When working in the vicinity of high-voltage components (identified accordingly with warning stickers and orange-colored coating), protect these components against damage.
- The specified work steps in the repair instructions must be adhered to exactly.
- High-voltage components and their holders must be screwed/bolted to the defined tightening torque. Tightening torques and tightening specifications must be observed.

- Connecting high-voltage components to body ground is crucial to safety for reasons of equipotential bonding. For this reason, it is prohibited to operate any high-voltage components without them being correctly connected to body ground. The measurement (insulation measurement) is performed by the vehicle automatically and therefore manual measurement is not required.

For a correct ground connection, the retaining elements of high-voltage components must not be painted. Follow further PAINTING NOTES .

- Removed high-voltage battery units must be stored in a manner that protects them from misuse and damage.

#### 6. *Potential compensation:*

Potential compensation wires, high-voltage cable, and the battery earth lead of the electrical machine electronics have a safety screw connection!

- Clean contact faces and have then checked by a second person.
- Tighten down screws/bolts to specified torque.
- Have tightening torque checked by a second person.
- Both persons must document that the work has been carried out correctly in the vehicle records.

### **61 20... BATTERY REPLACEMENT INFORMATION**

A vehicle battery is constructed for the installation location and the individual power requirements of the particular vehicle. These individual power requirements depend on the motorization and different types of equipment. The individually assigned vehicle battery is the ideal compromise between the power requirements of the vehicle electrical system and the weight and service life of the vehicle battery.

Vehicles with the automatic engine start-stop function or particular engine types and optional equipment are equipped with a special vehicle battery (AGM battery), since only this battery type can provide elevated power requirements over the extended service life. Installing a different vehicle battery can cause problems with vehicle electronics, can reduce functions or can cause leakage of battery acid.

In the event of an accident where the airbags are deployed in vehicles with a vehicle battery in the luggage compartment, the electrical connection between the vehicle battery and the trigger is automatically disconnected through pyrotechnics. This prevents possible short-circuiting.

Proper operation of all of these safety and convenience functions requires a battery that conforms with specifications and that is properly registered in vehicles with energy management systems (IBS, power module).

#### **Vehicles with energy management systems (IBS, power module): Register battery replacement**

The vehicle electrical system is informed about the vehicle battery characteristic data, such as type, size, age and current power capacity. Therefore, there will always be only one work scope provided that is permitted by the current status of information.

If the performance readiness drops below a defined minimum, a Check Control message will be generated to advise the driver that the battery must be replaced.

When installing a new vehicle battery, the battery must be registered and thus must also be registered with the vehicle electrical system.

**NOTE:** Only this registration/logon will ensure that the corresponding Check Control message will go out again.

*Diagnosis system:*

Register battery replacement

- Service functions
- Body



- Voltage supply
- Register battery replacement

When retrofitting, a more powerful battery may be used. Standard batteries may always be replaced by AGM batteries with the same specifications.

When installing a battery of a different size or a different battery type, this change in vehicle data must be programmed into the vehicle data in accordance with specifications.

*Programming system:*

- Battery retrofitting

## 61 13... BUTT CONNECTOR FOR REPAIRING A PLUG CONNECTION

**Special tools required:**

- 61 0 300
- 61 4 340
- 61 0 240

1. Identify cause of damage (e.g. sharp-edged body components, faulty electrical loads, jammed mechanisms, corrosion caused by ingress of water, etc.).

2. Read out fault memory

3. Eliminate cause of damage.

4. Disconnect battery negative terminal

IMPORTANT:

5. Make sure that no safety-related system according to circuit diagram (e.g. antilock braking system, active rear-axle kinematics, airbags, etc.) are influenced. Otherwise replace faulty wiring harness or use repair cable (sourcing reference: BMW Parts Department)

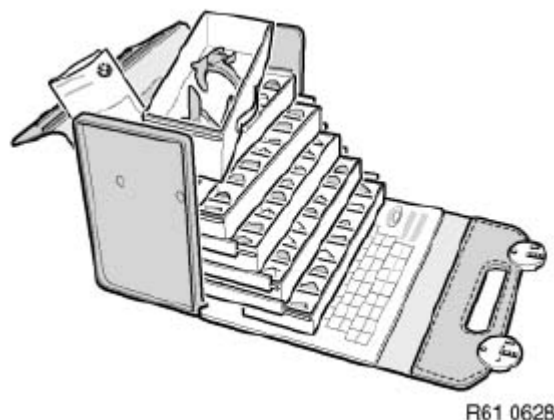
6. Carry out function test and read out fault memories again

7. Eliminate new faults if applicable and clear fault memories

**NOTE:**

**The repair range IV for vehicle electrical system contained the required special tools and individual parts for retrofitting and repair work with the aid of fan connectors.**

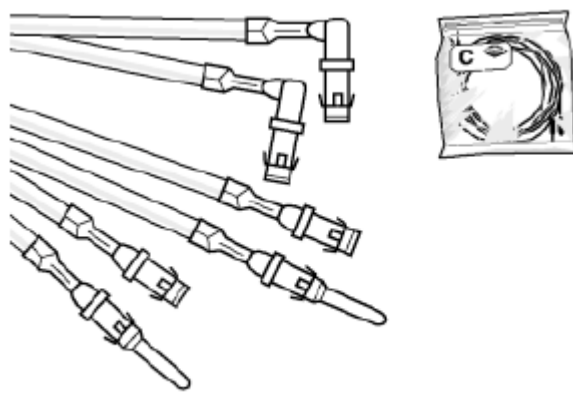
**The case can no longer be ordered.**



**Fig. 1: Identifying Special Tools For Vehicle Electrical System Repairing**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Choose repair kit.

Example: Repair kit, circular connector system D 2.5.

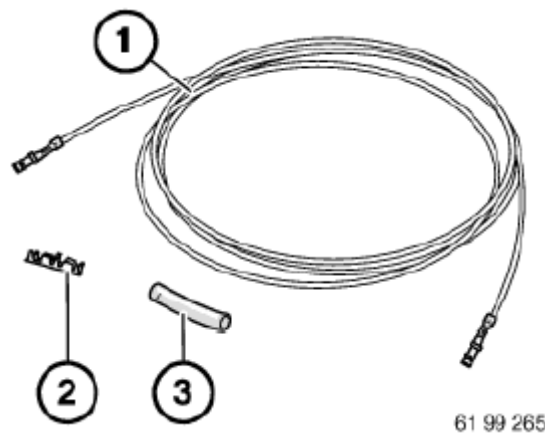


R61 99 257

**Fig. 2: Identifying Circular Connector System Repair Kit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove following parts:

1. Pre-packaged end of cable with requisite wire cross-section
2. Crimp connector for selected wire cross-section
3. Shrink-fit hose



61 99 265

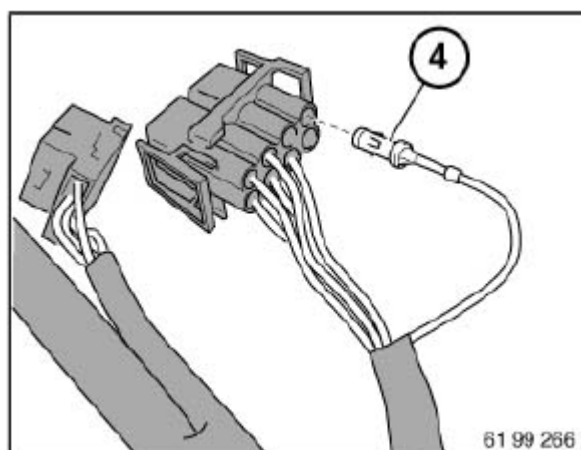
**Fig. 3: Identifying Cable End With Required Wire Cross-Section, Crimp Connector And Shrink-Fit Hose**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Open secondary lock on housing.

Mark damaged contact (4) with socket number of housing and press it out of housing using appropriate special tool contained in special tool set 61 0 300).

*See repair instructions:*

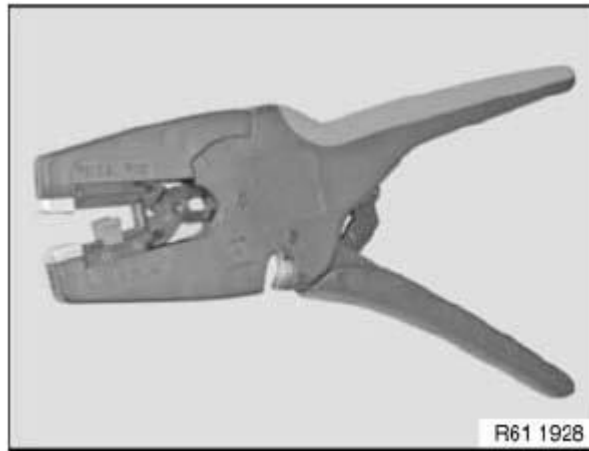
Notes for opening **CONTACTS AND LOCKS** of different plug contact systems.



61 99 266

**Fig. 4: Identifying Damaged Contact**  
Courtesy of BMW OF NORTH AMERICA, INC.

- IMPORTANT:
- Check maximum length of repair cable
  - If more than one wire is to be repaired, the individual interfaces must be offset so that the wiring harness is not too thick at the repaired point.



**Fig. 5: Identifying Crimping Tool**  
Courtesy of BMW OF NORTH AMERICA, INC.

Adhere to following procedure:

- Cut off wire with faulty contact at point which is easily accessible
- Strip insulation from end of wire at wiring harness end
- Cut preassembled wire end to length and strip insulation

*Refer also to repair instruction:*

Cutting to length and stripping **INSULATION FROM CABLES**

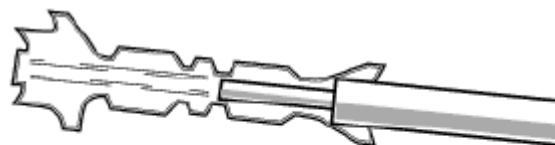
Crimp butt connector on preassembled wire end.

Special tools:

- 61 4 340 (0.35 - 2.5 sq mm)
- 61 0 240 (4.0 - 6.0 sq mm)

*See repair instructions:*

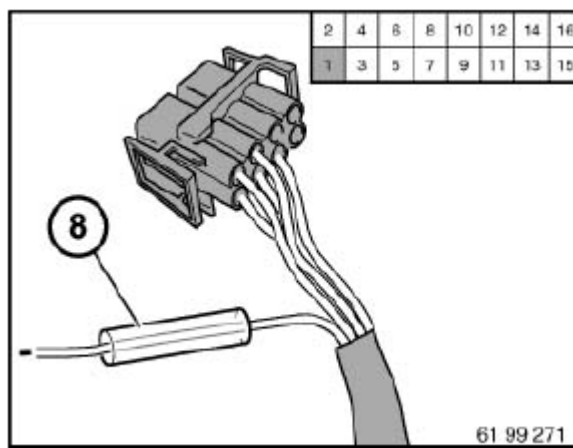
Crimping on **STOP PARTS**



61 99 270

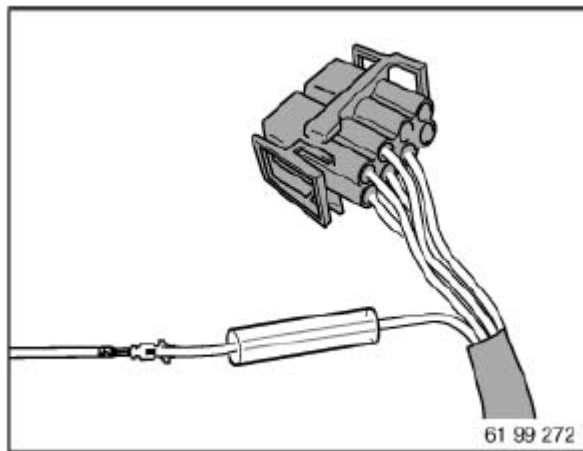
**Fig. 6: Identifying Crimp Butt Connector And Preassembled Wire End**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push shrink-fit hose (8) onto free wire end.



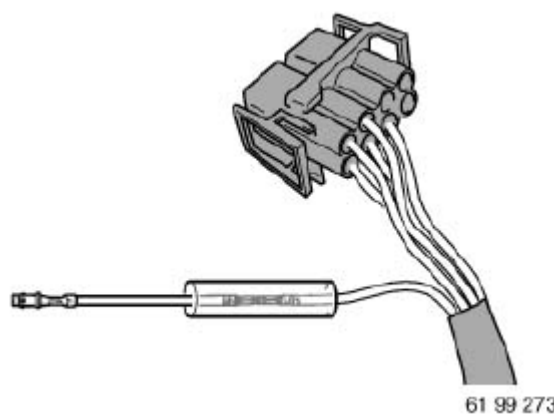
**Fig. 7: Identifying Shrink-Fit Hose On Free Wire End**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Crimp unused wire end to butt connector.



**Fig. 8: Crimping Unused Wire End To Butt Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull shrink-on sleeve over butt connector.



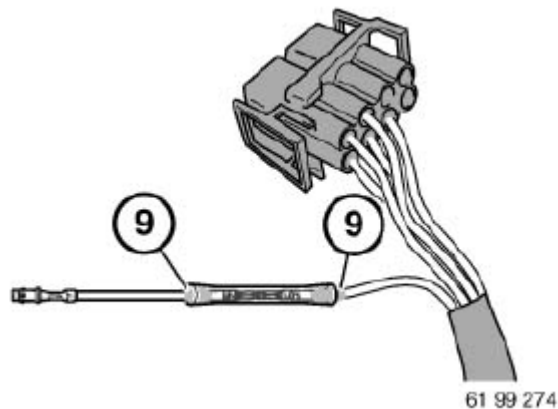
**Fig. 9: Identifying Shrink-On Sleeve And Butt Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Do not burn shrink-on sleeve.

With hot air blower, shrink the shrink-on sleeve on both sides (9) of shrink-fit hose until glue emerges uniformly all round.

Insert contact in housing.

Close secondary lock on housing.



**Fig. 10: Identifying Shrink-On Sleeve Ends**

Courtesy of BMW OF NORTH AMERICA, INC.

## **61 25 900 DISCONNECT HIGH-VOLTAGE SYSTEM FROM POWER**

**WARNING:** High-voltage system - danger to life!

**WARNING:** The following points must be strictly observed prior to starting work :

- Observe **SAFETY INFORMATION** for working with electric vehicles.

Stick to the procedure absolutely.

- IMPORTANT:**
1. Disconnect any connected high-voltage charging cable.
  2. Open engine compartment lid
  3. Switch off ignition
  4. Before disconnecting the high-voltage safety connector, ensure that the vehicle is in "sleep" state.

Comply with procedure for return to service!

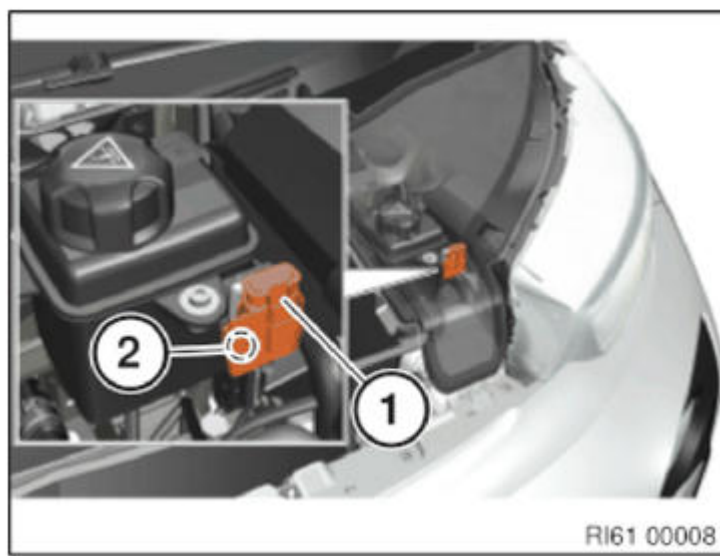
- IMPORTANT:**
1. If connected, disconnect 12V charger
  2. Remove shackle lock
  3. Connect high-voltage safety connector
  4. Perform double terminal change (operate START-STOP button 4 times with a 1-second between each operation)

### **Disconnect high-voltage system from power:**

**IMPORTANT:** The high-voltage safety connector cannot be fully disconnected.

Unlock high-voltage safety connector (1) and pull out until bore holes (2) on connector and bushing are fully exposed.

The labelling "OFF" is visible on the high-voltage safety connector.

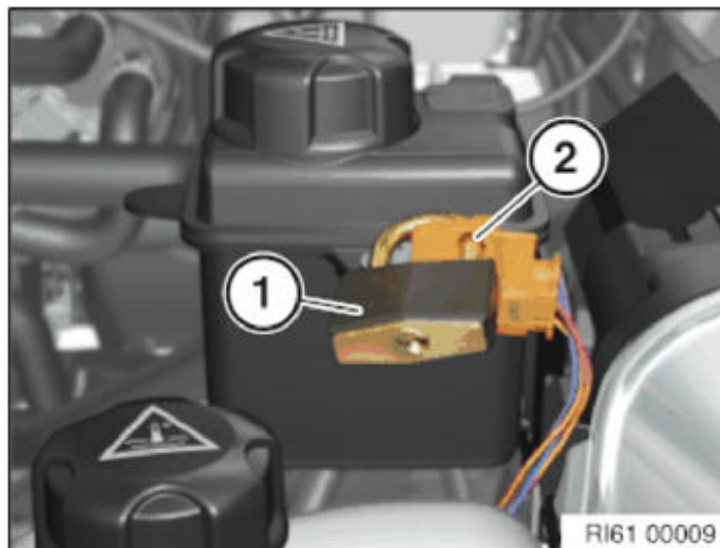


**Fig. 11: Identifying High-Voltage Safety Connector And Connector And Bushing Bore Holes**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Secure high-voltage system against being switched back on:**

Insert and lock shackle lock (1) in exposed bore hole (2) of high-voltage safety connector (2).

IMPORTANT: Store shackle lock key in a safe place.



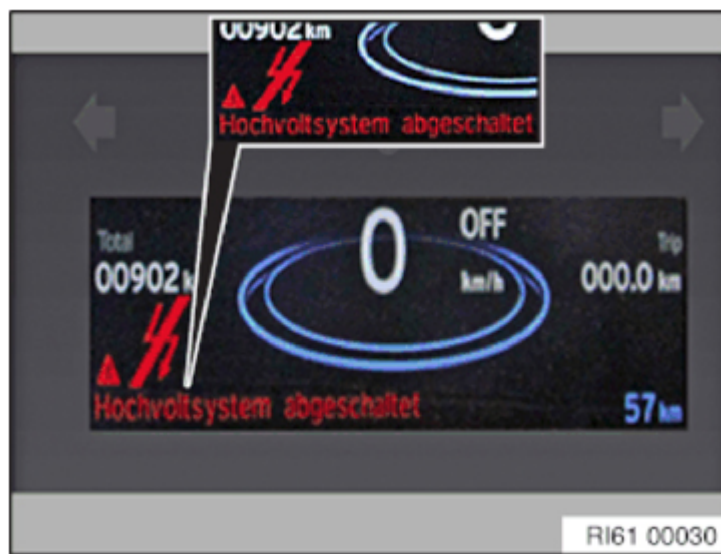
**Fig. 12: Identifying High-Voltage Safety Connector Bore Hole And Shackle Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Determine voltage free status:**

**WARNING:** Mandatory steps prior to carrying out further repair work:

- **Activate ignition and check that there is zero voltage in the instrument cluster. Check Control message "High-voltage system deactivated" must be displayed.**
- **Pay attention to active high-voltage warnings (indicator light, check control, etc.), determine cause and correct problem.**





**Fig. 13: Screen Display - Instrument Cluster**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- The **12V BATTERY MAY BE DISCONNECTED** only when Check Control Message "high-voltage system switched off" is displayed in the instrument cluster.

**NOTE:** With the ignition off and the high-voltage safety connector disconnected, the Check Control message "Hybrid system faulty" is displayed as standard. Zero voltage (high-voltage system switched-off) is only displayed with the ignition on.

**WARNING:** **Danger to life!**  
 If it cannot be established beyond doubt that the instrument cluster is de-energized, work is not permitted to begin. **Danger to life!**  
 Before work begins, a qualified, certified electrician must verify that the system has been disconnected from the power supply (1000 V DC) using appropriate measuring devices and measuring procedures.  
 => In this case, Technical Support must be contacted! Furthermore, the vehicle must be made inaccessible and blocked off with barrier tapes!

## 12 00... INSTRUCTIONS FOR REMOVAL AND REPLACEMENT OF CONTROL UNITS

- IMPORTANT:**
- Disconnecting the vehicle battery will cancel the fault memories of control units. Consequently, before disconnecting the car's battery, always interrogate the fault memories. Investigate stored faults and, once any faults have been remedied, cancel the fault memory.
  - Control unit plugs should only ever be connected and disconnected while the ignition is turned off.
  - The removal and installation of components, relays, fuses etc. can cause faults to be stored in fault memories capable of self diagnosis. Always interrogate the fault memories after completing work on the electrical system.
  - Investigate stored faults and, once any faults have been remedied, cancel the fault memory.
  - If necessary, initialize power window regulator Initialize power window regulator

On replacement of the DME/DDE control unit note the following:

- In every case use the diagnosis system to read out the hardware/software version of the corresponding control unit.

Comply with the diagnosis system instructions for the encoding and programming work operations.

On vehicles with an electronic immobilizer, comply with the diagnosis system instructions.

- In every control unit certain mean values are stored that are the basic values. The control unit receives different input values according to the engine condition. The teachable system compares the input values against the stored basic values and then forms the associated control commands. The control commands are forwarded to the corresponding actuators.
- When the DME control unit is de-energized for a long period (over one hour), the teachable system then loses the stored values. When a deleted control unit is returned to service or a new control unit is installed, the teachable system itself must read in and store the input value of the associated engine as new basic values.
- This process may cause uneven idle and faults in coasting mode after starting. Depending on the engine characteristics, it may take some time until all values have been compared with the engine condition.
- Therefore, comply with the following procedure before replacement or reinstallation of a DME/DDE control unit is carried out:
  1. If possible, bring the engine up to its operating temperature prior to replacement of the control unit.
  2. Change control units and drive the vehicle with changing engine speeds.

## **61 00... NOTES FOR DISCONNECTING AND CONNECTING BATTERY**

Observe **SAFETY INFORMATIONS FOR HANDLING VEHICLE BATTERY** .

### **Before disconnecting battery:**

Turn off the ignition and other electrical loads/consumers to prevent sparking when reconnecting.

**NOTE:**        **If the ignition is not turned off when the battery is disconnected, fault memories may be set in some control units.**

- IMPORTANT:
- There is a danger of mixing up battery cables: If the battery positive and negative leads are the same color and you are in doubt, follow the polarity to the battery, then mark and cover the leads.
  - The on-board computer and clock may lose your data.

### **General notes on disconnecting battery:**

- Do not disconnect battery leads and leads from alternator and starter motor while engine is running.
- Disconnect terminal of battery earth lead from the battery. Cover battery negative terminal(s) and secure.
- Disconnect both battery earth leads in version with auxiliary battery. Cover battery negative terminal(s) and secure.
- When work is carried out on the electrical system, faults may be caused in the fault memories of some control units when the battery is connected.
- When installing battery terminal: Tightening torque **61 21 1AZ** .

Only lead AGM battery:

- On vehicles with IBS at negative battery terminal:

**Do not under any circumstances pull/lever off pole shoes by force.**

**Do not under any circumstances release socket-head cap screw of IBS.**

## After connecting battery:

The scope of application of some systems may be restricted after an open circuit.  
Personal Profiles may also be lost.

Settings or activations must be carried out, depending on the equipment specification.

IMPORTANT: For example:

- Activate **SLIDE/TILT SUNROOF** , if necessary
- Activate **POWER WINDOW** , if necessary

## 61 13... NOTES FOR OPENING CONTACTS AND LOCKS OF DIFFERENT PLUG CONTACT SYSTEMS

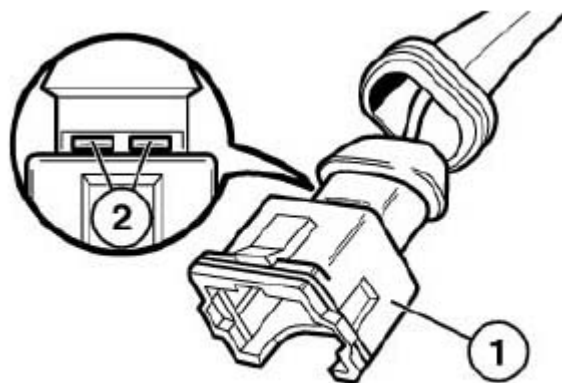
### Special tools required:

- 61 0 300
- 61 0 400
- 61 1 100

Abbreviations of contacts and what they mean:	
ELA	Strand seal
D 1.5/2.5/3.5	Round contacts with 1.5 mm, 2.5 mm or 3.5 mm diameter
MDK	Miniature double flat spring contact
JPT	Junior Power timer
DFK	Double flat spring contacts
Elo	Electronic contacts
Elo Power	Electronic contacts for heavy load
MQS	Micro Quadlock system
MPQ	Micro Power Quadlock
MLK	Mini laminated contact
SLK	Sensor laminated contact
LSK	Load current contact
MLK	Mini laminated contact
Mcon	Multi contact

The contacts can be changed on ultrasonically welded connectors (1).

IMPORTANT: Ultrasonically welded connectors (1) must be replaced completely.  
Ultrasonic-welded connectors (1) can be identified by the welds (2) on their longitudinal side.



36 61 126

**Fig. 14: Identifying Ultrasonic-Welded Connectors And Welds**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Special tools referred to in the repair instructions below are contained in

the following special tool sets:

- Unlocking and pressing-off tool 61 1 150

is replaced as of 09/2005 by 61 0 300 (BMW) and 61 0 400 (MINI)

- Release and pressing-off tool 61 1 100 (engine)

Repair instructions for opening connector housings and removing contacts of different connector systems:

Connector system D 1.5/D 2.5:

- CIRCULAR CONNECTORS, 7- OR 8-PIN, SYSTEM D 2.5
- CIRCULAR CONNECTORS, 13-PIN, SYSTEM D 2.5
- CIRCULAR CONNECTORS, 20-PIN, SYSTEM D 2.5
- Circular connectors, 4-, 7-, 10-, 12- or 25-pin, system D 1.5/D 2.5
- IN-LINE CONNECTORS, 15-PIN, SYSTEM D 2.5
- IN-LINE CONNECTORS, 8-, 12-PIN, SYSTEM D 2.5
- IN-LINE CONNECTORS, 30-PIN, SYSTEM D 2.5
- IN-LINE CONNECTORS, 20-PIN, SYSTEM D 2.5

Connector system JPT/MDK/DFK:

- IN-LINE CONNECTORS, 2-PIN, SYSTEM JPT ELA
- IN-LINE PLUGS, 2-PIN, SYSTEM MDK 3 PLUS 2.8
- IN-LINE PLUGS, 4-PIN, SYSTEM DFK ELA

Connector system Elo/Elo Power:

- IN-LINE PLUGS, 4-, 10-PIN, SYSTEM ELO
- IN-LINE CONNECTORS, 6- TO 50-PIN, SYSTEM ELO
- INLINE PLUGS, 3-, 6-PIN, SYSTEM ELO-POWER 2.8

Connector system LSK:

- CONNECTOR HOUSING LSK CONTACT

Connector system MQS/MPQ:

- IN-LINE CONNECTORS, 6-, 8-PIN, SYSTEM MQS
- IN-LINE PLUGS, 2-PIN, SYSTEM MPQ 2.8
- CONTROL UNIT CONNECTORS, 25-, 35-, 55-, 83-, 88-PIN
- IN-LINE PLUGS, 24-PIN, HYBRID SYSTEM MQS/MPQ
- SOCKET HOUSING 42-, 43-PIN, HYBRID SYSTEM MQS/MPQ
- SOCKET HOUSINGS 2X21-, 2X27-PIN, HYBRID SYSTEM MQS/MPQ, ELO/ELO POWER
- IN-LINE CONNECTORS, 30-PIN, HYBRID SYSTEM MQS/MPQ
- SOCKET HOUSINGS, 5-, 8-PIN, SYSTEM MQS/MPQ
- SOCKET HOUSING (RADIO CONNECTOR), HYBRID SYSTEM MQS/MPQ

## 61 00... NOTES ON ELECTRICAL PROPERTIES OF CARBON BODY

**NOTE:** The body of BMW i vehicles consists of several carbon body components linked together by means of adhesive.  
(carbon: carbon fibre reinforced plastic)

**IMPORTANT:** Carbon body components are electroconductive!

Nonetheless, the electrical conductivity of carbon is lower than the one of steel or aluminum.

Therefore, the carbon body cannot be used as the ground of the vehicle electrical system!

The adhesive partially prevents the electrical current flow between the carbon body components.

**IMPORTANT:** In the case of a short circuit between vehicle electrical system and carbon body, the current may be below the triggering threshold of electrical fuses!  
If the electrical fuse was not triggered in such case of a short circuit, the carbon body components may be damaged due to high heat load!

**To prevent damages on the carbon body, it is crucial to adhere to the following notes:**

- Carbon body may not be used as ground.
- Measurements may only be carried out to ground/ground support point, not to the carbon body.
- Ensure a correct ground contact according to the wiring diagram is set before carrying out checks relating to electrical components.

**In case of damages of electrical components, proceed as follows:**

1. Disconnect high-voltage system from power.
2. Disconnect battery ground cable.
3. Repair damaged electrical components.
4. Check carbon body for eventually visible surface damage caused by heat load in the area of damage of electrical components.
5. Contact Technical Support in cases of doubt.

## **61 00... NOTES ON HANDLING WIRING HARNESSES AND CABLES**

**The following applies in general:**

To avoid damage, observe the following instructions:

- Avoid compressive and tensile loads
- To ensure professional repairs, perform repair work only with BMW-approved or recommended special tools and spare parts
- Make sure cables are laid without kinks or abrasions
- Ensure non-contacting routing at sharp-edged body parts; use edge protection if necessary
- Secure additionally laid cables/leads with cable ties

**The following additionally applies**

### **Shielded cables**

Contact points in the shielding can cause problems with regard to noise radiation and interference immunity. Consequently, distinctions have to be drawn between the following types:

#### **Coaxial cable**

- Shielded coaxial cables RTK031 may only be repaired with a special crimping tool.
- For aerial lines only the bushing contact may be repaired.
- RG174 Lines and the bushing contact may not be repaired.

#### **CVBS cables**

- CVBS cables may not be repaired.
- CVBS cables must be replaced in their entirety.

## HSD cables

- HSD cables may not be repaired.
- HSD cables must be replaced in their entirety.

## Fibre-optic cables:

**NOTE:** Fibre-optic cables are colored differently as follows:

- **Green = MOST (Media Oriented Systems Transport) optical fibre**
- **Yellow = ISIS (Intelligent Safety Integration System) optical fibres**
- **Orange = repair fibre-optic cables**

## Attention!

- Optical fibres are permitted to show only **one** junction point (bridge). Replace optical fibres if necessary
- Smallest permissible bending radius is 25 mm
- Avoid effects of heat  $\geq 85 \text{ }^{\circ}\text{C}$

Treating cables and fibre-optic cables. See [CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH](#) and [CRIMPING OPTICAL FIBRES](#).

## FlexRay (twisted cables):

It is possible to repair the FlexRay. In the event of damage, the cables can be joined with conventional [BUTT CONNECTORS AND HEAT-SHRINK TUBING](#).

## NOTE:

- **FlexRay lines may only reveal one separation point (bride); renew complete line if necessary.**
- **If possible, maintain twisted cable after repair.**
- **After repairs, twist cables as close as possible to the connector/separation point.**
- **Twisting must be as symmetrical as possible.**

## Airbag lines:

Repairing [AIRBAG CABLES](#)

## Replacement of wiring harnesses:

If after replacing wiring harnesses connectors remain, they should be sealed outside the vehicle interior, for example, with butyl tape so that moisture ingress can be eliminated permanently.

## 61 13... UNLOCKING AND DISCONNECTING VARIOUS PLUG CONNECTIONS IN ELECTRICAL AND HYBRID VEHICLES

## Attention!

Observe the following instructions for handling high-voltage plug connections:

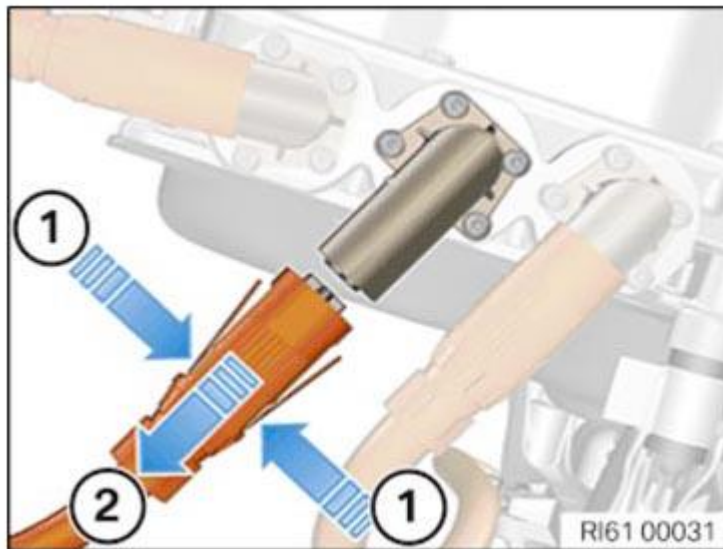
- Damaged high-voltage plug connections must be replaced completely. Repair is not permitted.
- Dirt contamination must be removed before opening the plug connection.

## Disconnect the Hirschmann high-voltage connector:

Press the lock (1) on the left and right on the connector in the direction of the arrow.



Pull off connector (2) in direction of arrow.



**Fig. 15: Pulling Off Hirschmann High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

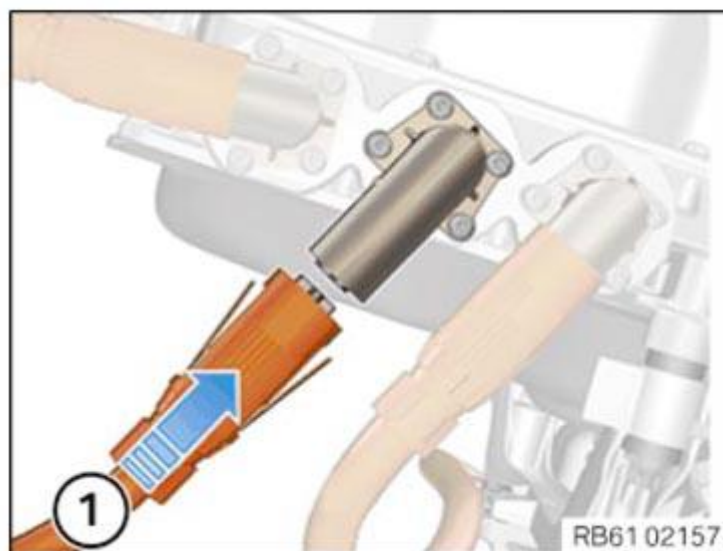
Connector (2) is difficult to pull off.

In the event of damage to high-voltage connector (2), the complete high-voltage cable must be replaced!

**Connect the Hirschmann high-voltage connectors:**

Slide the connector (1) on in the direction of the arrow.

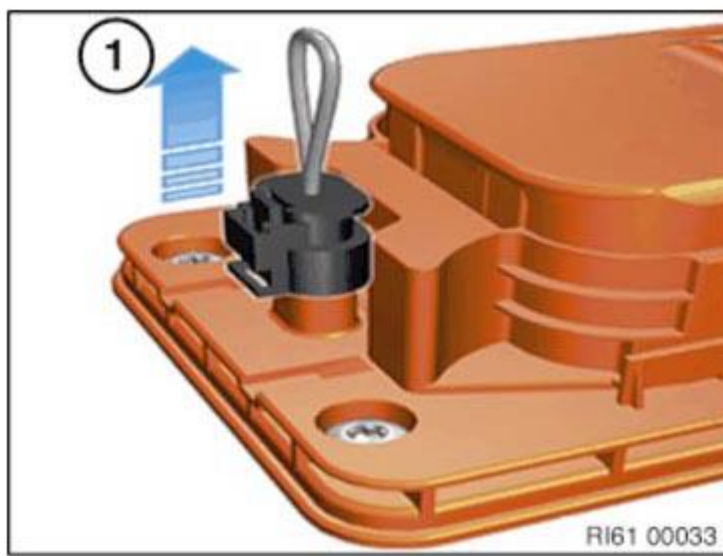
**NOTE:** Connector (2) must lock audibly.



**Fig. 16: Connecting Hirschmann High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Disconnect the Kostal high-voltage connector:**

Unlock and disconnect high-voltage interlock loop (1).



**Fig. 17: Disconnecting High-Voltage Interlock Loop**  
 Courtesy of BMW OF NORTH AMERICA, INC.

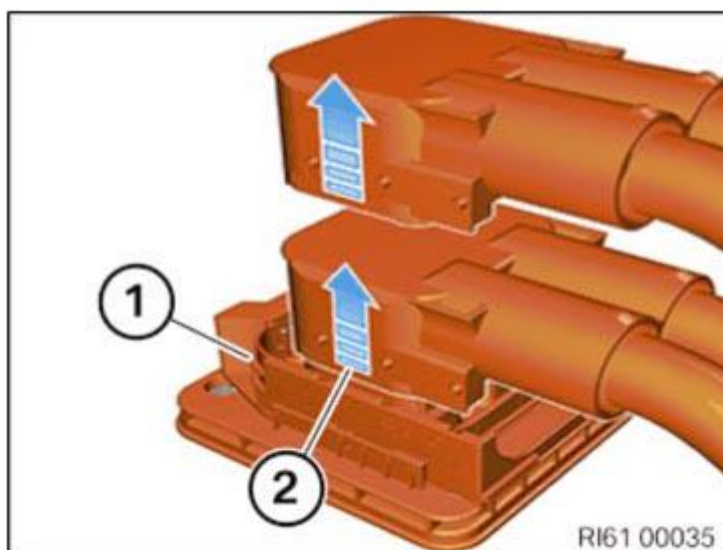
Push the lock (1) fully to the front.

Lift the connector (2) and remove it entirely.

**Attention!**

Plug connection (3) is difficult to pull off.

The connector (2) must be completely pulled off the opposite housing in one step. Damage may be caused to contact protection if connector is only partly pulled off and then closed again!

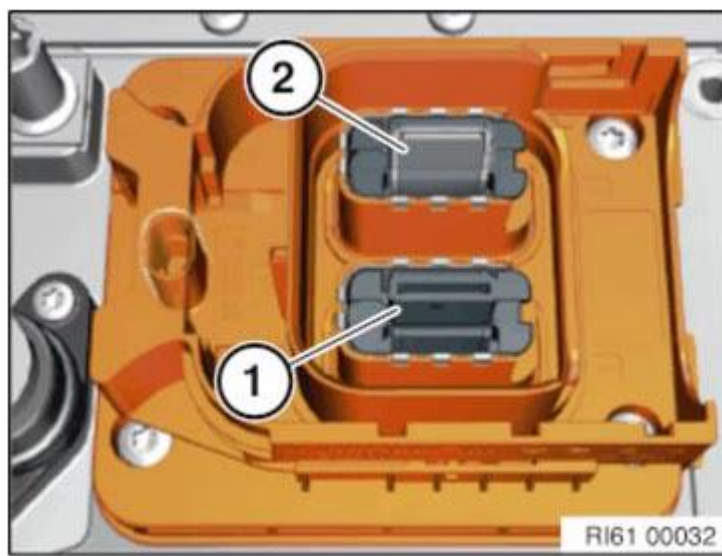


**Fig. 18: Removing Connector**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Check the Kostal high-voltage connector and connection for damage:**

Check the touch protection for damage and correct positioning (1).

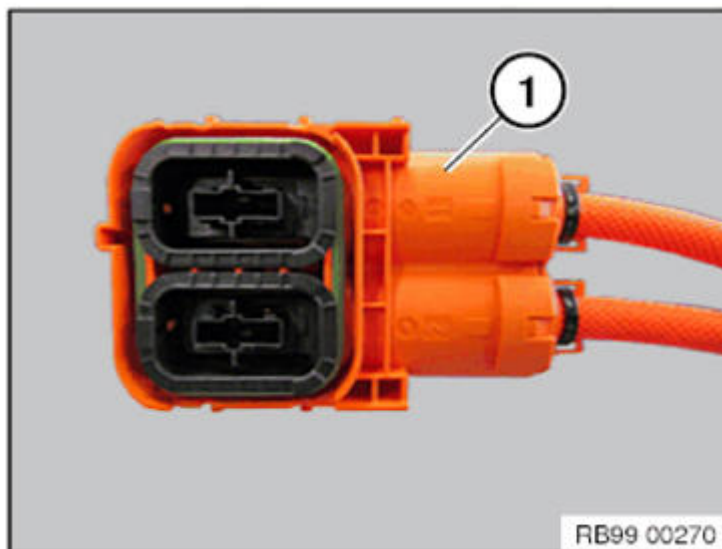
**WARNING:** Do not touch unprotected connector (2)!  
 If the contact protection (1) has been pushed to the bottom (2), the high-voltage connector must be refitted.  
 If contact protection (1) remains in bottom position (2) after reinstallation, the contact protection is faulty and the component must be replaced!



**Fig. 19: Identifying Contact Protection At Correct Position And At Bottom Position**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check the high-voltage connector (1) for damage.

**WARNING:** In the event of damage to the high-voltage connector (1), the complete high-voltage cable must be replaced!



**Fig. 20: Identifying High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

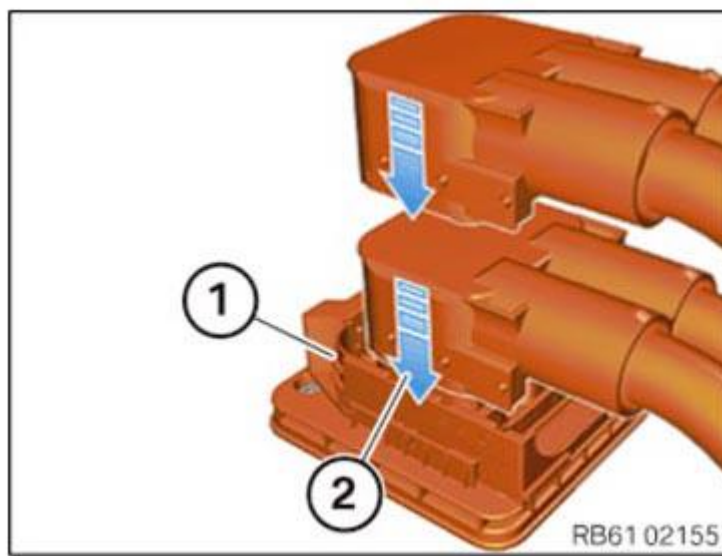
**Connect the Kostal high-voltage connector:**

Connect the connector (2) in one single movement to the counter-housing.

Push the lock (1) fully to the rear.

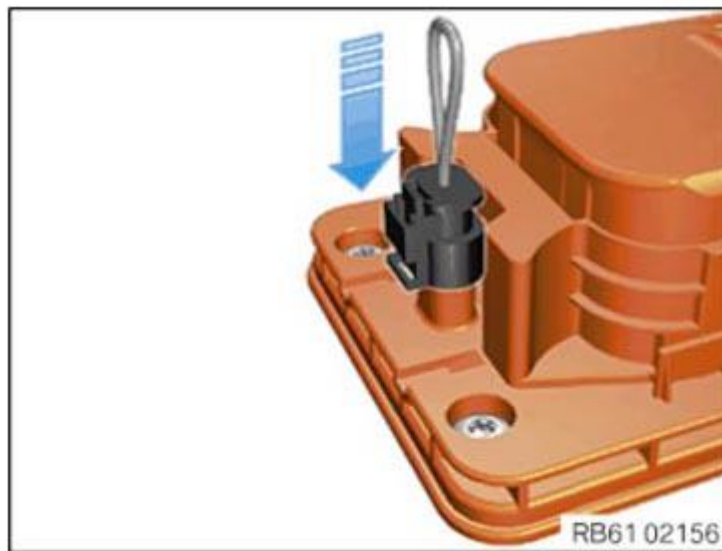
**Attention!**

Plug connection (3) must be correctly locked by lock (2), otherwise there is a risk of damage.



**Fig. 21: Connecting Kostal High-Voltage Connector To Counter-Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

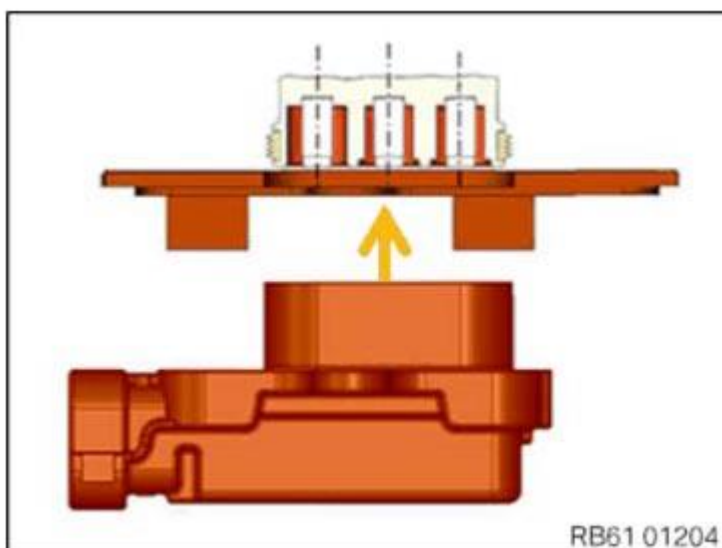
Connect the connector for the high-voltage interlock.



**Fig. 22: Connecting Connector For High-Voltage Interlock**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Three-phase high-voltage connector:**

Connect and disconnect the connector straight.



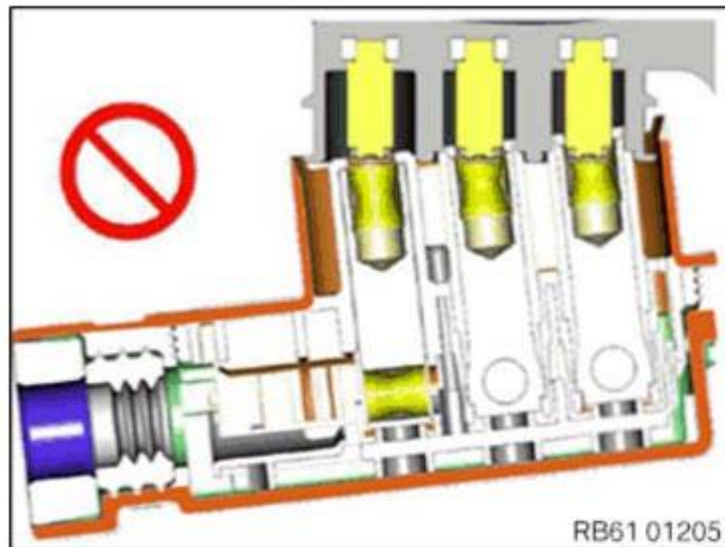


**Fig. 23: Disconnecting Three-Phase High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

The system is designed to only offer limited protection against damage caused by connectors that are inserted at an angle.

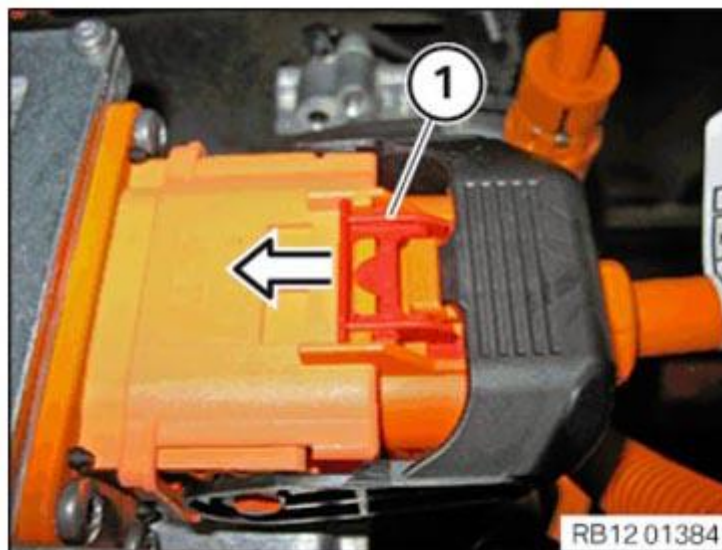
Increased tilted connections will increase the connecting force and the risk of danger.



**Fig. 24: Caution For Tilted Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Disconnect the high-voltage connector from the high-voltage connection of the KLE:**

Slide lock (1) in direction of arrow up to stop.



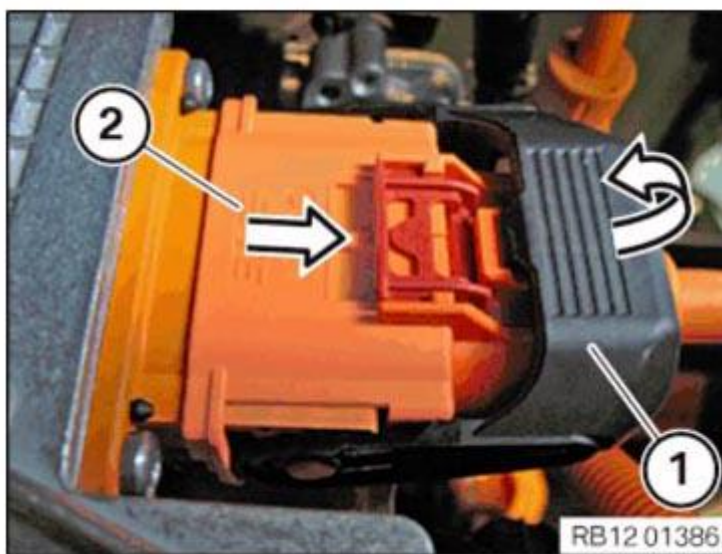
**Fig. 25: Disconnecting High-Voltage Connector From High-Voltage Connection Of KLE**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press lock (1).



**Fig. 26: Pressing High Voltage Connector Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open the lock (1) completely and disconnect the connector (2).



**Fig. 27: Opening Lock For Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Connect the high-voltage connector to the high-voltage connection of the KLE:**

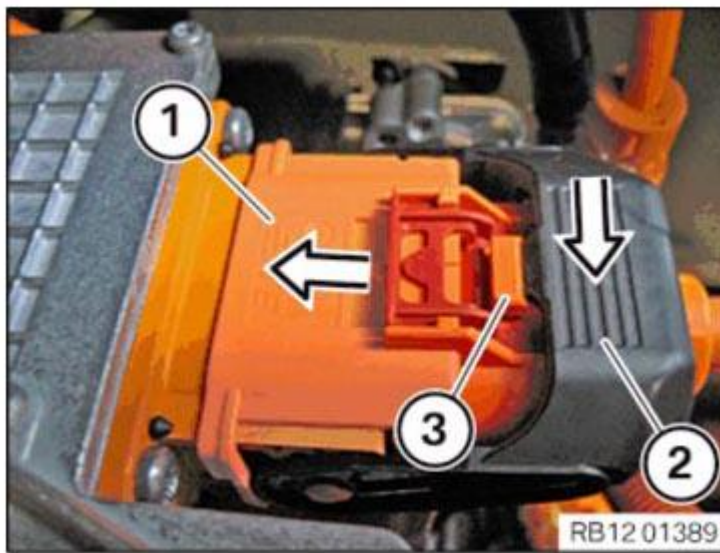
Connect the connector (1) to the limit position and close the lock (2).

**Attention!**

Lock (2) must snap audibly into place.

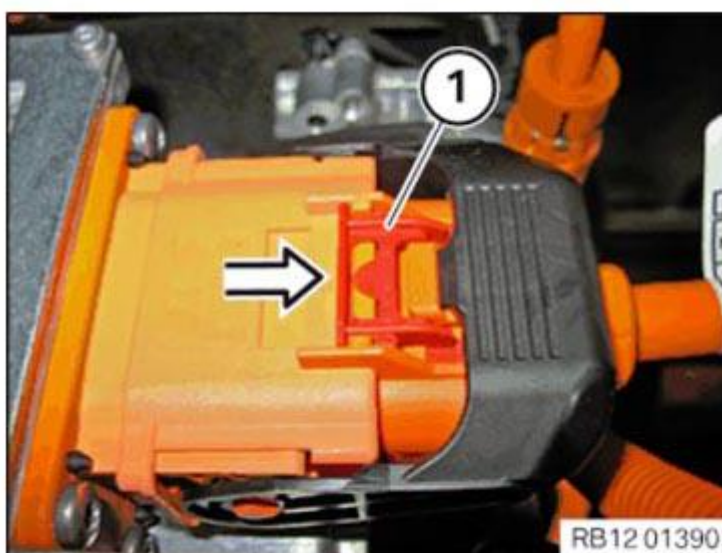
The retaining lug of the lock (2) must be positioned completely under the lock (2).





**Fig. 28: Connecting High-Voltage Connector To High-Voltage Connection Of KLE**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide the lock (1) on to the stop in the direction of the arrow.



**Fig. 29: Sliding Connector Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

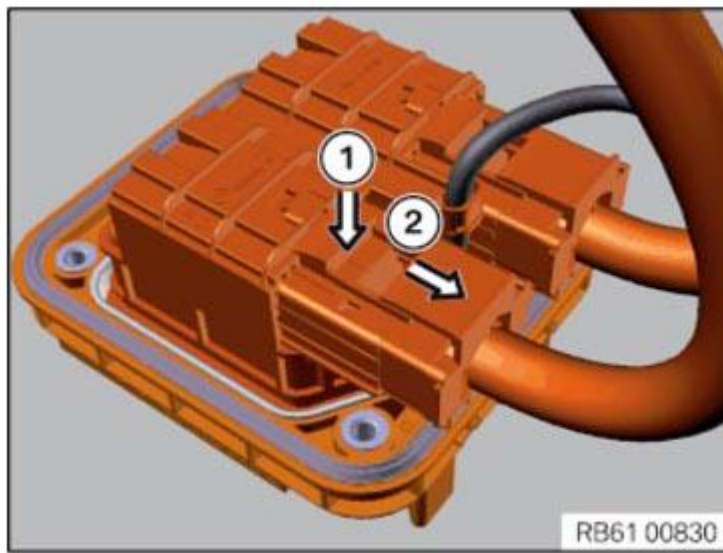
**High-voltage connector on the high-voltage connection of the high-voltage battery unit:**

Press down unlocking (1) in direction of arrow and pull off connector in direction of arrow (2).

**Attention!**

Contact protection is no longer provided in the event of a damaged connector housing.

In this case, contact technical support.



**Fig. 30: Pulling Out High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

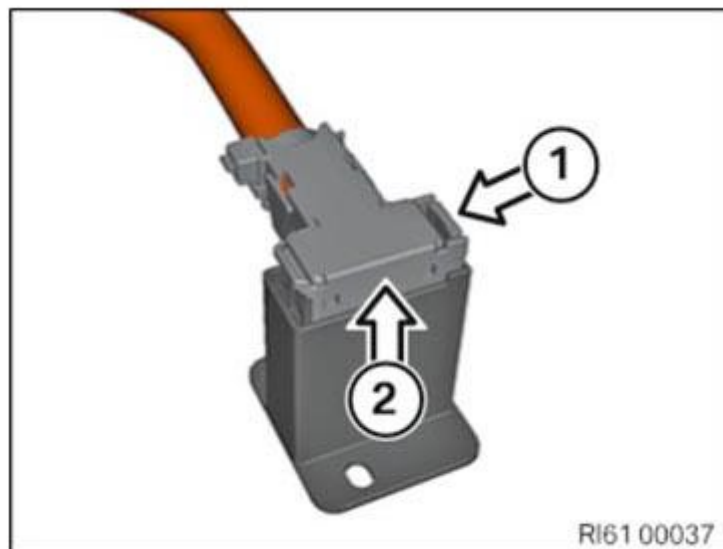
**High-voltage connector on the cell module I01:**

Press unlocking device (1) together and pull off connector upwards (2).

**Attention!**

Contact protection is no longer provided in the event of a damaged connector housing.

In this case, contact technical support.



**Fig. 31: Pulling Out Cell Module High-Voltage Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

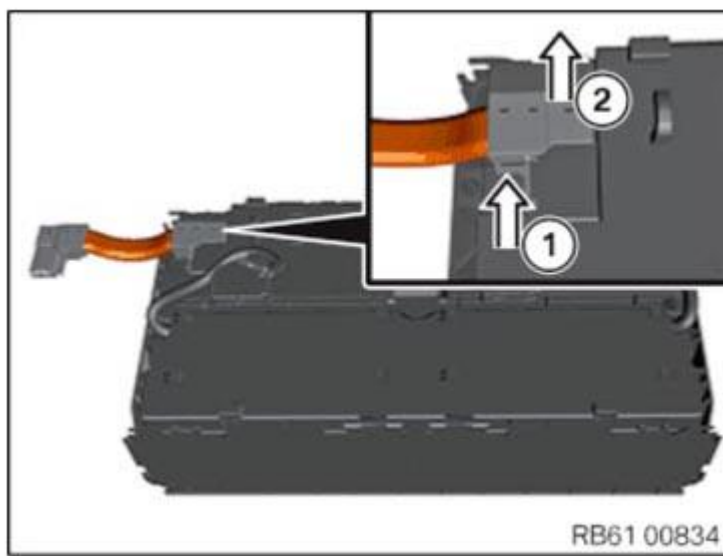
**High-voltage connector on the cell module (cell module connecting line):**

Press unlocking (1) in direction of arrow and pull off connector in direction of arrow (2).

**Attention!**

Contact protection is no longer provided in the event of a damaged connector housing.

In this case, contact technical support.



**Fig. 32: Pulling Out Cell Module High-Voltage Connector (Cell Module Connecting Line)**  
Courtesy of BMW OF NORTH AMERICA, INC.

## SPARK PLUGS

### 12 12 011 REMOVE AND INSTALL/REPLACE ALL SPARK PLUGS

#### Special tools required:

- [12 1 220](#)
- 12 1 230

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

#### Necessary preliminary tasks:

- Switch off ignition.
- Remove **IGNITION COILS**.

IMPORTANT: Wear safety goggles.  
Oil and dirt particles may get into your eyes!

#### Clean spark plug slot with compressed air.

1. Remove dirt contamination from the spark plug shaft. The plug shaft must be cleaned with compressed air after the ignition coils have been removed but before the spark plugs have been dismantled. After removing the spark plugs, check the sealing surface again for dirt contamination and if necessary, clean with a damp cloth or again with compressed air.

**NOTE:** Deposits that are not removed according to instructions may enter the combustion chamber and lead to uncontrolled combustion. Remaining deposits in the area of the spark plug seal can lead to leaks and to the spark plugs coming loose during engine operation.

2. Do not grease/oil thread or use any graphite or copper grease. Adhere to the torque values of the packaging information or regulation.

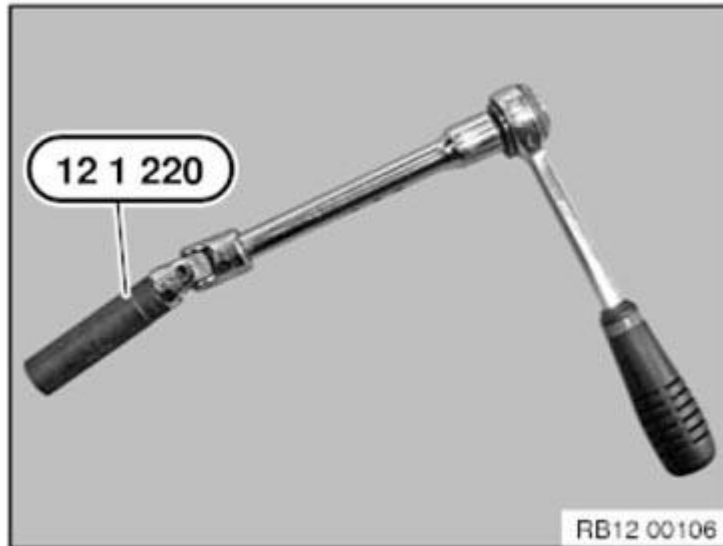
**NOTE:** If these instructions are not followed, especially with regard to greasing, this may result in mechanical damage to the spark plug housing/thread.

**Spark plugs that are not tightened sufficiently lead to leaks and to the spark plugs coming loose during engine operation.**

Unscrew spark plugs with special tool [12 1 220](#) and extension with min. 8° bend.

Flexible ratchet extensions must always be used. If rigid mounting tools are used, there is a risk of insulator breakages.

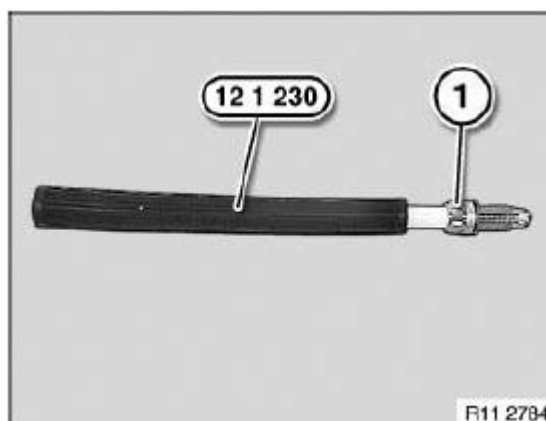
**NOTE:** Also do not use a variable plug connection with locking capability as this also poses a risk of insulator breakages.



**Fig. 33: Identifying Special Tool (12 1 220) And Extension**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attach new spark plug (1) to special tool 12 1 230.

**IMPORTANT:** Do not let spark plugs fall into the spark plug shaft. This can lead to a reduction of the electrode gap and so impair the smooth running of the engine, especially in idle mode. Screw spark plug with special tool 12 1 230 hand-tight into cylinder head plug thread as far as it will go.

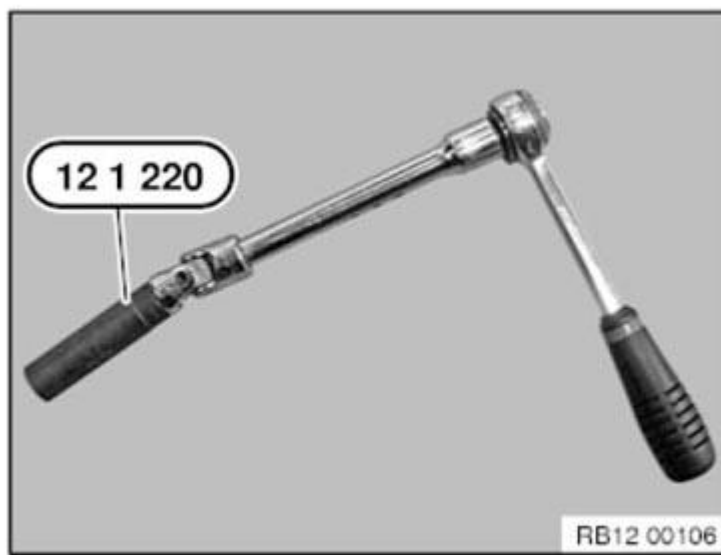


**Fig. 34: Attaching Spark Plug To Special Tool (12 1 230)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Tighten spark plugs with torque wrench, special tool [12 1 220](#) and extension with min. 8° bend.

Flexible ratchet extensions must always be used. If rigid mounting tools are used, there is a risk of insulator breakages.



**Fig. 35: Identifying Special Tool (12 1 220) And Extension**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Also do not use a variable plug connection with locking capability as this also poses a risk of insulator breakages.  
Observe tightening torque.  
Tightening torque **12 12 1AZ** .

## IGNITION COILS

### 12 13 511 REPLACING IGNITION COILS

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe **SAFETY INFORMATION** for handling electric vehicles.

*Necessary preliminary tasks:*

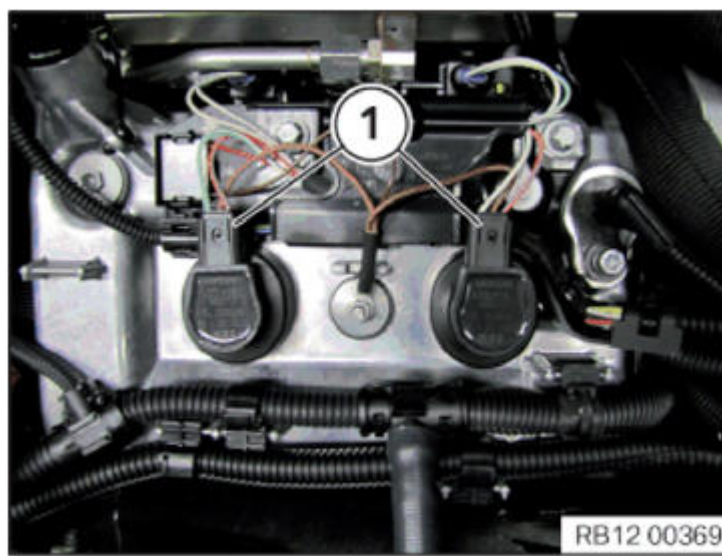
- Remove **INTAKE PLENUM** .

Ignition coils must not be contaminated by fuel.  
The resistance of the silicone material is reduced significantly by contact with fuel, which may cause the ignition coil to fail!

**IMPORTANT:** The silicone tube of the spark plug connector is coated with talc to reduce the pulling forces. The silicone tube must NOT be oiled or greased. This would greatly reduce the durability of the silicone material, which can lead to a malfunction of the ignition coil.

Unlock and pull off connectors (1) on ignition coils.





**Fig. 36: Identifying Ignition Coils Connectors**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push special tool 12 3 621 onto ignition coil in direction of arrow.



**Fig. 37: Pushing Special Tool (12 3 621) Onto Ignition Coil**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out ignition coil (1) with special tool 12 3 621 and remove.

Slowly pull the ignition coil (1) up and out without jerking it.

**NOTE:** There is a possibility that the silicone tube will tear and therefore be destroyed.

This procedure is applicable to all ignition coils.

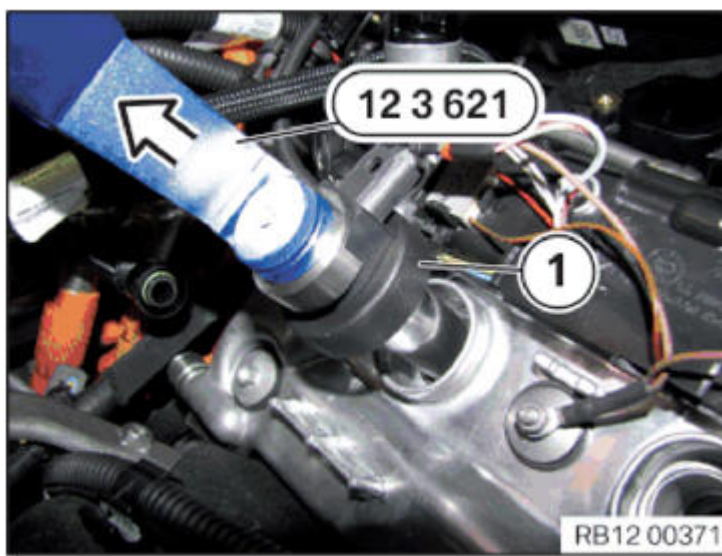
*Installation note:*

Position the ignition coil and gently push it to the limit position, if necessary by twisting it back and forth slightly.

The rubber cap must completely surround the sealing collar of the cylinder head cover.

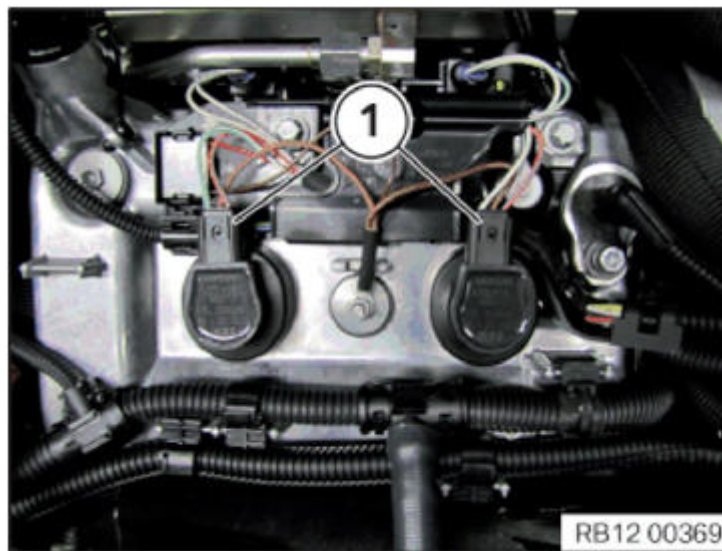
**NOTE:** If rubber parts are squashed, the ignition coil can slip out again during engine operation.





**Fig. 38: Pulling Out Ignition Coil (1) With Special Tool (12 3 621)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Reconnect connectors (1) to the ignition coils. Make sure the connectors are properly engaged.



**Fig. 39: Identifying Ignition Coils Connectors**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Assemble engine.

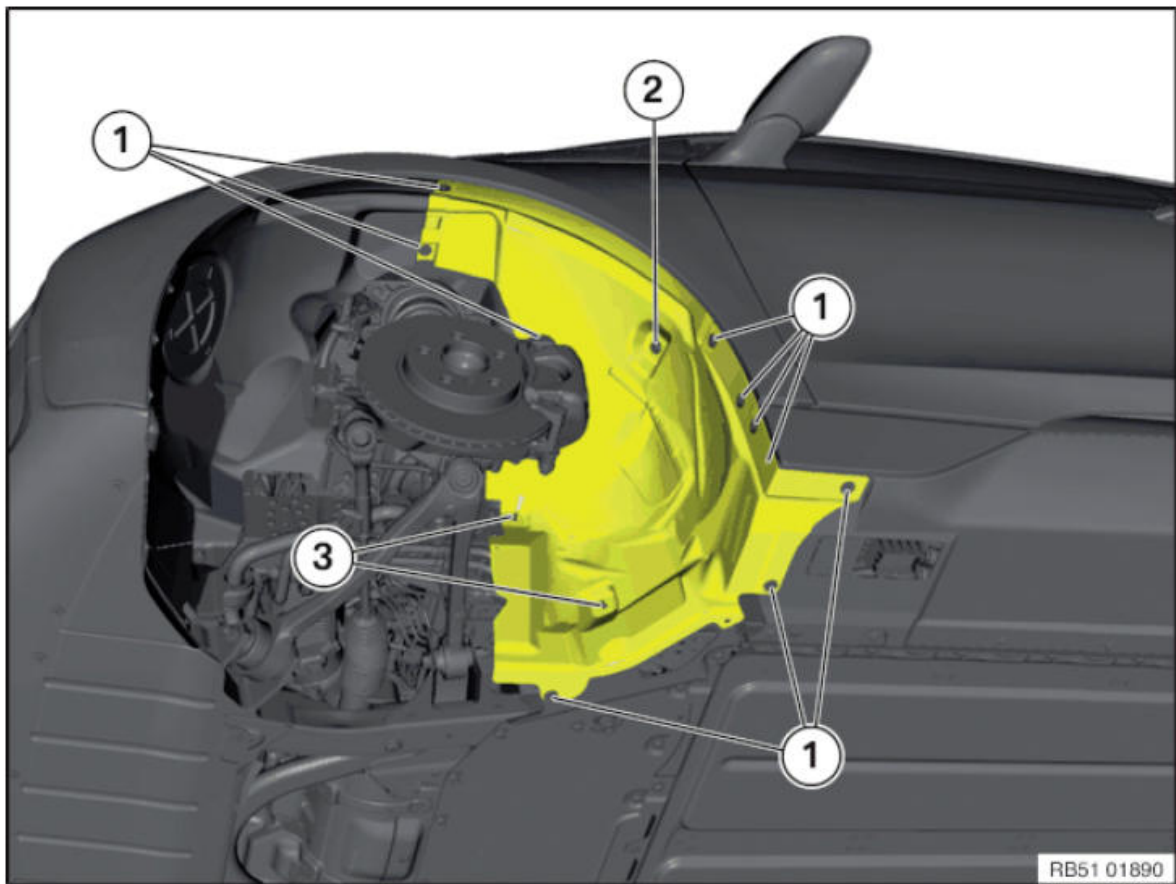
## **ELECTRONIC SWITCHING OR CONTROL UNITS**

### **12 14 750 REMOVING AND INSTALLING/REPLACING CONTROL UNIT (EDME)**

Necessary preliminary tasks:

- Detach the **BATTERY CABLE NEGATIVE TERMINAL** .

**NOTE:** Before disconnecting the battery cable, it must be ensured that the vehicle goes to sleep.



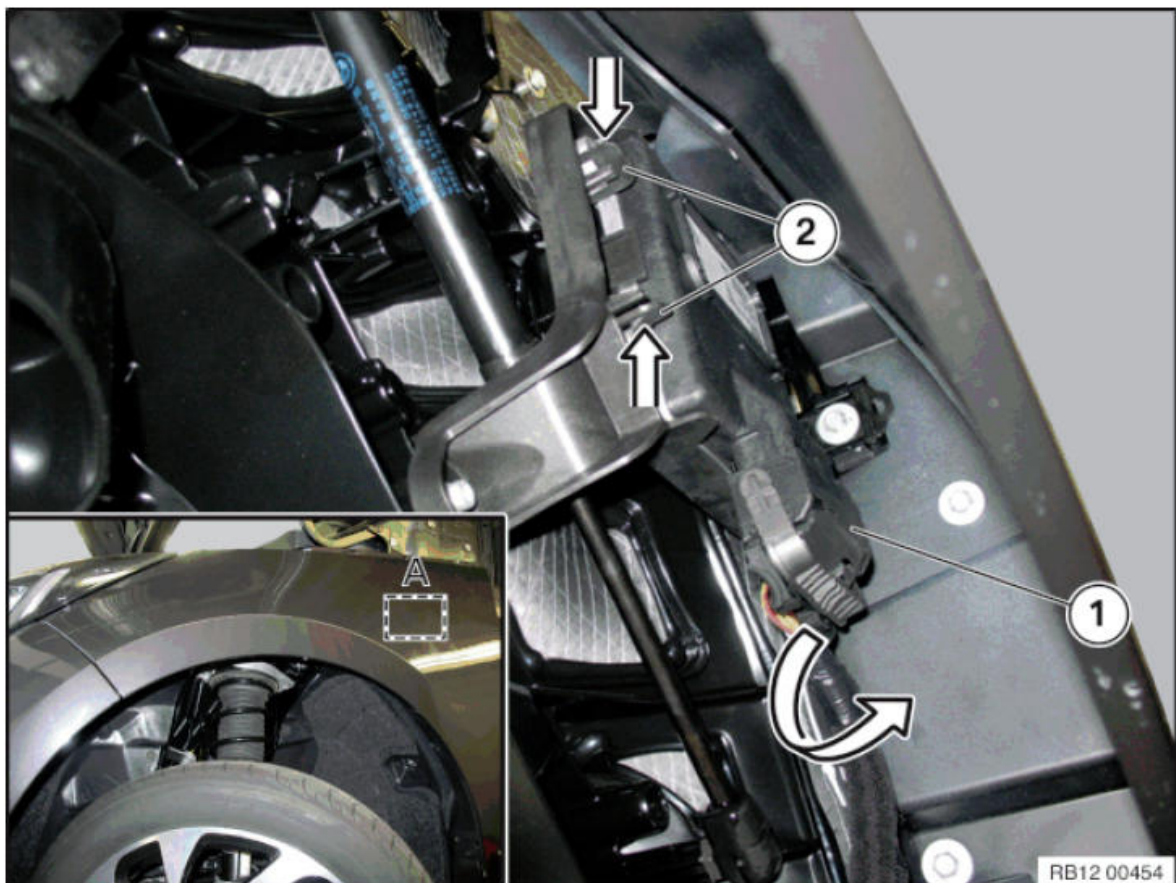
**Fig. 40: Identifying Wheel Arch Cover, Screws And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Slacken nut (2).

Release plastic nuts (3).

Feed out front wheel arch cover (rear part).



**Fig. 41: Pressing Control Unit (EDME) Locks**  
Courtesy of BMW OF NORTH AMERICA, INC.

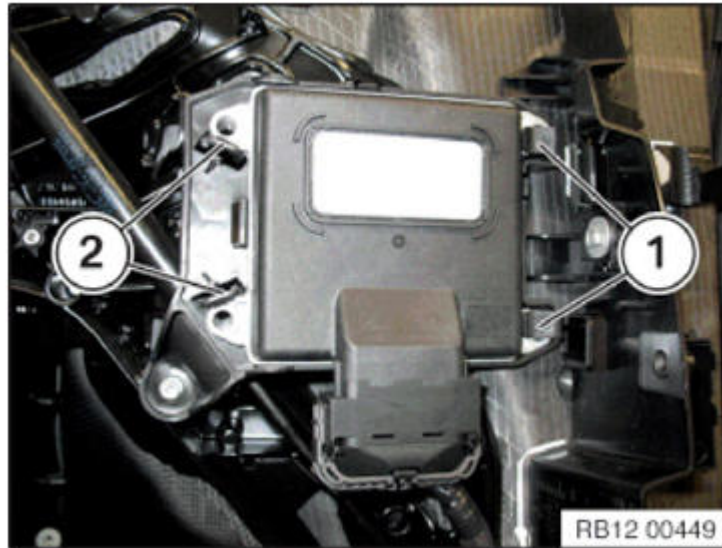
**NOTE:** The control unit (EDME) is positioned in the marked area (A).  
Unfasten plug connection (1) and disconnect.  
Press together the locks (2) and feed out control unit (EDME).

*Installation note:*

Make sure control unit (EDME) is correctly seated.

Control unit (EDME) must be situated under guide lugs (1).

Control unit (EDME) must be fully locked into locks (2).



**Fig. 42: Identifying Guide Lugs And Locks**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING** .

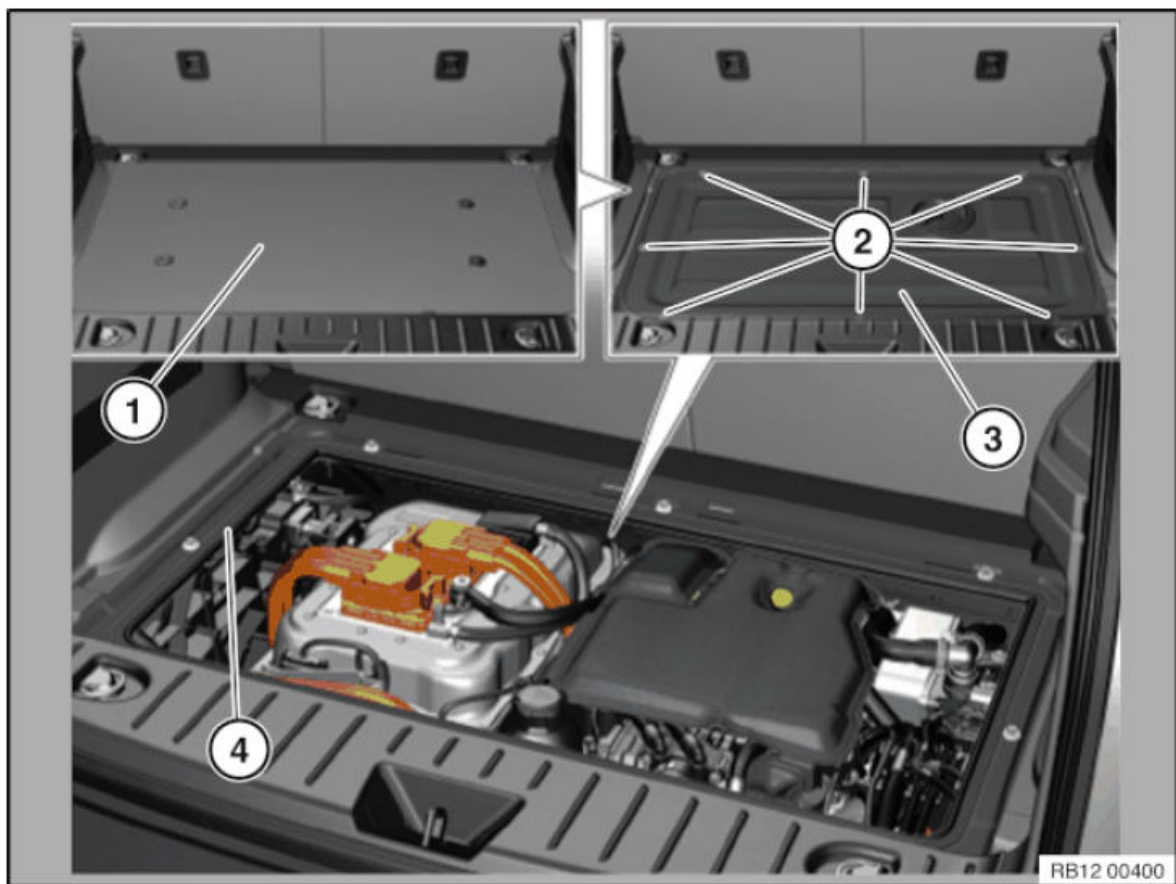
**12 14 760 REMOVING AND INSTALLING/REPLACING CONTROL UNIT (RDME)**

**Necessary preliminary tasks:**

- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**

**NOTE:** Before disconnecting the battery cable, it must be ensured that the vehicle goes to sleep.





**Fig. 43: Identifying Floor Trim Panel, Service Cap, Screws And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

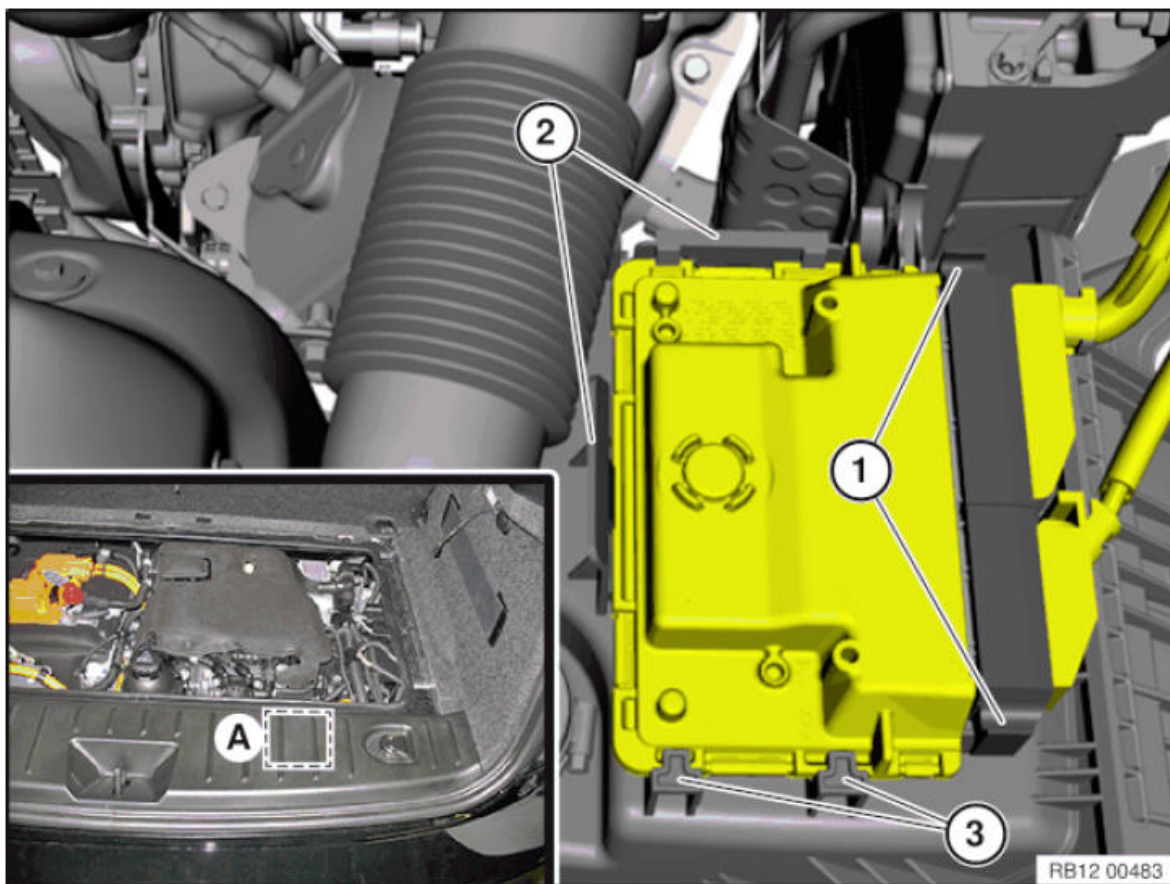
Remove luggage compartment floor trim panel (1).

Release screws (2) and remove service cap (3) towards top.

Tightening torque [51 47 04AZ](#) .

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.



**Fig. 44: Identifying Plug Connections Locks And Guide Lugs**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Control unit (RDME) is positioned in marked area (A).

Unlock plug connections (1) and disconnect.

Press locks (2) outwards and feed out control unit (RDME).

Installation note:

Make sure control unit (RDME) is correctly fitted.

Control unit (RDME) must be situated under guide lugs (3).

Control unit (RDME) must be fully locked into locks (2).

**Replacement:**

Carry out **VEHICLE PROGRAMMING/CODING**.

### **12 14 521 REPLACING CRANKSHAFT PULSE SENSOR**

**WARNING:** High-voltage system - danger to life  
 Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe **SAFETY INFORMATION** for handling electric vehicles.

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)**.

*Necessary preliminary tasks:*

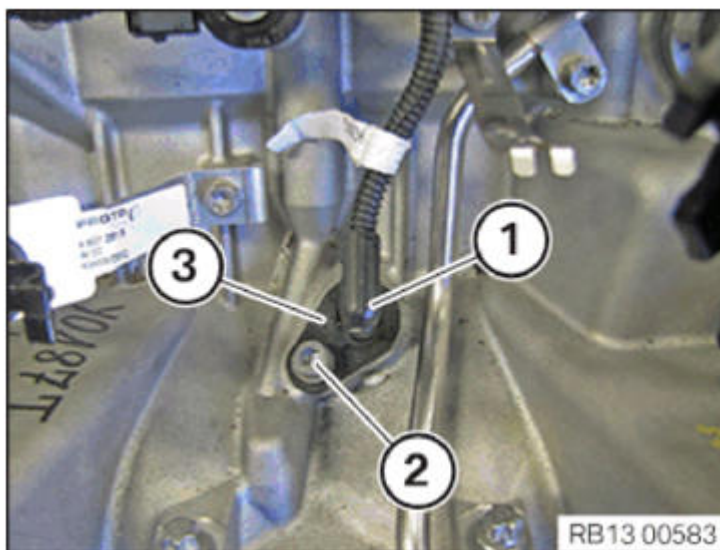
- Remove complete DRIVE UNIT.

Unlock connector (1) and remove.

Release screw (2).

Tightening torque 13 62 3AZ .

Remove pulse sensor (3).



**Fig. 45: Identifying Pulse Sensor, Connector And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Assemble engine.  
Check stored fault message.  
Clear diagnostic fault entries from fault memory.

### 12 14 600 REPLACING KNOCK SENSOR

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the HIGH-VOLTAGE SYSTEM.
- Observe SAFETY INFORMATION for working with electric vehicles.

*Necessary preliminary tasks:*

- Remove complete DRIVE UNIT.
- Undo the thermostat and set on the side.

Release screw (1).

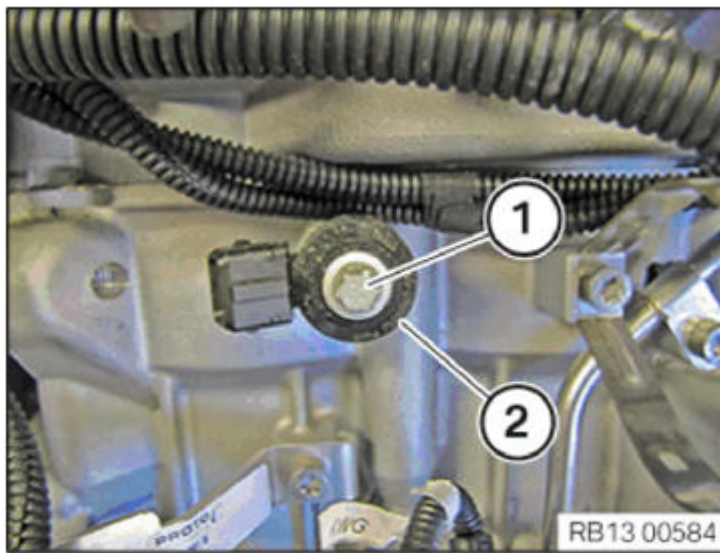
Remove knock sensor (2).

*Installation note:*

Clean contact surface of knock sensor on engine block.

Tightening torque 13 62 4AZ .





**Fig. 46: Identifying Knock Sensor And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Clear diagnostic fault entries from fault memory.

### **12 14 523 REPLACING PULSE SENSOR ON INTAKE CAMSHAFT**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe **SAFETY INFORMATION** for handling electric vehicles.

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)**.

*Necessary preliminary tasks:*

- Remove **INTAKE PLENUM**.

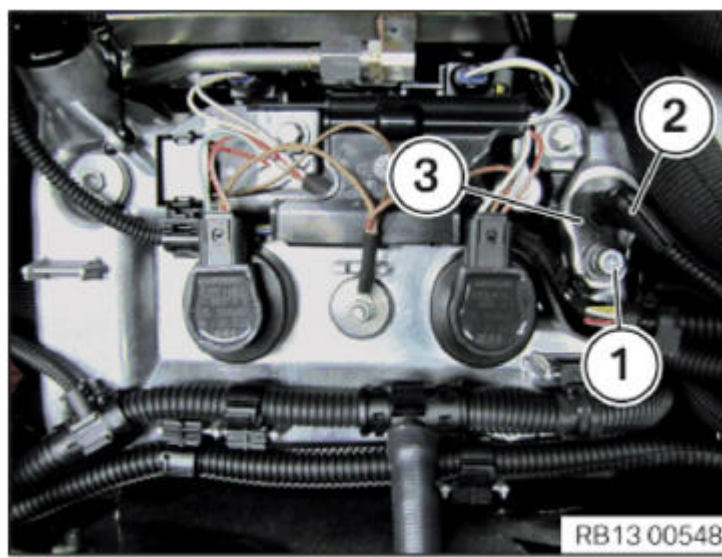
Unlock connector (2) and remove.

Release screw (1).

Tightening torque **13 62 2AZ**.

Remove pulse sensor (3).

Check gasket, renew damaged gasket.



**Fig. 47: Identifying Pulse Sensor, Connector And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Check stored fault message.  
Clear diagnostic fault entries from fault memory.

## **ELECTRICAL MACHINE AND E-TRANSMISSION**

### **27 00 015 REMOVING AND INSTALLING E-TRANSMISSION (VEHICLES WITHOUT RANGE EXTENDER)**

Special tools required:

- [2 285 545](#)
- [2 285 547](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.
- The electrical machine must be supported by a lift throughout the entire procedure while the transmission is being removed and installed.

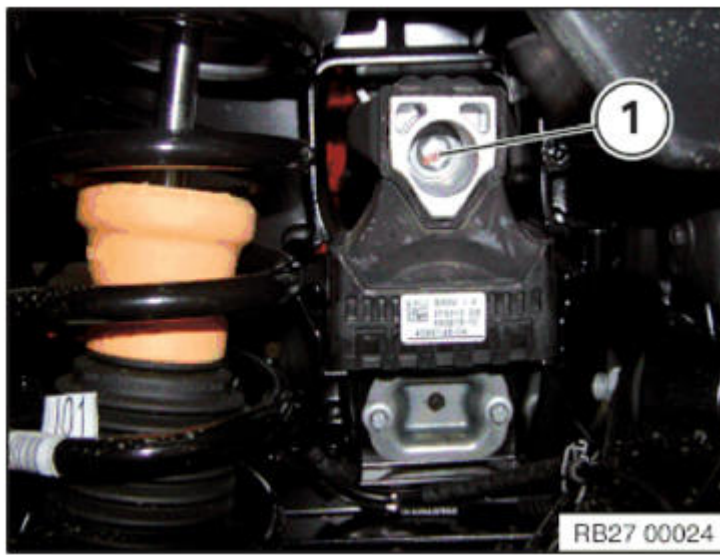
Aluminum screws/bolts **must** be replaced each time they are released .  
IMPORTANT: For reliable identification:  
Aluminum screws/bolts are **not magnetic** .  
Jointing torque and angle of rotation must be observed without fail (**risk of damage**) .

Necessary preliminary tasks:

- Remove left and right output shaft. See [REPLACING LEFT OUTPUT SHAFT](#) or [REPLACING RIGHT OUTPUT SHAFT](#) :

Release screw (1).

Tightening torque [27 00 6AZ](#) .



**Fig. 48: Identifying Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

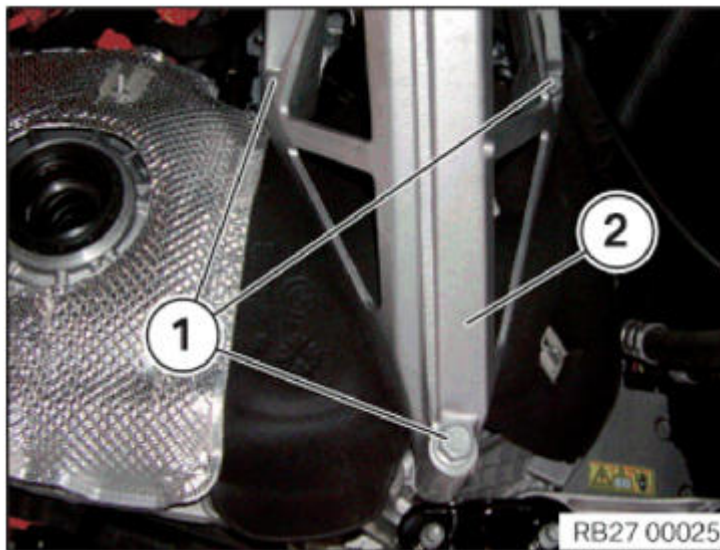
Release screws (1).

Remove transmission mounting bracket (2).

Tightening torque **27 00 3AZ** .

*Installation note:*

Replace screws (1).



**Fig. 49: Identifying Transmission Mounting Bracket And Screw**

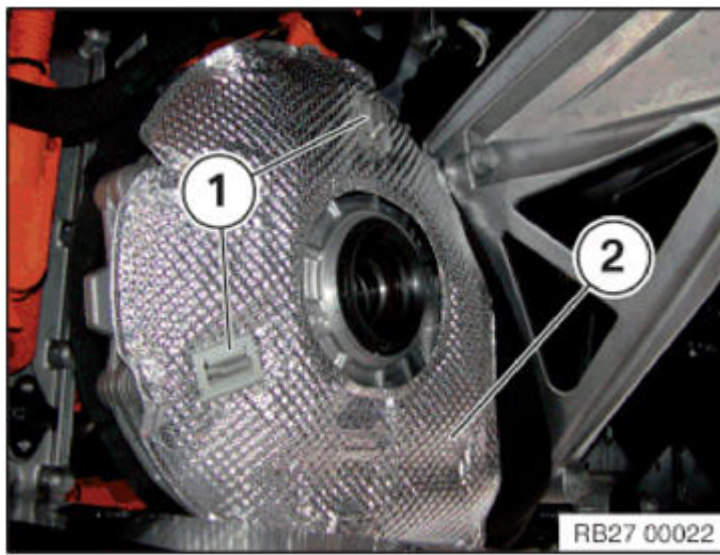
Courtesy of BMW OF NORTH AMERICA, INC.

Pry off clamps (1) of heat shield (2).

Remove heat shield (2).

*Installation note:*

Replace clamps (1).



**Fig. 50: Identifying Heat Shield And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pry off clamps (1) of sound insulation (2).

Remove soundproofing (2).

*Installation note:*

Replace clamps (1).



**Fig. 51: Identifying Sound Insulation And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect connector (1) on parking lock.

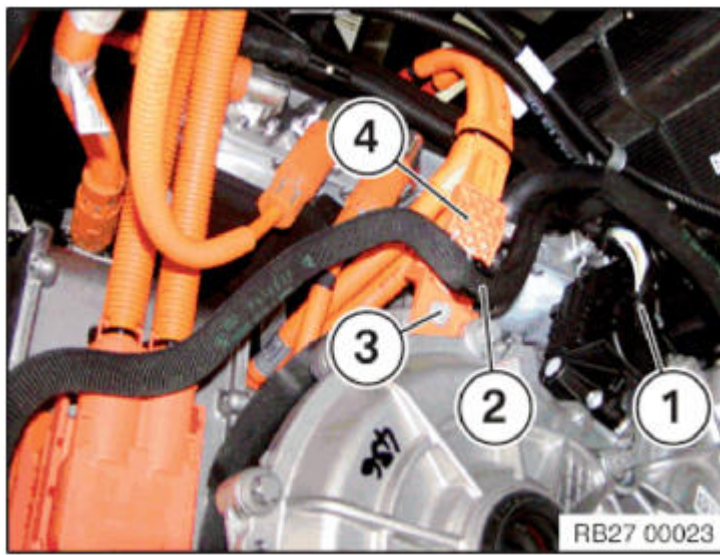
Release coolant hose (2) from bracket.

Release screw (3).

Release connector from transmission (4).

Tightening torque [27 00 11AZ](#) .





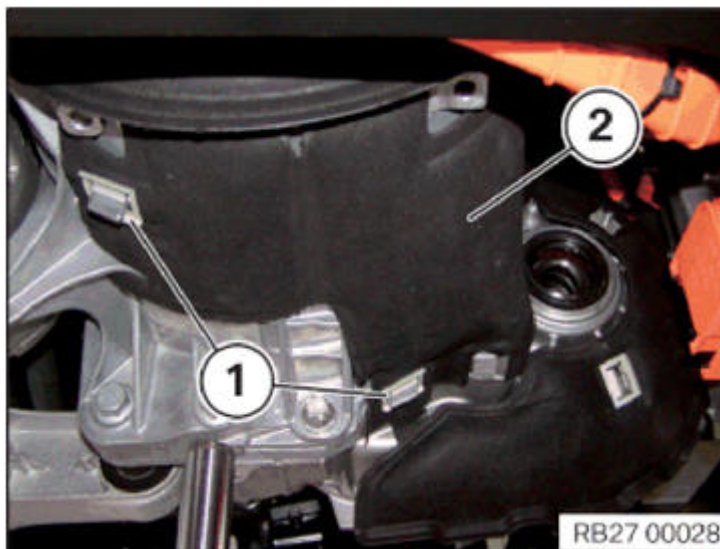
**Fig. 52: Identifying Parking Lock, Transmission Connector Coolant Hose And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pry off clamps (1) of sound insulation (2).

Remove soundproofing (2).

*Installation note:*

Replace clamps (1).

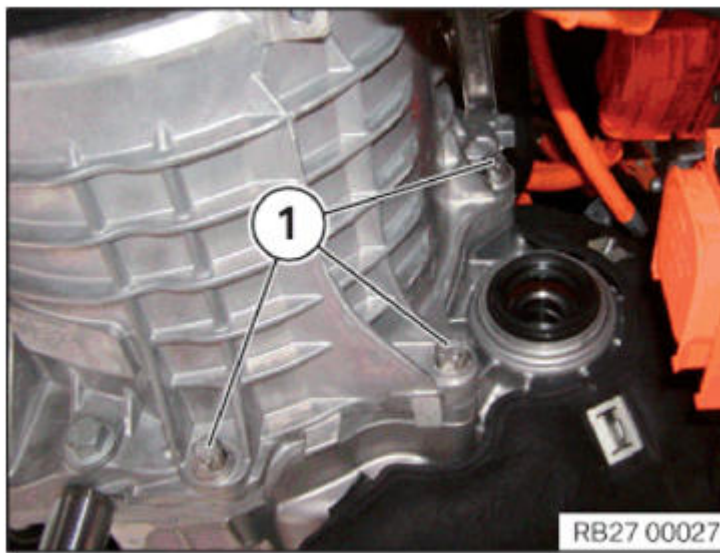


**Fig. 53: Identifying Sound Insulation And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release aluminum screws (1).

Aluminum screws/bolts must be replaced each time they are released.

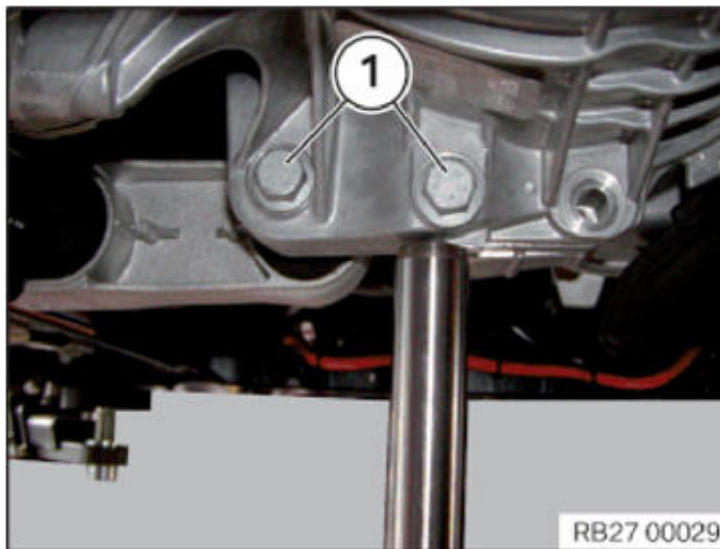
Tightening torque and angle of rotation [27 00 1AZ](#) .



**Fig. 54: Identifying Aluminum Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [27 00 9AZ](#) .



**Fig. 55: Identifying Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

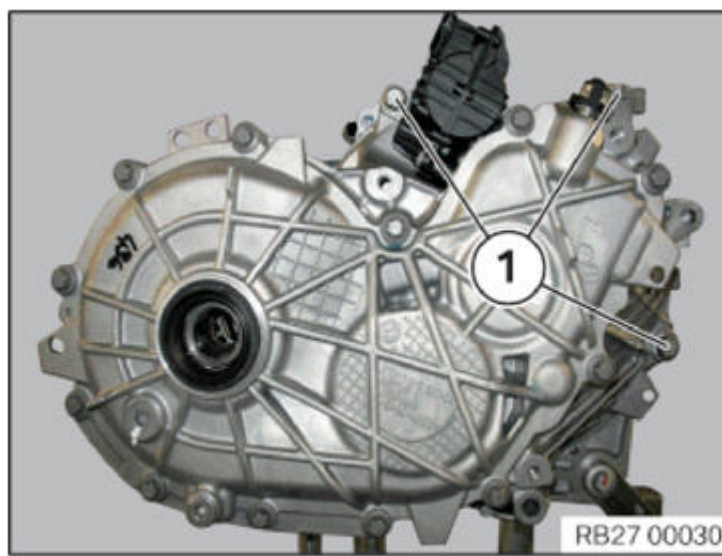
For better illustration: Gearbox out of vehicle.

Release aluminum screws (1).

Aluminum screws/bolts must be replaced each time they are released.

Tightening torque and angle of rotation [27 00 1AZ](#) .

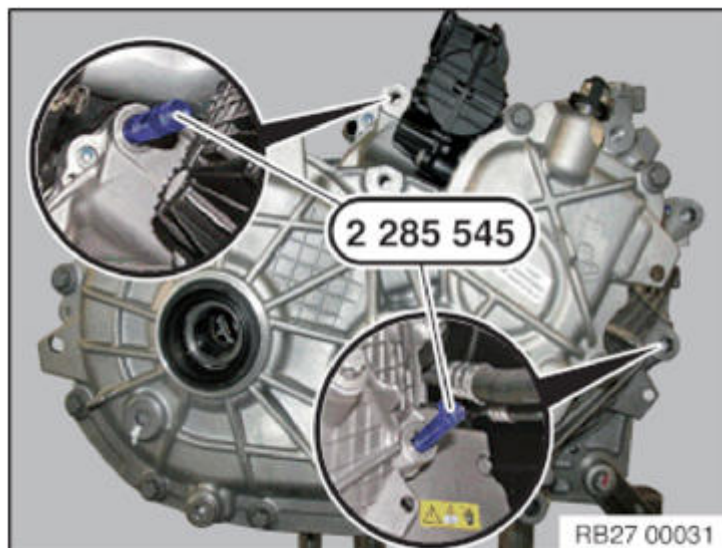




**Fig. 56: Identifying Aluminum Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw guide pins [2 285 545](#) into the electrical machine.

Pull transmission off of electrical machine.

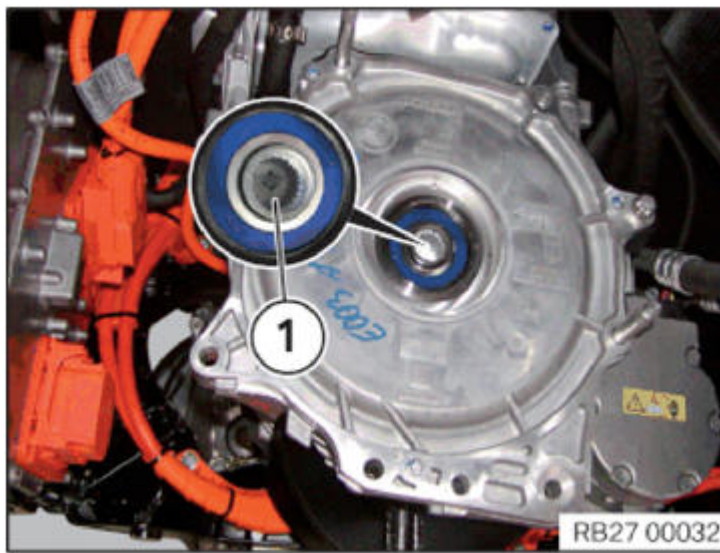


**Fig. 57: Screwing Guide Pins (2 285 545) Into Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Before installing the transmission:**

The hub base of the rotor shaft (1) and the gearing **must be completely** freed of grease without fail.

Cleaning must be performed only with the cleaning agent GE with the order number: 83 23 2 357 553 and a lint-free cloth for rough cleaning and a brush for fine cleaning and compressed air.



**Fig. 58: Identifying Rotor Shaft**

**Courtesy of BMW OF NORTH AMERICA, INC.**

**IMPORTANT:** Failure to observe these instructions will result in serious damage to or premature failure of the e-machine.

*Installation note:*

For lubrication, the grease GE with the order number: 83 23 2 357 146 must be used.

The full grease quantity (4 g) must be applied to the hub base of rotor shaft (1).

The gearing must not be greased.

When the transmission is joined with the electrical machine, the grease is distributed uniformly on the connection.

*Installation note:*

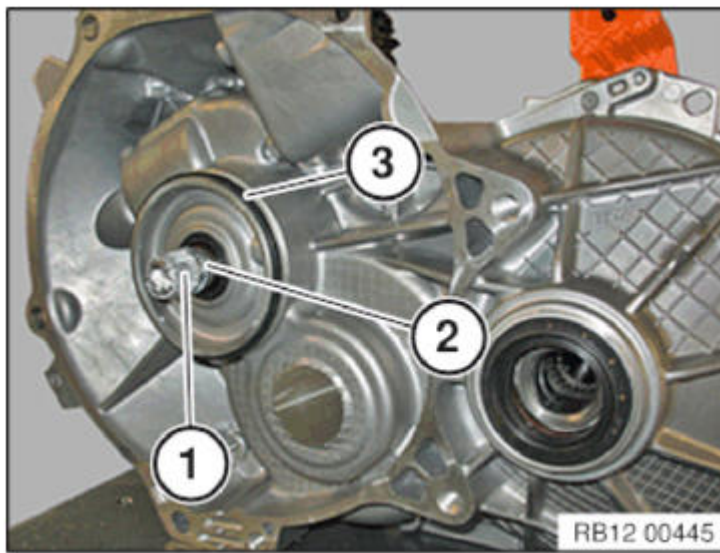
Clean the transmission input shaft (1). All existing grease must be completely removed without fail.

Cleaning must be performed only with the cleaning agent GE with the order number: 83 23 2 357 553 and a lint-free cloth for rough cleaning and a brush for fine cleaning and compressed air.

Completely remove any corrosion from the transmission input shaft (1) with a suitable wire brush.

Sealing ring (2) **must** be replaced every time the transmission is removed and installed.

Check the **SEALING RING** for damage and replace as needed. Lightly coat sealing ring (3) all-round with grease GE with the order number: 83 23 2 357 146.

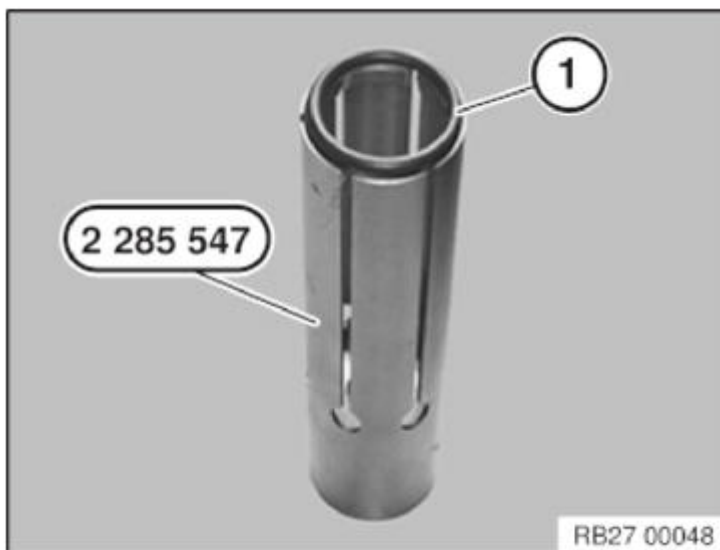


**Fig. 59: Identifying Input Shaft And Sealing Rings**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Failure to observe these instructions will result in serious damage to or premature failure of the e-machine.

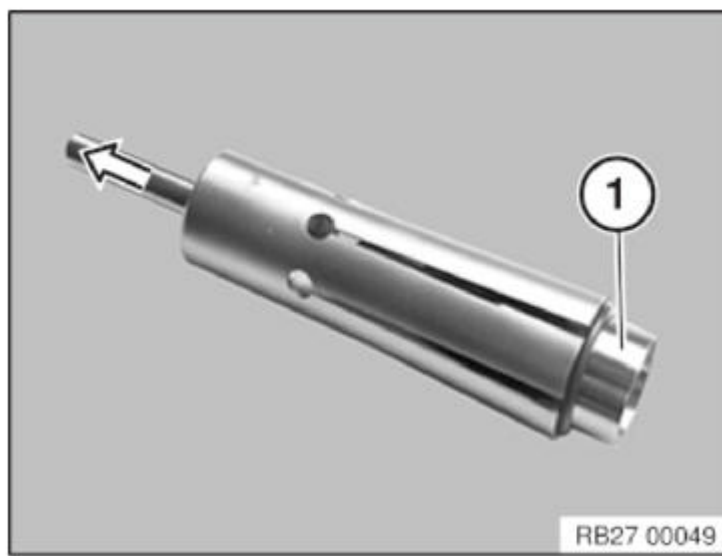
Position sealing ring (1) on special tool [2 285 547](#) .

IMPORTANT: The sealing ring must be lightly coated all-round with grease GE with the order number: 83 23 2 357 146 only in installed condition on the drive shaft.



**Fig. 60: Positioning Sealing Ring On Special Tool (2 285 547)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide in guide sleeve (1) and pry open sealing ring.



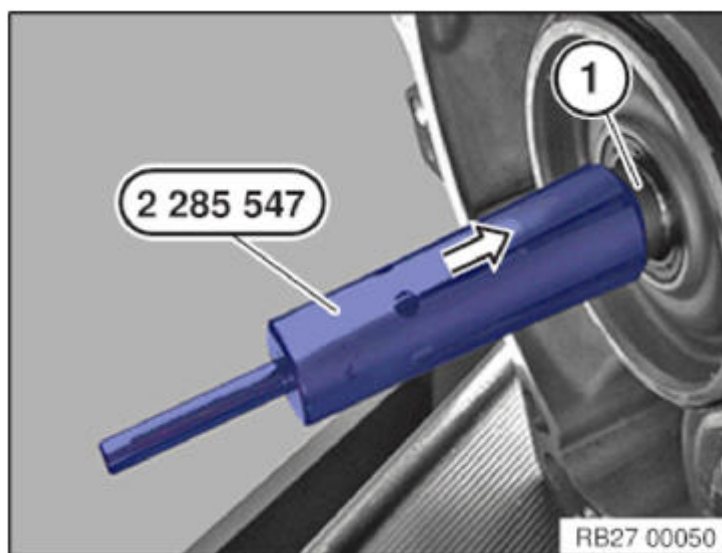
**Fig. 61: Sliding Guide Sleeve**

Courtesy of BMW OF NORTH AMERICA, INC.

Slide special tool [2 285 547](#) onto gearbox drive shaft.

Slip sealing ring (1) off of guide sleeve into guiding groove.

Lightly coat sealing ring all-round with grease GE with the order number: 83 23 2 357 146.



**Fig. 62: Sliding Special Tool (2 285 547) Onto Gearbox Drive Shaft**

Courtesy of BMW OF NORTH AMERICA, INC.

**27 00 065 REPLACE E-TRANSMISSION (VEHICLES WITHOUT RANGE EXTENDER)**

**WARNING:**

High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

IMPORTANT: After completion of work, check [TRANSMISSION OIL LEVEL](#) .  
Use only the approved transmission fluid.

Failure to comply with this instruction will result in serious damage to the transmission.

**Recycling:**

Catch and dispose of escaping transmission oil.

Observe country-specific waste disposal regulations

#### Necessary preliminary tasks:

- Drain transmission oil via oil drain plug, tightening torque: [27 00 13AZ](#) .
- Remove [E-TRANSMISSION](#)
- Remount sound insulation of E-transmission

*Installation note:*

After the transmission is installed, the parking lock module must be reinitialized.

### **27 00 020 REMOVING AND INSTALLING E-TRANSMISSION (VEHICLES WITH RANGE EXTENDER)**

#### Special tools required:

- [2 285 545](#)
- [2 285 547](#)

#### **WARNING:**

**High-voltage system - danger to life!**

**The following points must be strictly observed prior to starting work and during work:**

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

Aluminum screws/bolts **must** be replaced each time they are **released** .

IMPORTANT: For reliable identification:

Aluminum screws/bolts are **not magnetic** .

Jointing torque and angle of rotation must be observed without fail (**risk of damage**) .

#### Necessary preliminary tasks:

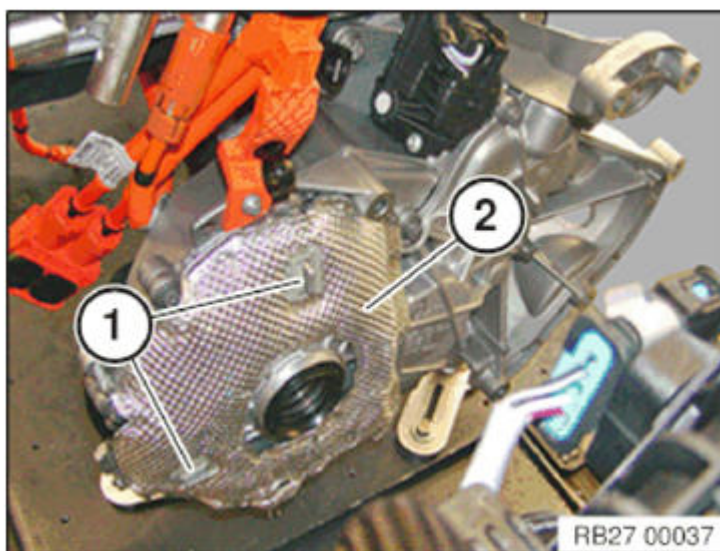
- Remove and install [ENGINE FROM DRIVE UNIT](#)

Pry off clamps (1) of heat shield (2).

Remove heat shield (2).

*Installation note:*

Replace clamps (1).





**Fig. 63: Identifying Heat Shield And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect connector (1) on parking lock.

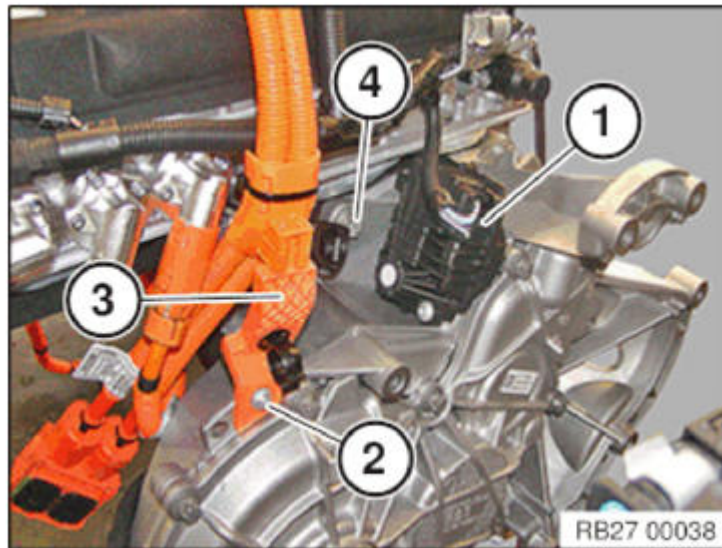
Release screw (2).

Release connector from transmission (3).

Release aluminum screw (4).

Aluminum screws/bolts must be replaced each time they are released.

Tightening torque [27 00 2AZ](#) .

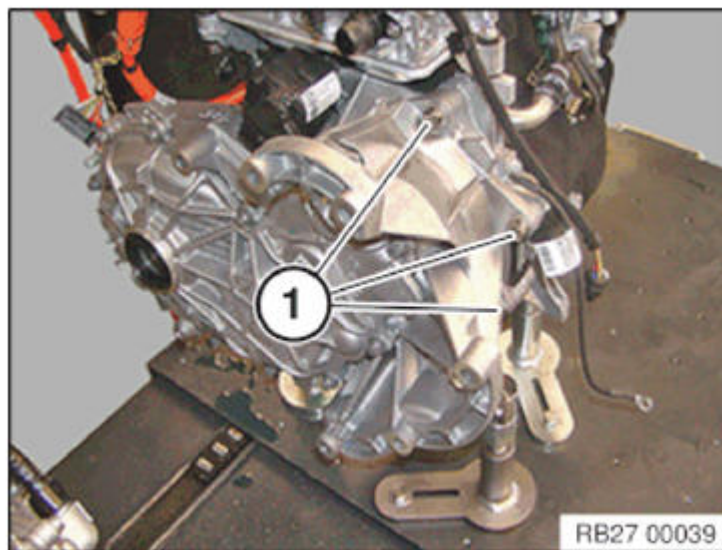


**Fig. 64: Identifying Parking Lock, Transmission Connector And Aluminum Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release aluminum screws (1).

Aluminum screws/bolts must be replaced each time they are released.

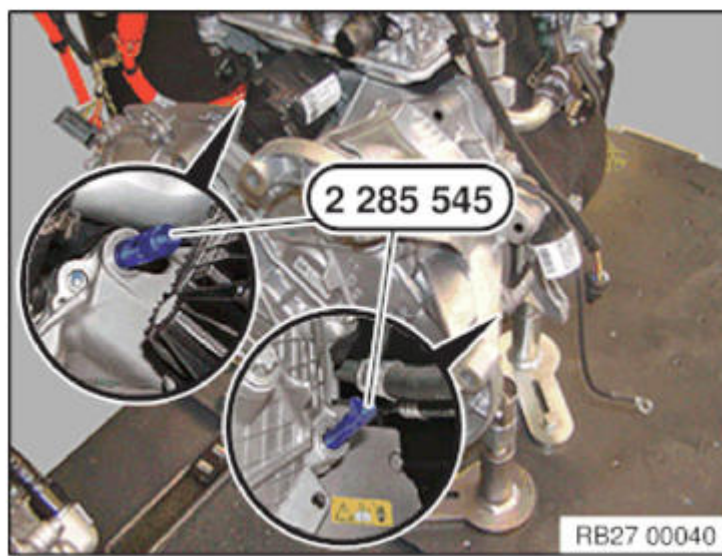
Tightening torque and angle of rotation [27 00 2AZ](#) .



**Fig. 65: Identifying Aluminum Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

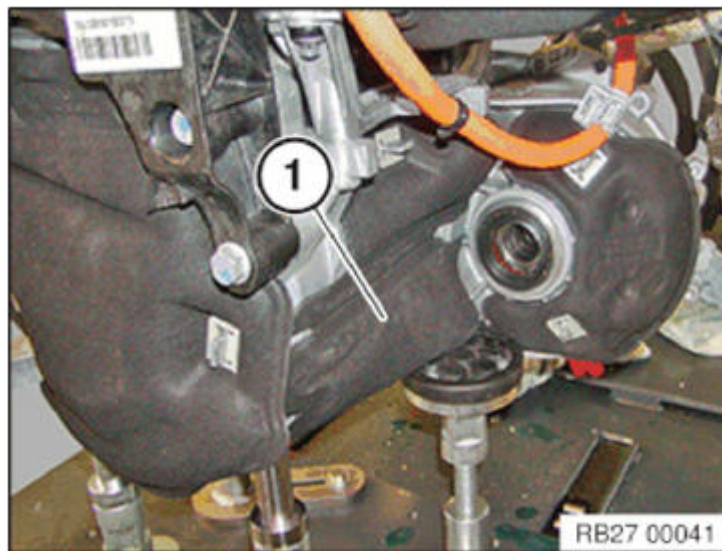
Screw guide pins [2 285 545](#) into the electrical machine.





**Fig. 66: Screwing Guide Pins (2 285 545) Into Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove soundproofing (1).



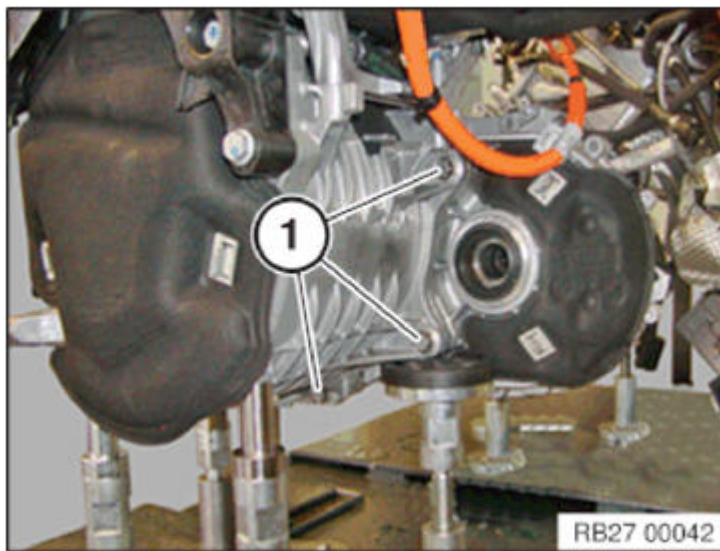
**Fig. 67: Identifying Soundproofing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release aluminum screws (1).

Aluminum screws/bolts must be replaced each time they are released.

Tightening torque [27 00 2AZ](#) .

Pull transmission off of electrical machine.



**Fig. 68: Identifying Aluminum Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Before installing the transmission:**

The hub base of the rotor shaft (1) and the gearing **must be completely** freed of grease without fail.

Cleaning must be performed only with the cleaning agent GE with the order number: 83 23 2 357 553 and a lint-free cloth for rough cleaning and a brush for fine cleaning and compressed air.

**IMPORTANT:** Failure to observe these instructions will result in serious damage to or premature failure of the e-machine.



**Fig. 69: Identifying Rotor Shaft**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

For lubrication, the grease GE with the order number: 83 23 2 357 146 must be used.

The full grease quantity (4 g) must be applied to the hub base of rotor shaft (1).

The gearing must not be greased.

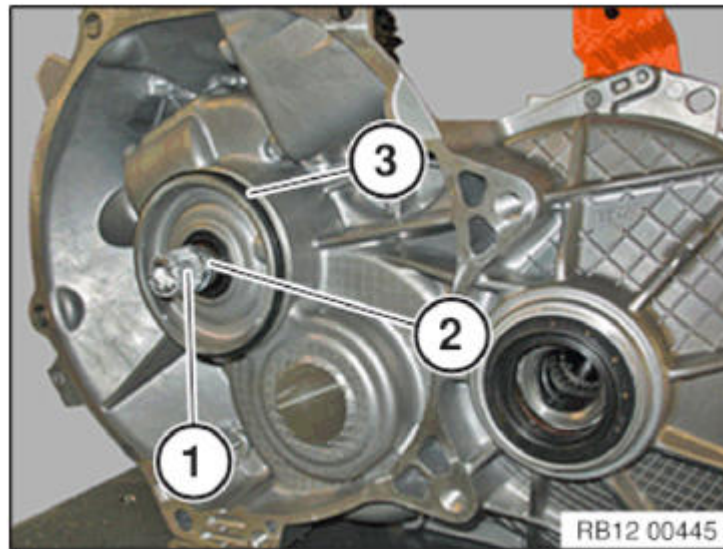
When the transmission is joined with the electrical machine, the grease is distributed uniformly on the connection.

*Installation note:*

Clean the transmission input shaft (1). All existing grease **must be completely** removed without fail.

Cleaning must be performed only with the cleaning agent GE with the order number: 83 23 2 357 553 and a lint-free cloth for rough cleaning and a brush for fine cleaning and compressed air.

Completely remove any corrosion from the transmission input shaft (1) with a suitable wire brush.



**Fig. 70: Identifying Input Shaft And Sealing Rings**  
Courtesy of BMW OF NORTH AMERICA, INC.

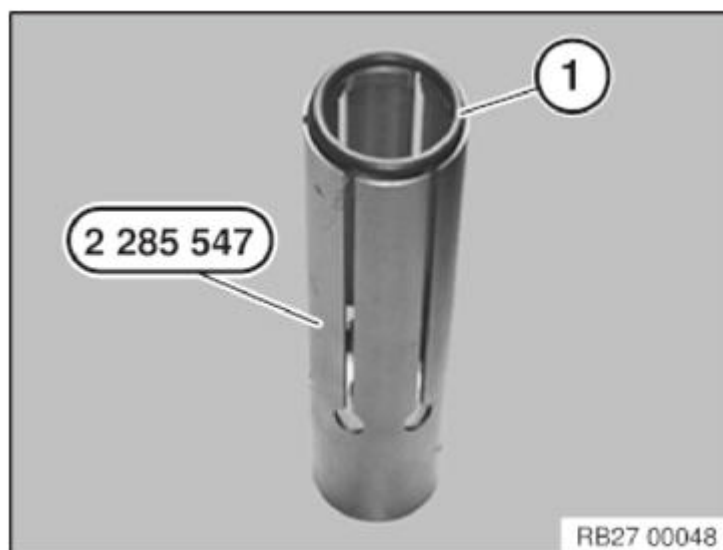
Sealing ring (2) **must** be replaced every time the transmission is removed and installed.

Check the **SEALING RING** for damage and replace as needed. Lightly coat sealing ring (3) all-round with grease GE with the order number: 83 23 2 357 146.

**IMPORTANT:** Failure to observe these instructions will result in serious damage to or premature failure of the e-machine.

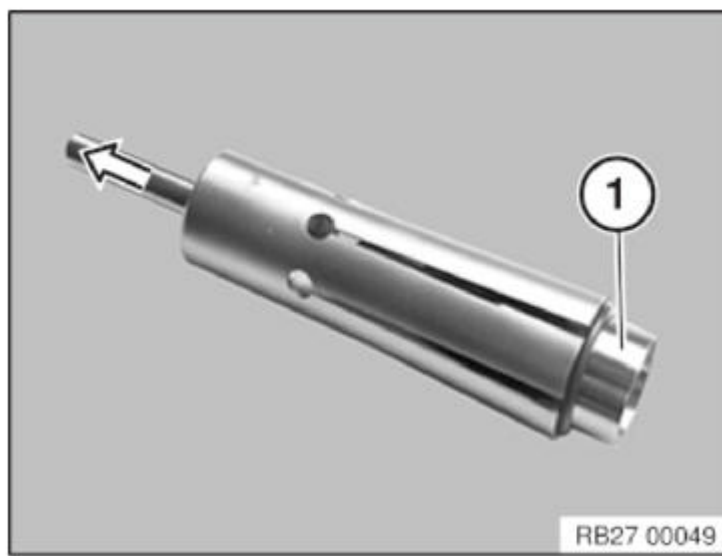
Position sealing ring (1) on special tool **2 285 547**.

**IMPORTANT:** The sealing ring must be lightly coated all-round with grease GE with the order number: 83 23 2 357 146 only in installed condition on the drive shaft.



**Fig. 71: Positioning Sealing Ring On Special Tool (2 285 547)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide in guide sleeve (1) and pry open sealing ring.



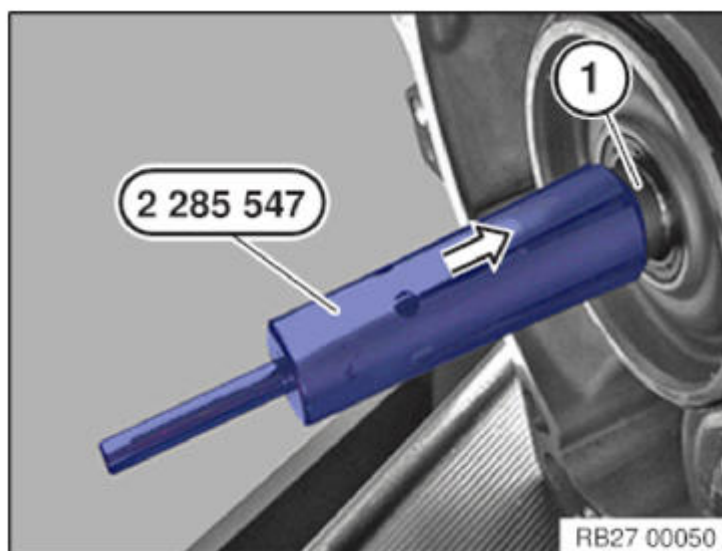
**Fig. 72: Sliding Guide Sleeve**

Courtesy of BMW OF NORTH AMERICA, INC.

Slide special tool [2 285 547](#) onto gearbox drive shaft.

Slip sealing ring (1) off of guide sleeve into guiding groove.

Lightly coat sealing ring all-round with grease GE with the order number: 83 23 2 357 146.



**Fig. 73: Sliding Special Tool (2 285 547) Onto Gearbox Drive Shaft**

Courtesy of BMW OF NORTH AMERICA, INC.

**27 00 070 REPLACING E-TRANSMISSION (VEHICLES WITH RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

IMPORTANT: After completion of work, check [TRANSMISSION OIL LEVEL](#) .  
Use only the approved transmission fluid.

Failure to comply with this instruction will result in serious damage to the transmission.

**Recycling:**

Catch and dispose of escaping transmission oil.



Observe country-specific waste disposal regulations

#### Necessary preliminary tasks:

- Drain transmission oil via oil drain plug, tightening torque: 27 00 13AZ.
- Remove **E-TRANSMISSION**
- Remount sound insulation of E-transmission

*Installation note:*

After the transmission is installed, the parking lock module must be reinitialised.

### **12 35 506 REPLACE ELECTRICAL MACHINE (VEHICLES WITHOUT RANGE EXTENDER)**

#### Special tools required:

- **2 286 332**
- **2 356 947**
- **2 357 269**
- **2 285 545**
- **2 285 547**

#### **WARNING:**

**High-voltage system - danger to life!**

The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.
- Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS**
- The workbay required for the repair of the drive unit must be clean (free of grease, dirt and debris), dry (no leaking fluid) and free of flying sparks. Therefore, avoid close vicinity to areas intended for cleaning of vehicles and to workbays intended for repair work relating to the body.

Use movable walls and high-voltage barrier tapes for separation, if needed.

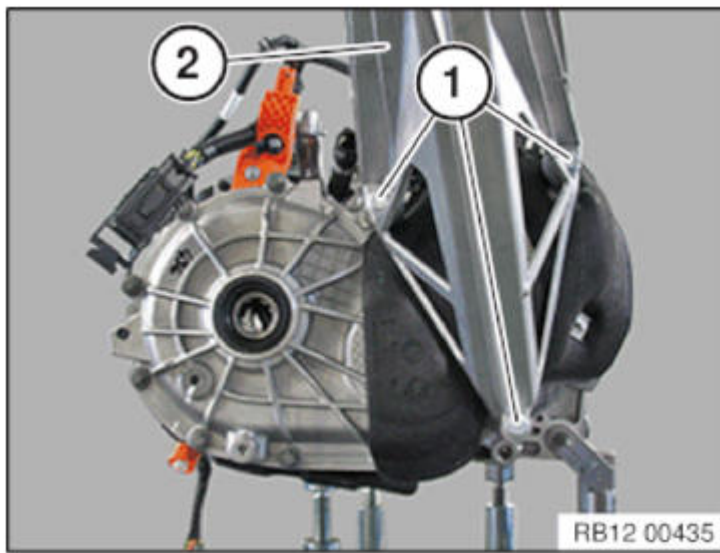
- It is absolutely essential to remove all small parts/screws that fell into the electrical machine.
- Perform a visual inspection for contamination and damage of the housing, connections and gaskets or sealing surfaces of the electrical machine and electrical machine electronics.

#### Necessary preliminary tasks:

Remove **ELECTRICAL MACHINE ELECTRONICS**.

#### Removal:

Release screws (1) and remove transmission mounting bracket (2).

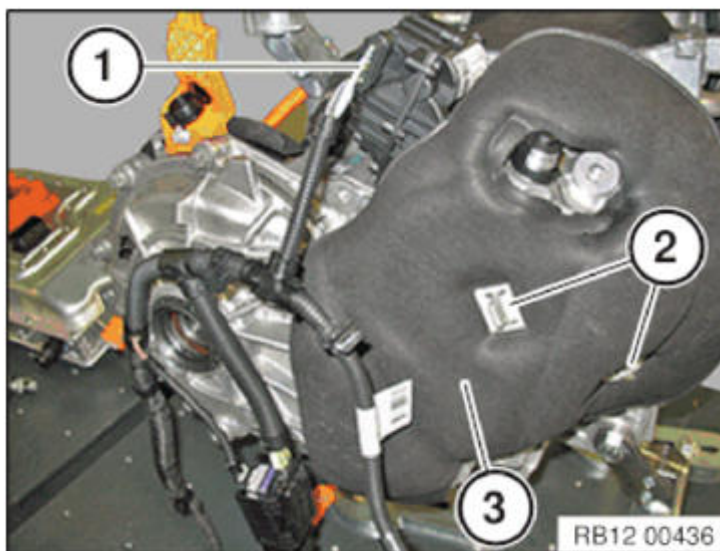


**Fig. 74: Identifying Transmission Mounting Bracket With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1) at parking lock and remove wiring harness.

Pry off clamps (2) of sound insulation (3).

Remove sound insulation (3).

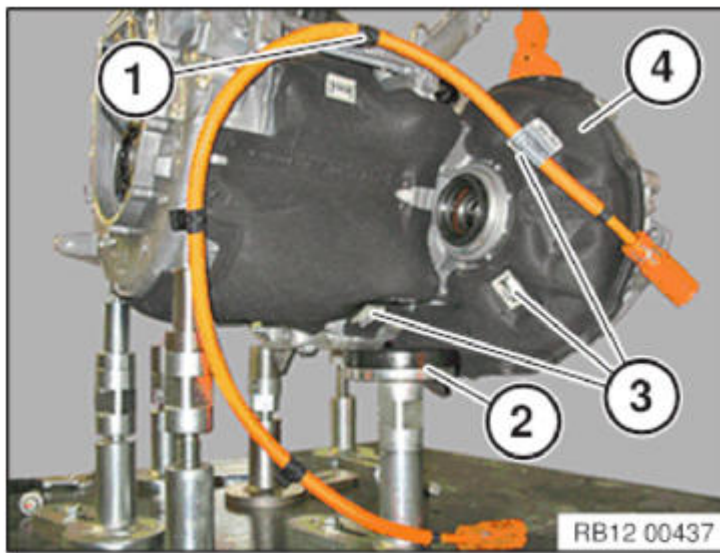


**Fig. 75: Identifying Parking Lock Plug Connection, Clamps And Sound Insulation**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach high-voltage cable at attachment point (1) and remove.

**NOTE:** For better accessibility, turn back support plate (2) temporarily. Support plate (2) must be positioned back on the electrical machine after this operation.





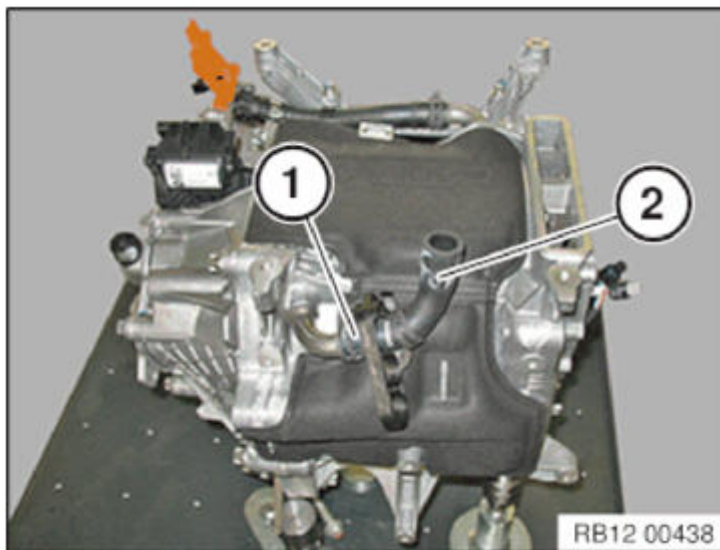
**Fig. 76: Identifying Support Plate, Clamps, Sound Insulation And High-Voltage Cable Attachment Point**

**Courtesy of BMW OF NORTH AMERICA, INC.**

Take clamps (3) off of sound insulation (4).

Remove sound insulation (4).

Open clamp (1) and pull off coolant hose (2).



**Fig. 77: Identifying Coolant Hose And Clamp**

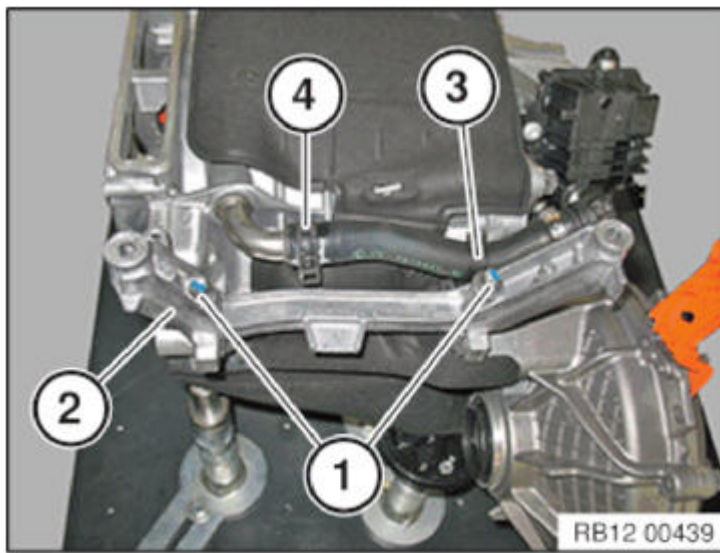
**Courtesy of BMW OF NORTH AMERICA, INC.**

Release screws (1) and remove support (2).

Detach coolant hose from clamp (3).

Open clamp (4) and pull off coolant hose.

Lever out clamp (3) and remove.

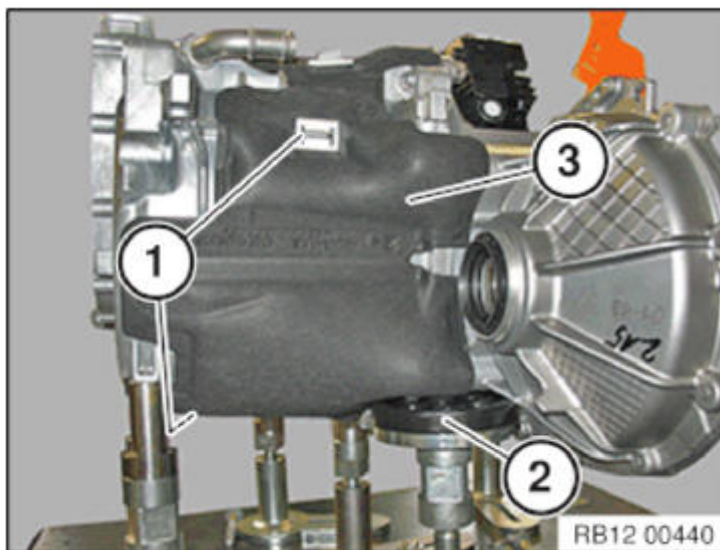


**Fig. 78: Identifying Coolant Hose Clamps, Screws And Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** For better accessibility, turn back support plate (2) temporarily. Support plate (2) must be positioned back on the electrical machine after this operation.

Pry off clamps (1) of sound insulation (3).

Feed out and remove sound insulation (3).

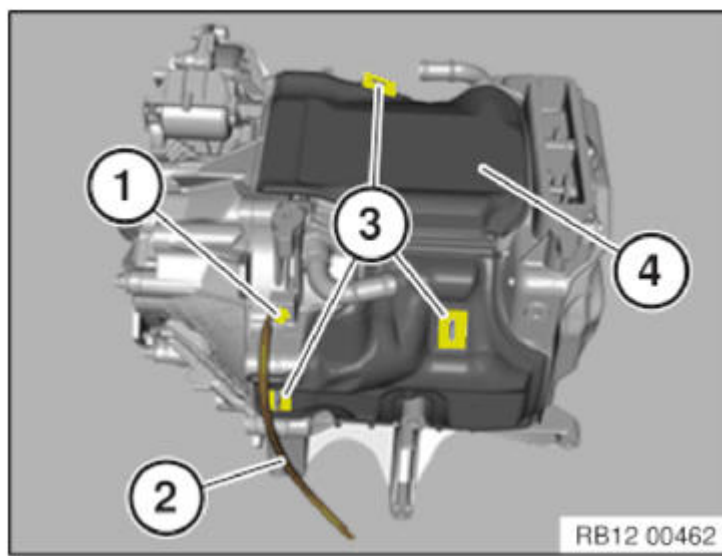


**Fig. 79: Identifying Sound Insulation, Support Plate And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) from equipotential bonding line (2).

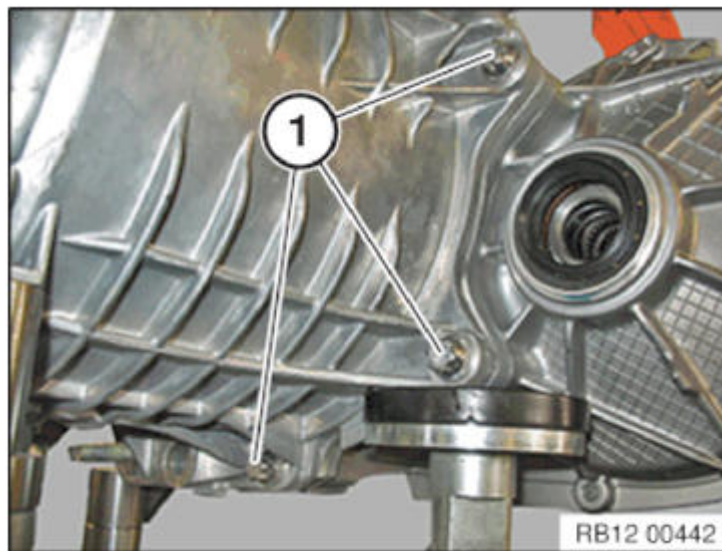
Pry off clamps (3) of sound insulation (4).

Remove sound insulation (4).



**Fig. 80: Identifying Equipotential Bonding Line, Clamps And Sound Insulation**  
 Courtesy of BMW OF NORTH AMERICA, INC.

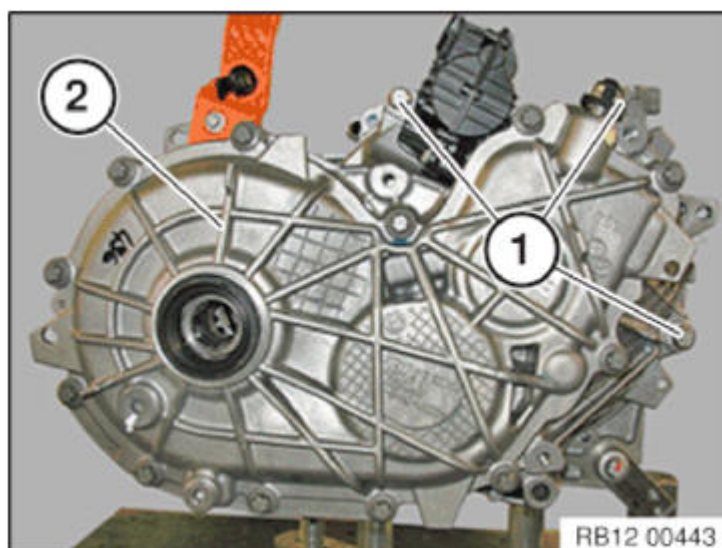
Release rear screws (1) from transmission.

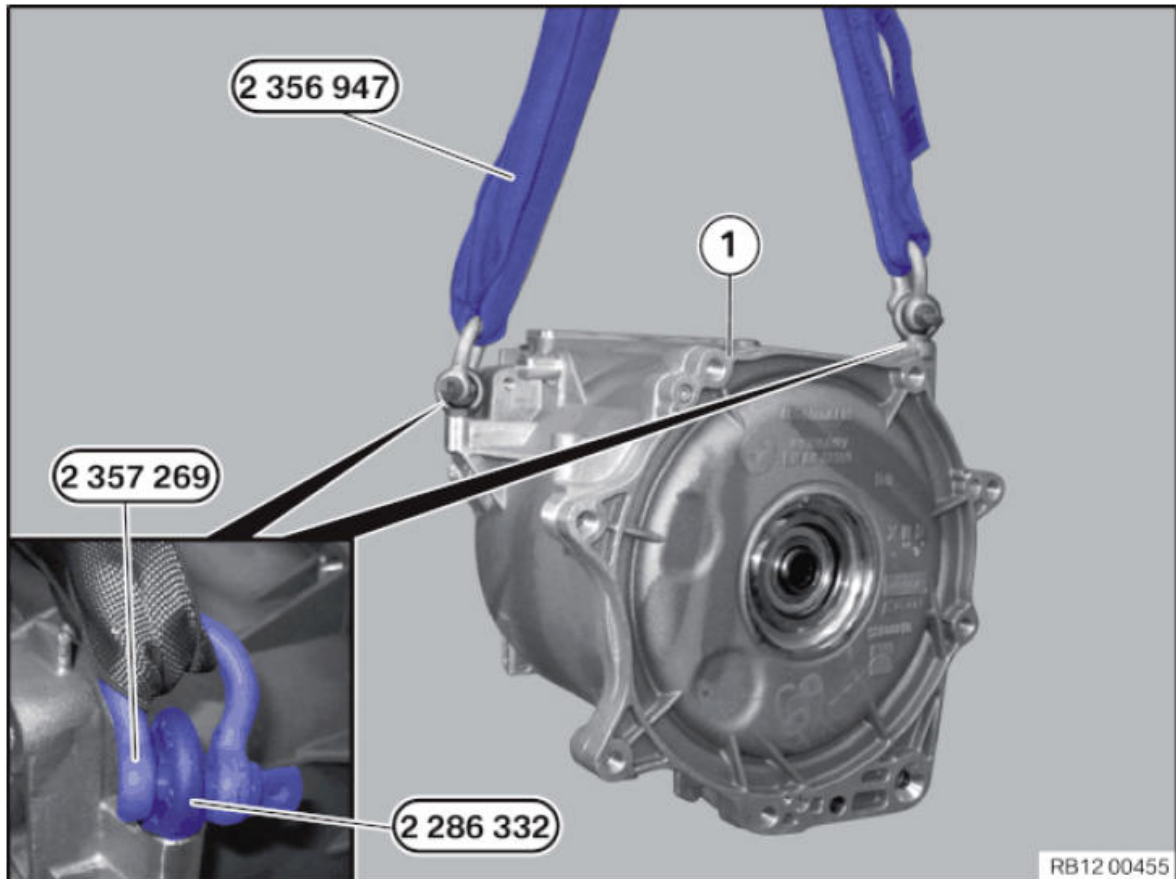


**Fig. 81: Identifying Transmission Rear Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release front screws (1) on transmission (2).

Remove transmission (2) carefully by pulling off forward.





**Fig. 83: Screwing Special Tools (2 286 332) Into Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tools [2 286 332](#) all the way into electrical machine (1).

Secure special tool [2 356 947](#) with special tool [2 357 269](#) at special tool [2 286 332](#) .

Release screw connection of table lift support on electrical machine (1).

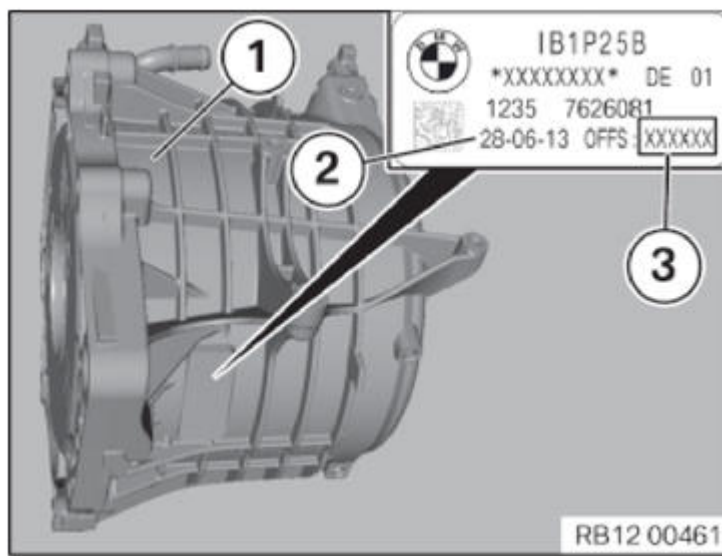
Position new electrical machine (1) on table lift with workshop crane and secure with table lift support.

**Installation:**

Read adaptation value of rotor position sensor (3) from type plate (2) of new electrical machine (1).  
Type plate (2) is located on the underside of the electrical machine (1).

The new adaptation value of the rotor position sensor (3) must be read in via the diagnosis system when the rotor position sensor is adjusted.



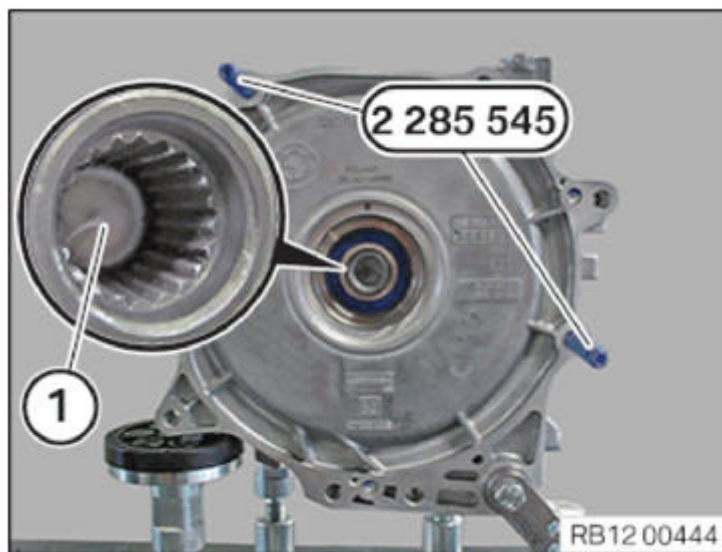


**Fig. 84: Identifying Electrical Machine, Type Plate And Rotor Position Sensor Adaptation Value**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Cleaning:**

The hub base of the rotor shaft (1) and the transmission input shaft must be completely  
**IMPORTANT:** freed of existing grease without fail.

Only cleaning agent GE (part number 83 23 2 357 553) may be used for cleaning.



**Fig. 85: Identifying Rotor Shaft And Special Tool (2 285 545)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Remove grease from the hub of the rotor shaft (1) with a lint-free cloth.

Place solvent cleaner in the hub of rotor shaft (1). Drag grease with light brush strokes from inside to outside.

Carefully blow out grease residue with compressed air. Collect grease residue with a lint-free cloth.

**Re-lubrication:**

Grease GE (part number 83 23 2 357 146) must be used for lubrication.

**IMPORTANT:** Maximum grease quantity of 4 g must not be exceeded. Any old grease residue must be completely removed before lubrication.

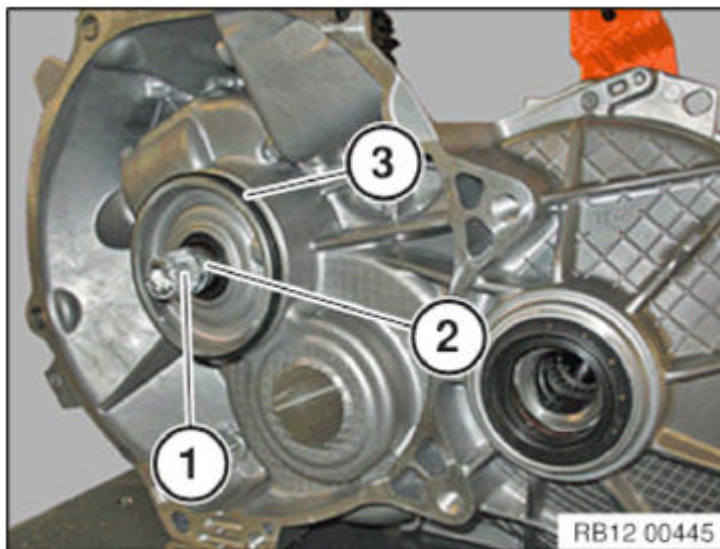
The full grease quantity (4 g) must be applied to the hub base of rotor shaft (1). The gearing must not be greased. When the transmission is joined with the electrical machine, the grease is distributed uniformly on the connection.

### Installing the special tool:

Screw special tools [2 285 545](#) into electrical machine. Transmission must be assembled with electrical machine using special tools [2 285 545](#) .

**IMPORTANT:** Only cleaning agent GE (part number 83 23 2 357 553) may be used for cleaning. All existing grease must be removed entirely.

Clean transmission input shaft (1) with a lint-free cloth.



**Fig. 86: Identifying Input Shaft And Sealing Rings**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply cleaning agent and remove grease residue with compressed air and a lint-free cloth.

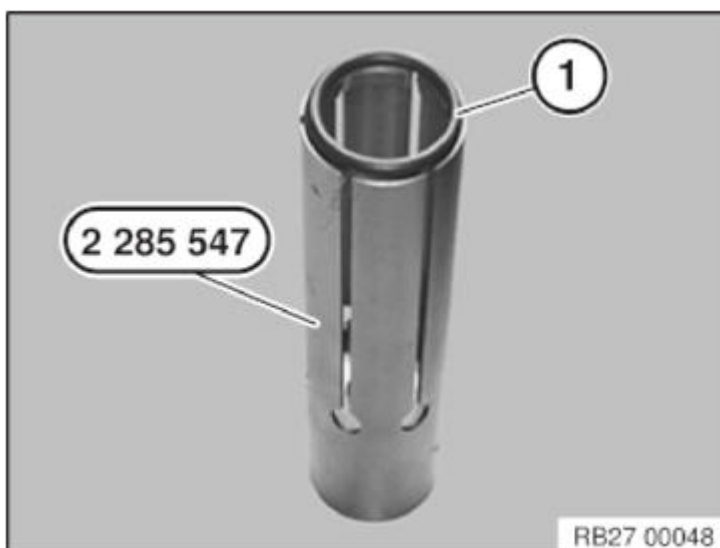
Completely remove any corrosion from the transmission input shaft (1) with a suitable wire brush.

Sealing ring (2) must be replaced every time the transmission is removed and installed.

Check sealing ring (3) for damage. **REPLACE SEALING RING, IF NECESSARY** . Apply light coating of grease GE all round on the outside of sealing ring (3).

Position sealing ring (1) on special tool [2 285 547](#) .

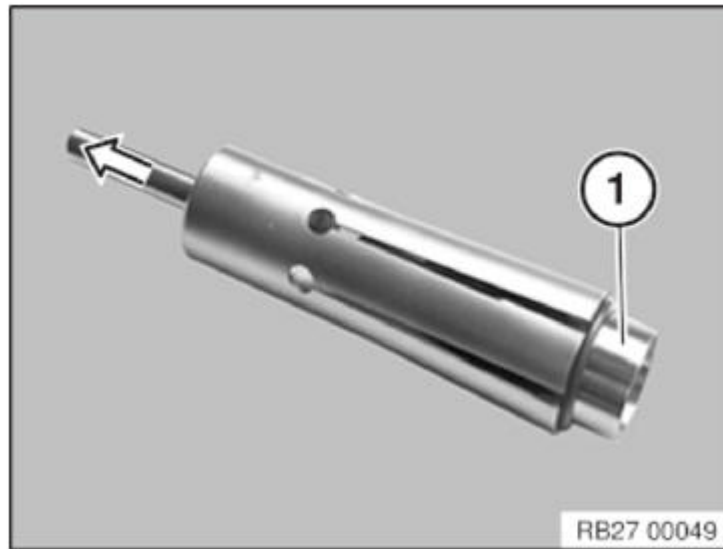
**IMPORTANT:** The sealing ring (1) may be coated lightly all-round with grease GE only in installed condition on the drive shaft.





**Fig. 87: Positioning Sealing Ring On Special Tool (2 285 547).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide in guide sleeve (1) and pry open sealing ring.



**Fig. 88: Sliding Guide Sleeve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide special tool [2 285 547](#) onto transmission input shaft.

Slip sealing ring (1) off of guide sleeve into guiding groove.

Apply light coating of grease GE all round on sealing ring (1).



**Fig. 89: Sliding Special Tool (2 285 547) Onto Gearbox Drive Shaft**  
Courtesy of BMW OF NORTH AMERICA, INC.

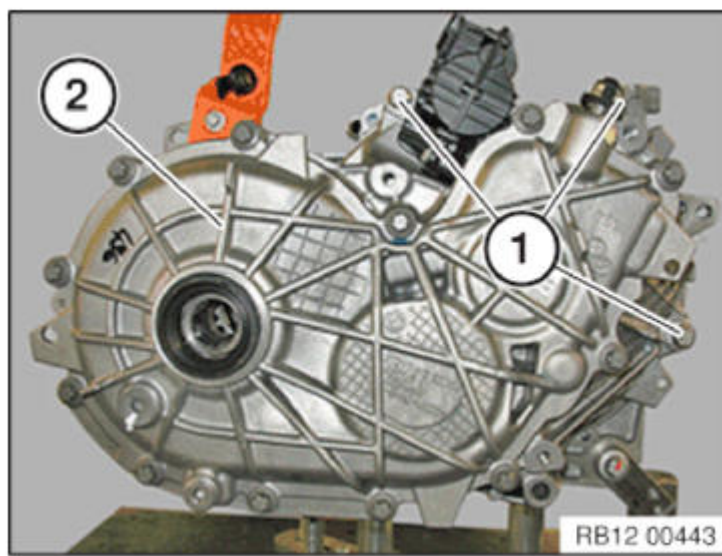
Mount transmission (2) carefully.

Tighten front screws (1) on transmission (2).

*Installation note:*

Renew screws (1).

Tightening torque [27 00 1AZ](#) .



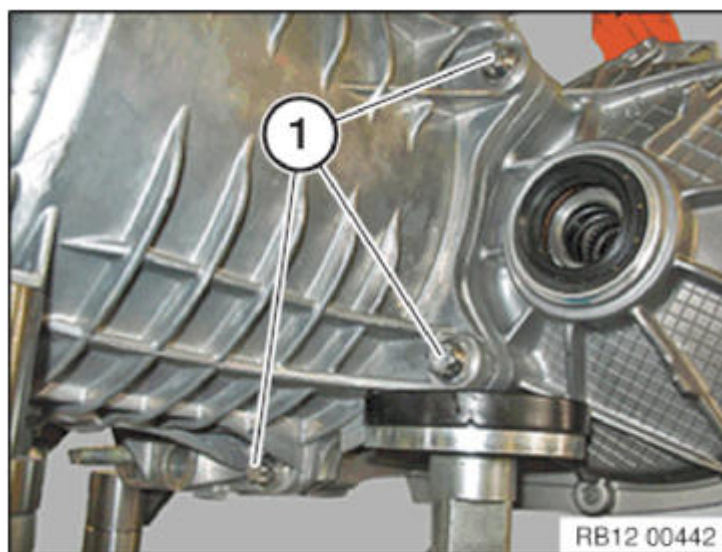
**Fig. 90: Identifying Transmission Front Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Tighten rear screws (1) on transmission.

*Installation note:*

Renew screws (1).

Tightening torque **27 00 1AZ** .



**Fig. 91: Identifying Transmission Rear Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

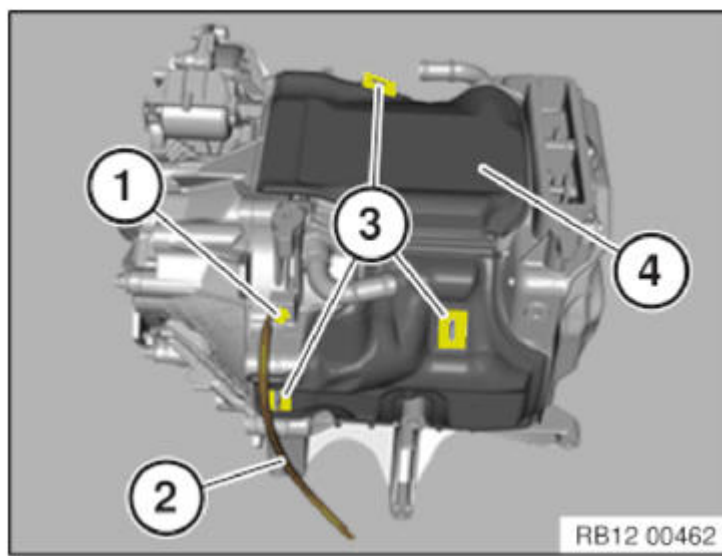
Position sound insulation (4).

Connect clamps (3) on sound insulation (4).

IMPORTANT: Replace clamps (3).

Tighten equipotential bonding line (2) with screw (1).

IMPORTANT: Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS !**  
 Tightening torque **12 35 5AZ** .

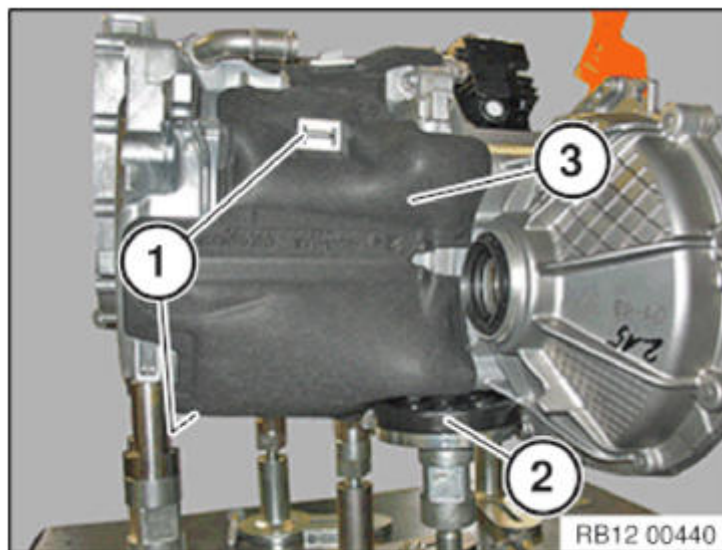


**Fig. 92: Identifying Equipotential Bonding Line, Clamps And Sound Insulation**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** For better accessibility, turn back support plate (2) temporarily. Support plate (2) must be positioned back on the electrical machine after this operation.

Feed in and position sound insulation (3).

Connect clamps (1) on sound insulation (3).



**Fig. 93: Identifying Sound Insulation, Support Plate And Clamps**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Replace clamps (1).

Mount clamp (3).

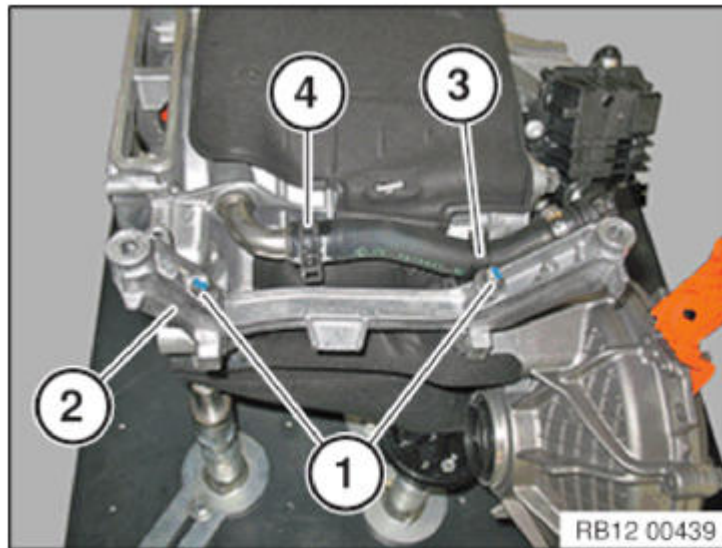
IMPORTANT: Tabs of clamp (3) must be positioned on the side. When positioned at the top, collision occurs with the electrical machine electronics.

Connect coolant hose and close clamp (4).

Attach coolant hose in clamp (3).

Tighten support (2) with screw (1).

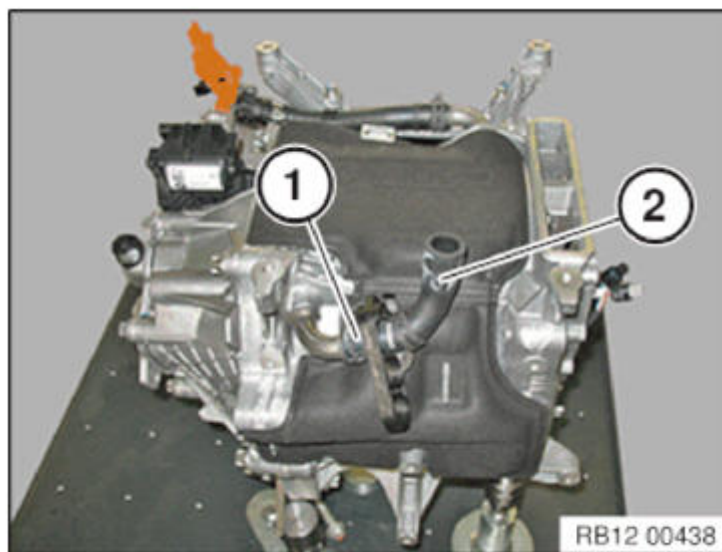
IMPORTANT: Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS !**



**Fig. 94: Identifying Coolant Hose Clamps, Screws And Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect coolant hose (2) and close clamp (1).

**NOTE:** Make sure coolant hose (2) is correctly positioned. Opening of coolant hose (2) must face up.



**Fig. 95: Identifying Coolant Hose And Clamp**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** For better accessibility, turn back support plate (2) temporarily. Support plate (2) must be positioned back on the electrical machine after this operation.

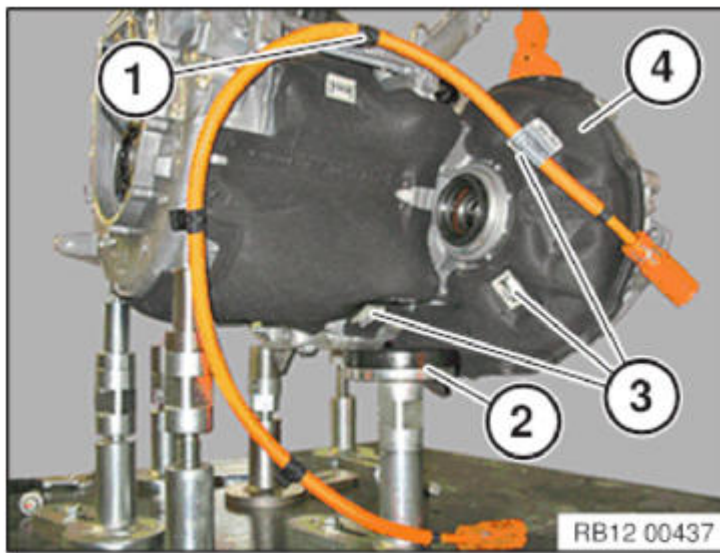
Position sound insulation (4).

Connect clamps (3) on sound insulation (4).

IMPORTANT: Replace clamps (3).

Attach high-voltage cable to attachment point (1).





**Fig. 96: Identifying Support Plate, Clamps, Sound Insulation And High-Voltage Cable Attachment Point**

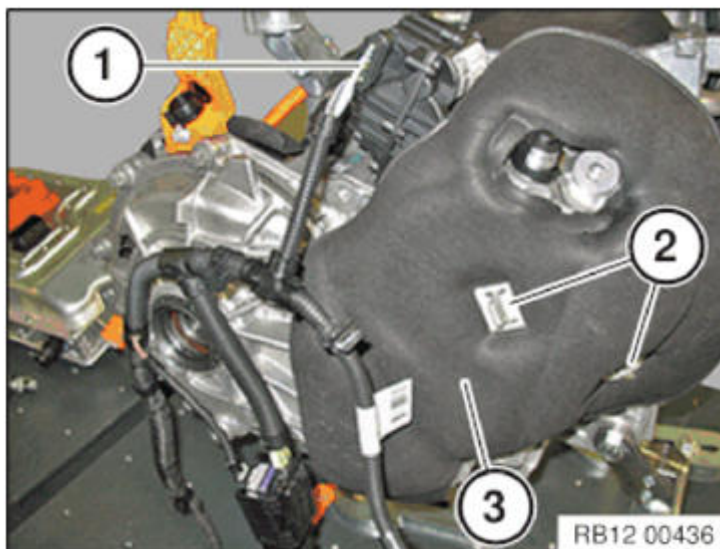
Courtesy of BMW OF NORTH AMERICA, INC.

Position sound insulation (3).

Connect clamps (2) on sound insulation (3).

IMPORTANT: Replace clamps (2).

Attach plug connection (1) on parking lock and lock.



**Fig. 97: Identifying Parking Lock Plug Connection, Clamps And Sound Insulation**

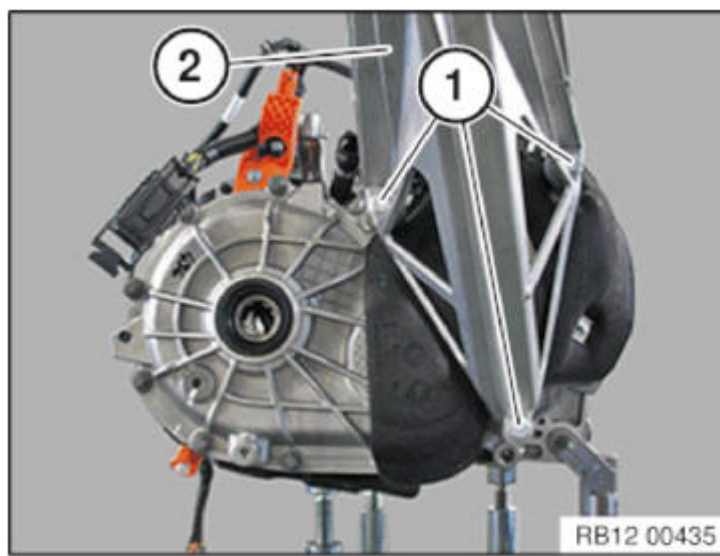
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws (1) on transmission mounting bracket (2).

*Installation note:*

Renew screws.

Tightening torque **27 00 3AZ** .



**Fig. 98: Identifying Transmission Mounting Bracket With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

**Connect BMW diagnosis system:**

1. Service functions
2. Power train
3. Electrical machine electronics
4. Motor position sensor adjustment

## **12 35 506 REPLACING ELECTRICAL MACHINE (VEHICLES WITH RANGE EXTENDER)**

**Special tools required:**

- [2 286 332](#)
- [2 356 947](#)
- [2 357 269](#)
- [2 285 545](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.
- Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS** .
- The workbay required for the repair of the drive unit must be clean (free of grease, dirt and debris), dry (no leaking fluid) and free of flying sparks. Therefore, avoid close vicinity to areas intended for cleaning of vehicles and to workbays intended for repair work relating to the body.

Use movable walls and high-voltage barrier tapes for separation, if needed.

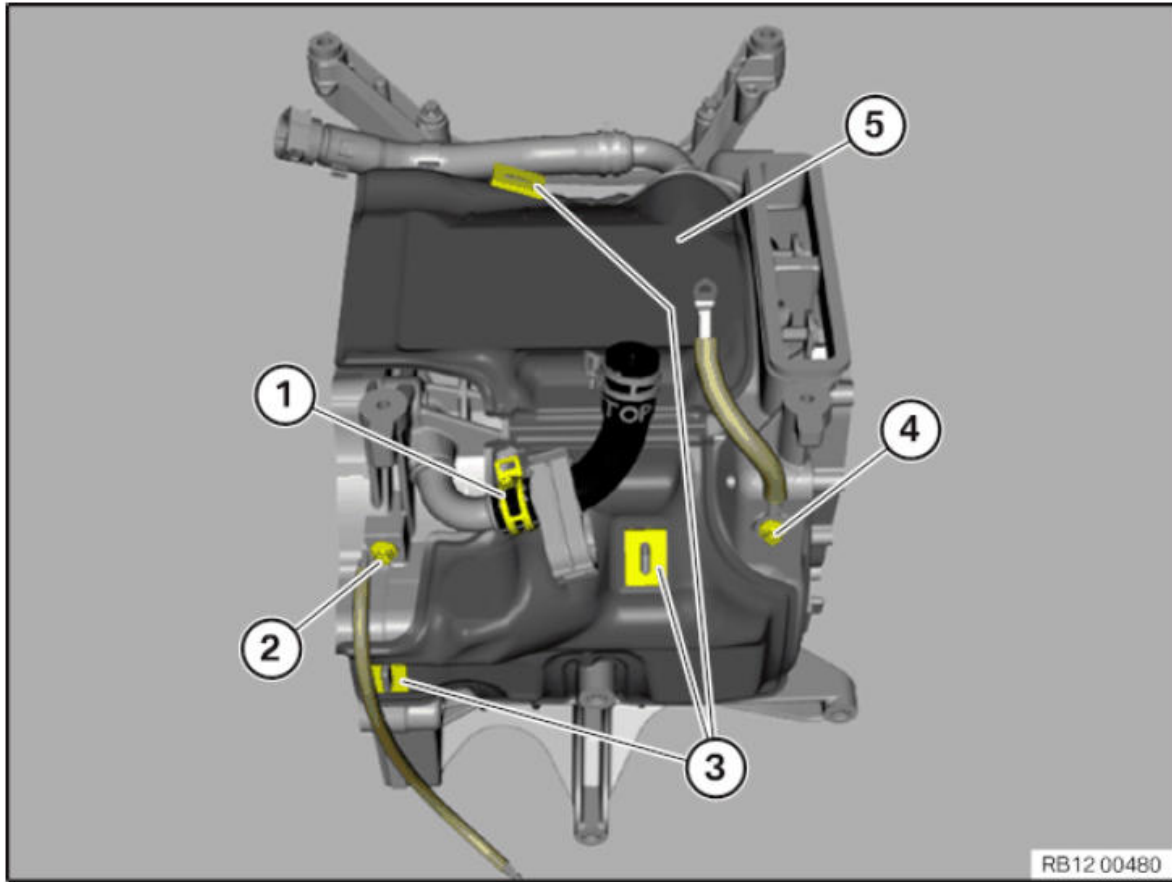
- It is absolutely essential to remove all small parts/screws that fell into the electrical machine.
- Perform a visual inspection for contamination and damage of the housing, connections and gaskets or sealing surfaces of the electrical machine and electrical machine electronics.



**Necessary preliminary tasks:**

- Remove [ELECTRICAL MACHINE ELECTRONICS](#).
- Remove [E-TRANSMISSION](#).

**Removal:**



**Fig. 99: Identifying Sound Insulation, Clamps And Screws**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Open clamp (1) and detach coolant hose.

Release screw (1) from equipotential bonding line.

Pry off clamps (3) of sound insulation (5).

Remove sound insulation (5).

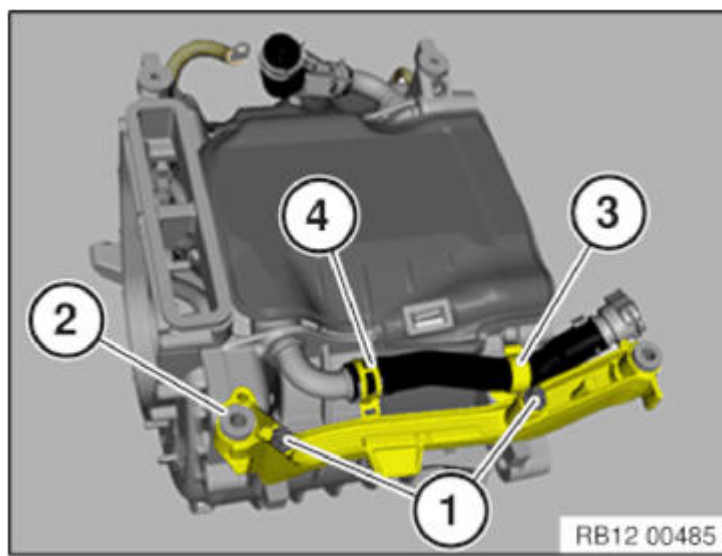
Release screw (4) from equipotential bonding line.

Release screws (1) and remove support (2).

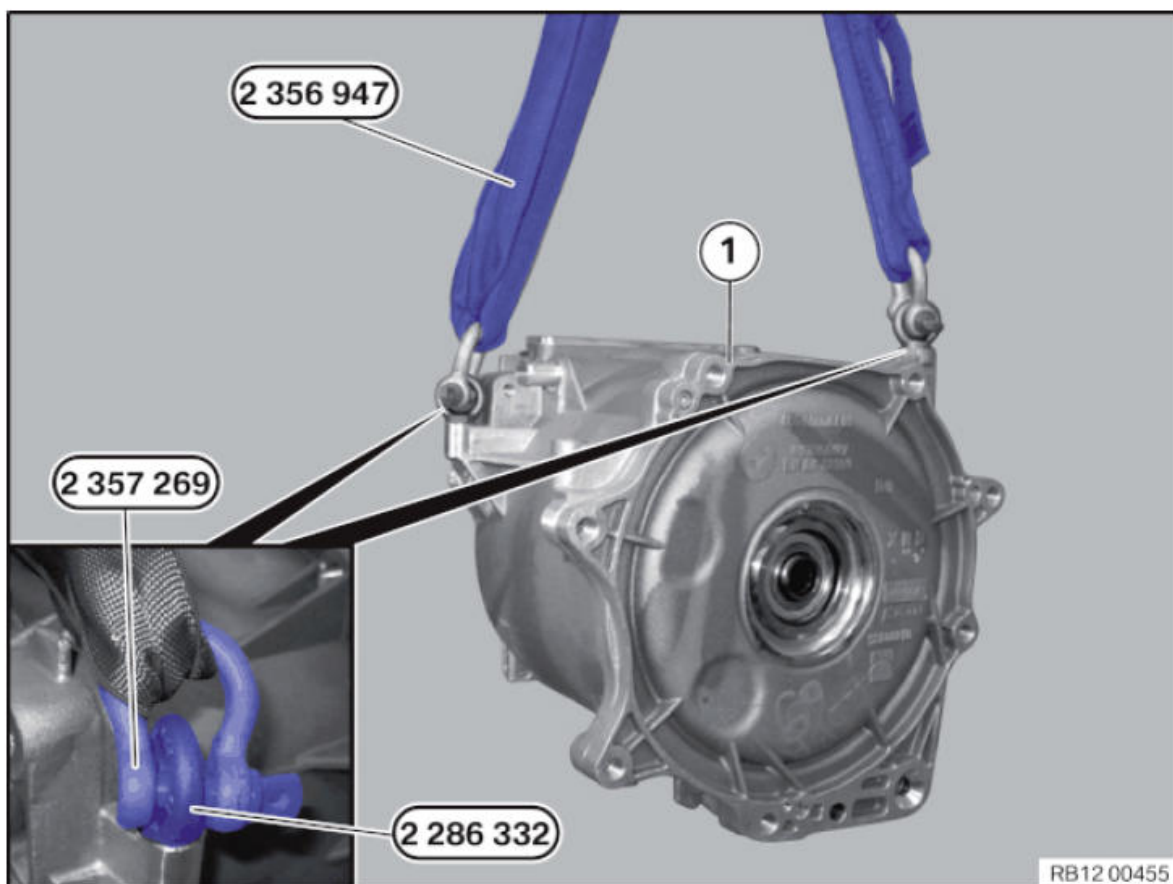
Detach coolant hose from clamp (3).

Open clamp (4) and pull off coolant hose.

Lever out clamp (3) and remove.



**Fig. 100: Identifying Coolant Hose Clamps, Support And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 101: Screwing Special Tools (2 286 332) Into Electrical Machine**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tools [2 286 332](#) all the way into electrical machine (1).

Secure special tool [2 356 947](#) with special tool [2 357 269](#) at special tool [2 286 332](#) .

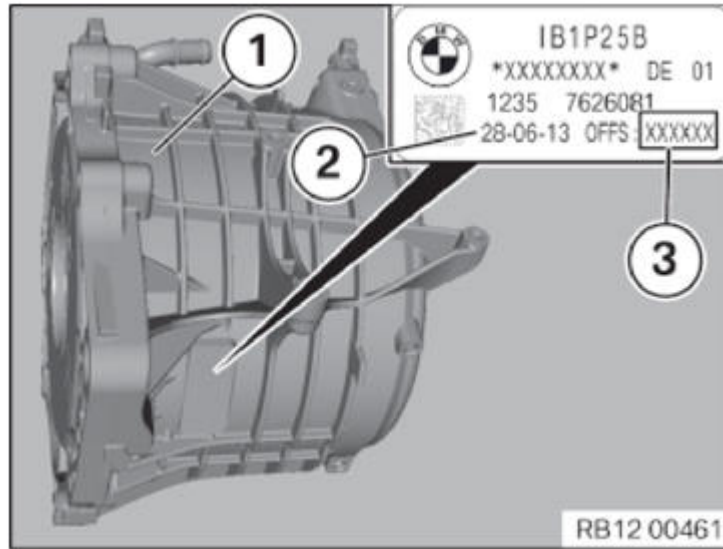
Release screw connection of table lift support on electrical machine (1).

Position new electrical machine (1) on table lift with workshop crane and secure with table lift support.

**Installation:**

Read adaptation value of rotor position sensor (3) from type plate (2) of new electrical machine (1).  
 Type plate (2) is located on the underside of the electrical machine (1).

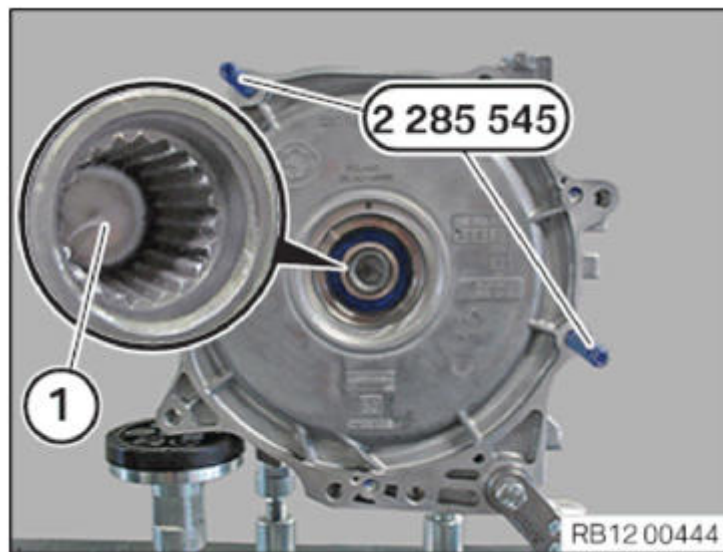
The new adaptation value of the rotor position sensor (3) must be read in via the diagnosis system when the rotor position sensor is adjusted.



**Fig. 102: Identifying Electrical Machine, Type Plate And Rotor Position Sensor Adaptation Value**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Grease GE (part number 83 23 2 357 146) must be used for lubrication.

The full grease quantity (4 g) must be applied to the hub base of rotor shaft (1). The gearing must not be greased. When the transmission is joined with the electrical machine, the grease is distributed uniformly on the connection.



**Fig. 103: Identifying Rotor Shaft And Special Tool (2 285 545)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tools [2 285 545](#) into electrical machine. Transmission must be assembled with electrical machine using special tools [2 285 545](#).

Connect coolant hose and close clamp (4).

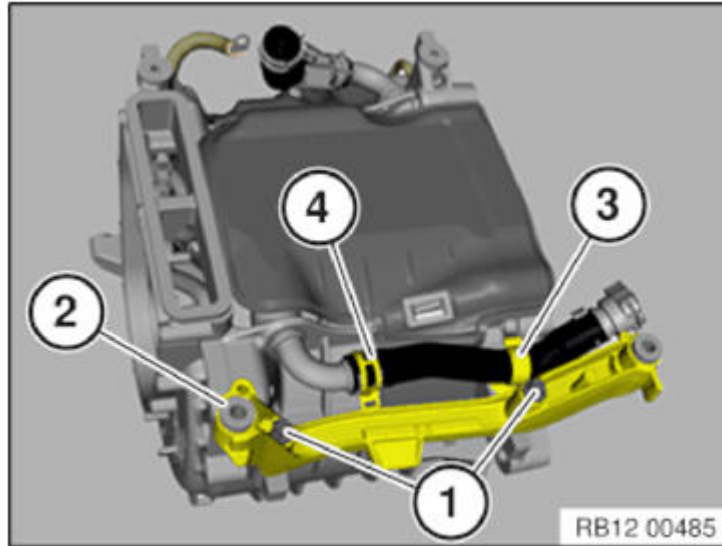
**IMPORTANT:** Tabs of clamp (4) must be positioned on the side. When positioned at the top, collision occurs with the electrical machine electronics.

Mount clamp (3).

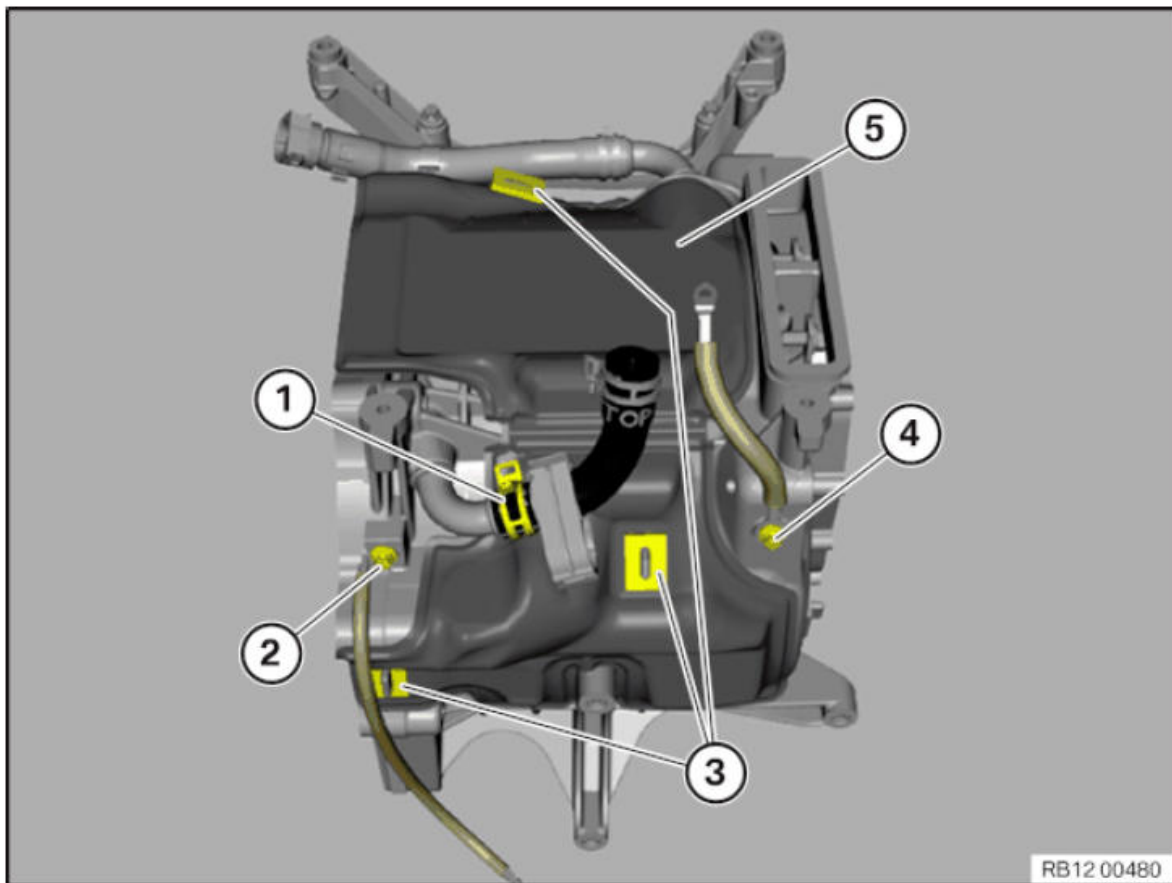
Attach coolant hose in clamp (3).

Tighten support (2) with screw (1).

IMPORTANT: Observe NOTES ON EARTH BONDING SCREW CONNECTIONS !  
Tightening torque 12 35 4AZ .



**Fig. 104: Identifying Coolant Hose Clamps, Support And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 105: Identifying Sound Insulation, Clamps And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position sound insulation (5).

Connect clamps (3) of sound insulation (5).

IMPORTANT: Replace clamps (3).

Connect coolant hose and close clamp (1).

**NOTE:** Make sure coolant hose is correctly positioned. Opening of coolant hose must face up.

Tighten equipotential bonding line with screw (2).

IMPORTANT: Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) !

Tightening torque [12 35 5AZ](#) .

Tighten equipotential bonding line with screw (4).

IMPORTANT: Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) !

Tightening torque [12 35 5AZ](#) .

### Required follow-up work:

#### Connect BMW diagnosis system:

1. Service functions
2. Power train
3. Electrical machine electronics
4. Motor position sensor adjustment

## 12 35 015 REPLACING THE RANGE EXTENDER ELECTRICAL MACHINE (W20)

### Special tools required:

- [2 285 548](#)
- [2 286 315](#)

### Necessary preliminary tasks:

- Mount [ENGINE ON ASSEMBLY STAND](#) .

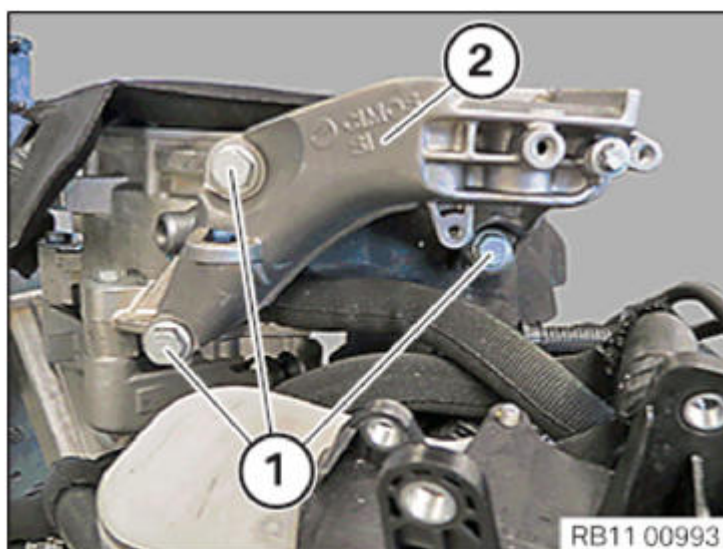
#### *Installation note:*

Once disassembled, a torsion splined shaft must not be reused.

Reset adaptation values after replacing the torsion splined shaft.

Risk of damage to engine and range extender electrical machine during operation.

Release screws (1) and take off engine support arm (2).

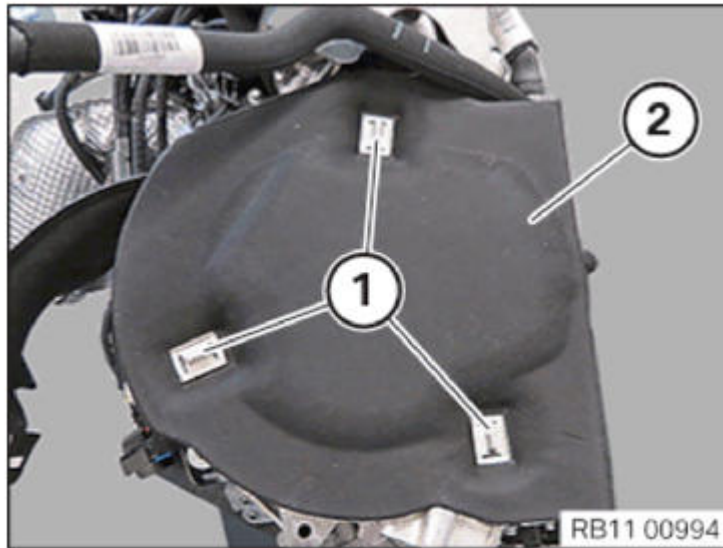


**Fig. 106: Identifying Engine Support Arm With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



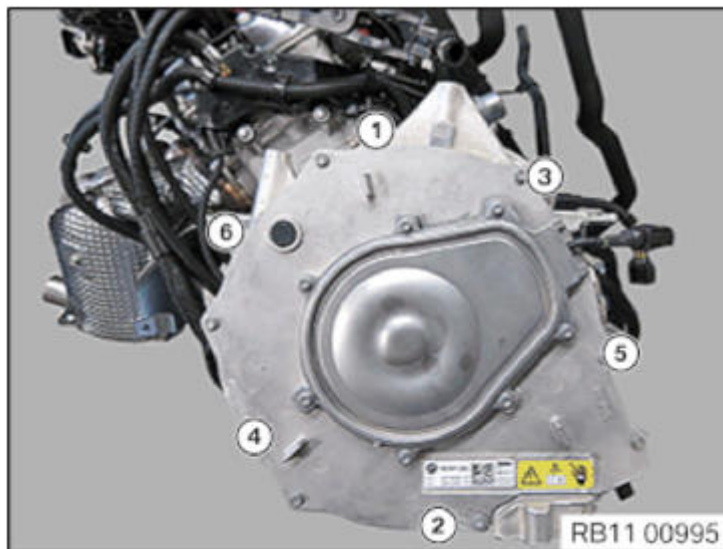
Lever out holding clamps (1).

Remove sound insulation (2).



**Fig. 107: Identifying Sound Insulation And Holding Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws in sequence (1 to 6).



**Fig. 108: Torsion Splined Shaft Screws Tightening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tool [2 285 548](#) in bolting points (1, 4 and 5).

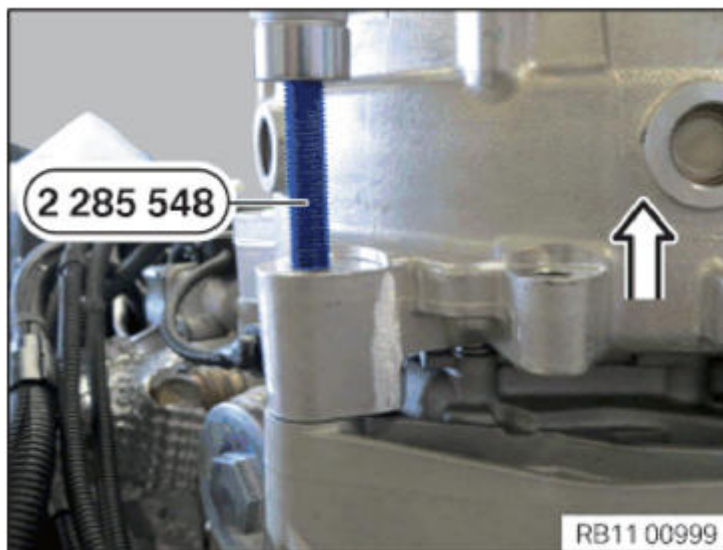




**Fig. 109: Screwing Special Tool (2 285 548) Into Bolting Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

To extract the range extender electrical machine, screw the special tool [2 285 548](#) into bolting points (1, 4 and 5).

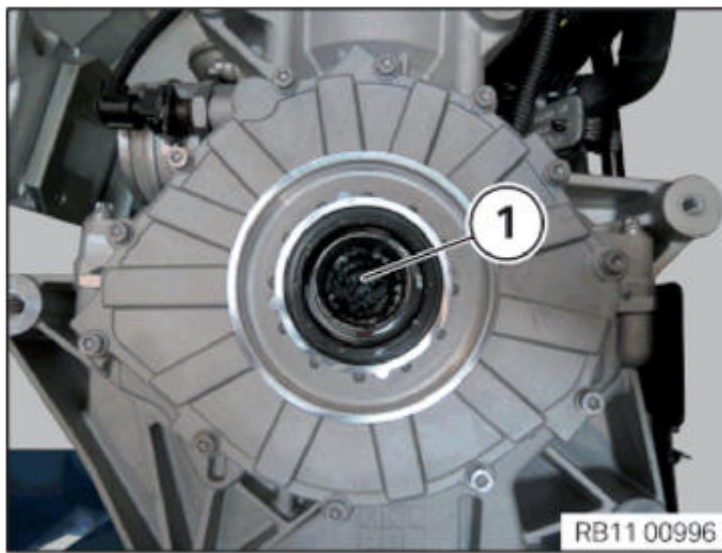
Uniformly pull off range extender electrical machine in 360°, steps until the torsion splined shaft releases.



**Fig. 110: Pulling Off Range Extender Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check crankshafts and generator gearing for damage and if necessary clean metal residues (debris) on the tooth flanks.

Replace [RADIAL SHAFT SEAL](#) .



**Fig. 111: Identifying Radial Shaft Seal**  
Courtesy of BMW OF NORTH AMERICA, INC.

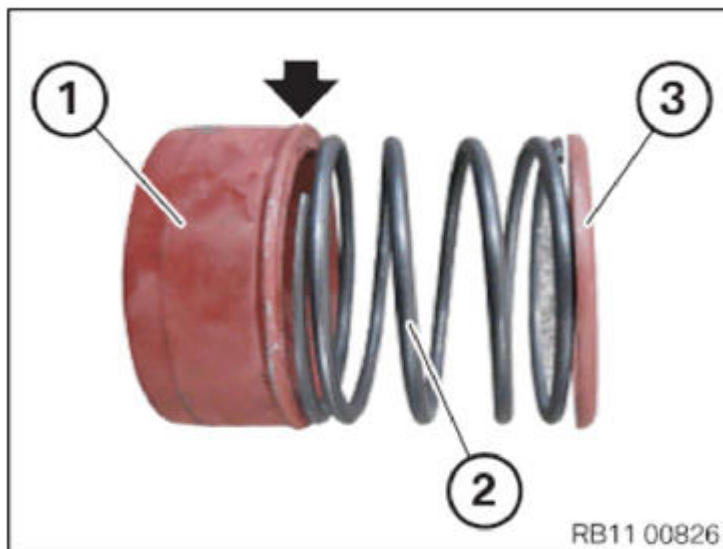
Sealing sleeve (1) with clamping ring

Length compensation spring (2)

Valve seat insert (3)

*Installation note:*

Always renew sealing sleeve (1) and valve seat insert (3).

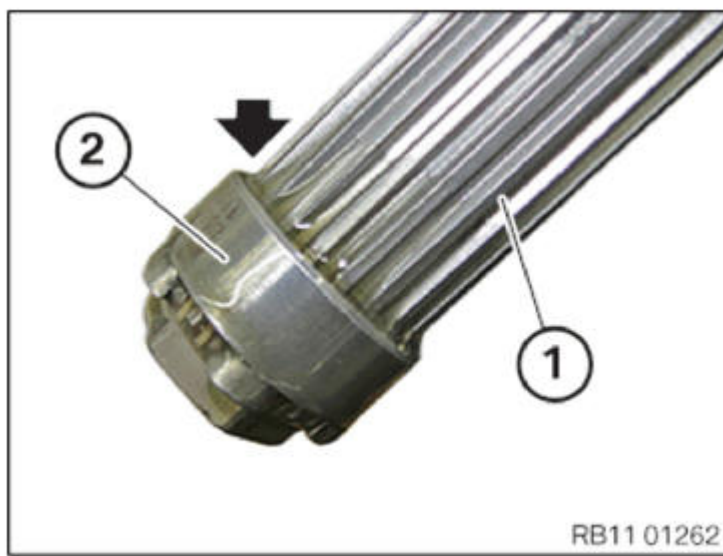


**Fig. 112: Locating Sealing Sleeve**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

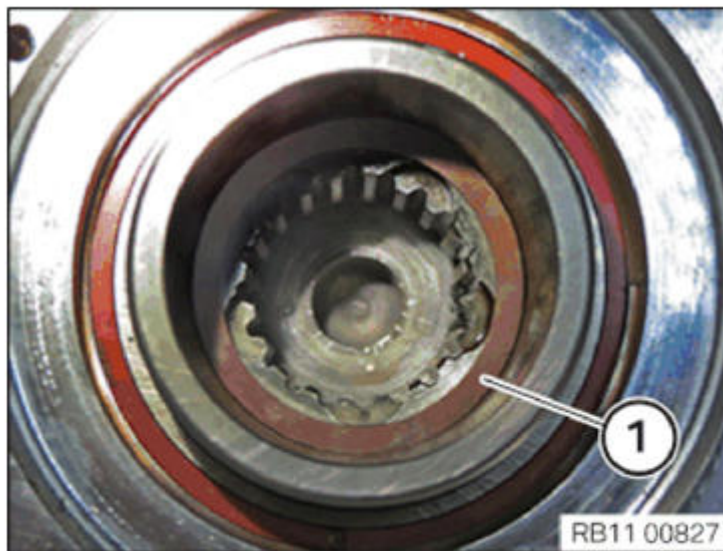
Replace torsion splined shaft (1).

Coat torsion splined shaft (1) at both ends (2) with sufficient engine oil.



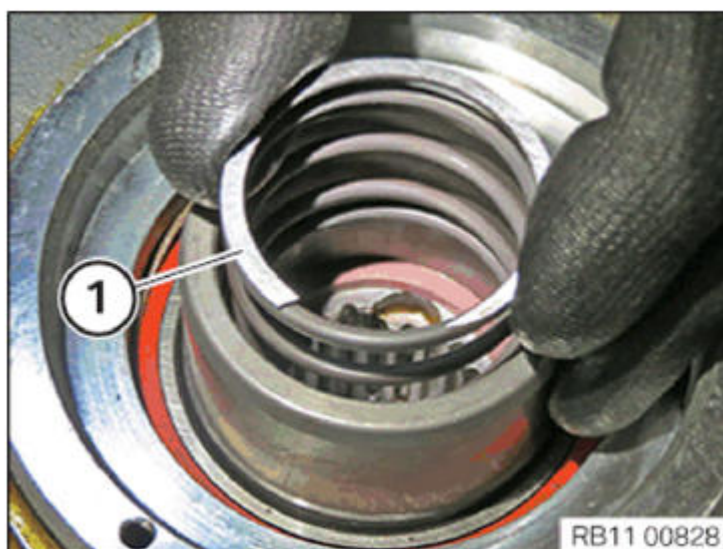
**Fig. 113: Locating Torsion Splined Shaft End**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert valve seat insert (1) in the alternator with the rounded area downwards.



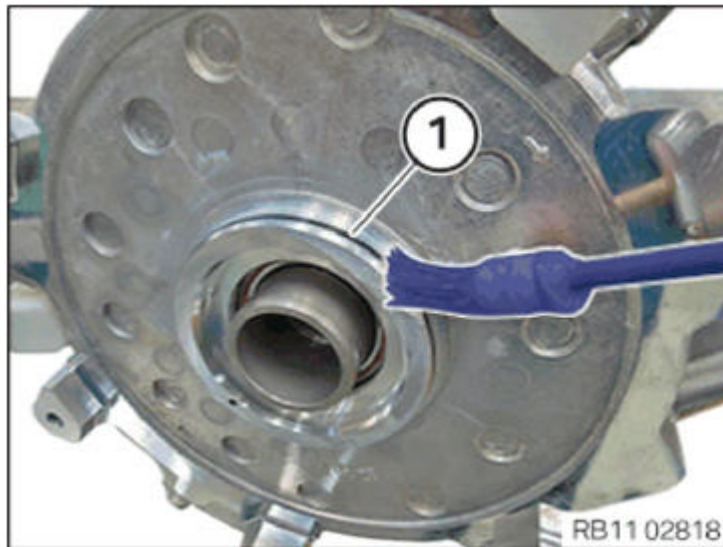
**Fig. 114: Identifying Valve Seat Insert**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert length compensation spring (1).



**Fig. 115: Inserting Length Compensation Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

Grease the O-ring on the alternator (1) with **4.9 GREASE**.

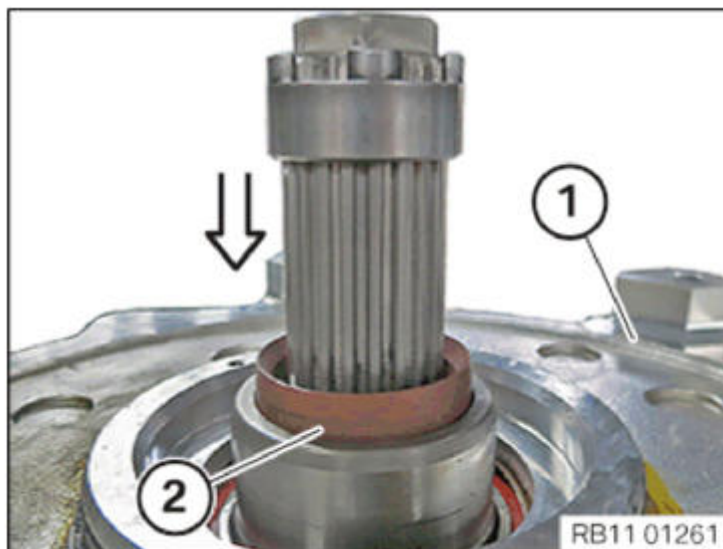


**Fig. 116: Greasing O-Ring On Alternator**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push sealing sleeve (2) and clamping ring down in the alternator (1).

Insert torsion splined shaft in direction of arrow.

During joining, position in such a way that the 5 crowns of the clamping sleeve match the 5 alternator shaft pockets.



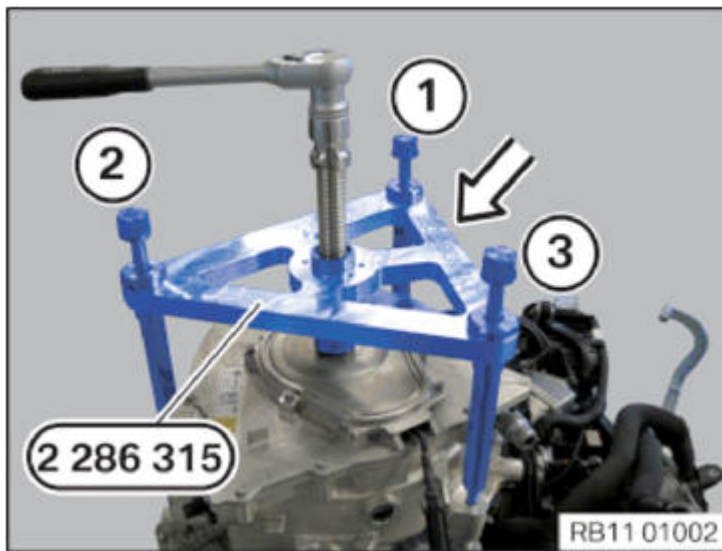
**Fig. 117: Pushing Sealing Sleeve And Clamping Ring Down In Alternator**  
Courtesy of BMW OF NORTH AMERICA, INC.

Mount range extender electrical machine and torsion splined shaft.

Position the range extender electrical machine during joining in such a way that the 5 crowns of the clamping sleeve match the 5 crankshaft pockets.

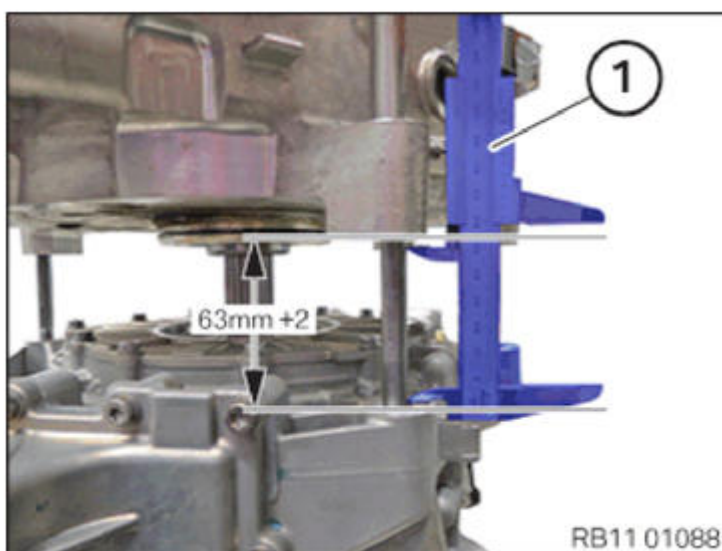
Align special tool **2 286 315** with notch on housing facing cylinder head and screw in at crankcase until hand-tight.





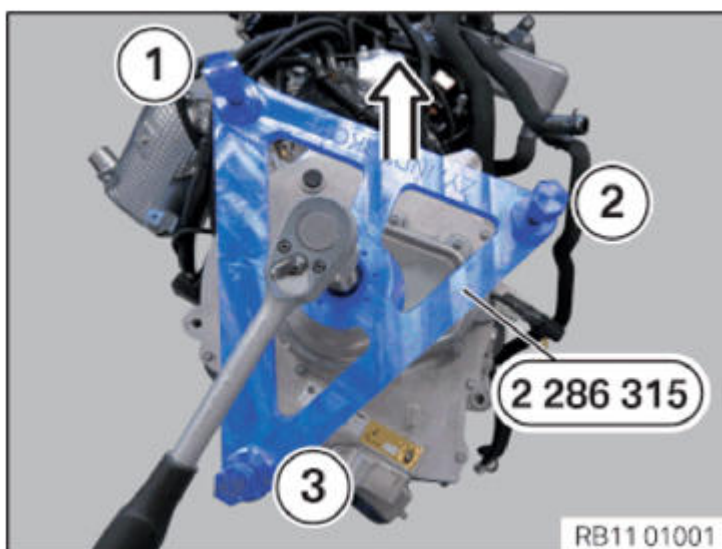
**Fig. 118: Aligning Special Tool (2 286 315) With Notch On Housing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Measure distance between both housing halves by means of a caliper gauge (1) **63 mm** and re-align the range extender electrical machine if necessary.



**Fig. 119: Measuring Distance Between Both Housing Halves With Caliper Gauge**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Screw in mounting bolts 1, 2 and 3 on engine block with 15 Nm.

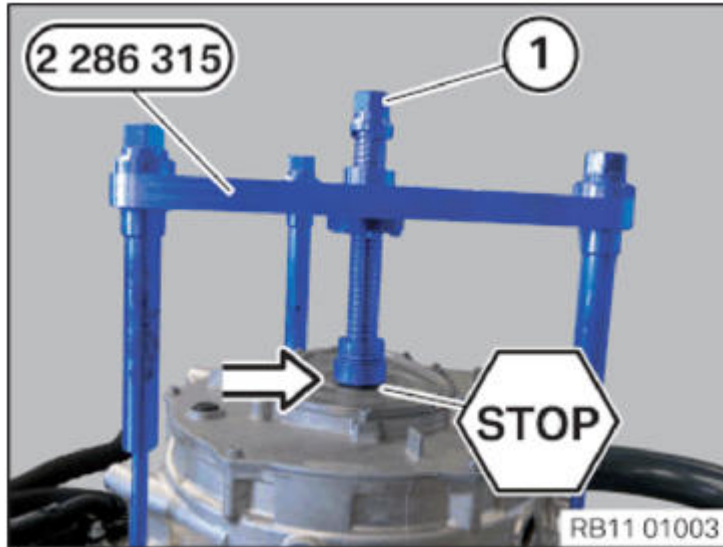


**Fig. 120: Screwing Mounting Bolts On Engine Block**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage! On range extender electrical machine.

Join engine and range extender electrical machine with a torque of **12.5 Nm** by means of special tool **2 286 315** to a distance of **5 mm** .

IMPORTANT: Connect range extender electrical machine to spindle (1) with special tool **2 286 315** with **MAXIMUM 7.5 Nm** , leaving no gap.



**Fig. 121: Joining Engine And Range Extender Electrical Machine With Special Tool (2 286 315).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert screws (1) and tighten with 10 Nm.

Remove special tool **2 286 315** .

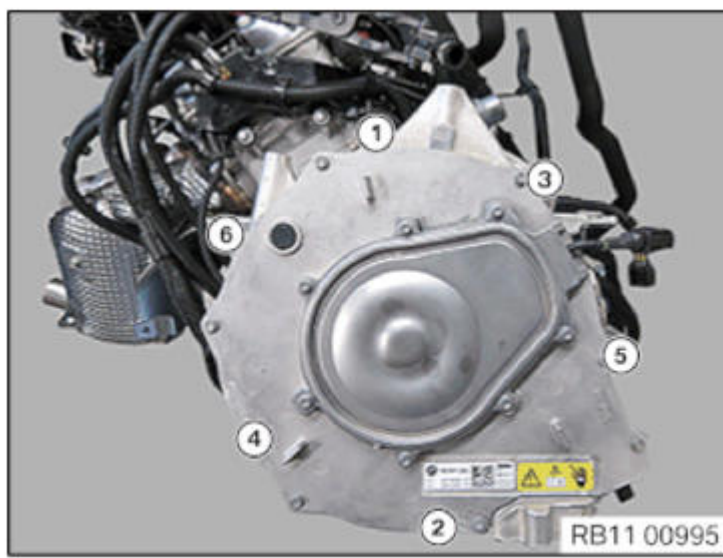


**Fig. 122: Removing Special Tool (2 286 315)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws in sequence (1 to 6).

Tightening torque: **12 35 9AZ** .





**Fig. 123: Torsion Splined Shaft Screws Tightening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Reset adaptation values.

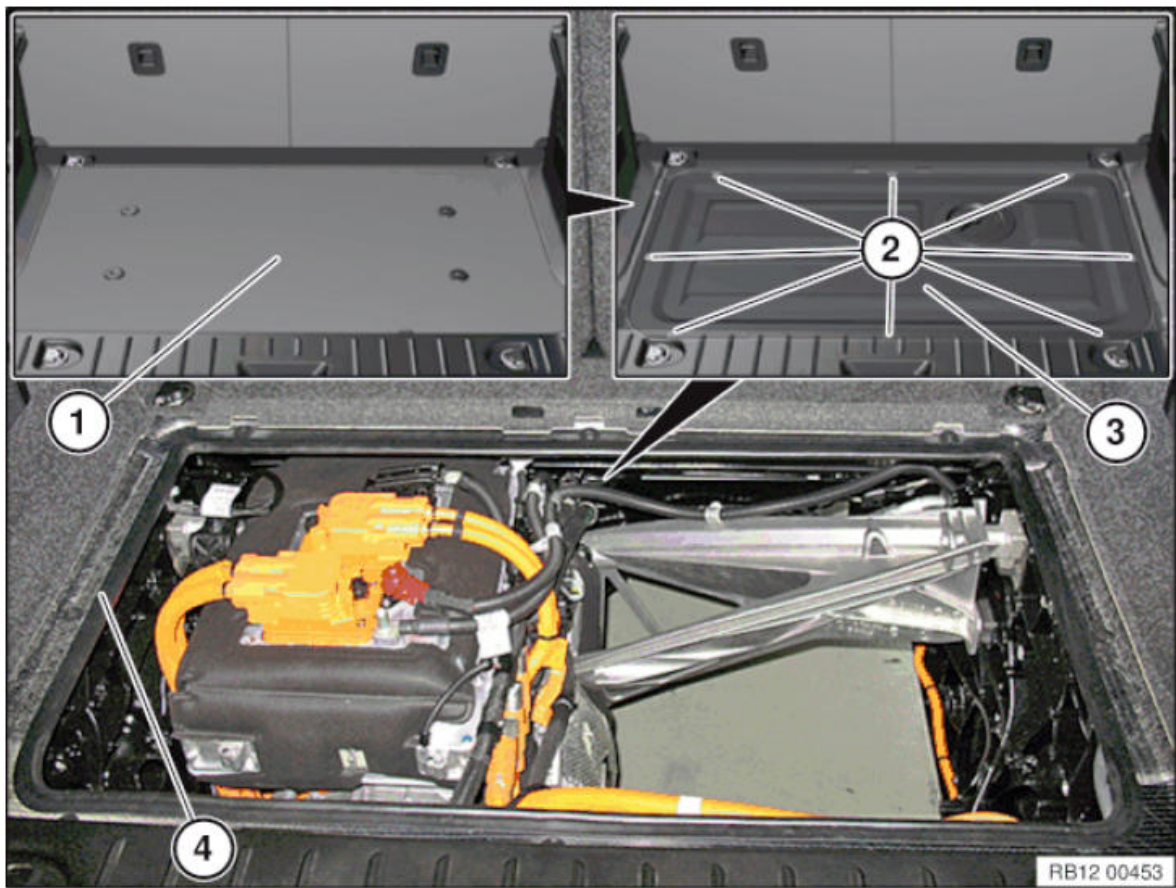
### **27 21 315 REMOVING AND INSTALLING ACTUATOR FOR PARKING LOCK (VEHICLES WITHOUT RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

Necessary preliminary tasks:

- De-energize the **HIGH-VOLTAGE SYSTEM**.



**Fig. 124: Identifying Floor Trim Panel, Service Cap, Gasket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

Release screws (2) and remove service cap (3) towards top.

Tightening torque [51 47 04AZ](#) .

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

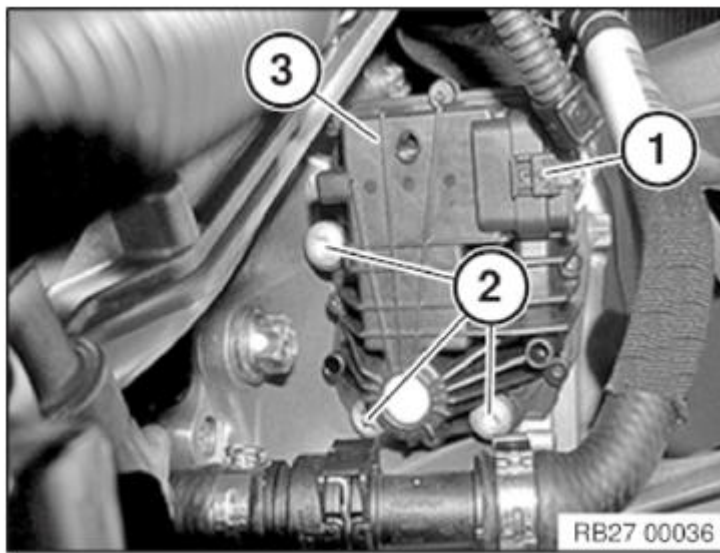
Unlock connector (1) from actuator and disconnect.

Unfasten screws (2).

Remove actuator (3).

*Installation note:*

Tightening torque [27 00 12AZ](#) .



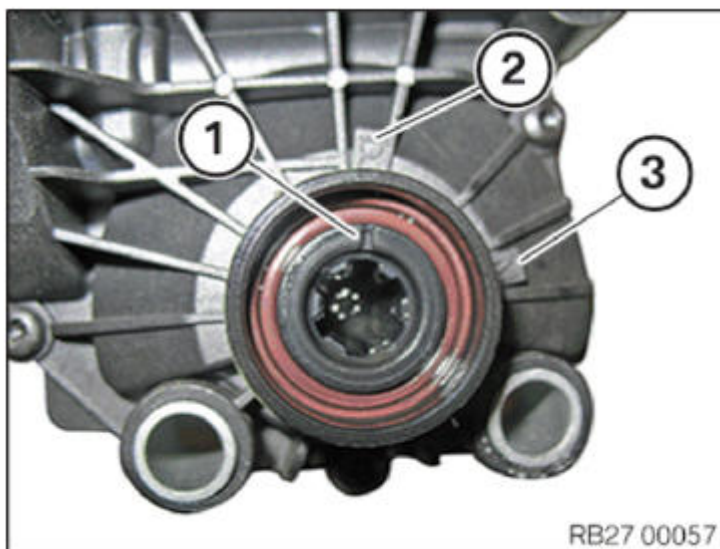
**Fig. 125: Identifying Actuator, Connector And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Check the position of the disassembled actuator with the help of mark (1).

If mark (1) on the disassembled actuator is pointing to "N" position (3) →**install a new actuator**

If mark (1) on the disassembled actuator is pointing to "P" position (2) →**see the following instructions**



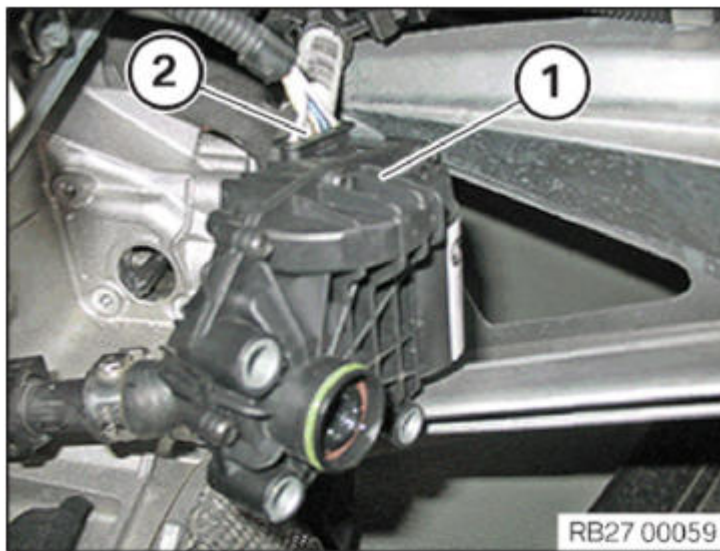
**Fig. 126: Identifying Disassembled Actuator Mark, P And N Positions**

Courtesy of BMW OF NORTH AMERICA, INC.

**Moving the new actuator to "P" position:**

Connect the new actuator (1) to the wiring harness (2) before installation.

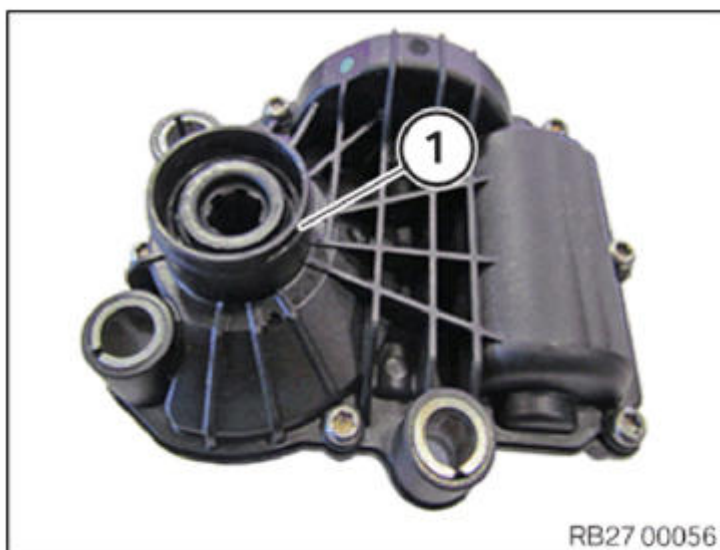
Perform the service function "EME: **preparing parking lock module for installation**". (Move actuator to "P" position)



**Fig. 127: Identifying Actuator And Wiring Harness**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Before installing the actuator, it is essential that the sealing ring (1) is coated with lubricant.



**Fig. 128: Identifying Sealing Ring**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

After installing the actuator, the parking lock module must be reinitialized with the service function "EME: teach-in parking lock module" .

### **27 21 320 REMOVING AND INSTALLING ACTUATOR FOR PARKING LOCK (VEHICLES WITH RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**Necessary preliminary tasks:**

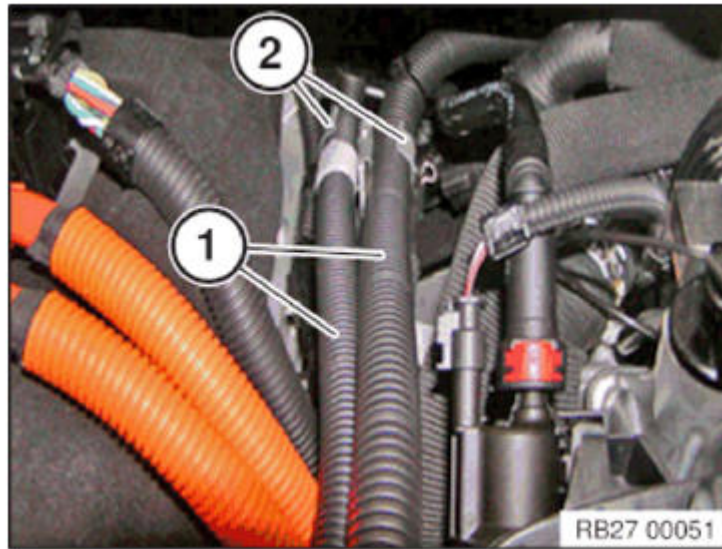
- De-energize the **HIGH-VOLTAGE SYSTEM**.



- Drain coolant. See **DRAINING COOLING CIRCUIT (HIGH-TEMPERATURE COOLING SYSTEM) OF RANGE EXTENDER** and **DRAINING COOLING CIRCUIT (LOW TEMPERATURE COOLING SYSTEM) FOR DRIVE** .
- Remove **INTAKE PLENUM**

Release lines (1) from brackets (2).

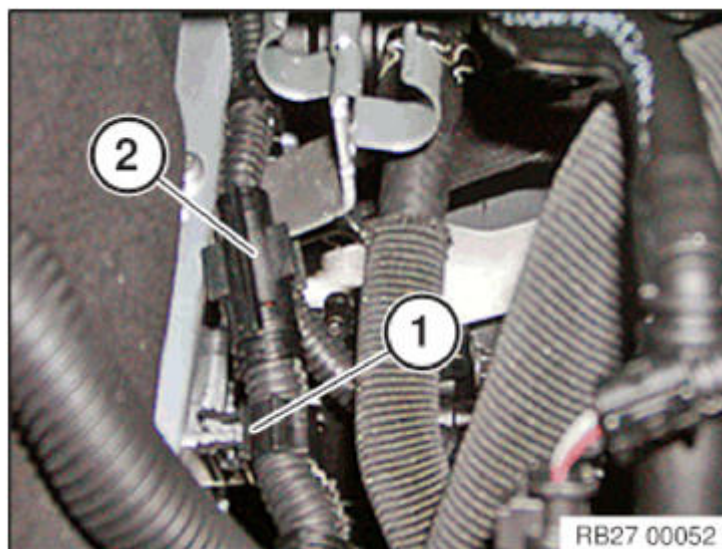
Lay lines to one side.



**Fig. 129: Identifying Lines And Brackets**  
 Courtesy of BMW OF NORTH AMERICA, INC.

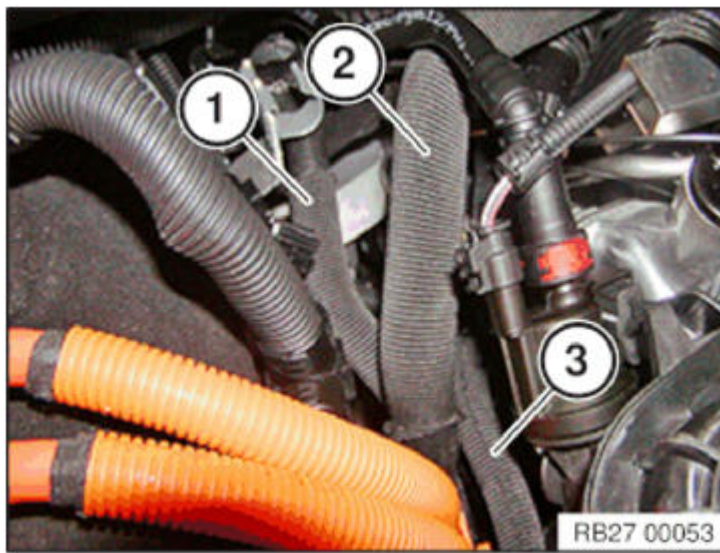
Release clip (1) from electrical machine.

Lay cable (2) to one side.



**Fig. 130: Identifying Cable And Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect coolant hoses (1, 2, 3) at connections and lay to one side.



**Fig. 131: Identifying Coolant Hoses**

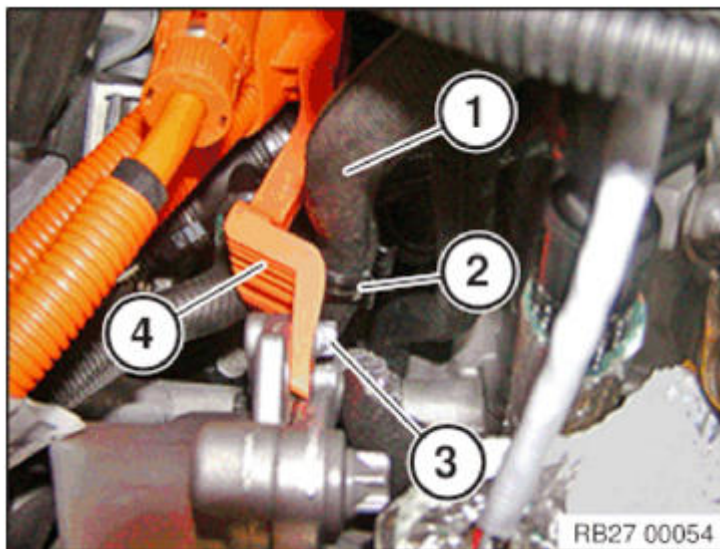
Courtesy of BMW OF NORTH AMERICA, INC.

Release coolant hose (1) from bracket (2).

Release screw (3).

Release connector from transmission (4).

Tightening torque [27 00 11AZ](#) .



**Fig. 132: Identifying Coolant Hose, Transmission, Bracket And Screw**

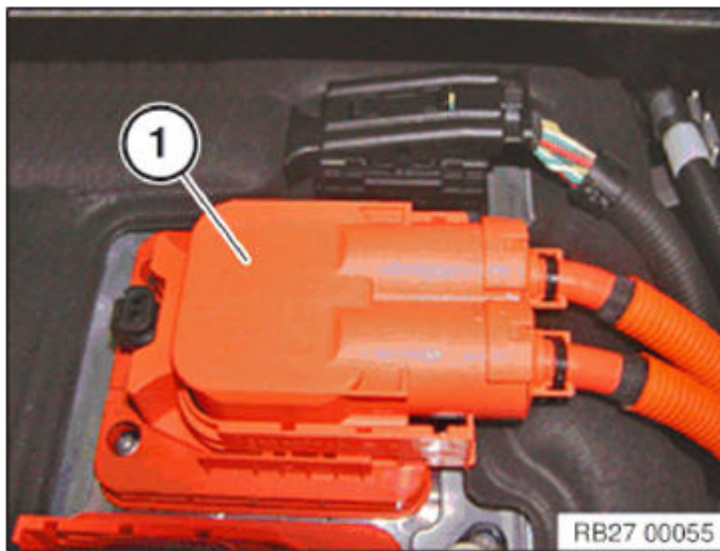
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect high-voltage cable (1) for convenience charging electronics.

Lay high-voltage cable to one side towards rear.

**IMPORTANT:** Observe notes on [UNLOCKING AND DISCONNECTING PLUG CONNECTIONS](#) on electric vehicles.





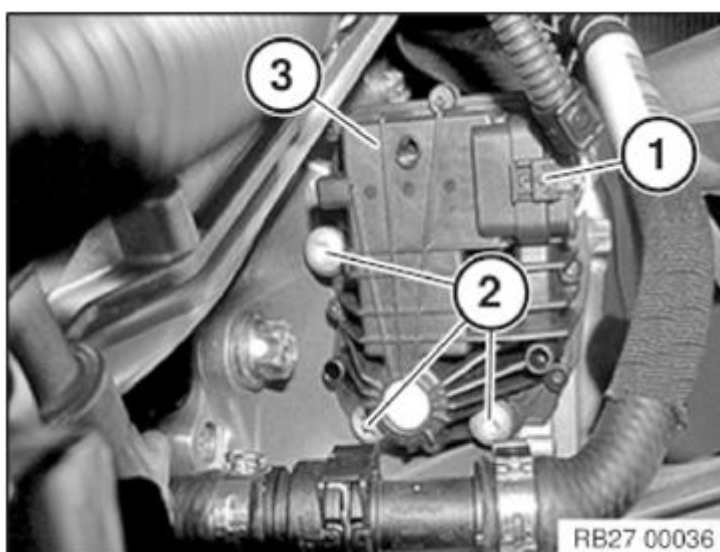
**Fig. 133: Identifying High-Voltage Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock connector (1) from actuator and disconnect.

Unfasten screws (2).

Remove actuator (3).

Tightening torque [27 00 12AZ](#) .

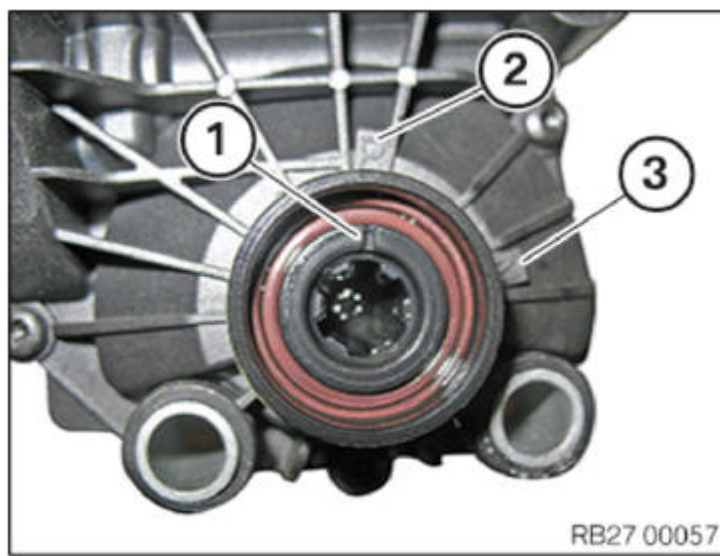


**Fig. 134: Identifying Actuator, Connector And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check the position of the disassembled actuator with the help of mark (1).

If the mark (1) is pointing to position "N" (3) after actuator disassembly, → **Install new actuator**

If mark (1) on the disassembled actuator is pointing to "P" position (2) → **See the following instructions**

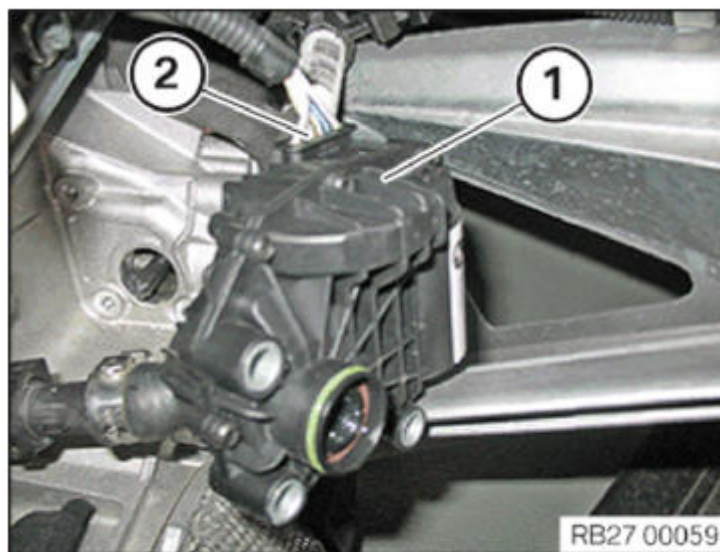


**Fig. 135: Identifying Disassembled Actuator Mark, P And N Positions**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Moving the new actuator to "P" position:**

Connect the new actuator (1) to the wiring harness (2) before installation.

Perform the service function "EME: Perform Prepare parking lock module for installation " (set actuator to position "P").



**Fig. 136: Identifying Actuator And Wiring Harness**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Before installing the actuator, it is essential that the sealing ring 1 is coated with lubricant.



**Fig. 137: Identifying Sealing Ring**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

After installing the actuator, the parking lock module must be reinitialized with the service function "EME: Teach-in parking lock module "":

**12 35 000 REMOVING AND INSTALLING COMPLETE DRIVE UNIT (VEHICLES WITHOUT RANGE EXTENDER)**

**Special tools required:**

- [2 184 136](#)
- [2 305 379](#)
- [2 357 222](#)
- [2 357 221](#)

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the [HIGH-VOLTAGE SYSTEM](#).
- Observe the [SAFETY INFORMATION](#) for working with electric vehicles.
- Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) .

**Necessary preliminary tasks:**

- Clamp off [BATTERY LEAD FROM NEGATIVE CONNECTION POINT](#)

**NOTE:** Before disconnecting the battery cable, it must be ensured that the vehicle goes to sleep.

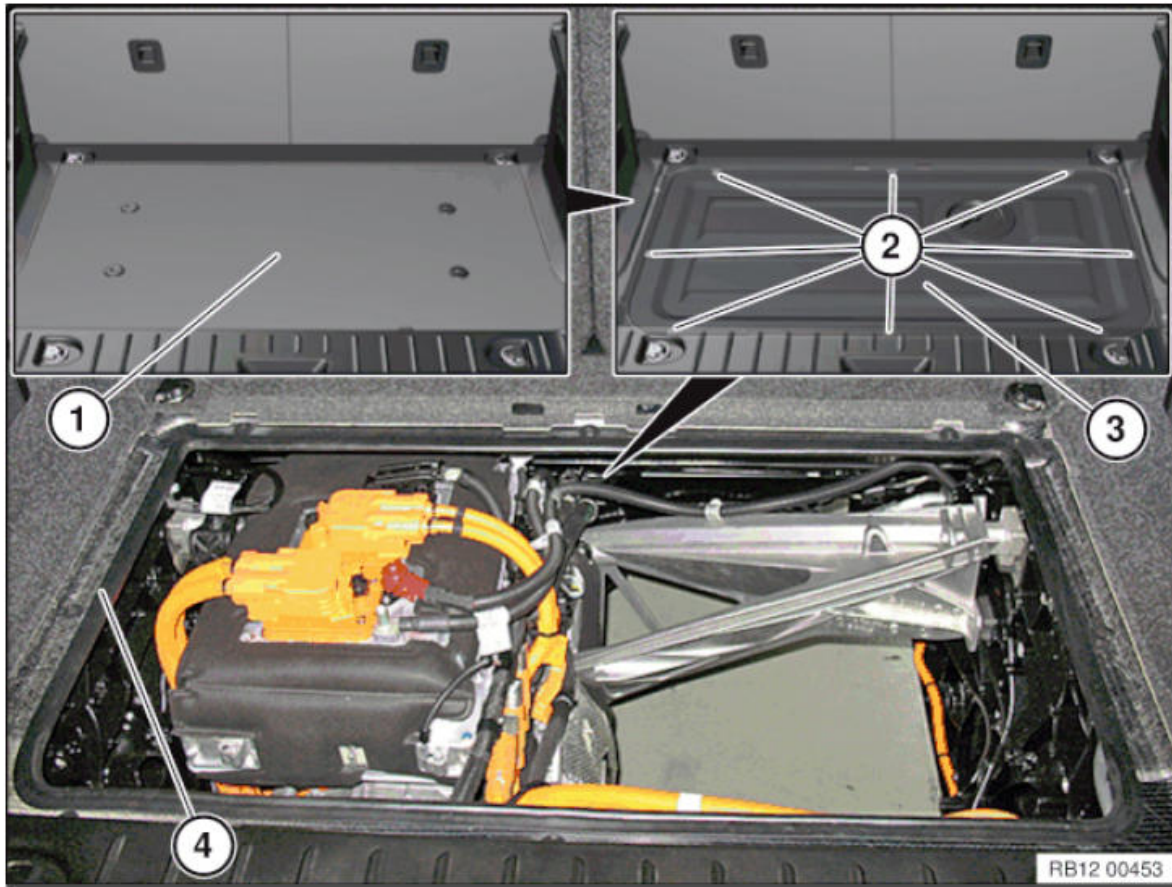
- Drain [COOLANT](#) .
- Remove [SUPPORT FOR REAR BUMPER PANEL](#) .
- Remove VERTICAL STRUT .
- With equipment "rapid charging direct current" (SA4U7) and "rapid charging alternating current" (SA4U6 or SA4U8):

Remove convenience charging electronics. See [REPLACING CONVENIENCE CHARGING ELECTRONICS](#) .



- Remove BOTH HORIZONTAL STRUTS .
- Remove REAR CROSS STRUT .
- Remove output shaft on left and right. See [REPLACING LEFT OUTPUT SHAFT](#) or [REPLACING RIGHT OUTPUT SHAFT](#) .

**REMOVAL:**



**Fig. 138: Identifying Floor Trim Panel, Service Cap, Gasket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

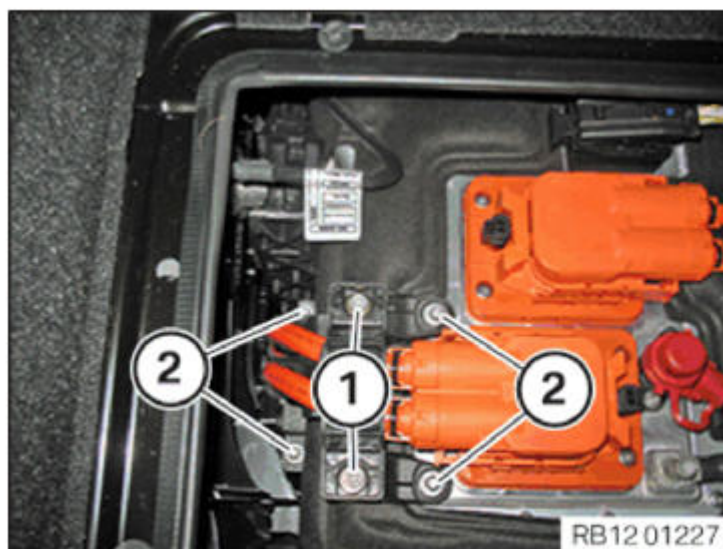
Remove luggage compartment floor trim panel (1).

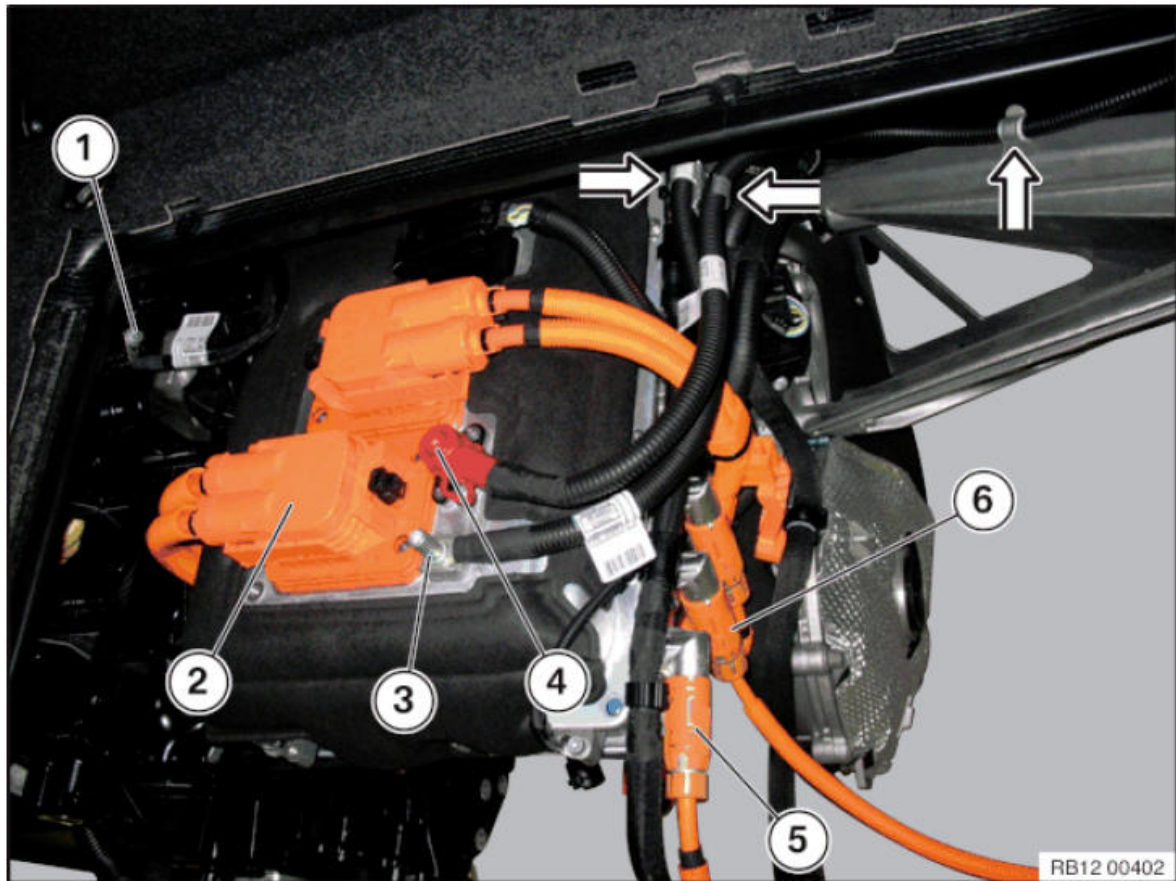
Release screws (2) and remove service cap (3) towards top.

**On vehicles from version 12/2014:**

Release the screws (1) and remove the tension relief.

Loosen the screws (2) from the bracket for tension relief.





**Fig. 140: Locating Earth Lead And Positive Battery Cable Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw from equipotential bonding line (1) on Drive module.

Disconnect high-voltage cable (2) from high-voltage battery unit on electrical machine electronics.

Attention!

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Release nut (3) from battery earth lead on electrical machine electronics.

Take off cover and release nut (4) from positive battery cable on electrical machine electronics.

Unclip battery earth lead and positive battery cable.

Disconnect high-voltage cable (5) from charging socket and convenience charging electronics at EME.

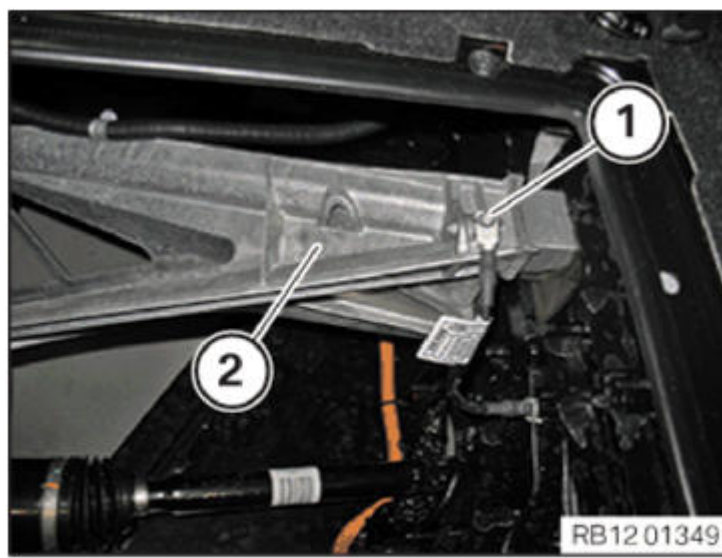
Disconnect high-voltage cable (6) from electric auxiliary heater at EME.

Attention!

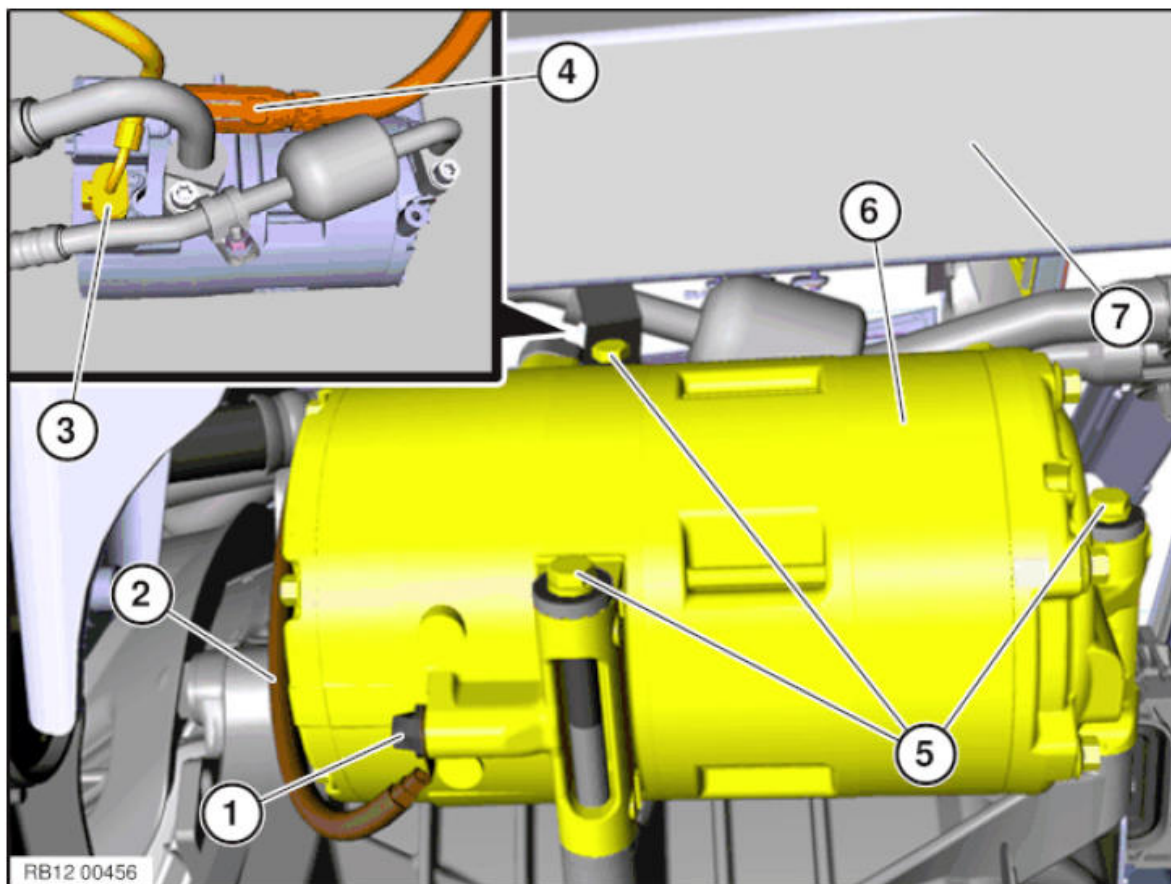
Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Release screw from the equipotential bonding line (1) on the transmission mounting bracket (2).





**Fig. 141: Identifying Bonding Line And Transmission Mounting Bracket**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 142: Identifying Signal Line, High Voltage Cable Plug Connection, Equipotential Bonding Line And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) from equipotential bonding line (2).

Disconnect plug connection (3) from signal line.

Disconnect plug connection (4) from high-voltage cable.

Attention!

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Release screws (5) from air conditioning compressor (6).

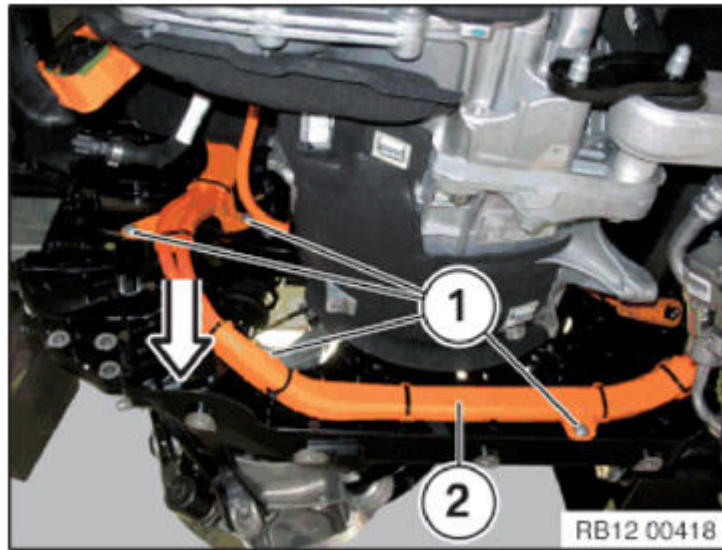


Secure air conditioning compressor (6) on Drive module (7) with cable tie or tensioning strap.

**For vehicles built up to 12/2014:**

Release screws (1) from cable duct (2).

Slip out high-voltage cable with cable duct (2) downward and secure on the outer side.

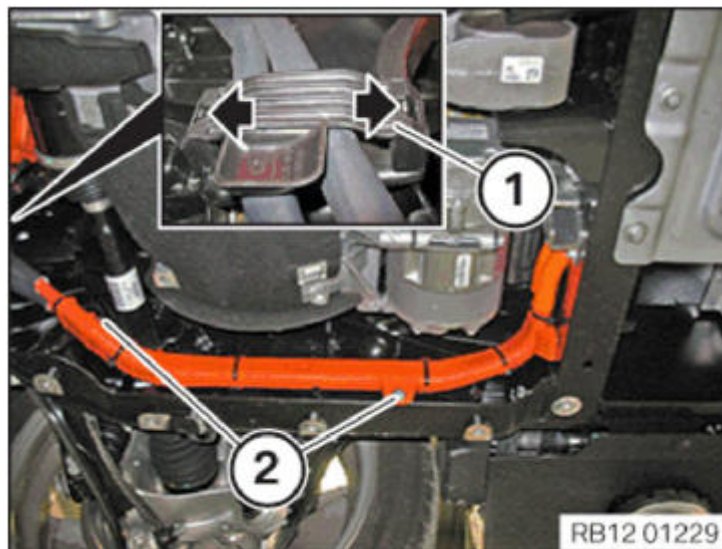


**Fig. 143: Removing High-Voltage Cable With Cable Duct**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Press the retaining lugs towards the outside and pull off the line clip (1).

Unfasten screws (2).

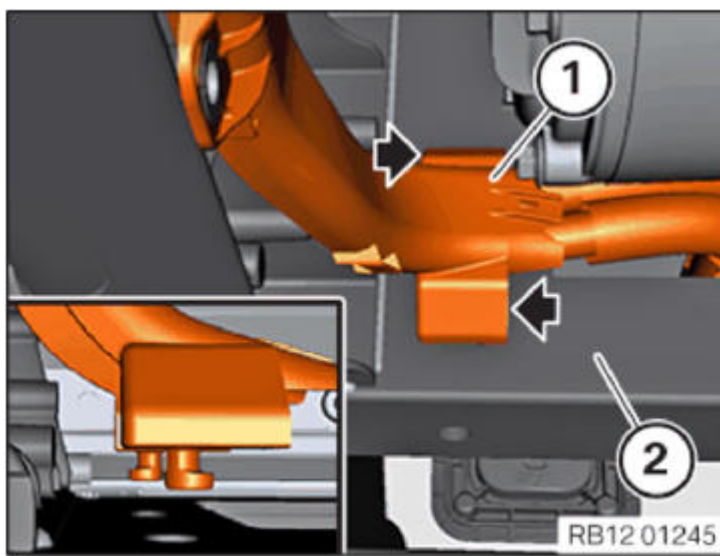


**Fig. 144: Pressing Line Clip Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Detach the retaining lugs from the cable channel (1) of the Drive module (2) in the direction of the arrow.

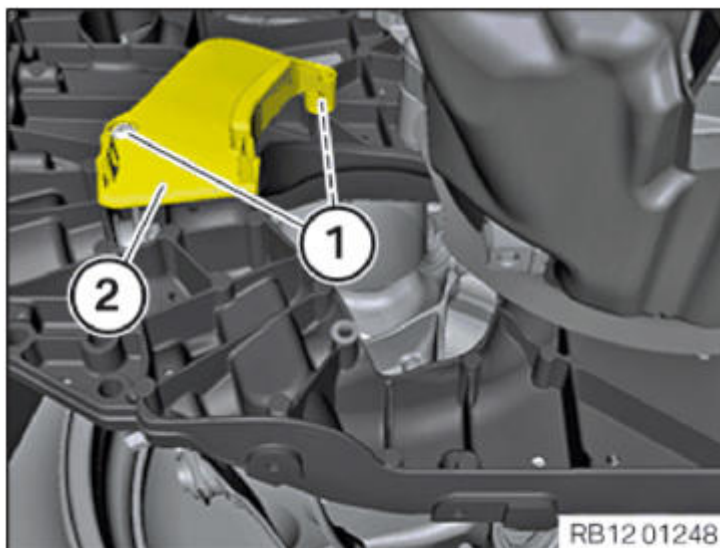
Remove the high-voltage cable including cable channel (1) towards the bottom and secure to the side on the outside.



**Fig. 145: Detaching Retaining Lugs From Cable Channel Of Drive Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Loosen the screws (1) and remove the shaft (2).



**Fig. 146: Identifying Shaft And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connections (1) from wiring harness.



**Fig. 147: Identifying Wiring Harness Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

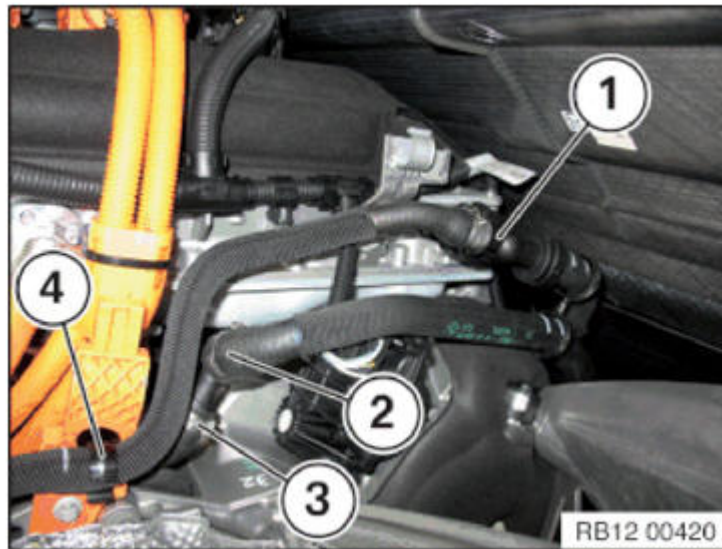
Disconnect coolant line (1) from EME.

Disconnect coolant line (2) from electrical machine.

**Only for equipment "rapid charging alternating current" (SA4U6 or SA4U8):**

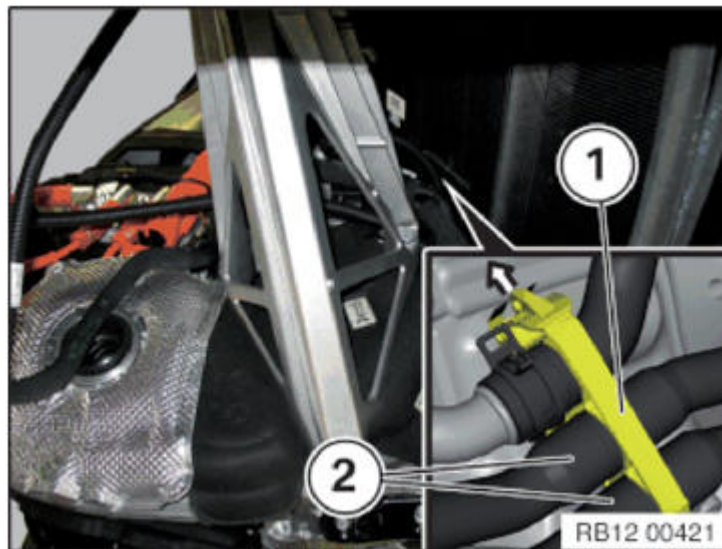
Feed out coolant line (3) for convenience charging electronics.

Unclip coolant line (4) for convenience charging electronics.

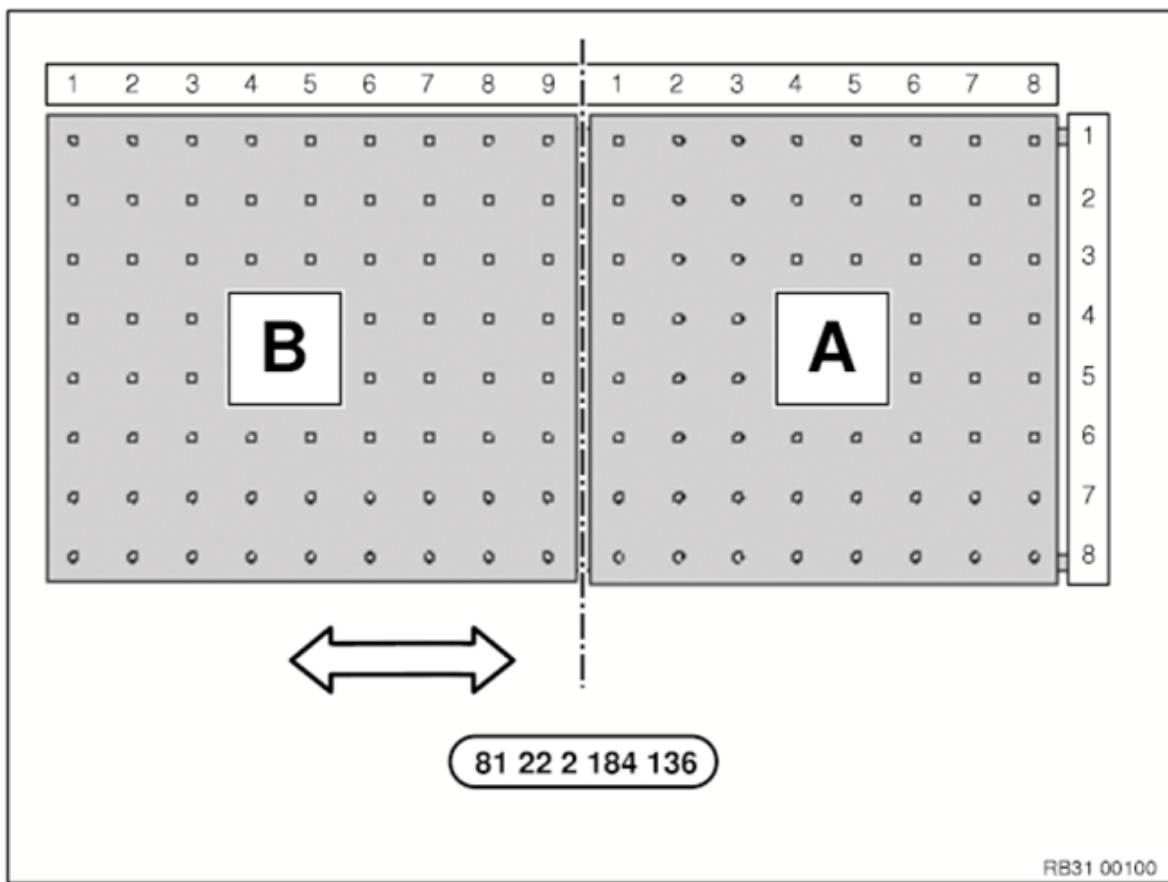


**Fig. 148: Identifying Coolant Lines**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open retaining clip (1) and expose coolant lines (2).



**Fig. 149: Opening Coolant Lines Retaining Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.



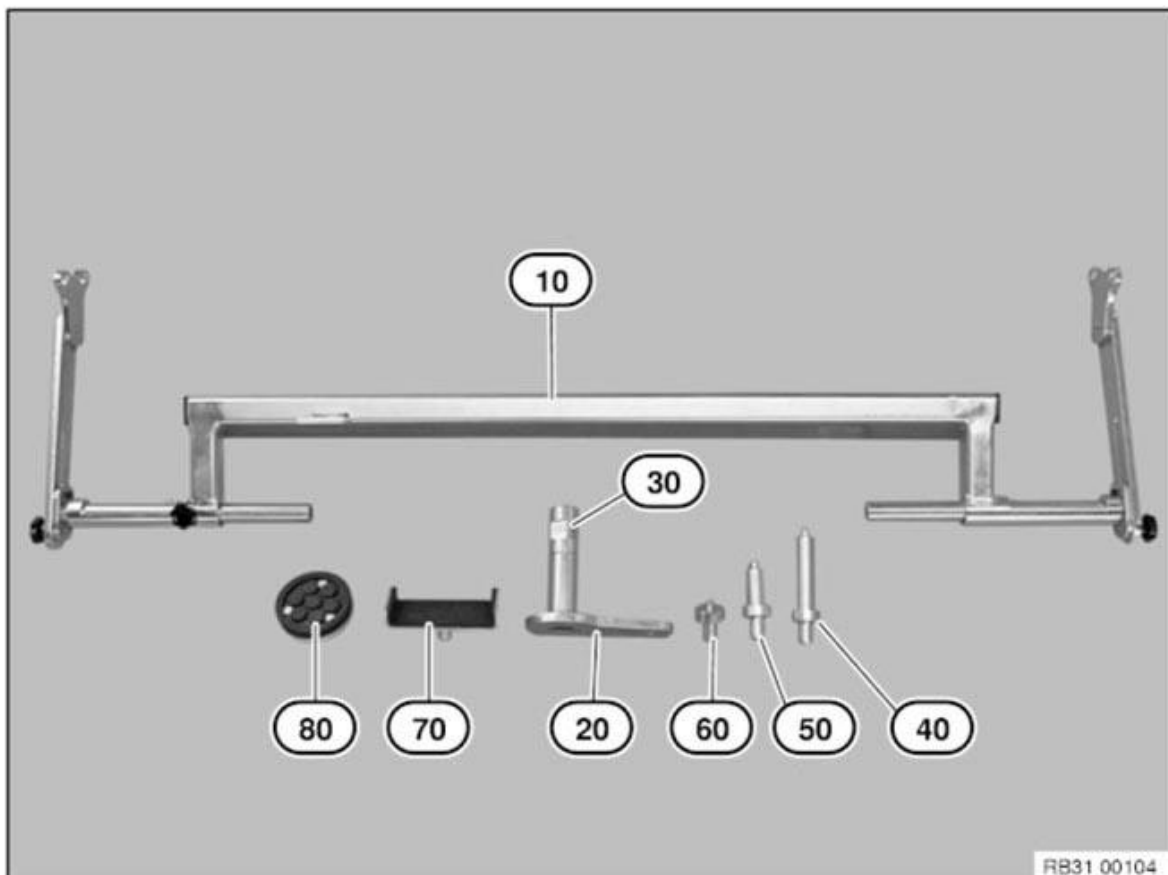
**Fig. 150: Identifying Mobile Table Lift**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

**Coordinate determination always begins at the top.**

**Sourcing reference, mobile table lift 2 184 136 :**

Comply with **NOTES REGARDING MOBILE TABLE LIFT !**

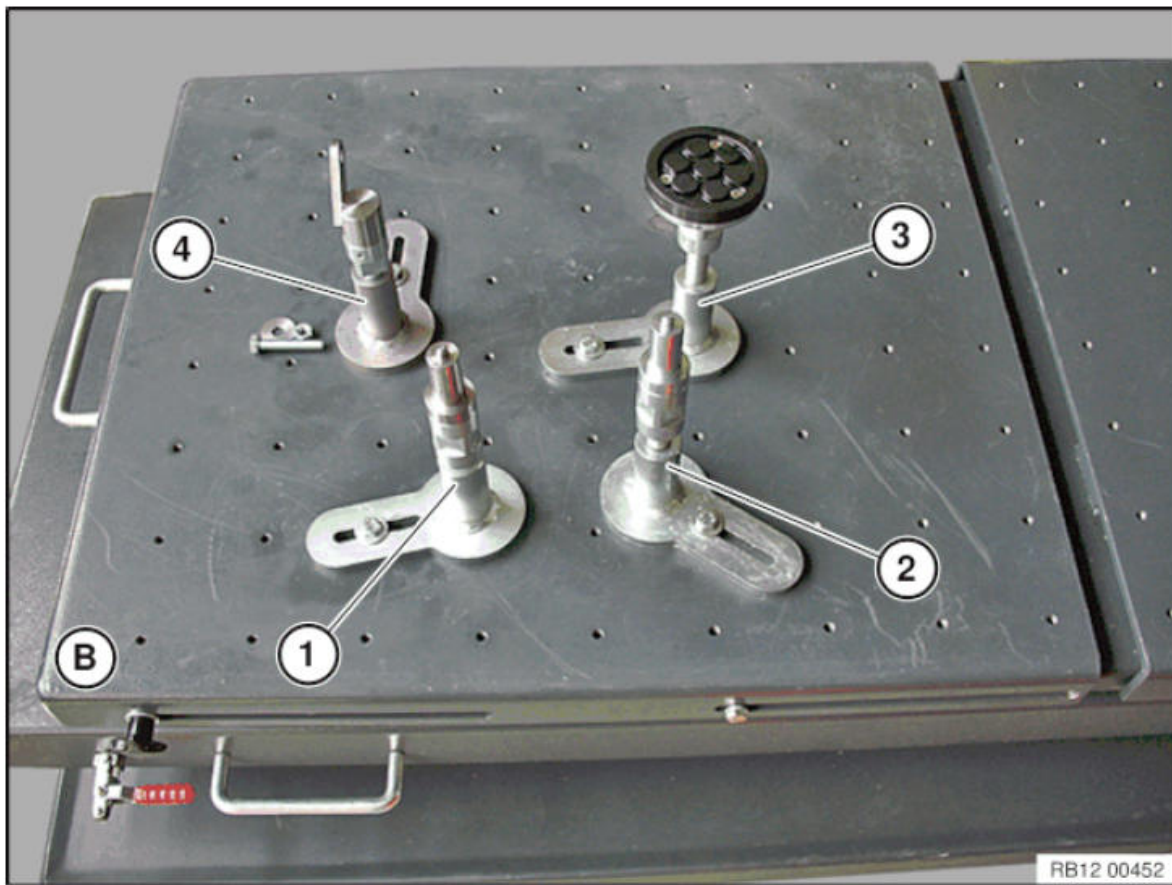




**Fig. 151: Identifying Tools From Lifting Table Attachment Set**  
Courtesy of BMW OF NORTH AMERICA, INC.

The following tools from the lifting table attachment set (part number [2 305 379](#) ) are required:

Tool number:	Number:
20	3
80	1



**Fig. 152: Identifying Structure Table Lift Positions**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Structure, table lift:**

Position 1:

Position retaining element (20) with special tool [2 357 222](#) on table top {**B**} at coordinates 3/7.

Position 2:

Position retaining element (20) with special tool [2 357 222](#) on table top {**B**} at coordinates 6/7.

Position 3:

Position retaining element (20) with mounting plate (80) on table top {**B**} at coordinates 5/5.

Position 4:

Position special tool [2 357 221](#) on table top {**B**} at coordinates 3/4.

**Overview of table lift mounting points to electrical machine:**

Position 1:

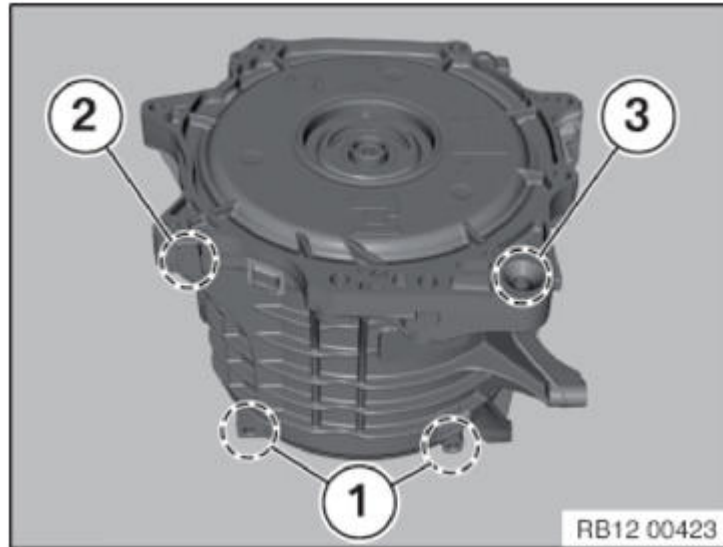
2 x special tool [2 357 222](#) with fixture 20

Position 2:

1 x support plate 80 with fixture 20

Position 3:

1 x special tool [2 357 221](#)



**Fig. 153: Overview Of Table Lift Mounting Points To Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 154: Positioning Special Tool (2 357 222) At Mounting Points Of Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide the lifting table under the vehicle from the rear and position the mounting points under the drive unit.

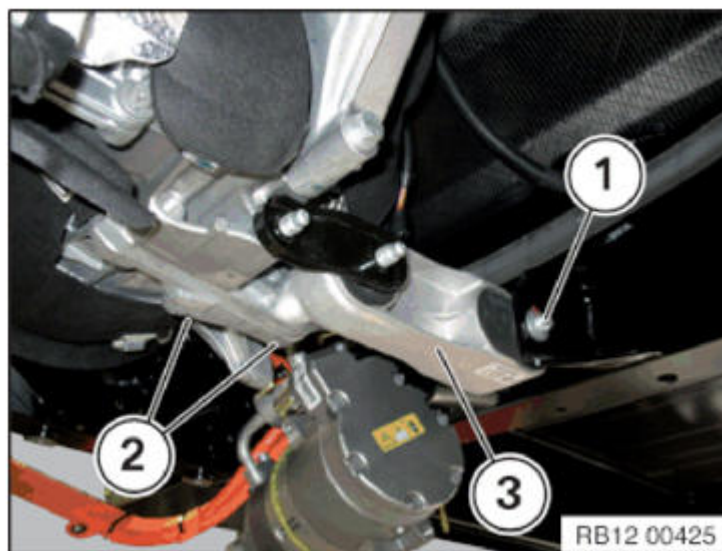
Raise the lifting table and position special tool [2 357 222](#) at the mounting points of the electrical machine (1).

Position mounting plate (2) at mounting point of electrical machine.

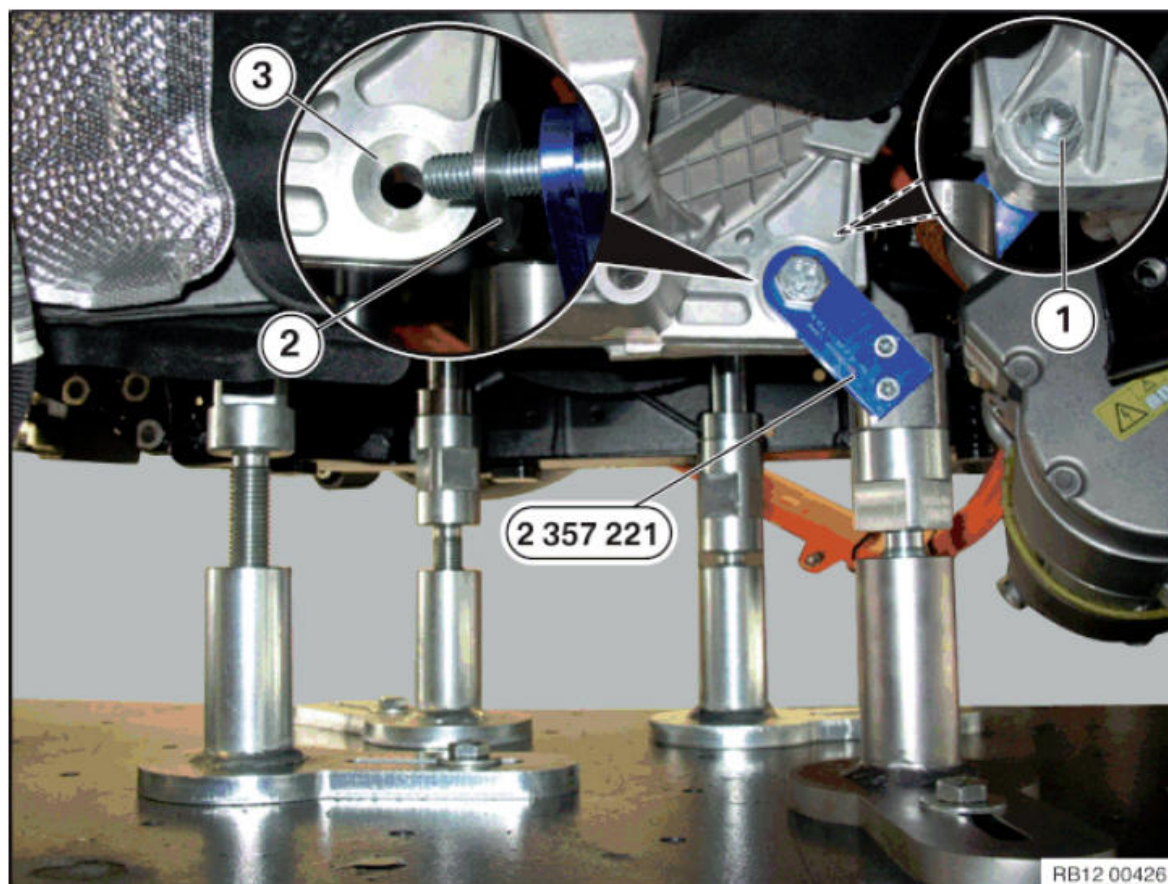


Release screw (1) of engine anti-roll bar link (3).

Release screws (2) and remove engine anti-roll bar link (3).



**Fig. 155: Identifying Anti-Roll Bar Link And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 156: Positioning Special Tool (2 357 222) On Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

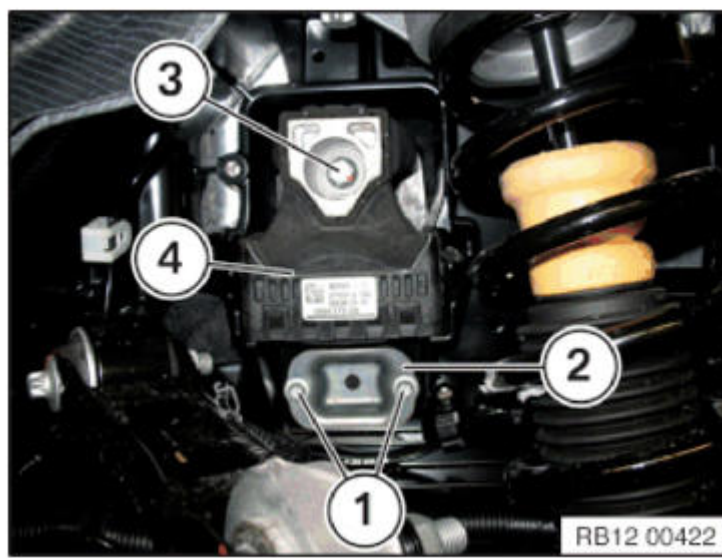
Position special tool [2 357 221](#) on electrical machine and secure with nut (1).

**NOTE:** Washer (2) must rest against taper (3) of electrical machine.

Release left and right screws (1) and remove stop pad (2).

Release left and right screws (3) from support bearing.

Carefully lower the lifting table including drive unit.



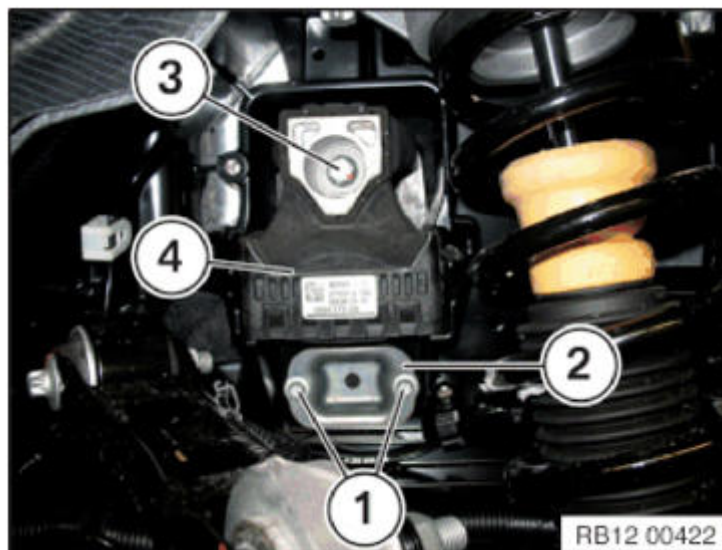
**Fig. 157: Identifying Stop Pad And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**INSTALLATION:**

Check support bearing (4) on left and right for damage. Renew the damaged support bearing.

**Attention!**

It is also necessary to align the bore holes in front of the screw connection when installing a new engine mounting bracket or transmission mounting bracket. Align support bearing (4) with the engine mounting bracket/transmission mounting bracket before screwing on with a suitable tool (e.g. drill with shaft diameter of 11 mm).



**Fig. 158: Identifying Stop Pad And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully lift and position the lifting table including drive unit.

Tighten left and right screws (3) on support bearing (4).

*Installation note:*

**Left side - support bearing on engine mounting bracket of the electrical machine:**

Renew screw.

Tightening torque **27 00 8AZ** .

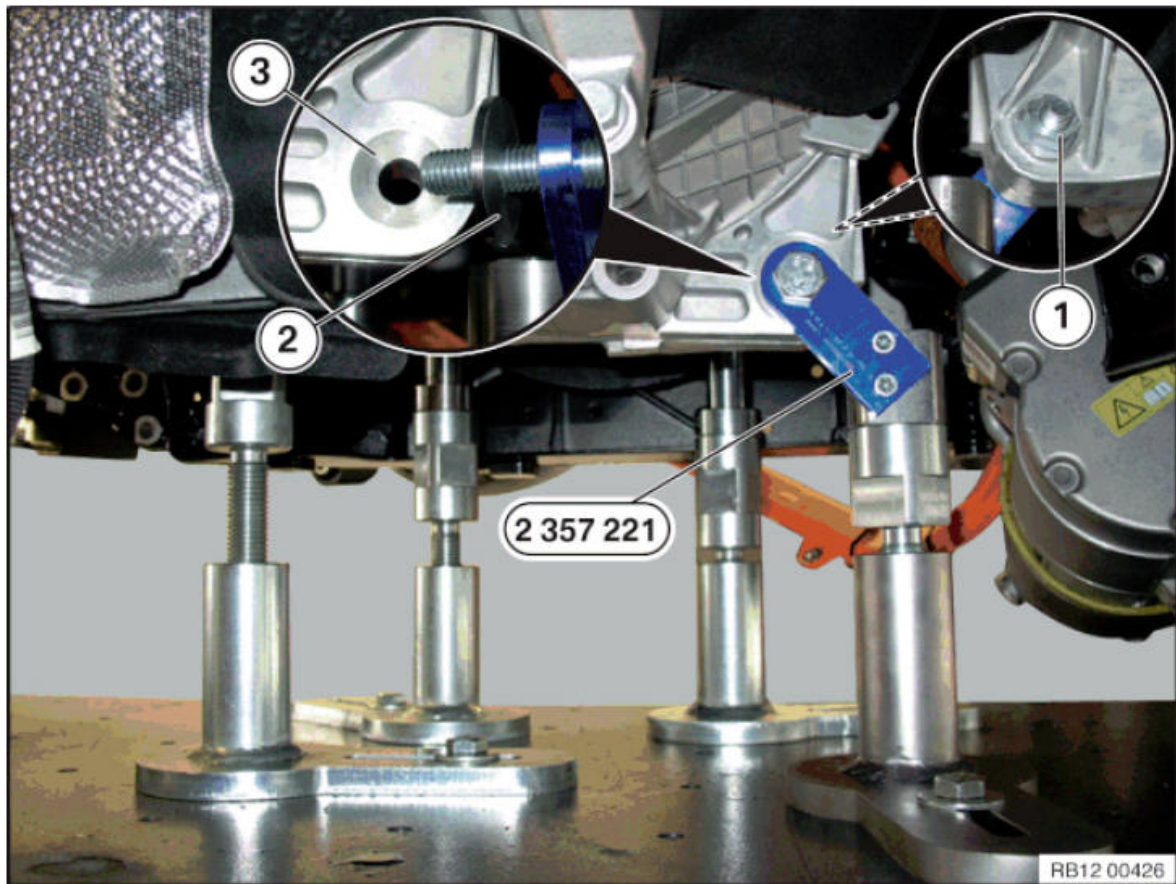
**Right side** - support bearing on transmission mounting bracket:

Renew screw.

Tightening torque [27 00 6AZ](#) .

Tighten left and right screws (1) with stop pad (2).

Tightening torque [12 35 1AZ](#) .



**Fig. 159: Positioning Special Tool (2 357 222) On Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut (1) from electrical machine (3).

Remove special tool [2 357 221](#) with screw and washer (2).

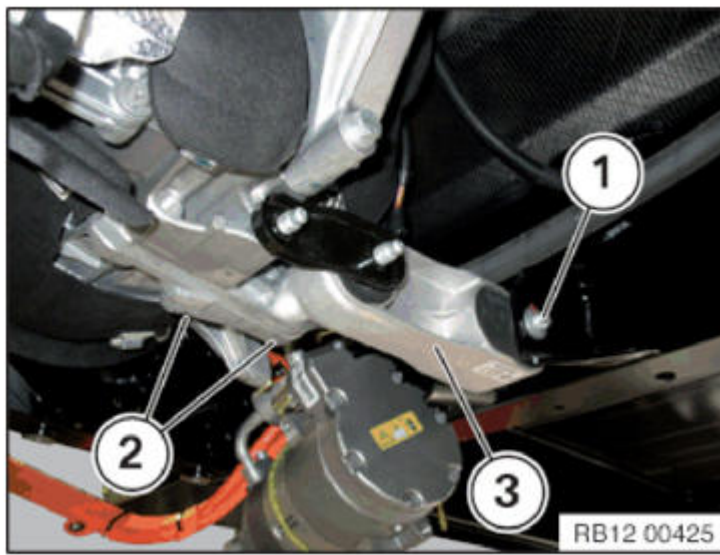
Tighten screws (2) on engine anti-roll bar link (3).

Tightening torque [27 00 9AZ](#) .

Tighten screw (1) on engine anti-roll bar link (3).

Tightening torque [27 00 10AZ](#) .



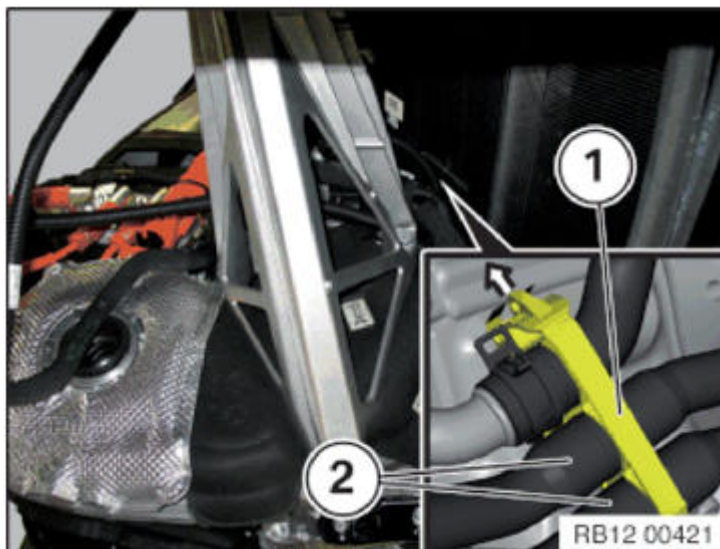


**Fig. 160: Identifying Anti-Roll Bar Link And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lower the lifting table.

Position coolant lines (2) in retaining clip (1).

Lock retaining clip (1).



**Fig. 161: Opening Coolant Lines Retaining Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.

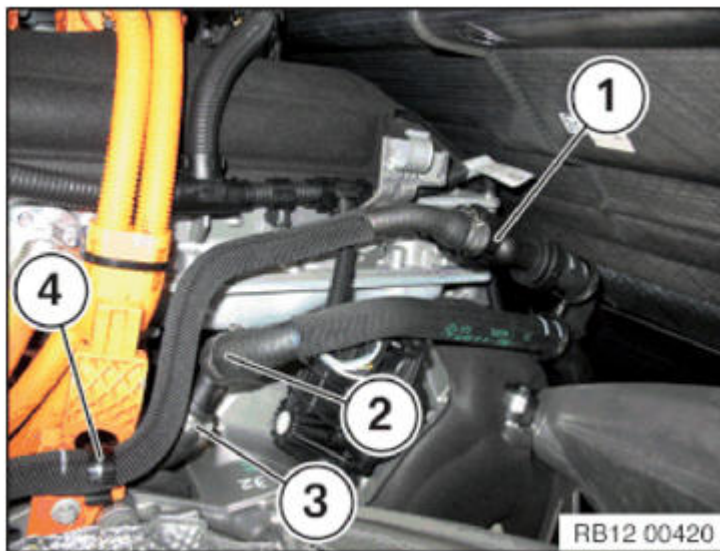
Connect and lock coolant line (1) of EME.

Connect and lock coolant line (2) of electrical machine.

**Only for equipment "rapid charging alternating current" (SA4U6 or SA4U8):**

Feed in coolant line (3) for convenience charging electronics.

Clip in coolant line (4) for convenience charging electronics.



**Fig. 162: Identifying Coolant Lines**

Courtesy of BMW OF NORTH AMERICA, INC.

Connect connector (1) of wiring harness and lock.



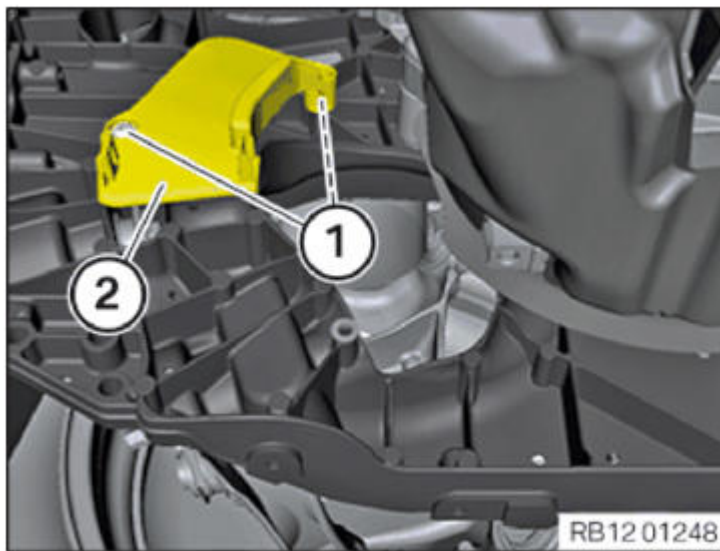
**Fig. 163: Identifying Wiring Harness Plug Connections**

Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Position the shaft (2) and tighten the screws (1).

Tightening torque [61 12 9AZ](#) .

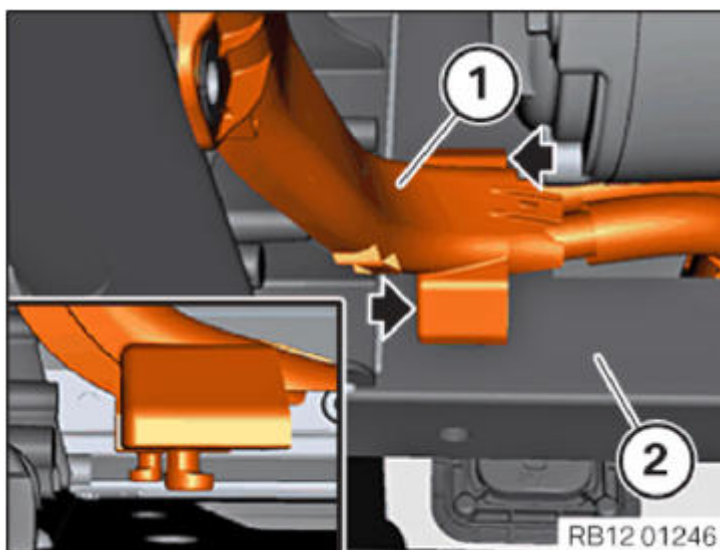


**Fig. 164: Identifying Shaft And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Attach the retaining lugs of the cable channel (1) in the direction of the arrow at the Drive module (2).



**Fig. 165: Attaching Retaining Lugs Of Cable Channel At Drive Module**

Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

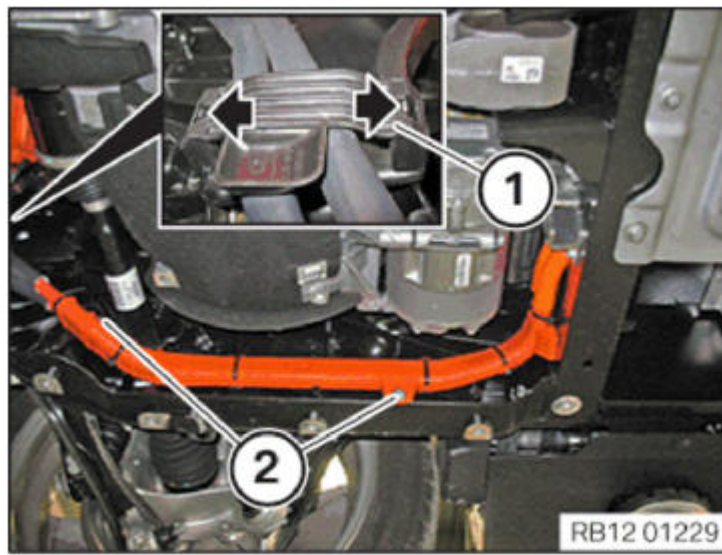
Insert the high-voltage cable towards the top.

Position the high-voltage cable and clip in the line clip (1).

Tighten down screws (2).

Tightening torque [61 12 4AZ](#) .





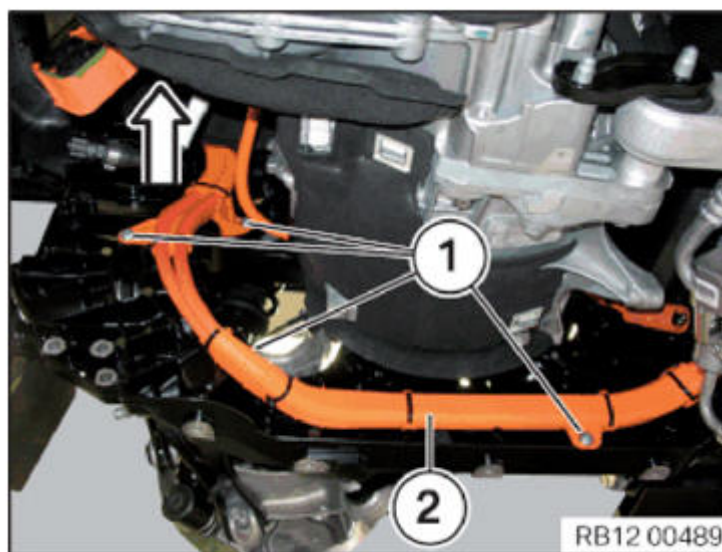
**Fig. 166: Pressing Line Clip Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

**For vehicles built up to 12/2014:**

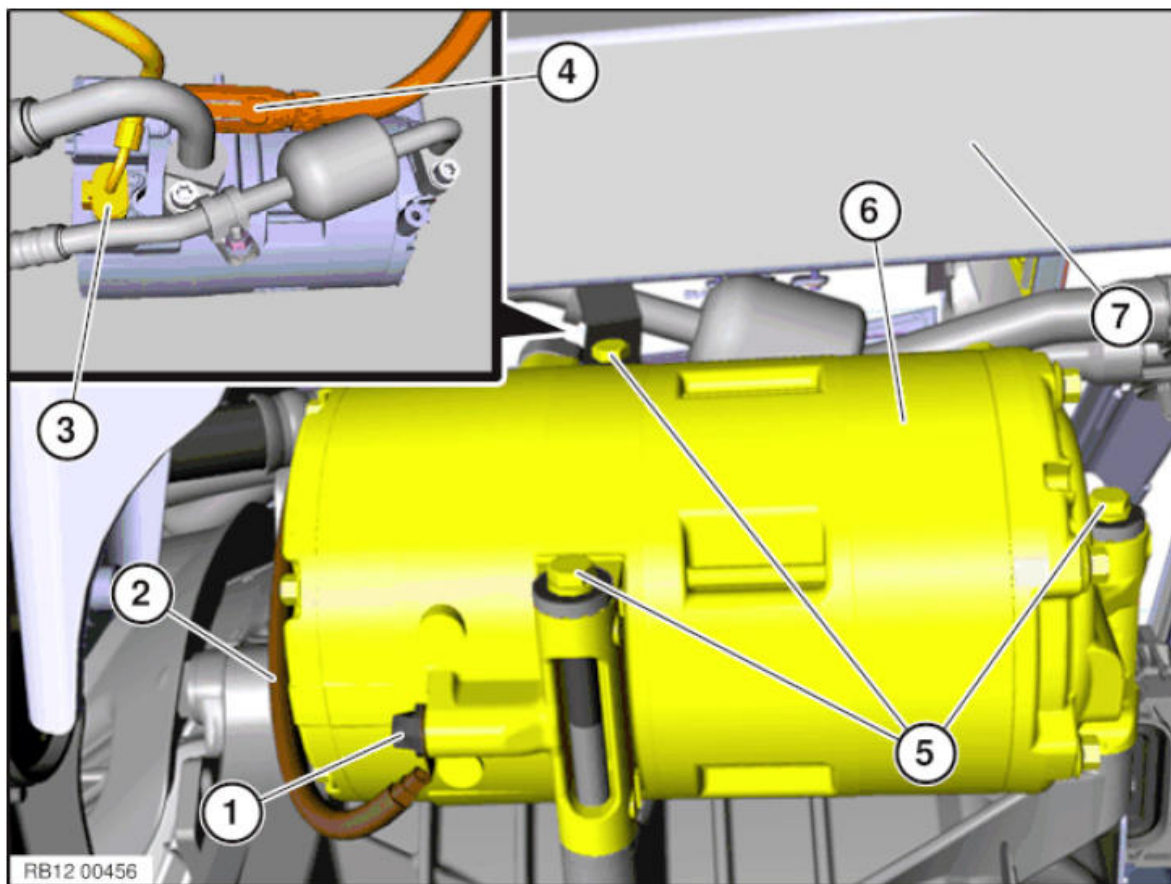
Slip in high-voltage cable with cable duct (2) in an upward direction.

Tighten screws (1) on cable duct (2).

Tightening torque [61 12 4AZ](#) .



**Fig. 167: Removing High-Voltage Cable With Cable Duct**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 168: Identifying Signal Line, High Voltage Cable Plug Connection, Equipotential Bonding Line And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Release fixation of air conditioning compressor (6) on Drive module (7).

Tighten screws (5) on air conditioning compressor (6).

Tightening torque [64 52 2AZ](#) .

Attention!

Observe notes on [UNLOCKING AND DISCONNECTING PLUG CONNECTIONS](#) on electric vehicles.

Connect connector (4) of high-voltage cable and lock.

Connect connector (3) of signal line and lock.

Tighten equipotential bonding line (2) with screw (1).

Attention!

Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) !

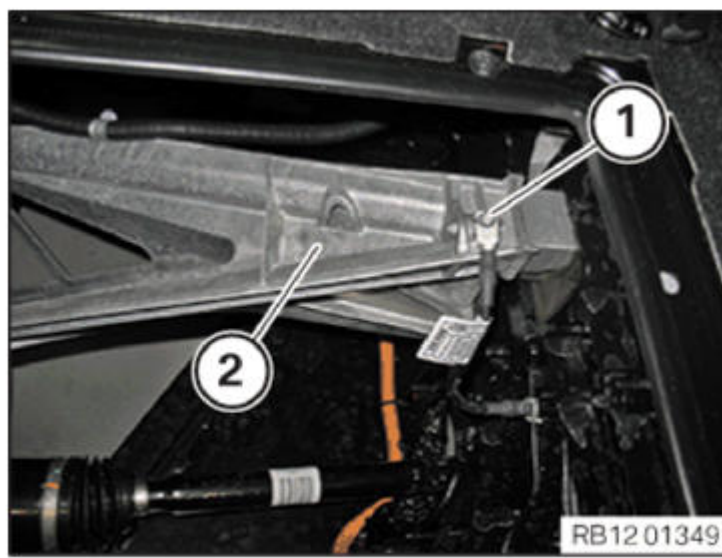
Tightening torque [64 52 3AZ](#) .

Tighten the screw from the equipotential bonding line (1) on the transmission mounting bracket (2).

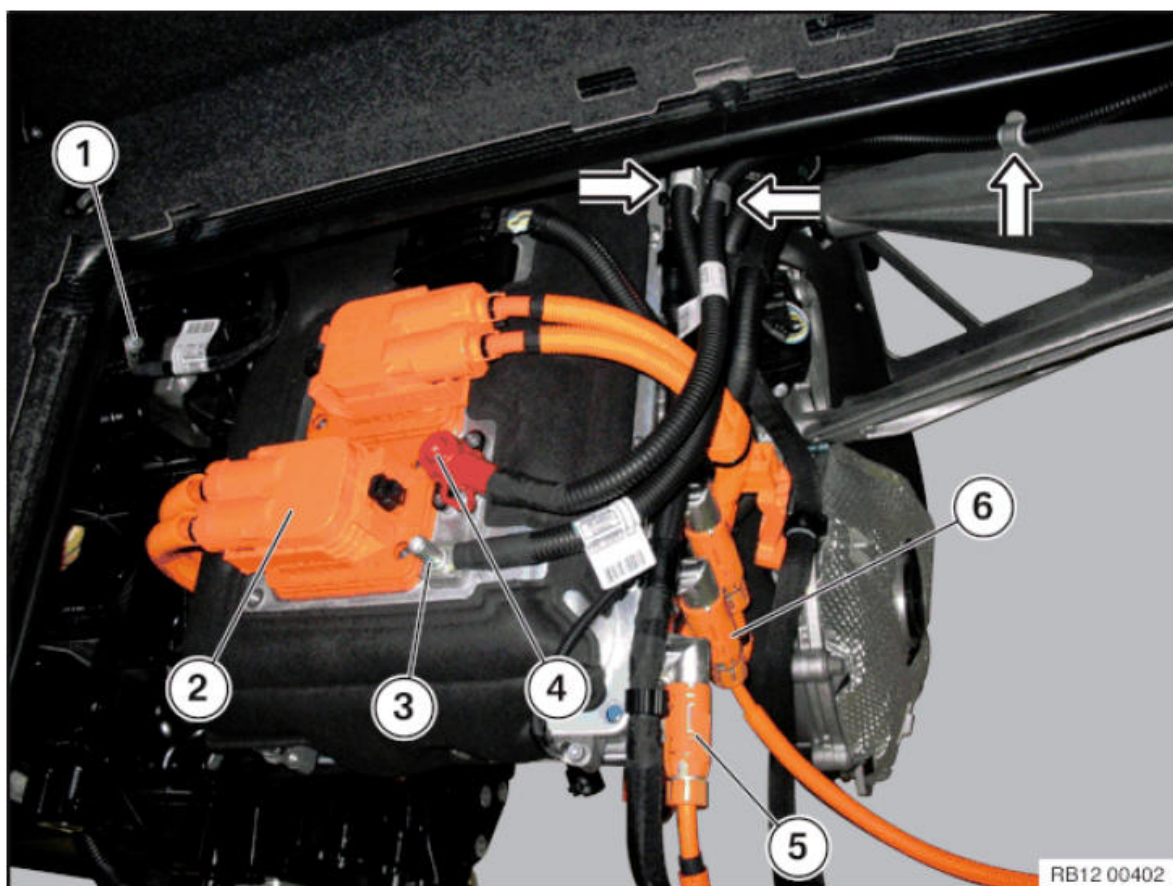
**Attention!**

Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) !

Tightening torque [12 36 12AZ](#) .



**Fig. 169: Identifying Bonding Line And Transmission Mounting Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 170: Locating Earth Lead And Positive Battery Cable Clips**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Connect and lock connector of high-voltage cable (6) to electric auxiliary heater at EME.

Connect and lock connector of high-voltage cable (5) to charging socket and convenience charging electronics at EME.

Clip in battery earth lead and positive battery cable.

Tighten nut (4) of positive battery cable at EME and connect cover.



Tightening torque [12 36 3AZ](#) .

Tighten battery earth lead with nut (3) at EME.

Attention!

Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) !

Tightening torque [12 36 2AZ](#) .

Connect and lock connector of high-voltage cable (2) to high-voltage battery unit at EME.

Attention!

Observe notes on [UNLOCKING AND DISCONNECTING PLUG CONNECTIONS](#) on electric vehicles.

Tighten equipotential bonding line with screw (1) at Drive module.

Attention!

Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) !

Tightening torque [12 36 1AZ](#) .

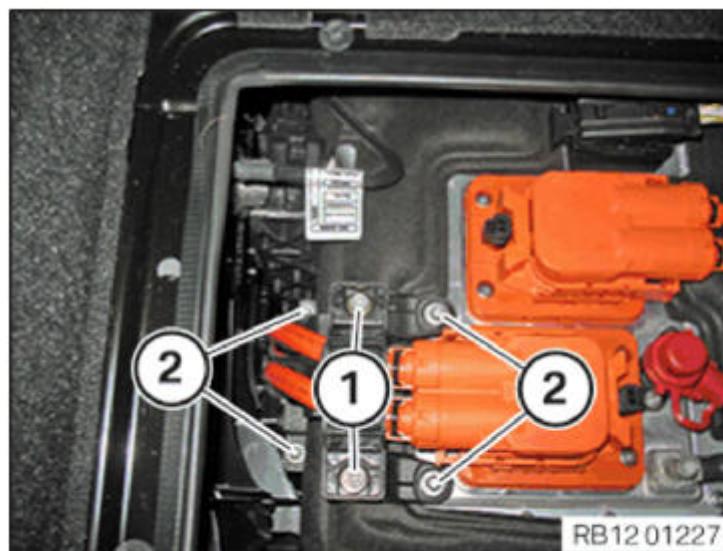
**On vehicles from version 12/2014:**

Tighten the screws (2) of the tension relief bracket.

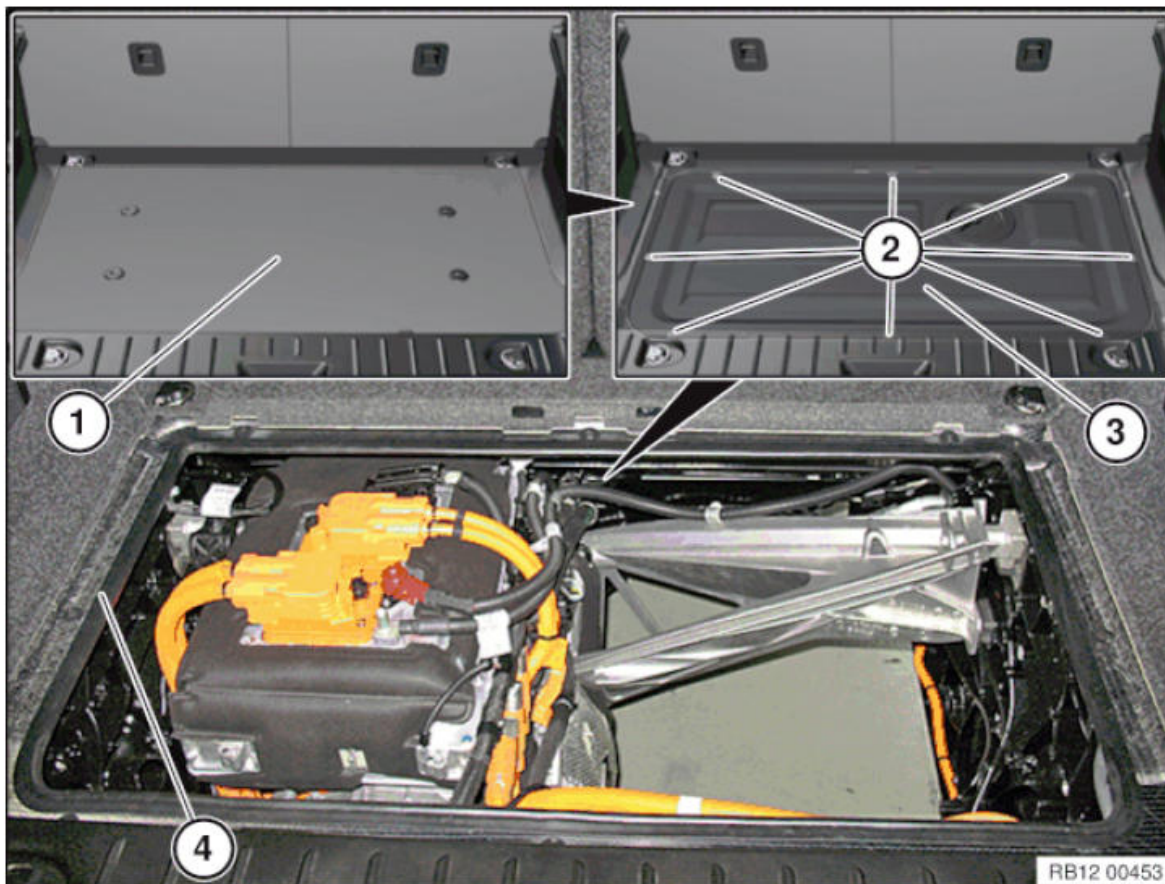
Tightening torque [61 12 7AZ](#) .

Position tension relief and tighten screws (1).

Tightening torque [61 12 8AZ](#) .



**[Fig. 171: Identifying Tensioner Relief And Bracket Screws](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 172: Identifying Floor Trim Panel, Service Cap, Gasket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

Position service cap and tighten screws (2).

Tightening torque [51 47 4AZ](#) .

Insert luggage compartment floor trim panel (1).

**Required follow-up work:**

- Fill and vent [COOLING SYSTEM](#)

**12 35 000 REMOVING AND INSTALLING COMPLETE DRIVE UNIT (VEHICLES WITH RANGE EXTENDER)**

**Special tools required:**

- [2 357 222](#)
- [2 357 221](#)
- [2 286 319](#)
- 0 490 567

**WARNING:**

High-voltage system - danger to life  
 Compliance with the following points is mandatory before beginning work:

- De-energize the [HIGH-VOLTAGE SYSTEM](#).
- Observe [SAFETY INFORMATION](#) for handling electric cars.
- Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) .

## Necessary preliminary tasks:

- Briefly open the fuel filler cap to reduce pressure in fuel tank.

In this way, it prevents after-run of fuel of an opened fuel line.

- **CLAMP OFF BATTERY LEAD FROM NEGATIVE TERMINAL**

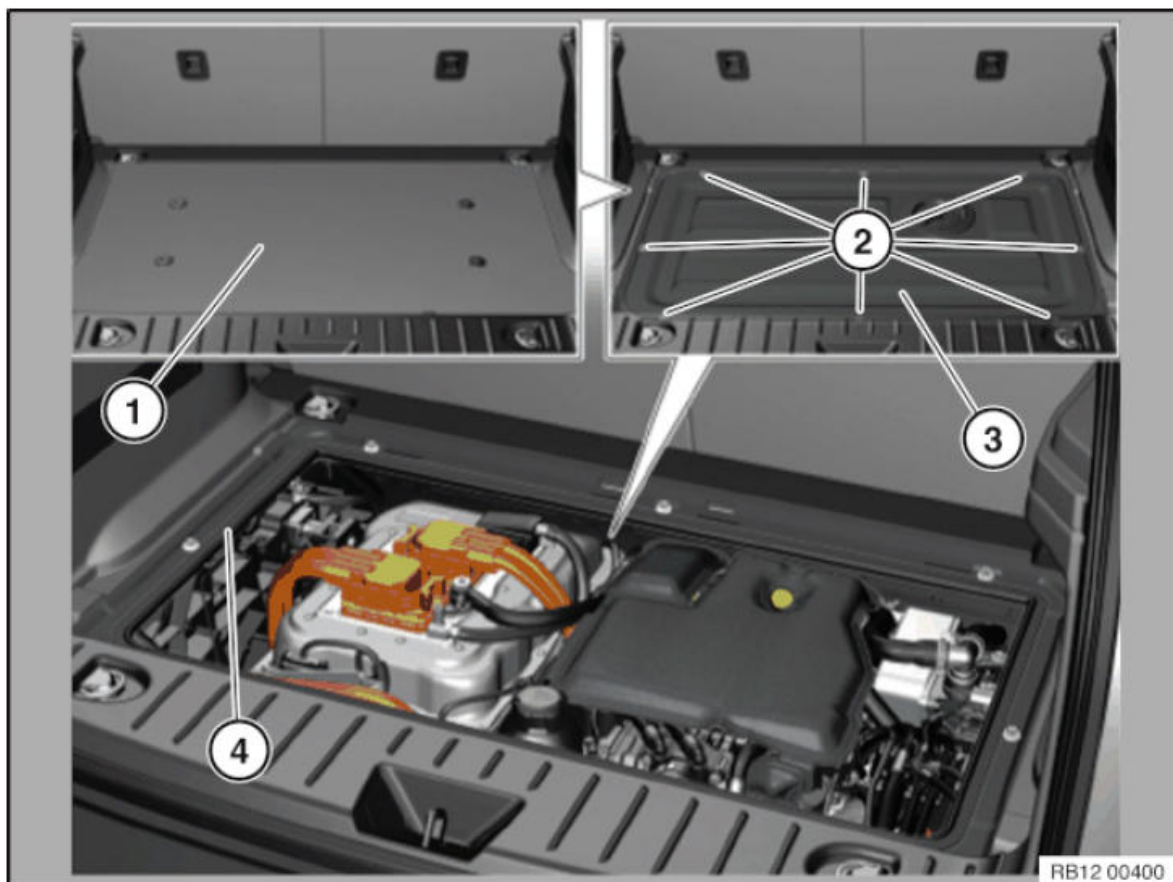
**NOTE:** Before disconnecting the battery cable, it must be ensured that the vehicle goes to sleep.

- Drain **COOLANT** .
- Remove **SUPPORT FOR REAR BUMPER PANEL** .
- Remove BOTH HORIZONTAL STRUTS .
- Remove VERTICAL STRUT .
- With equipment "rapid charging direct current" (SA4U7) and "rapid charging alternating current" (SA4U6 or SA4U8):

Remove convenience charging electronics. See **REPLACING CONVENIENCE CHARGING ELECTRONICS** .

- Remove **RANGE EXTENDER ELECTRICAL MACHINE ELECTRONICS**.
- Take off REAR CROSSMEMBER .
- Remove output shaft on left and right. See **REPLACING LEFT OUTPUT SHAFT** or **REPLACING RIGHT OUTPUT SHAFT** .

## REMOVAL:



**Fig. 173: Identifying Floor Trim Panel, Service Cap, Screws And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

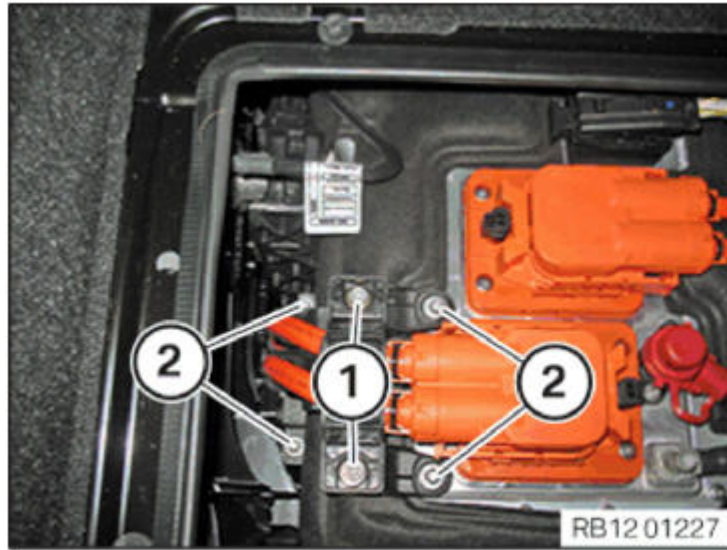
Release screws (2) and remove service cap (3) towards top.



**On vehicles from version 12/2014:**

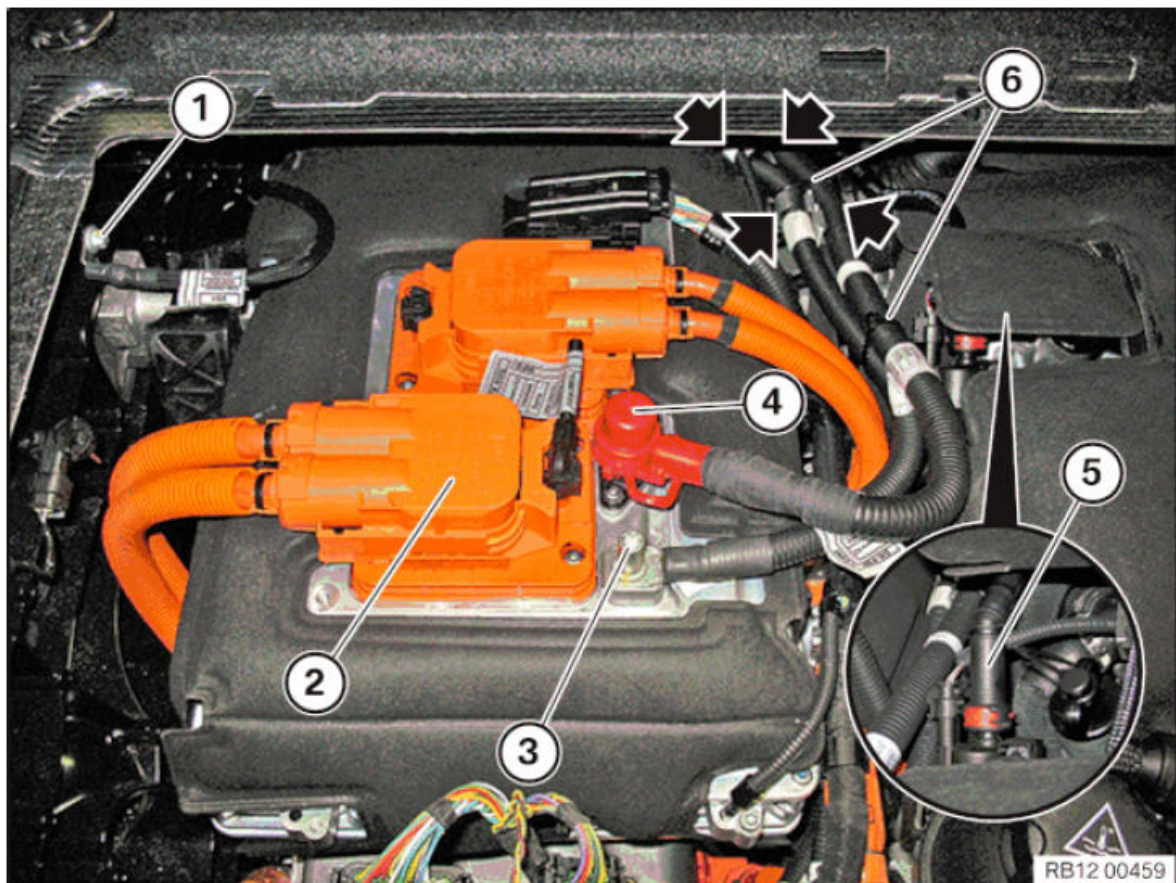
Release the screws (1) and remove the tension relief.

Loosen the screws (2) from the bracket for tension relief.



**Fig. 174: Identifying Tensioner Relief And Bracket Screws**

Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 175: Locating Positive Battery Cable Strap**

Courtesy of BMW OF NORTH AMERICA, INC.

Release equipotential bonding line (1) from drive module.

Disconnect high-voltage cable (2) from high-voltage battery unit on electrical machine electronics.

Attention!

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

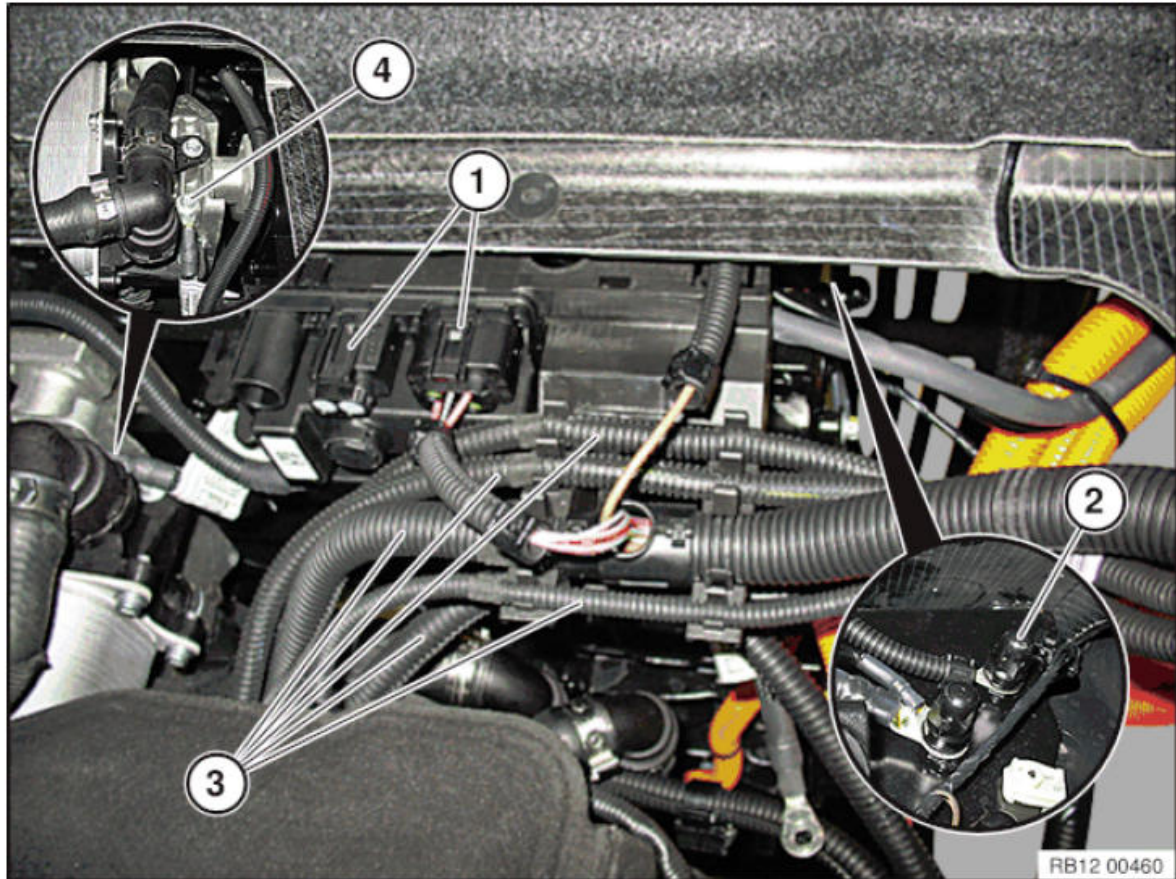
Release nut (3) from battery earth lead on electrical machine electronics.

Take off cover and release nut (4) from positive battery cable on electrical machine electronics.

Fold open sound insulation and unlock and disconnect plug connection of tank vent valve (5).

Unclip the battery earth lead and positive battery cable on both cable clips of the electrical machine electronics.

Detach cable strap (6) from positive battery cable on battery earth lead.



**Fig. 176: Identifying Power Distribution Box Plug Connections, Lines, Screw And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

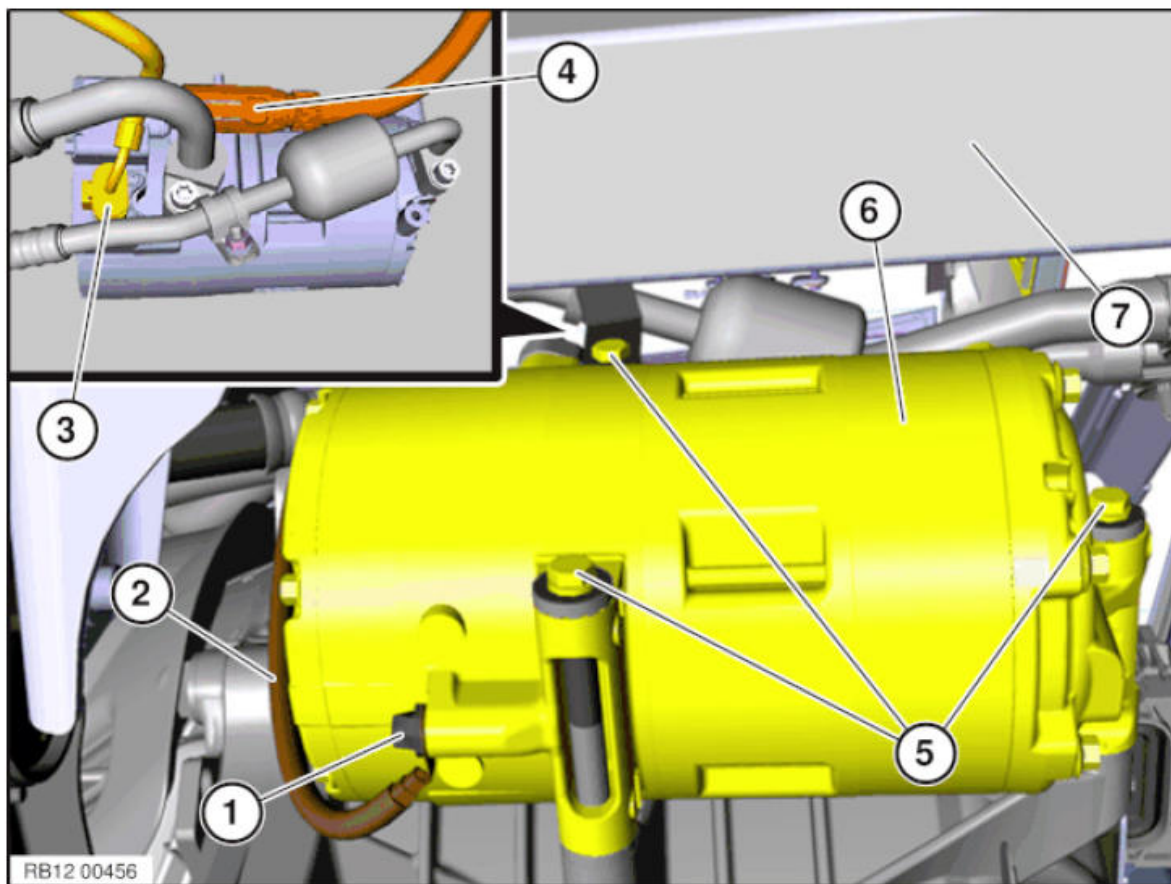
Depending on equipment version, unlock and disconnect plug connections (1) on power distribution box.

Unclip lines (3) from holder.

Release nut (2) on earth strap.

Release screw (4) from equipotential bonding on engine mounting bracket.





**Fig. 177: Identifying Signal Line, High Voltage Cable Plug Connection, Equipotential Bonding Line And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) from equipotential bonding line (2).

Disconnect plug connection (3) from signal line.

Attention!

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Disconnect plug connection (4) from high-voltage cable.

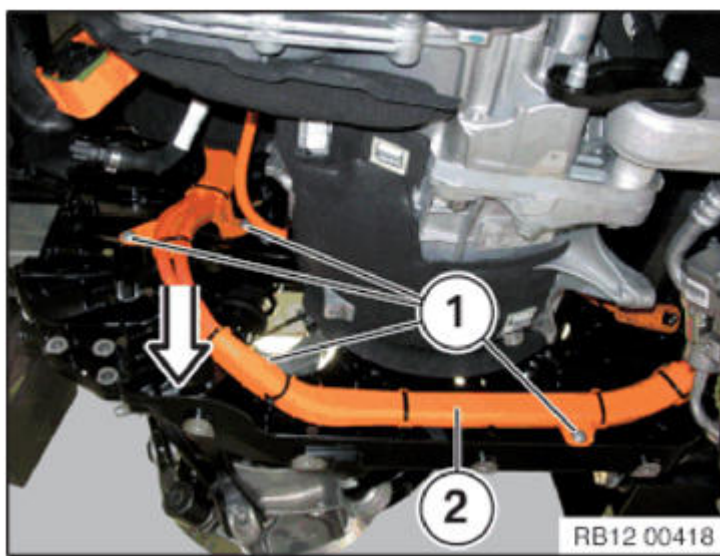
Release screws (5) from air conditioning compressor (6).

Secure air conditioning compressor (6) on Drive module (7) with cable tie or tensioning strap.

**For vehicles built up to 12/2014:**

Release screws (1) from cable duct (2).

Slip out high-voltage cable with cable duct (2) downward and secure on the outer side.

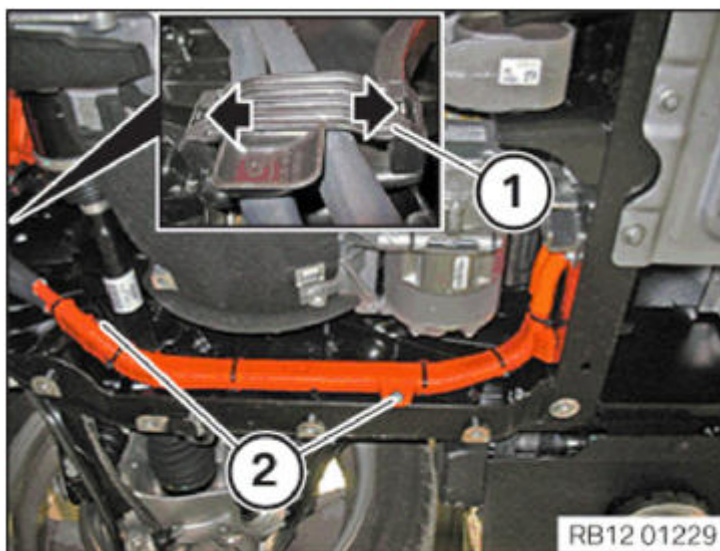


**Fig. 178: Removing High-Voltage Cable With Cable Duct**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Press the retaining lugs towards the outside and pull off the line clip (1).

Unfasten screws (2).

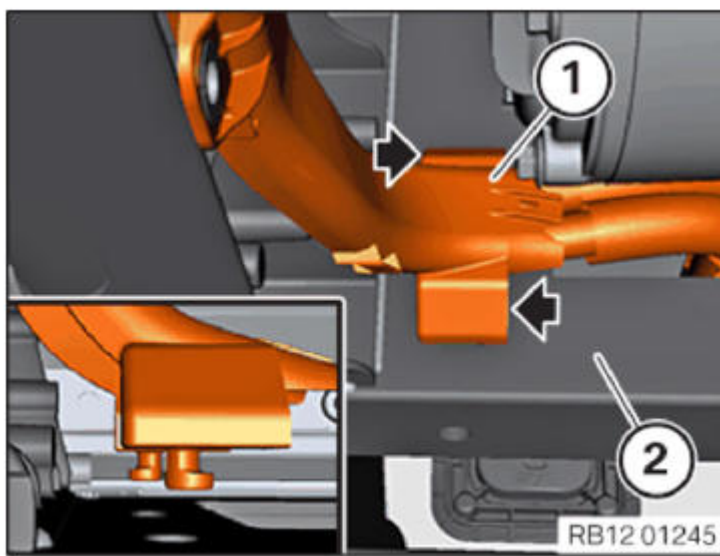


**Fig. 179: Pressing Line Clip Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Detach the retaining lugs from the cable channel (1) of the Drive module (2) in the direction of the arrow.

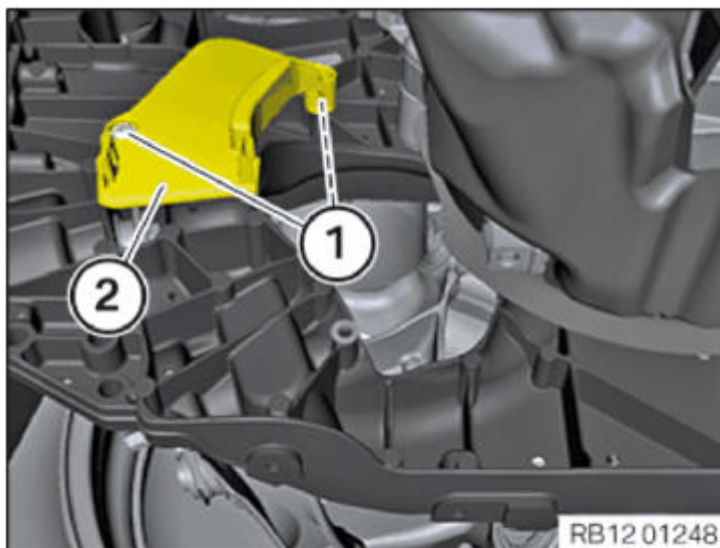
Remove the high-voltage cable including cable channel (1) towards the bottom and secure to the side on the outside.



**Fig. 180: Detaching Retaining Lugs From Cable Channel Of Drive Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Loosen the screws (1) and remove the shaft (2).



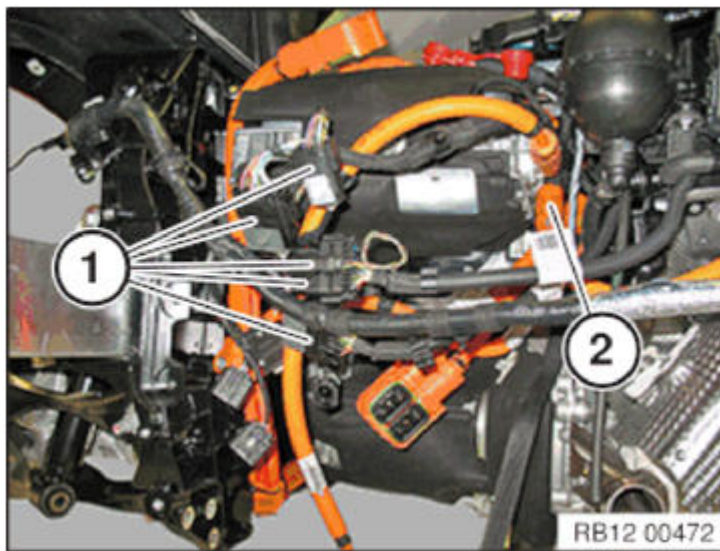
**Fig. 181: Identifying Shaft And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

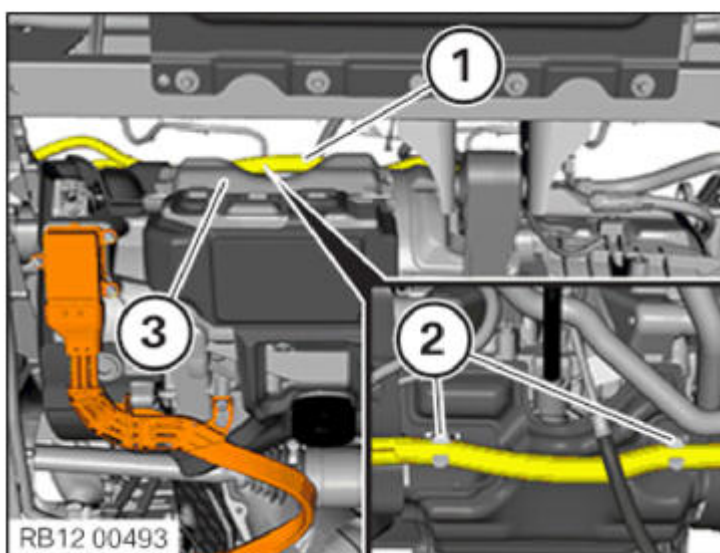
Disconnect plug connections (1) from wiring harness.

Disconnect plug connection (2) from high-voltage cable on electrical machine electronics.



**Fig. 182: Identifying Wiring Harness And High Voltage Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach positive battery cable (1) from clamps (2) on range extender (3).



**Fig. 183: Identifying Positive Battery Cable, Clamps And Range Extender**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

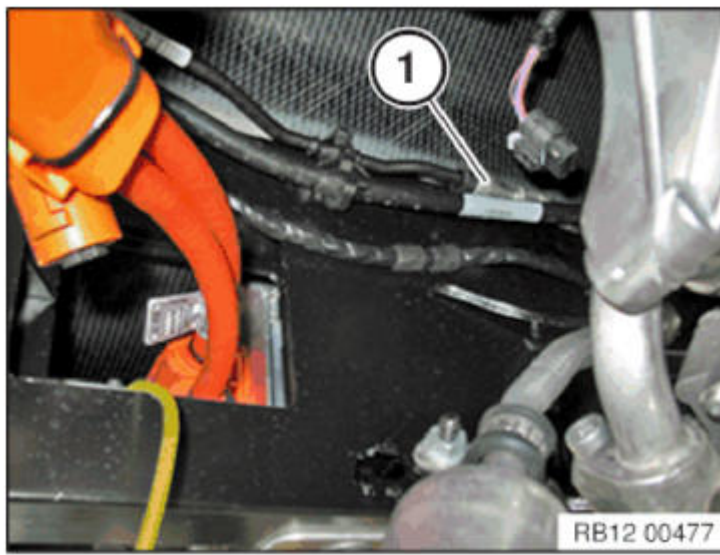
Fuel escapes when fuel line is detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

Unfasten fuel line (1) and disconnect.





**Fig. 184: Identifying Fuel Line**

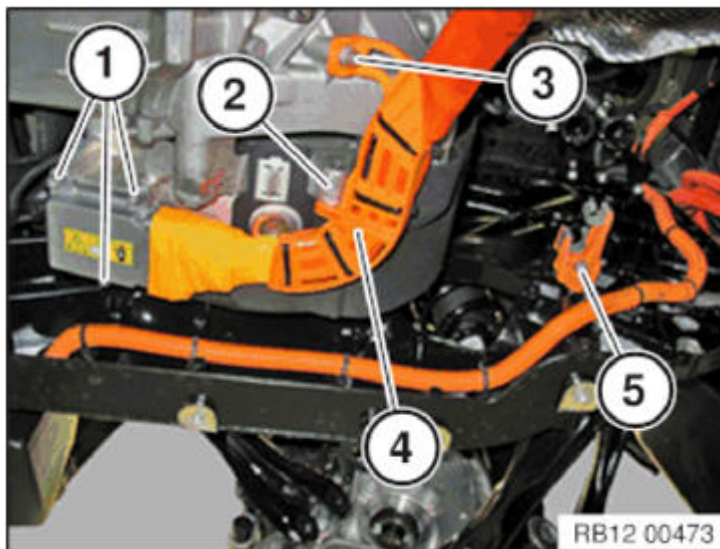
Courtesy of BMW OF NORTH AMERICA, INC.

Undo screws (1) and pull off connector of high-voltage cable on range extender electrical machine (2).

Unscrew nut (3).

Detach high-voltage cable (4) from range extender electrical machine (2) and remove.

Release screw (5) and remove holder for high-voltage cables of range extender electrical machine.



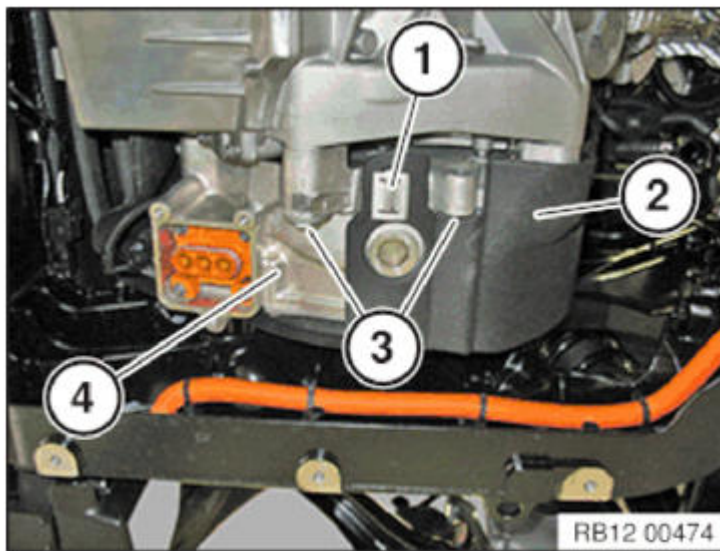
**Fig. 185: Identifying Range Extender Electrical Machine, High-Voltage Cable, Nut And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Pry off clamp (1).

Slip out sound insulation (2) and fold away downward.

Undo screws (3) on range extender electrical machine (4).

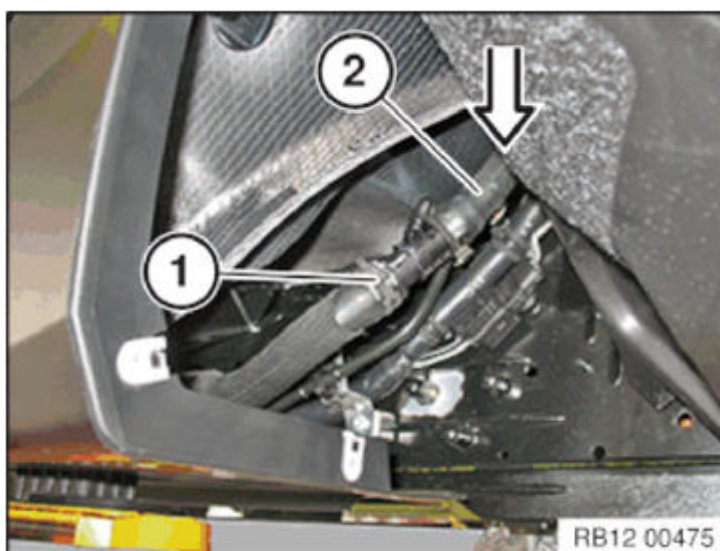


**Fig. 186: Identifying Range Extender Electrical Machine, Sound Insulation, Screws And Clamp**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Left side of vehicle:**

Open clamp (1) if necessary and disconnect coolant hose (2).

Unclip coolant hose (2) on Drive module and slip out.

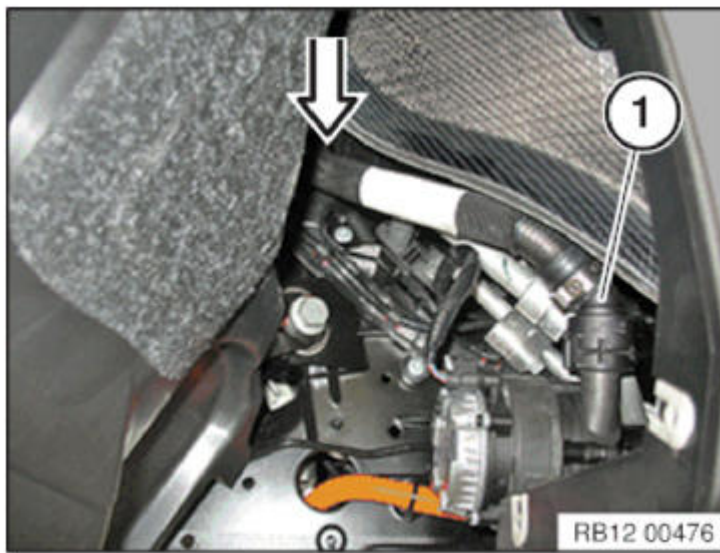


**Fig. 187: Unclipping Coolant Hose On Drive Module (Vehicle Left Side)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Right side of vehicle:**

Unlock and disconnect coolant hose (1).

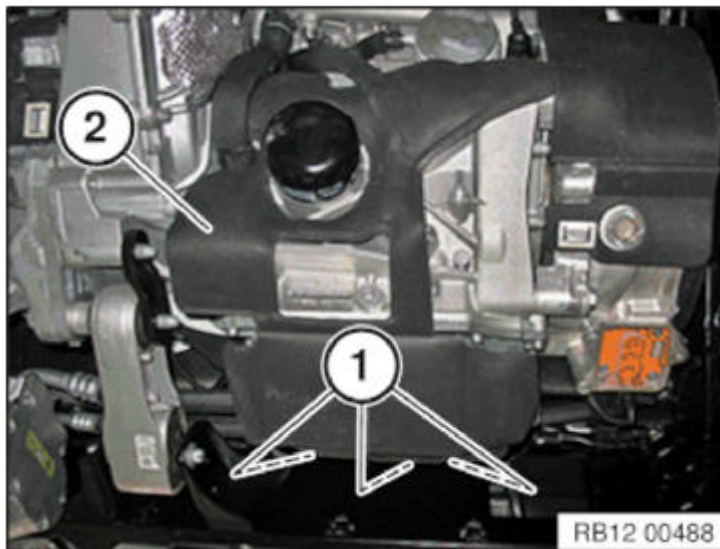
Unclip coolant hose (1) on Drive module and slip out.



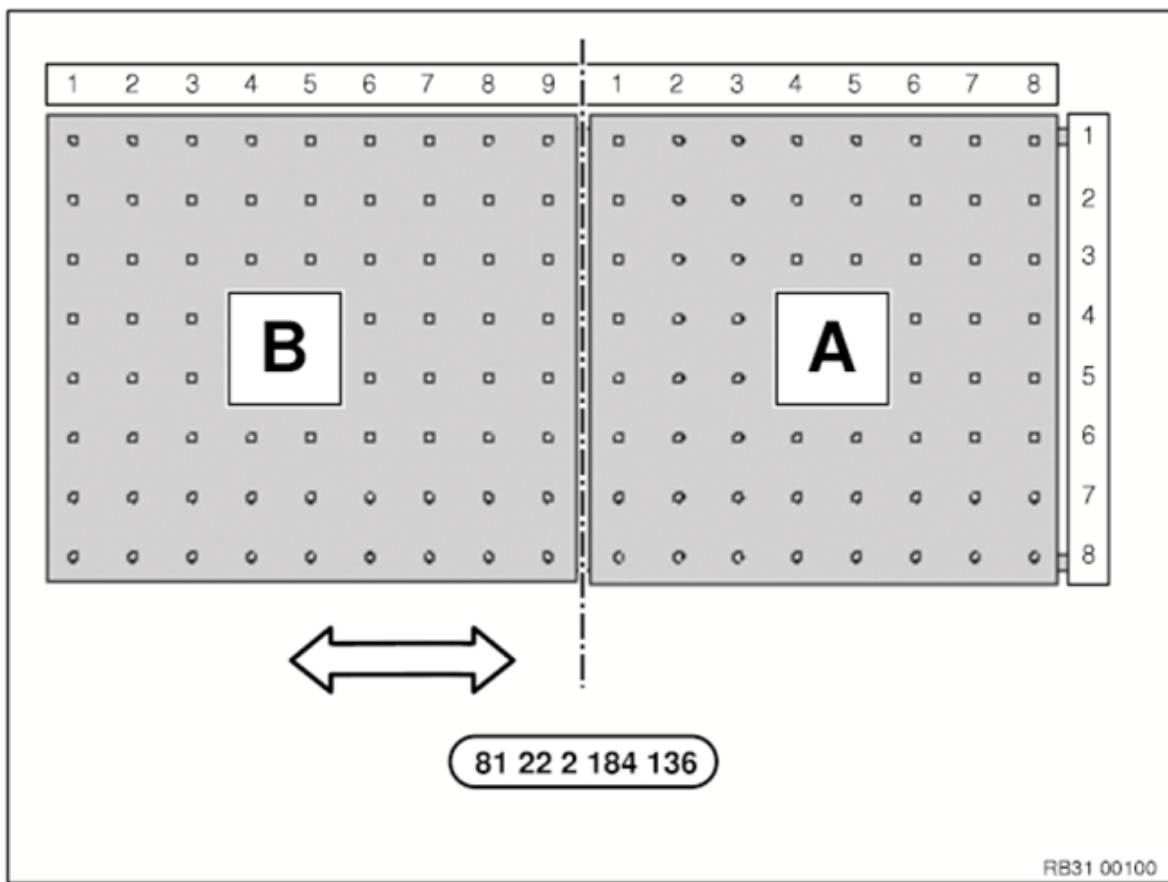
**Fig. 188: Unclipping Coolant Hose On Drive Module (Vehicle Right Side)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pry off clamps (1).

Feed out and remove sound insulation (2).



**Fig. 189: Identifying Sound Insulation And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 190: Identifying Mobile Table Lift**

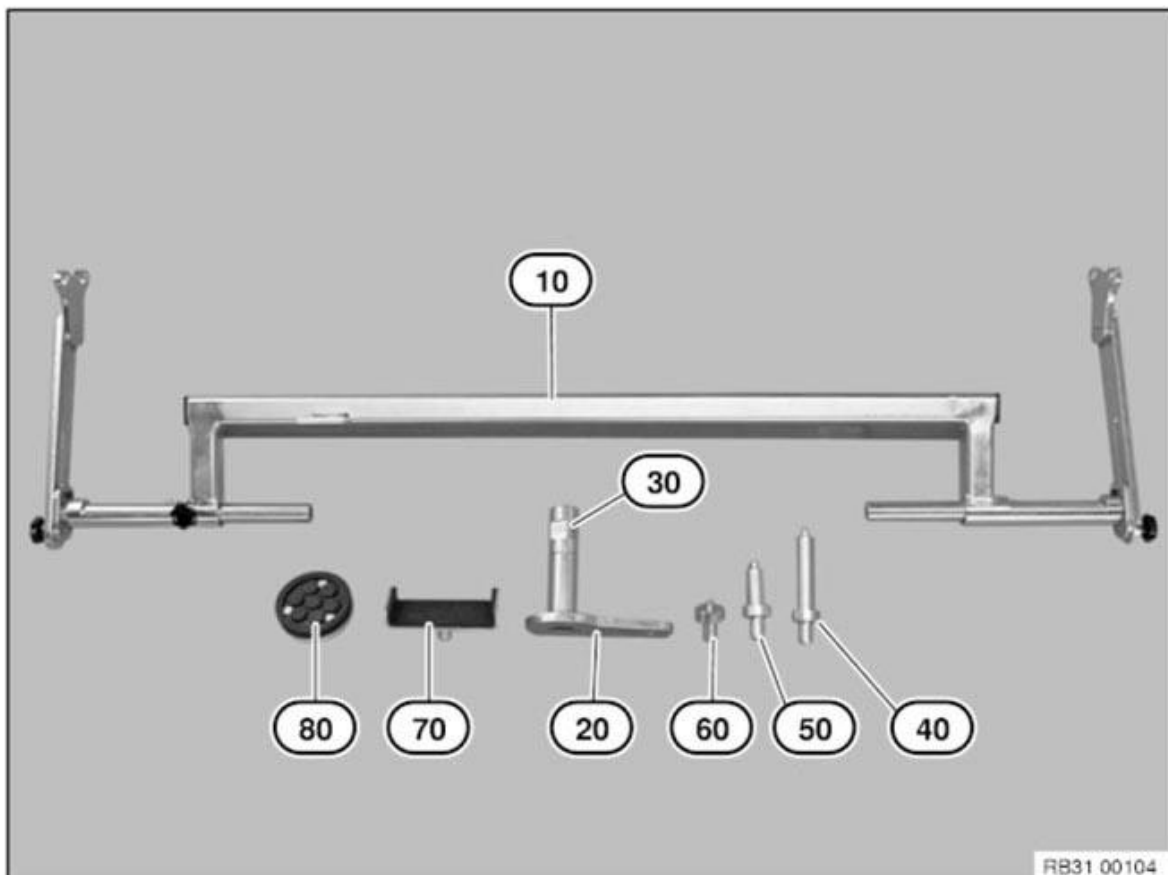
Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

**Coordinate determination always begins at the top.**

**Sourcing reference for mobile table lift (part number 81 22 2 184 136):**

Comply with **NOTES REGARDING HANDLING MOBILE TABLE LIFT** .

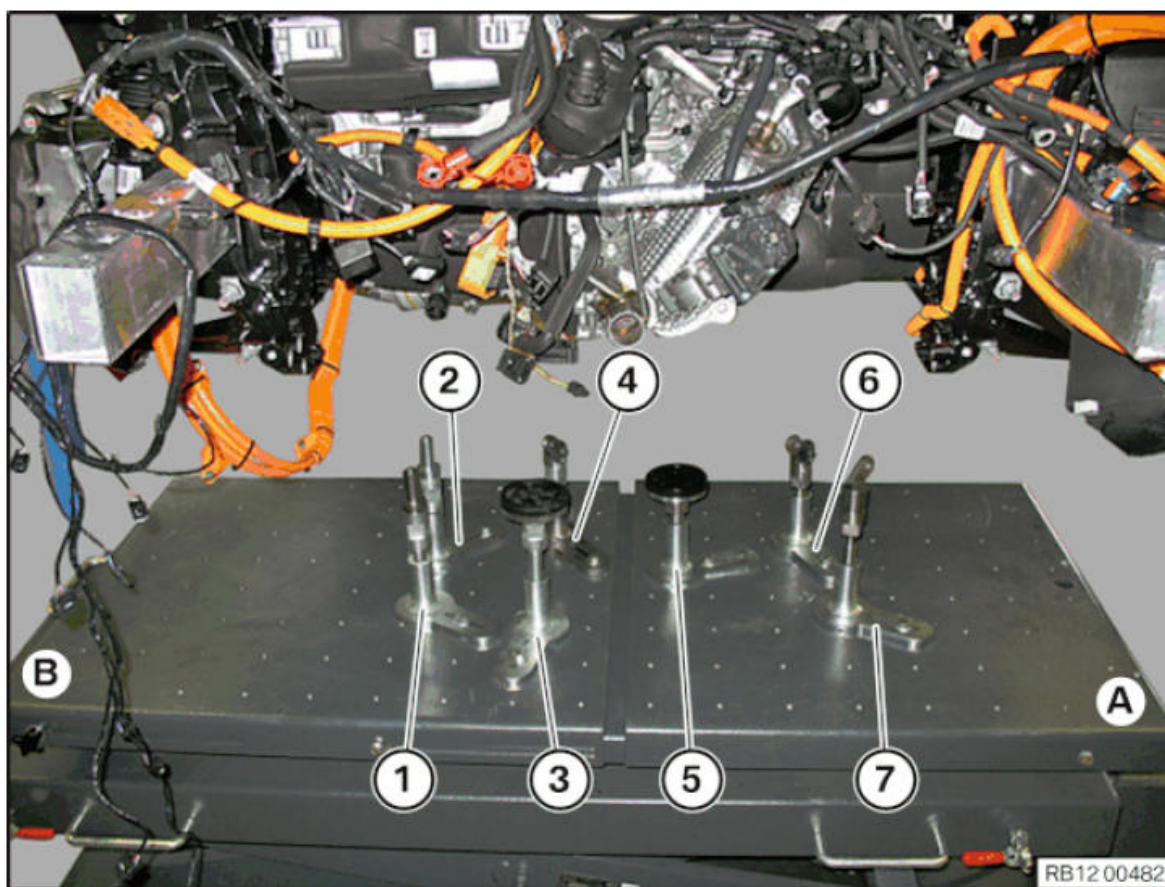




**Fig. 191: Identifying Tools From Lifting Table Attachment Set**  
Courtesy of BMW OF NORTH AMERICA, INC.

The following tools from the lifting table attachment set (part number 81 22 2 305 379) are required:

Tool number:	Number:
20	3
80	2



**Fig. 192: Overview Of Structure Table Lift**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Structure, table lift:**

Position 1:

Position retaining element (20) using special tool [2 357 222](#) onto table plate {B} at coordinates 7/6.

Position 2:

Position retaining element (20) using special tool [2 357 222](#) onto table plate {B} at coordinates 7/3.

Position 3:

Position retaining element (20) with support plate (80) onto table plate {B} at coordinates 8/7.

Position 4:

Position special tool [2 357 221](#) onto table plate {B} at coordinates 9/4.

Attention!

Secure special tool [2 357 221](#) onto the table lift at a later stage.

Position 5:

Position lower section of special tool [2 357 221](#) with support plate (80) onto table plate {A} at coordinates 2/4.

**NOTE:** Drive dowel pin out of special tool [2 357 221](#) and remove upper section. Insert support plate (80) in lower section of special tool [2 357 221](#) .

Position 6:

Position special tool [2 357 221](#) onto table plate {A} at coordinates 5/6.

Position 7:

Position special tool [2 357 221](#) onto table plate {A} at coordinates 5/6.

**Overview of mounting points of table lift on electrical machine and range extender:**

Position 1:

2 x special tool [2 357 222](#) with fixture 20

Position 2:

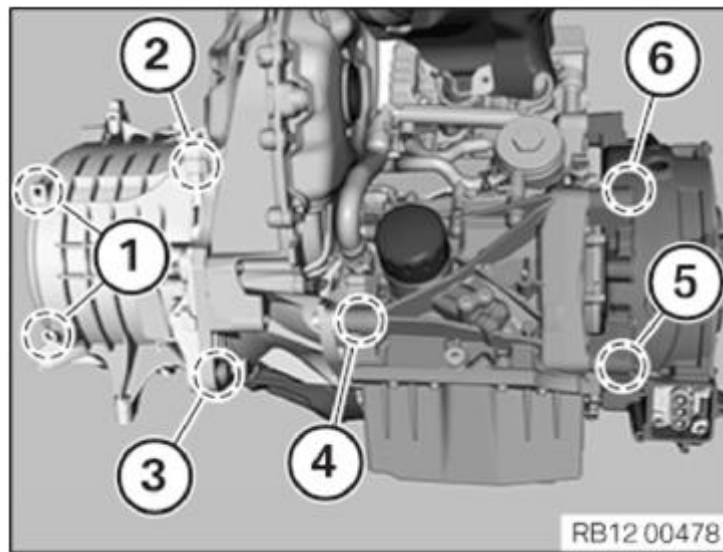
1 x support plate 80 with fixture 20

Position 3:

1 x special tool [2 357 221](#)

Position 4:

1 x support plate 80 with lower section of special tool [2 357 221](#)



**Fig. 193: Overview Of Mounting Points Of Table Lift On Electrical Machine And Range Extender**  
Courtesy of BMW OF NORTH AMERICA, INC.

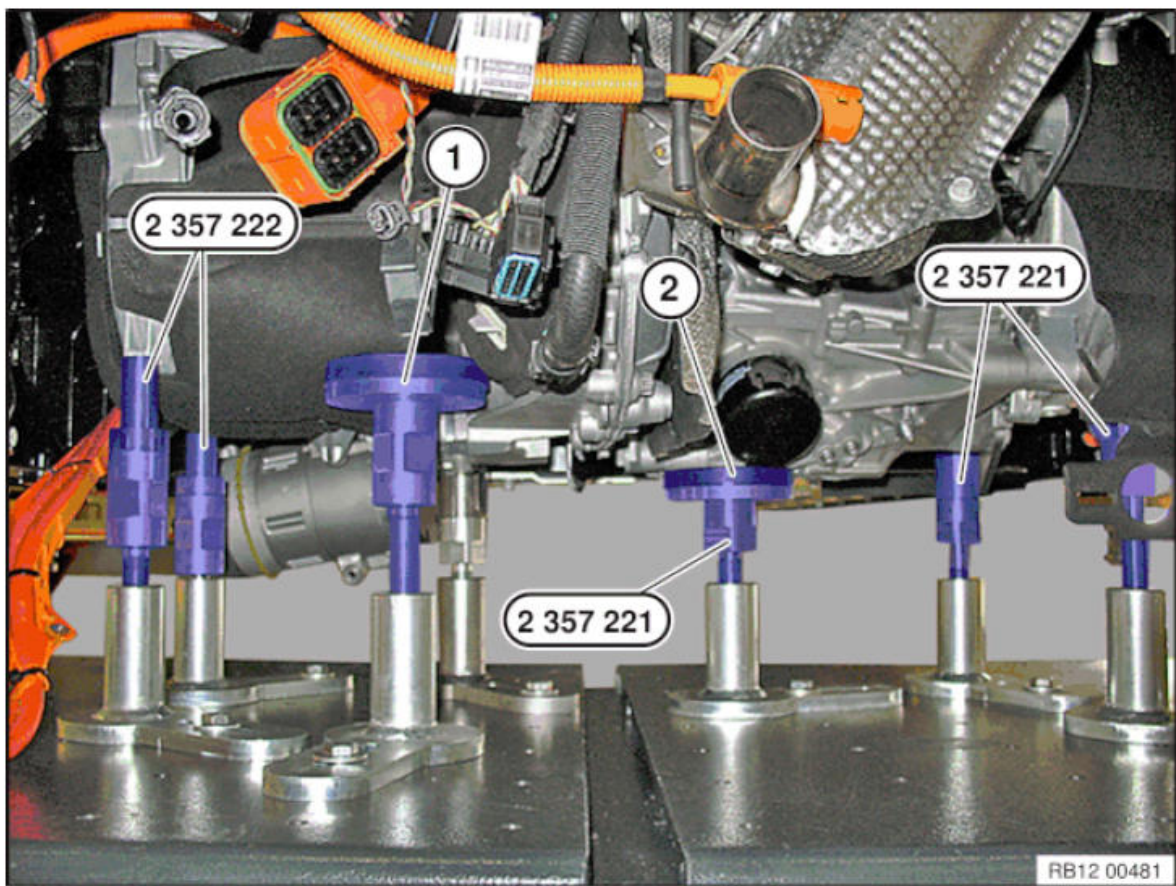
Position 5:

1 x special tool [2 357 221](#)

Position 6:

1 x special tool [2 357 221](#)





**Fig. 194: Positioning Special Tool (2 357 221) On Range Extender Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide the lifting table under the vehicle from the side (from the right-hand side). Position mounting below drive unit.

Raise the lifting table and position special tool [2 357 222](#) at the mounting points of the electrical machine.

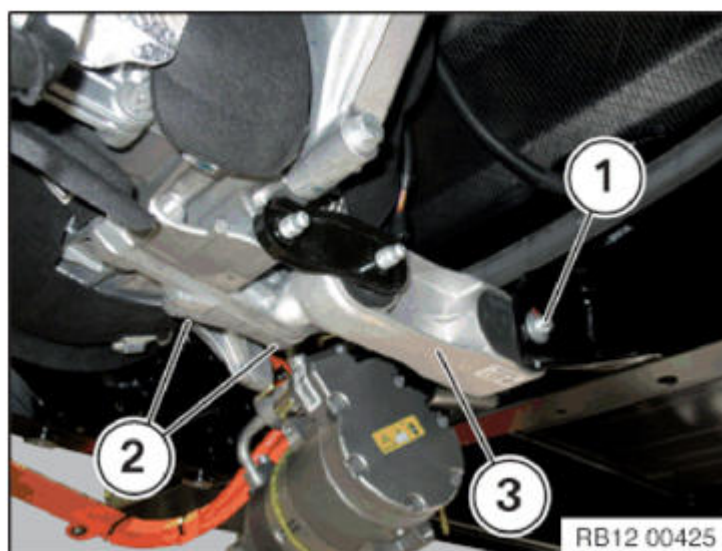
Position support plate (1) at mounting point of electrical machine.

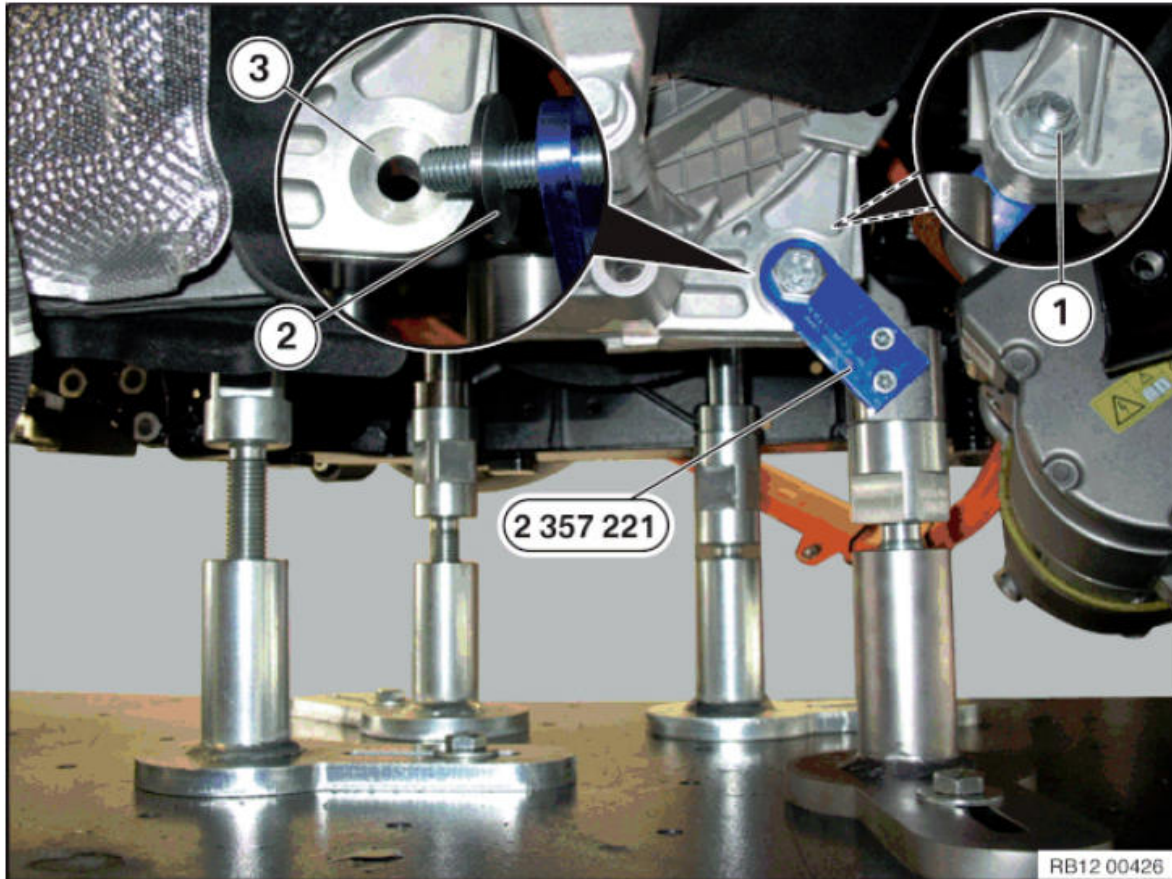
Position support plate (2) at mounting point of range extender.

Position special tool [2 357 221](#) on range extender electrical machine and fix in place with original screws.

Release screw (1) of engine anti-roll bar link (3).

Release screws (2) and remove engine anti-roll bar link (3).





**Fig. 196: Positioning Special Tool (2 357 222) On Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

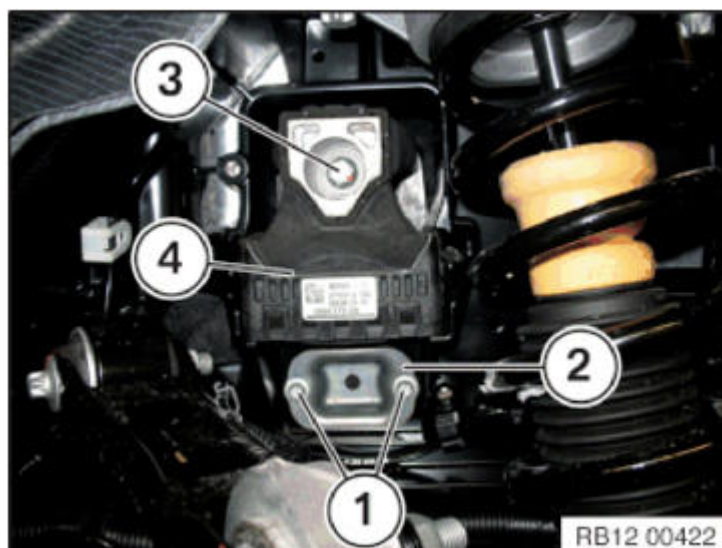
Position special tool [2 357 221](#) on electrical machine and secure with nut (1).

**NOTE:** Washer (2) must rest against taper (3) of electrical machine.

Release left and right screws (1) and remove stop pad (2).

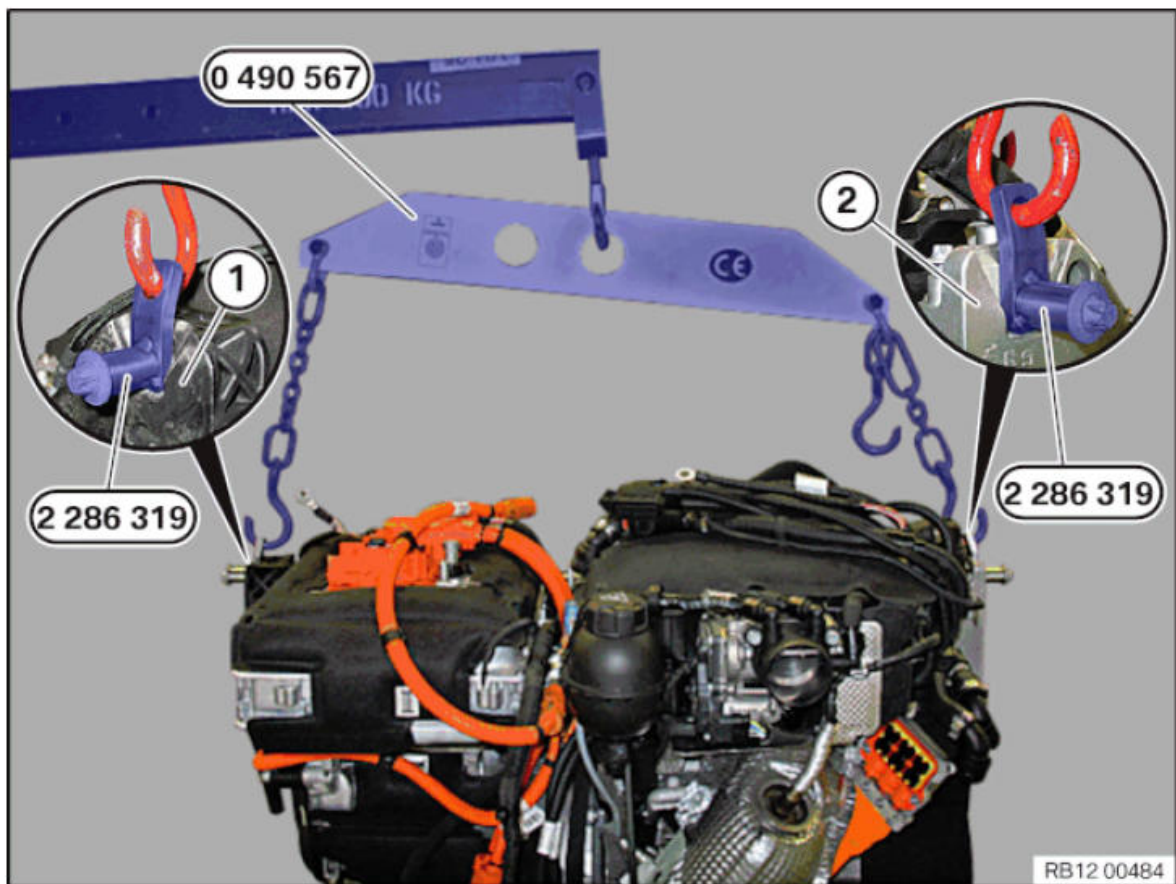
Release left and right screws (3) from support bearing.

Carefully lower the lifting table including drive unit.



**Fig. 197: Identifying Stop Pad And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.





**Fig. 198: Securing Special Tool (2 286 319) On Engine Mounting Bracket On Left And Right**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** If it is necessary to remove the entire drive unit from the table lift, note the following:

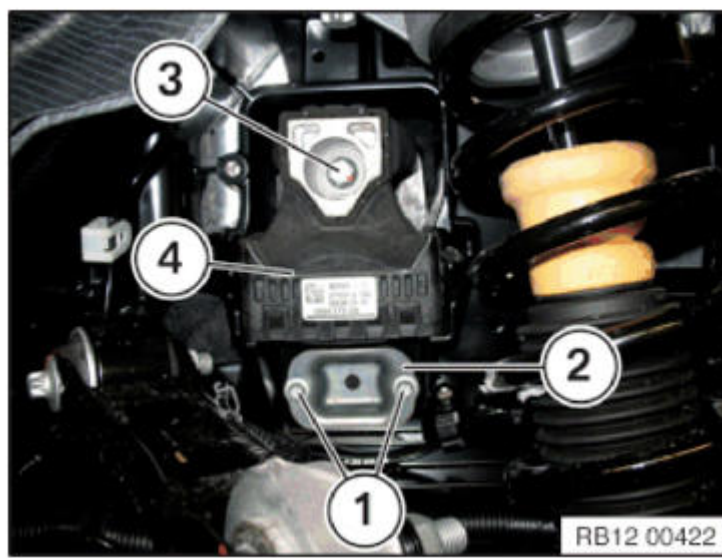
1. Secure special tool **2 286 319** on engine mounting bracket on the left and right (1, 2) with original screws.
2. Attach special tool **0 490 567** to special tool **2 286 319** .
3. Release fixations of drive unit on table lift.
4. Lift drive unit off of table lift with workshop crane.

**INSTALLATION:**

Check support bearing (4) on left and right for damage. Renew the damaged support bearing.

**Attention!**

It is also necessary to align the bore holes in front of the screw connection when installing a new engine mounting bracket or transmission mounting bracket. Align support bearing (4) with the engine mounting bracket/transmission mounting bracket before screwing on with a suitable tool (e.g. drill with shaft diameter of 11 mm).



**Fig. 199: Identifying Stop Pad And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully lift and position the lifting table including drive unit.

Tighten left and right screws (3) on support bearing (4).

*Installation note:*

**Left side - support bearing on engine mounting bracket of the electrical machine:**

Renew screw.

Tightening torque [27 00 8AZ](#) .

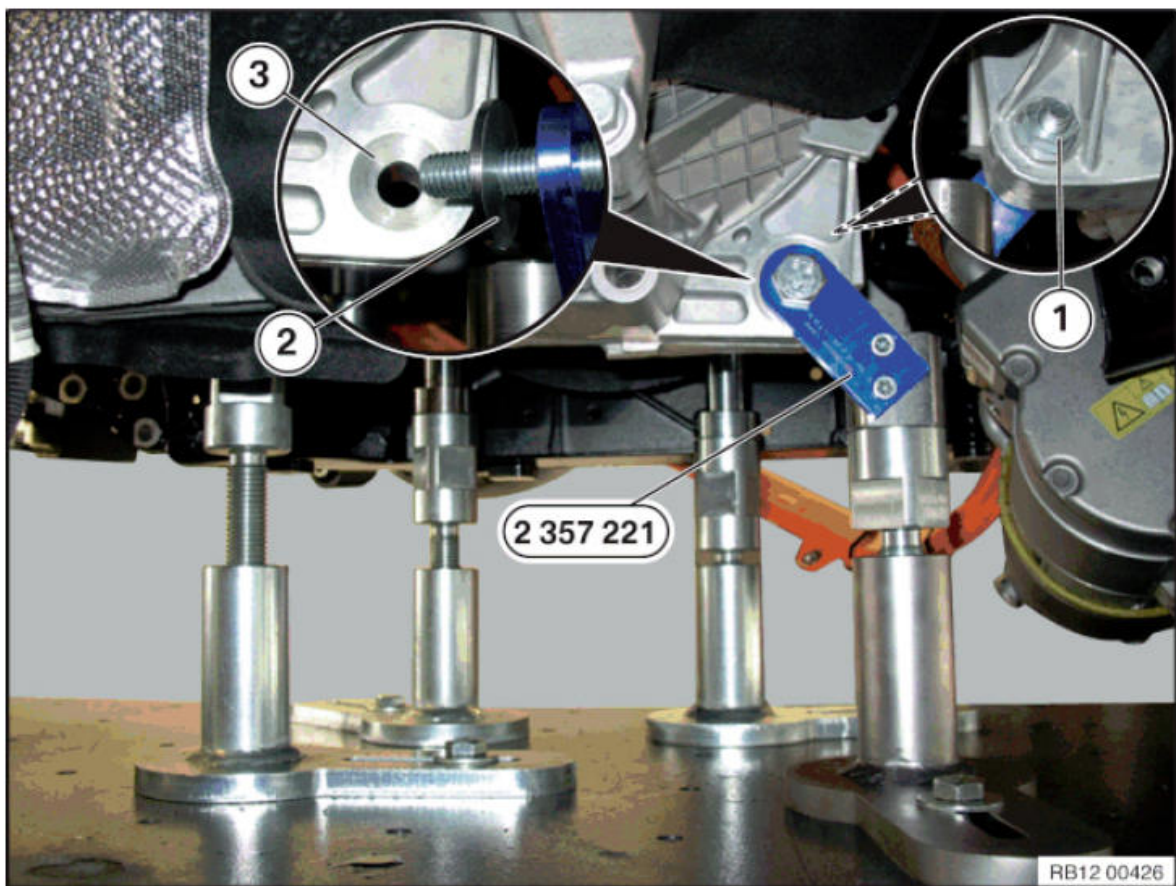
**Right side - support bearing on the engine mounting bracket of the range extender electrical machine:**

Renew screw.

Tightening torque [27 00 7AZ](#) .

Tighten left and right screws (1) with stop pad (2).

Tightening torque [12 35 1AZ](#) .



**Fig. 200: Positioning Special Tool (2 357 221) On Electrical Machine**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release nut (1) from electrical machine (3).

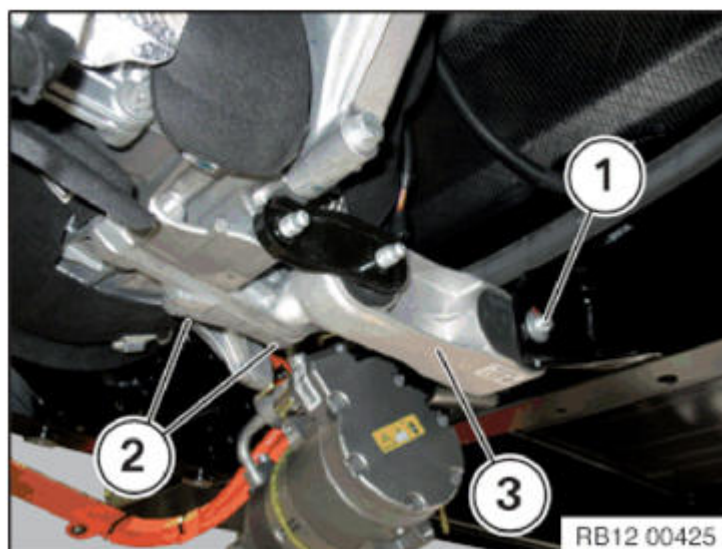
Remove special tool [2 357 221](#) with screw and washer (2).

Tighten screws (2) on engine anti-roll bar link (3).

Tightening torque [27 00 9AZ](#) .

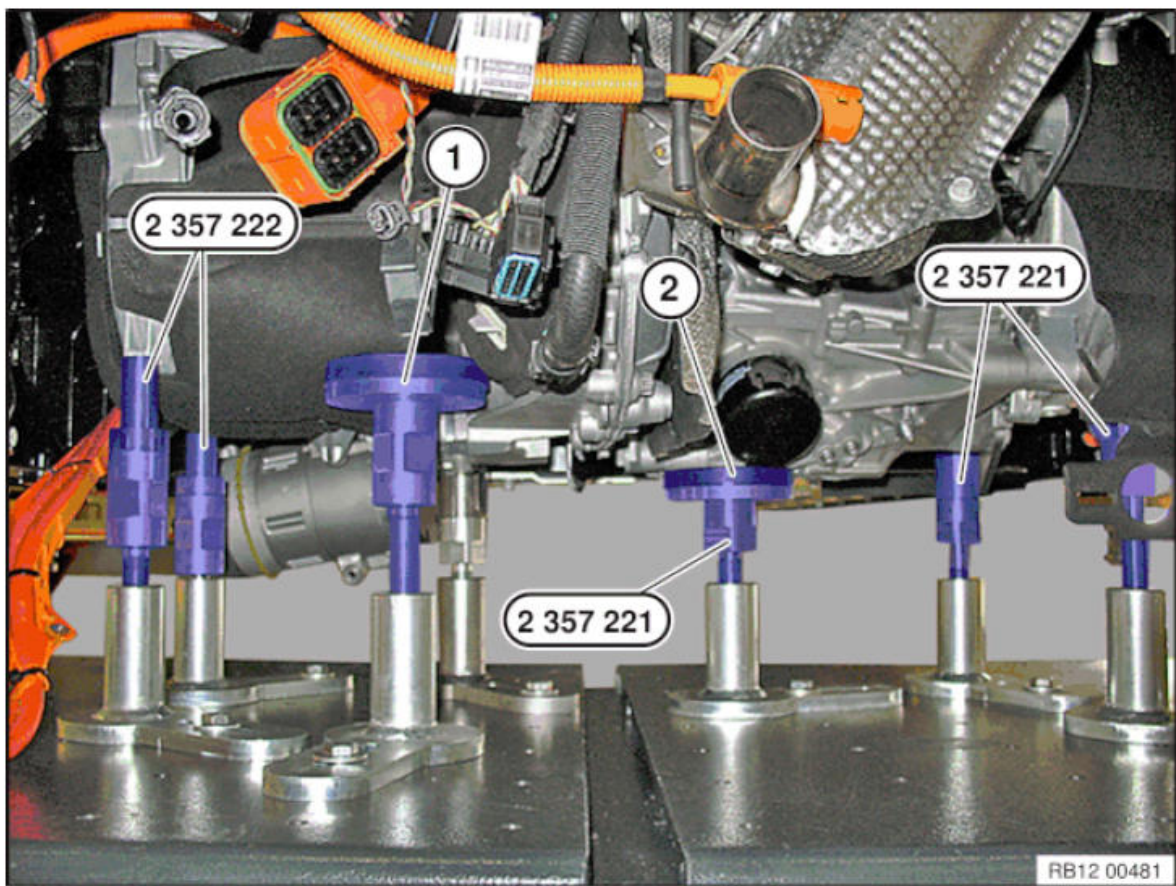
Tighten screw (1) on engine anti-roll bar link (3).

Tightening torque [27 00 10AZ](#) .



**Fig. 201: Identifying Anti-Roll Bar Link And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.





**Fig. 202: Positioning Special Tool (2 357 221) On Range Extender Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

Unclamp special tool [2 357 221](#) before disassembly.

Undo screws on special tools [2 357 221](#) on range extender electrical machine.

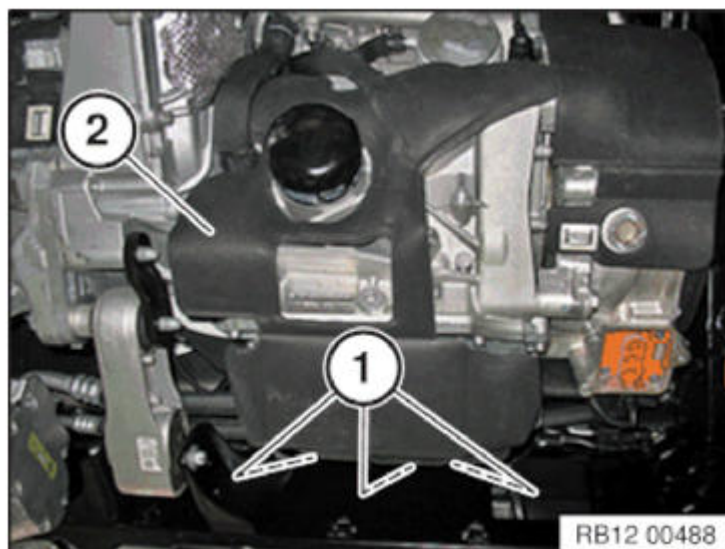
Lower the lifting table.

Feed in and position sound insulation (2).

Connect clamps (1).

**Attention!**

Replace clamps (1).





**Fig. 203: Identifying Sound Insulation And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws (3) on range extender electrical machine.

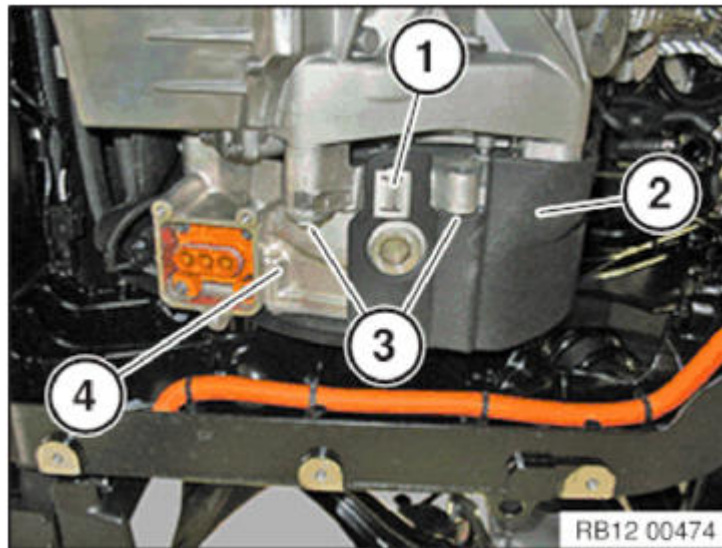
Tightening torque [12 35 9AZ](#) .

Feed in and position sound insulation (2).

Connect clamp (1).

**Attention!**

Use new clamp (1).



**Fig. 204: Identifying Range Extender Electrical Machine, Sound Insulation, Screws And Clamp**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screw (5) on holder for high-voltage cables of range extender electrical machine.

Tightening torque [61 12 5AZ](#) .

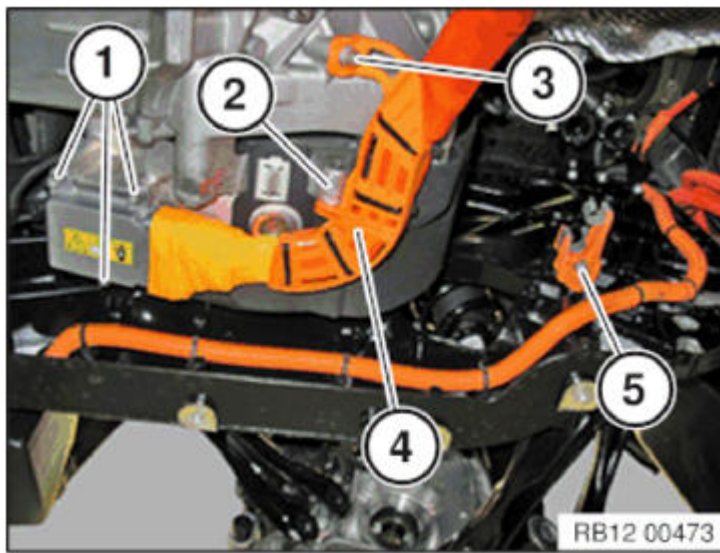
Attach high-voltage cable (4) on range extender electrical machine (2).

Tighten nut (3).

Tightening torque [12 35 8AZ](#) .

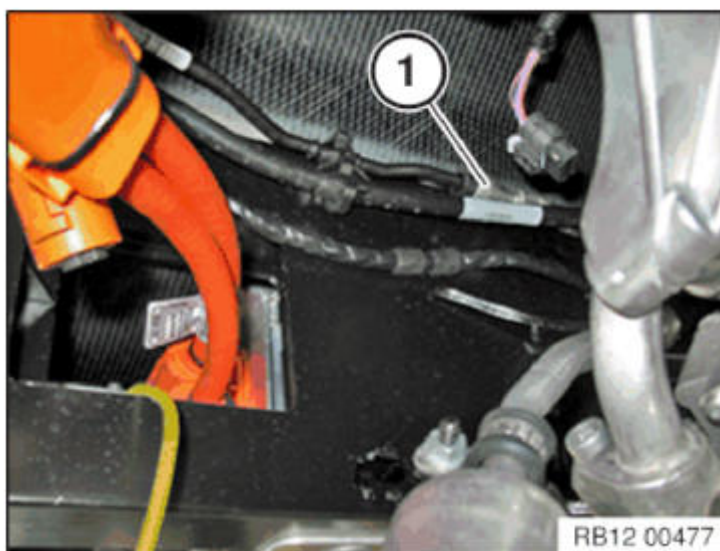
Tighten screws (1) on high-voltage cable connector on range extender electrical machine (2).

Tightening torque [12 35 7AZ](#) .



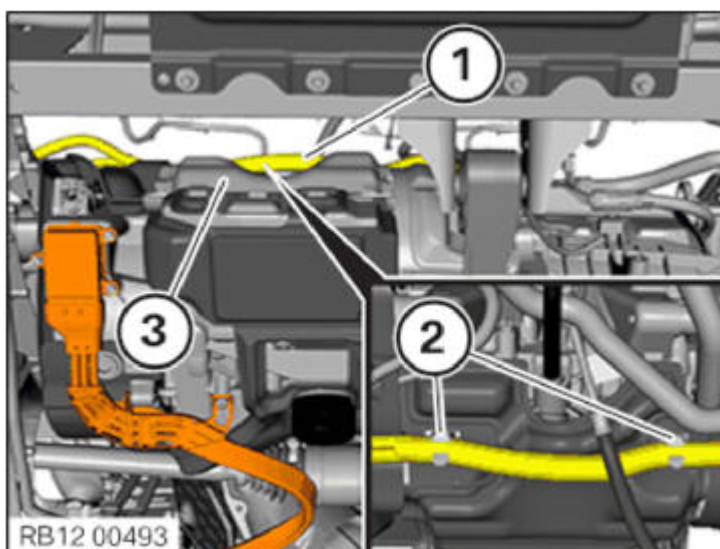
**Fig. 205: Identifying Range Extender Electrical Machine, High-Voltage Cable, Nut And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect fuel line (1) and lock.



**Fig. 206: Identifying Fuel Line**  
Courtesy of BMW OF NORTH AMERICA, INC.

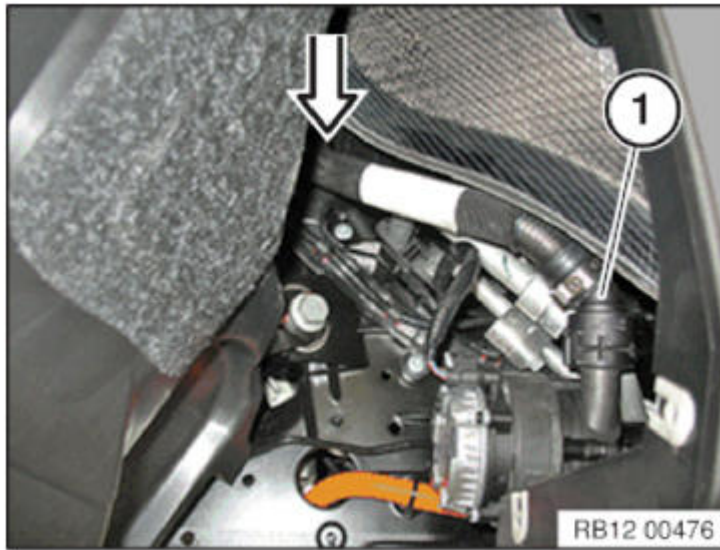
Attach positive battery cable (1) in clamps (2) on range extender (3).



**Left side of vehicle:**

Slip in coolant hose (1) on Drive module and clip in.

Connect coolant hose (1) and lock.

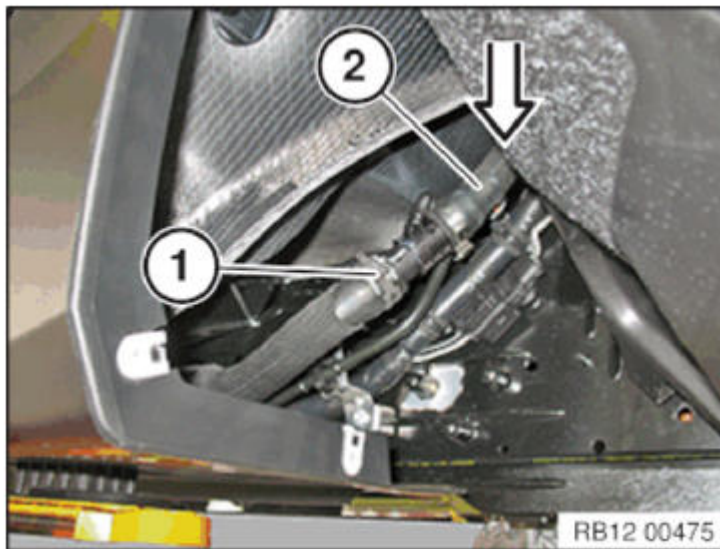


**Fig. 208: Unclipping Coolant Hose On Drive Module (Vehicle Right Side)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Right side of vehicle:**

Slip in coolant hose (2) on Drive module and clip in.

Connect coolant hose (2) and close clamp (1).



**Fig. 209: Unclipping Coolant Hose On Drive Module (Vehicle Left Side)**  
Courtesy of BMW OF NORTH AMERICA, INC.

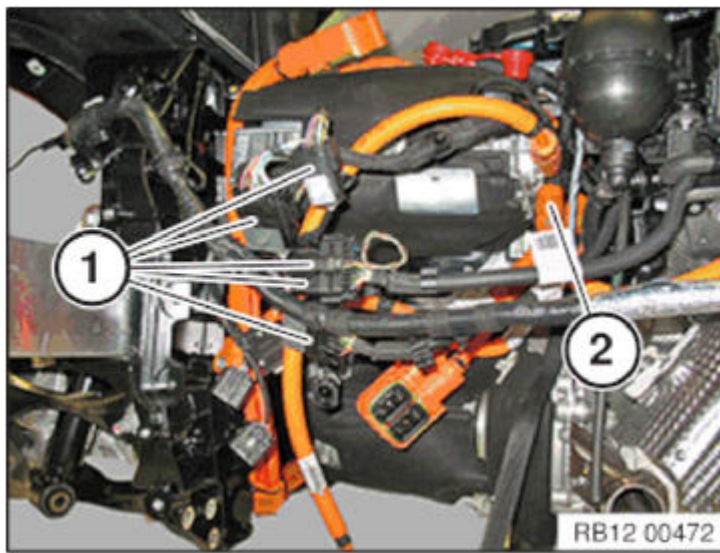
**Attention!**

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Connect connector (2) of high-voltage cable on electrical machine electronics and lock.

Connect connector (1) of wiring harness and lock.



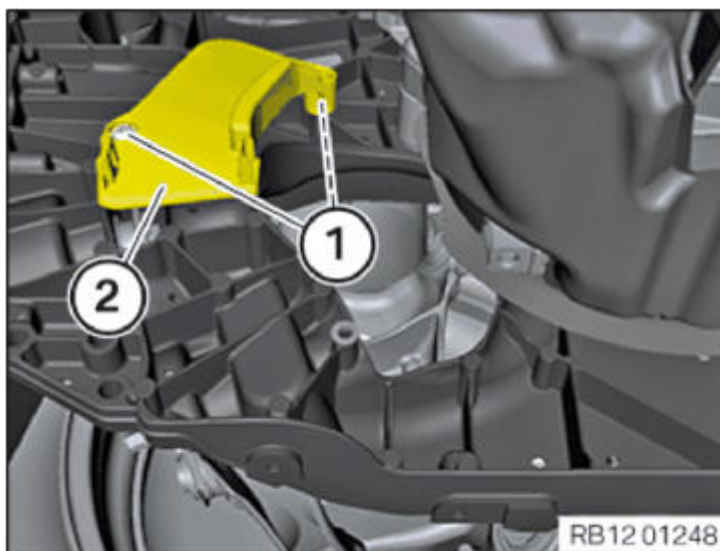


**Fig. 210: Identifying Wiring Harness And High Voltage Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Position the shaft (2) and tighten the screws (1).

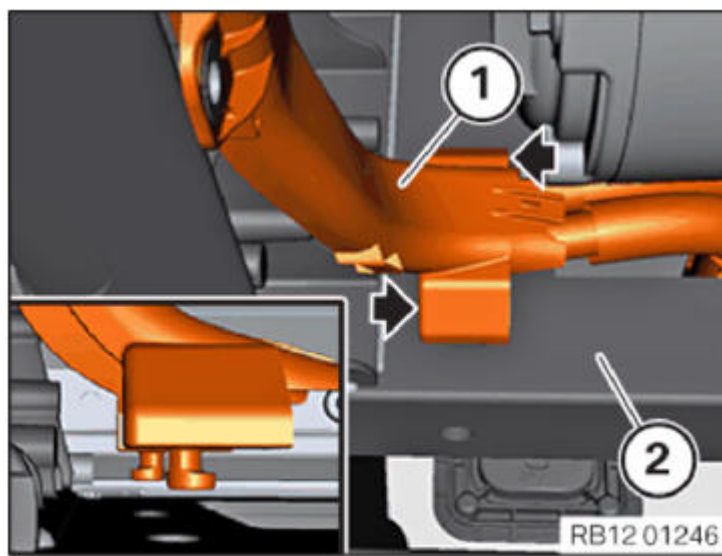
Tightening torque [61 12 9AZ](#) .



**Fig. 211: Identifying Shaft And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On vehicles from version 12/2014:**

Attach the retaining lugs of the cable channel (1) in the direction of the arrow at the Drive module (2).



**Fig. 212: Attaching Retaining Lugs Of Cable Channel At Drive Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

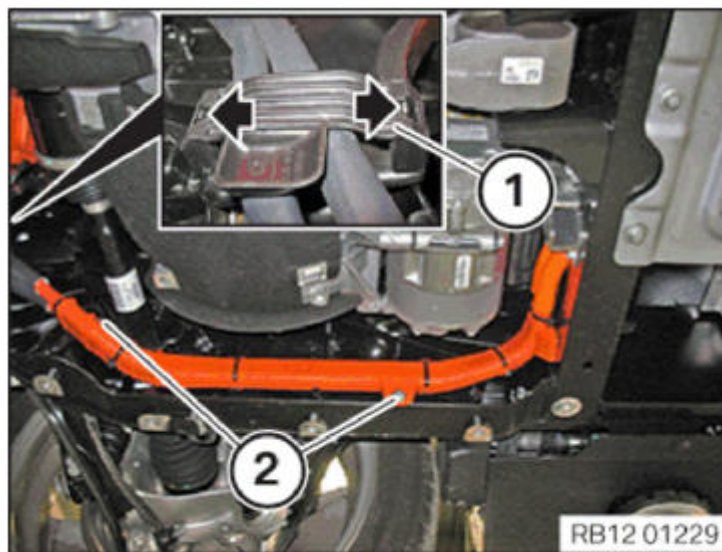
**On vehicles from version 12/2014:**

Insert the high-voltage cable including cable channel towards the top.

Position the high-voltage cable and clip in the line clip (1).

Tighten down screws (2).

Tightening torque [61 12 4AZ](#) .



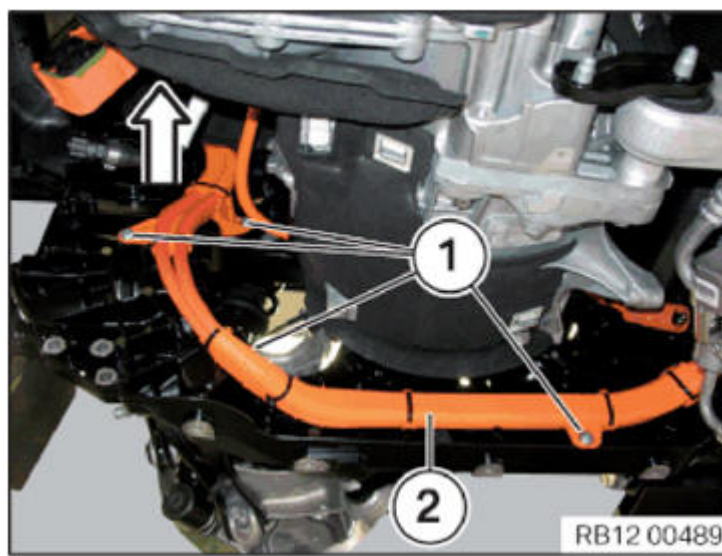
**Fig. 213: Pressing Line Clip Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

**For vehicles built up to 12/2014:**

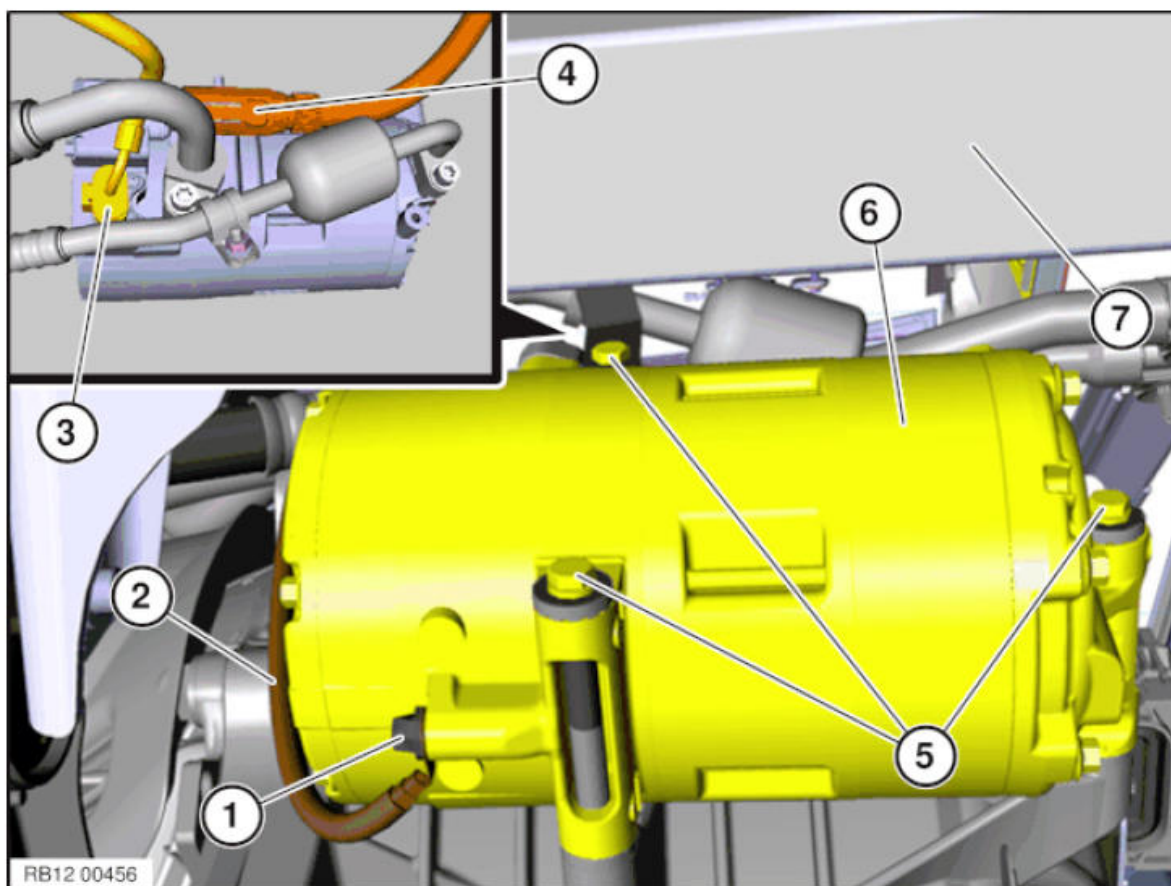
Slip in high-voltage cable with cable duct (2) in an upward direction.

Tighten screws (1) on cable duct (2).

Tightening torque [61 12 4AZ](#) .



**Fig. 214: Removing High-Voltage Cable With Cable Duct**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 215: Identifying Signal Line, High Voltage Cable Plug Connection, Equipotential Bonding Line And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release fixation of air conditioning compressor (6) on Drive module (7).

Tighten screws (5) on air conditioning compressor (6).

Tightening torque [64 52 2AZ](#) .

Attention!

Observe notes on [UNLOCKING AND DISCONNECTING PLUG CONNECTIONS](#) on electric vehicles.

Connect connector (4) of high-voltage cable and lock.



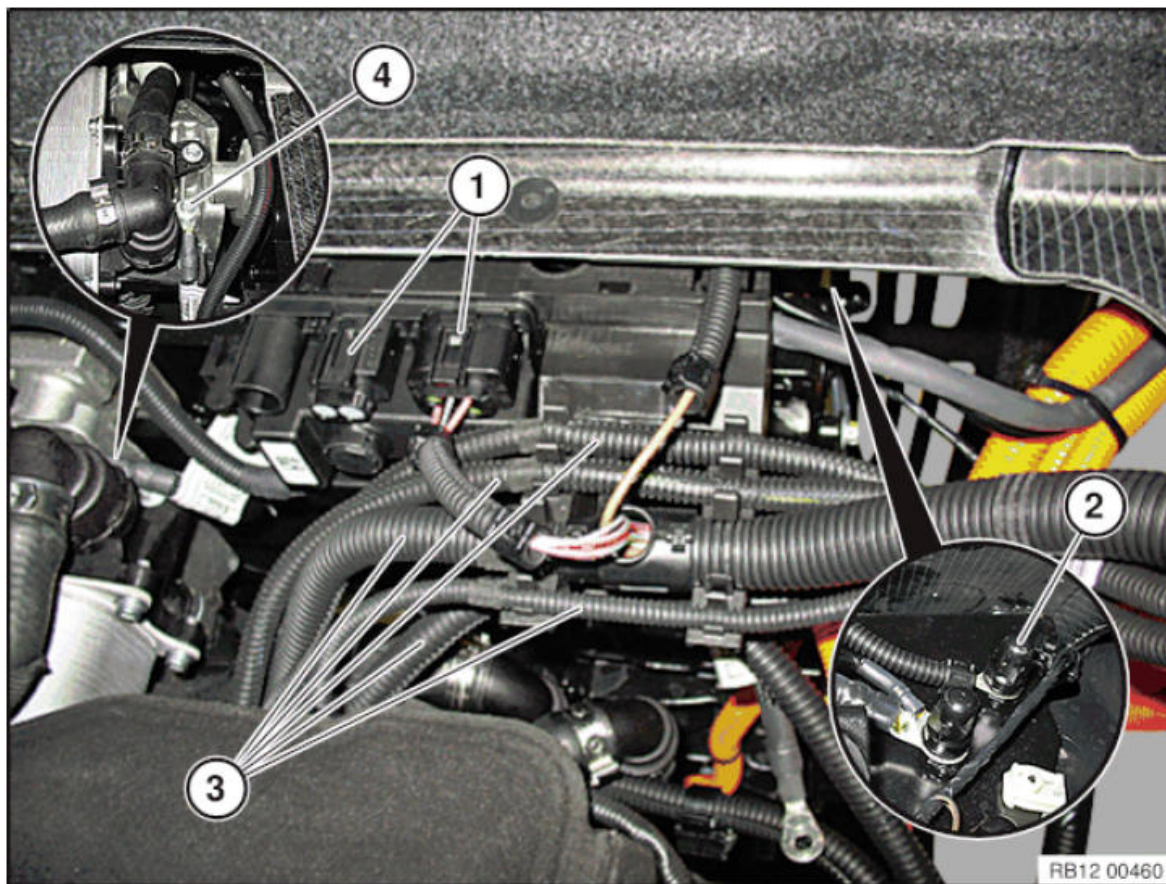
Connect connector (3) of signal line and lock.

Tighten equipotential bonding line (2) with screw (1).

Attention!

Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS !**

Tightening torque **64 52 3AZ** .



**Fig. 216: Identifying Power Distribution Box Plug Connections, Lines, Screw And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten equipotential bonding line with screw (4) on engine mounting bracket.

Attention!

Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS !**

Tightening torque **12 35 6AZ** .

Tighten nut (2) for ground strap on drive module.

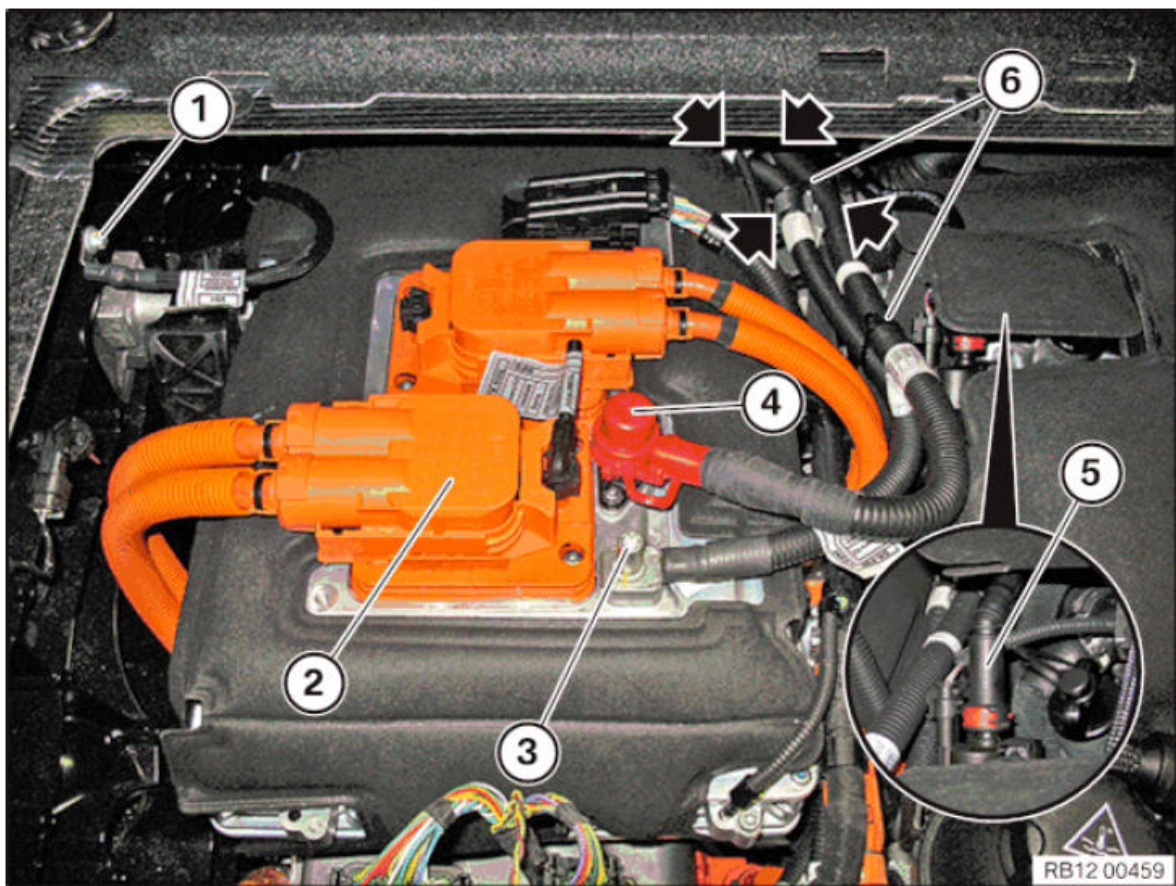
Attention!

Risk of damage! The tightening torque must be observed without fail.

Tightening torque **61 12 3AZ** .

Depending on equipment version, connect and lock connector (1) on power distribution box.

Clip lines (3) into holder.



**Fig. 217: Locating Positive Battery Cable Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Fold open sound insulation and connect and lock plug connection of tank vent valve (5).

Tighten battery earth lead with nut (3) at EME.

Attention!

Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS !**

Tightening torque **12 36 2AZ** .

Tighten nut (4) for positive battery cable on electrical machine electronics and connect cover.

Tightening torque **12 36 3AZ** .

Clip the battery earth lead and positive battery cable into both cable clips of the electrical machine electronics.

Carefully pull positive battery cable towards the rear end of the vehicle and secure with cable strap (6) on battery earth lead.

Attention!

Secure and position positive battery cable in such a way that there is no contact to the carbon body in the rear seat area!

Connect and lock connector (2) of high-voltage cable to high-voltage battery unit on electrical machine electronics.

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Tighten equipotential bonding line with screw (1) at Drive module.

Attention!



Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS !](#)

Tightening torque [12 36 1AZ](#) .

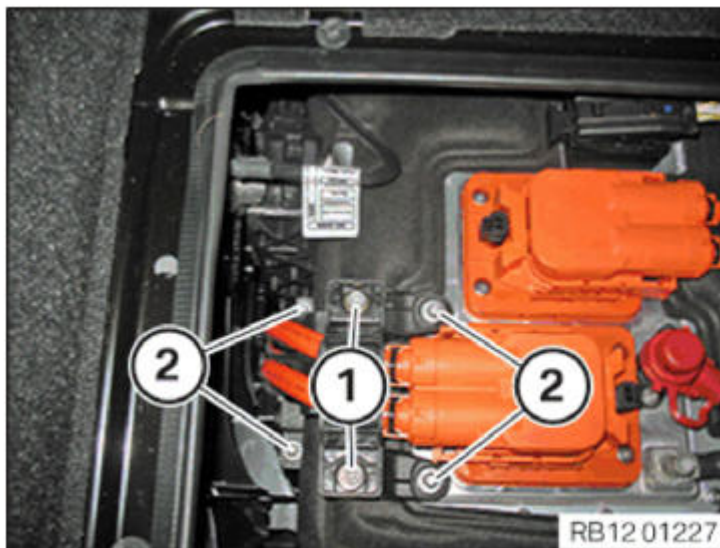
**On vehicles from version 12/2014:**

Tighten the screws (2) of the tension relief bracket.

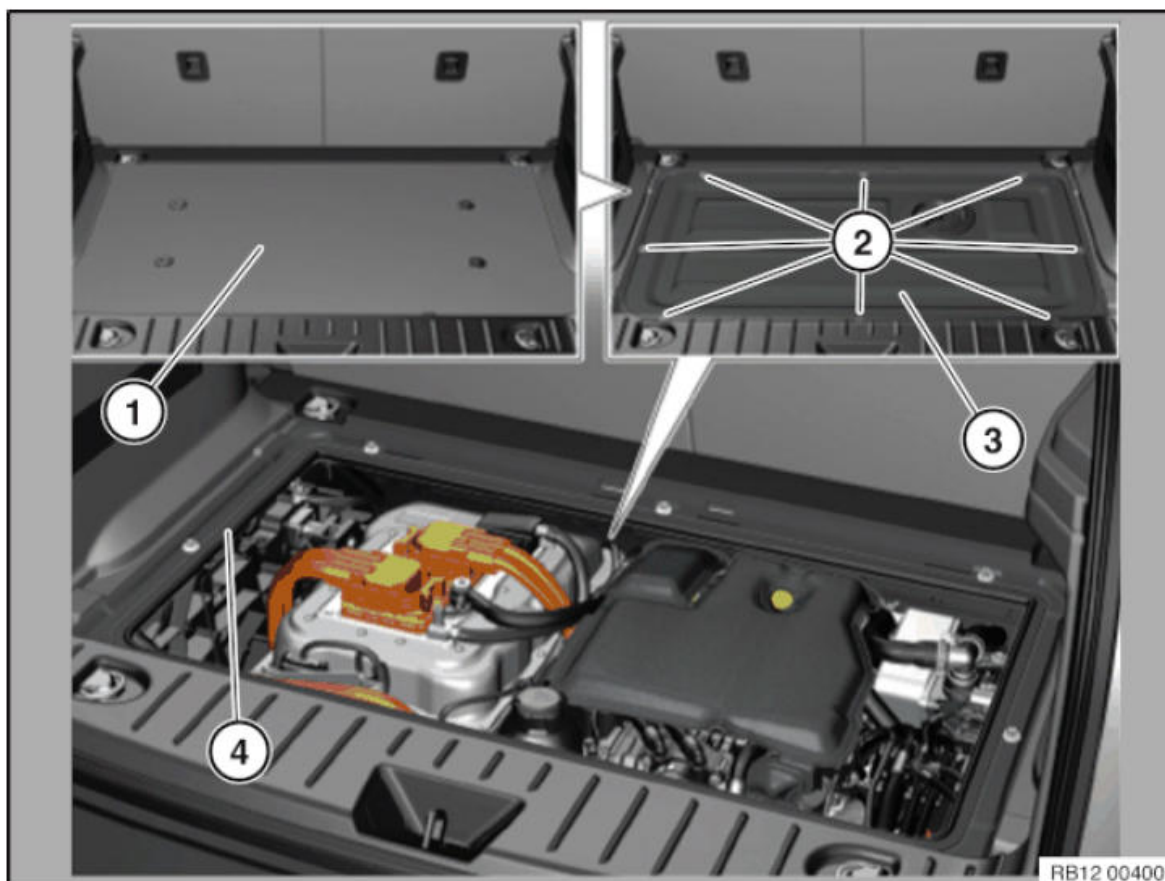
Tightening torque [61 12 7AZ](#) .

Position tension relief and tighten screws (1).

Tightening torque [61 12 8AZ](#) .



**Fig. 218: Identifying Tensioner Relief And Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 219: Identifying Floor Trim Panel, Service Cap, Screws And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

Position service cap and tighten screws (2).

Tightening torque [51 47 4AZ](#) .

Insert luggage compartment floor trim panel (1).

#### **Required follow-up work:**

- Fill and vent [COOLING SYSTEM](#)
- Check oil level:

After work on range extender:

#### **Connect diagnosis system:**

1. Service functions
2. Power train
3. Range extender digital engine electronics
4. Service start range extender

Carry out leakage test for 20 min.

Attention!

If there is an oil leak, engine must be cleaned thoroughly.

### **22 11 160 REMOVING AND INSTALLING/REPLACING TRANSMISSION BEARING BLOCK (VEHICLES WITHOUT RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**IMPORTANT:** If the transmission mounting bracket or the screw connection of the support bearing is broken, it is absolutely mandatory to follow the [REPAIR INSTRUCTIONS](#).

#### **Necessary preliminary tasks:**

- Remove HORIZONTAL STRUT on left or right
- The drive unit must be supported by a jack throughout the entire procedure while the transmission mounting bracket is being removed and installed.

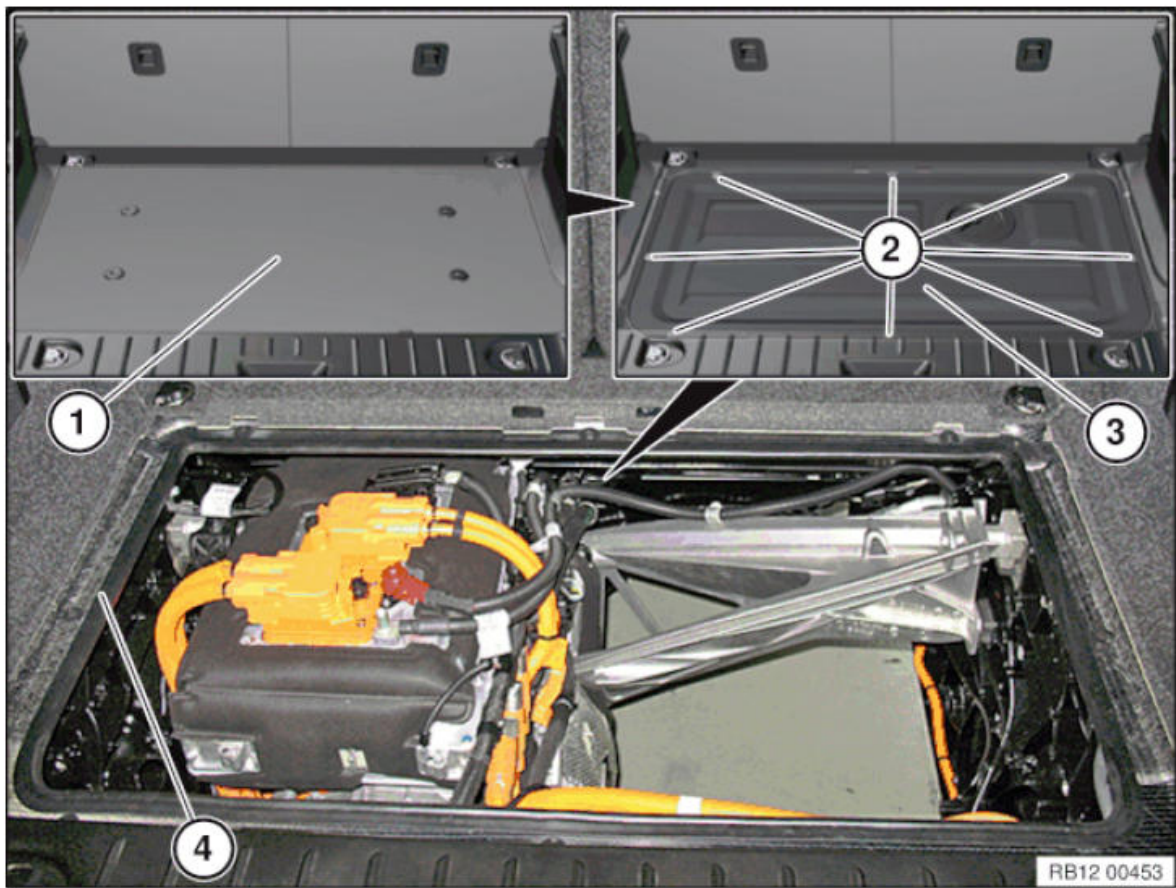
Remove luggage compartment floor trim panel (1).

Release screws (2) and remove service cap (3) towards top.

Tightening torque [51 47 4AZ](#) .

*Installation note:*

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.



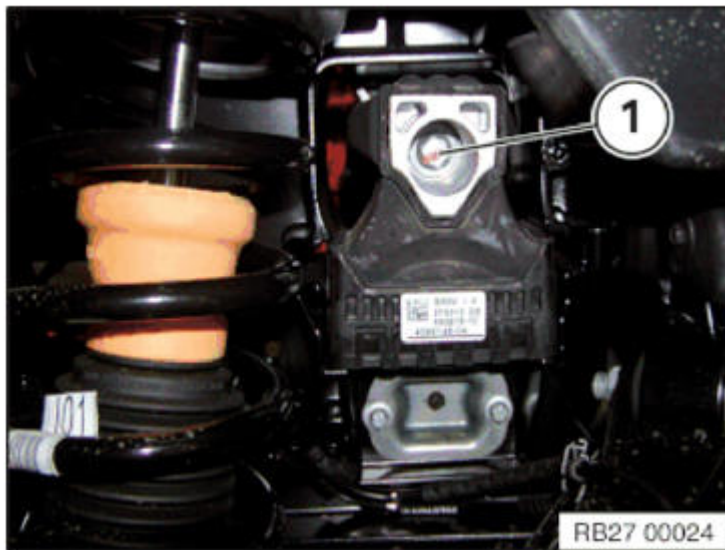
**Fig. 220: Identifying Floor Trim Panel, Service Cap, Gasket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

*Installation note:*

Replace screw.

Tightening torque [27 00 6AZ](#) .



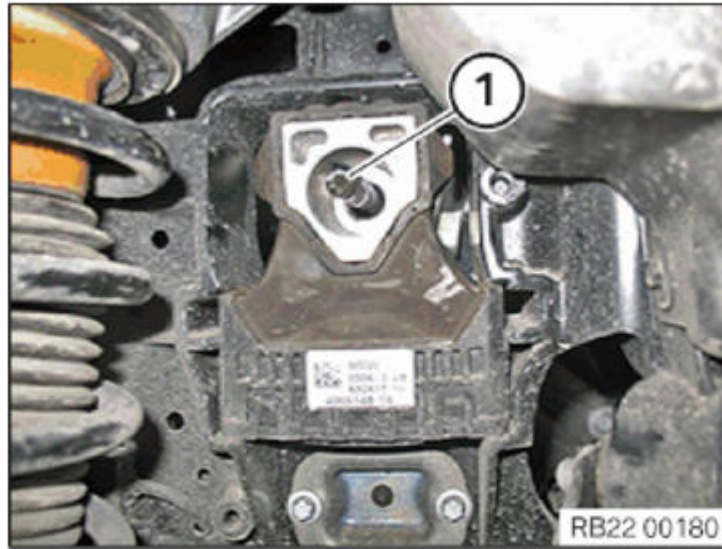
**Fig. 221: Identifying Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

IMPORTANT: During installation, the bore holes of support bearing and transmission mounting bracket **absolutely** must fall in line precisely.



For alignment of bore holes use a suitable tool (1), for example drill with 11 mm diameter shank.



**Fig. 222: Identifying Tool For Bore Holes Alignment**  
Courtesy of BMW OF NORTH AMERICA, INC.

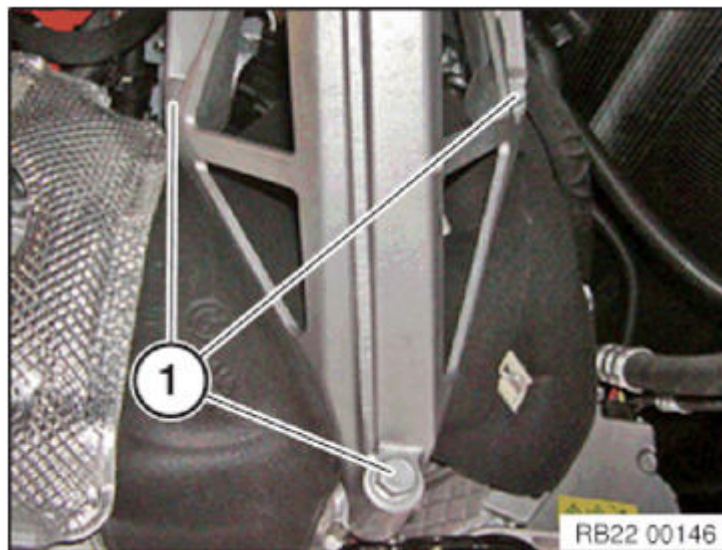
Release screws (1).

Remove transmission mounting bracket (2).

Tightening torque **27 00 3AZ** .

*Installation note:*

Screws must be replaced.



**Fig. 223: Identifying Transmission Mounting Bracket With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**22 11 155 REMOVING AND INSTALLING/REPLACING MOUNTING BRACKET OF ELECTRICAL MACHINE (VEHICLES WITH RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.



**IMPORTANT:** If the mounting bracket or the screw connection of the support bearing is broken, it is absolutely mandatory to follow the **REPAIR INSTRUCTIONS**.

### **Necessary preliminary tasks:**

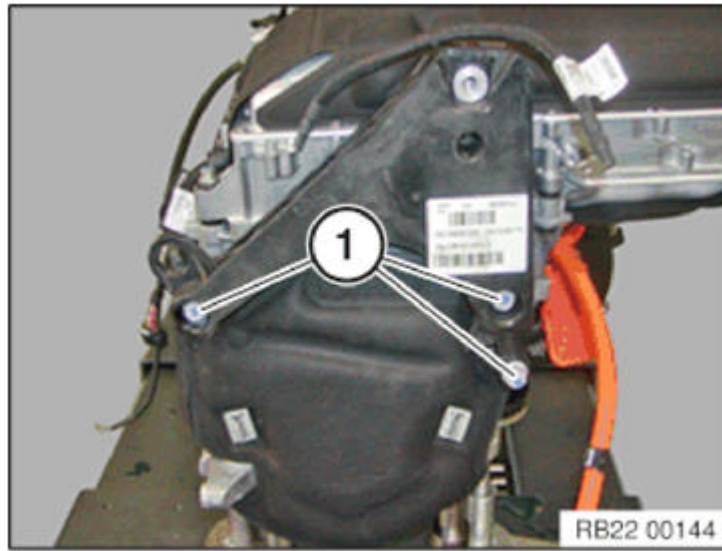
- Remove complete drive unit. See **REMOVING COMPLETE DRIVE UNIT** or **REMOVING COMPLETE DRIVE UNIT (RANGE EXTENDER)**.

Release screws (1).

Remove transmission mounting bracket.

*Installation note:*

Tightening torque **27 00 5AZ** .



**Fig. 224: Identifying Transmission Mounting Bracket Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

## **22 11... REPAIR INSTRUCTIONS FOR BROKEN ENGINE MOUNTING BRACKET/ENGINE MOUNT SCREW CONNECTION**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

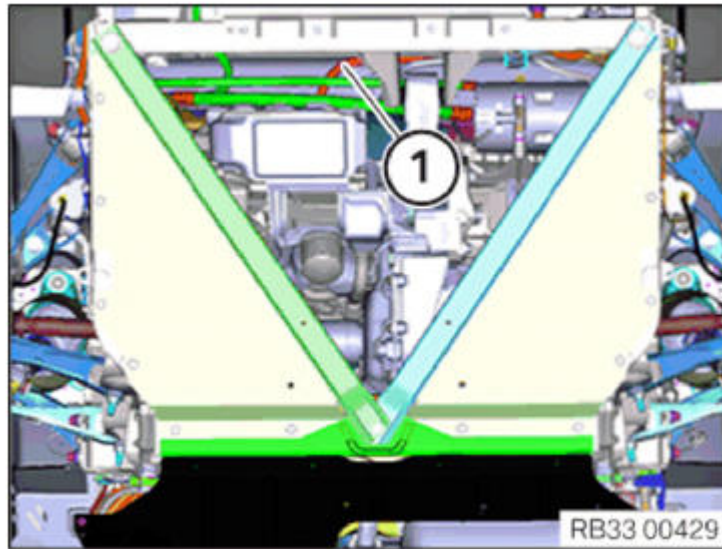
- Observe **SAFETY INFORMATION** for working with electric vehicles.

The following work must be performed when the engine mount screw connection or the engine mounting bracket is broken.

- Renew **LEFT AND RIGHT SUPPORT BEARINGS INCL. SCREW CONNECTION**
- Renew left and right mounting brackets. See **MOUNTING BRACKET OF ELECTRICAL MACHINE WITH RANGE EXTENDER** and **TRANSMISSION MOUNTING BRACKET OF RANGE EXTENDER** , or **REPLACING TRANSMISSION BEARING BLOCK**.
- Renew left and right output shaft. See **REPLACING LEFT OUTPUT SHAFT** or **REPLACING RIGHT OUTPUT SHAFT**
- Renew **A/C LINES**
- Check the **HIGH-VOLTAGE CABLE** under the drive shaft sleeve and renew it in the event of damage
- Check the BRACING STRUT for paintwork damage and apply corrosion protection to potentially damaged areas of the paintwork

- Check **BATTERY VOLTAGE LINE** in the area of the iso-fix strip for damage and renew if necessary.
- Program the vehicle to integration level version I001-15-11-501 (from ISTA/P3.57.0)
- Check fuel lines (1) for damage.

Renew damaged fuel lines.



**Fig. 225: Identifying Fuel Lines**

Courtesy of BMW OF NORTH AMERICA, INC.

### **11 21 515 REPLACE TORSION SPLINED SHAFT (W20)**

**Special tools required:**

- **2 285 548**
- **2 286 315**

**Necessary preliminary tasks:**

- Mount **ENGINE ON ASSEMBLY STAND** .

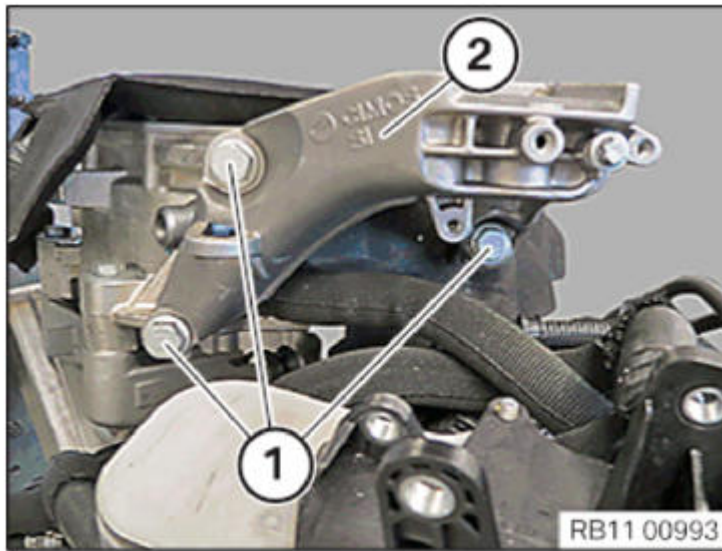
*Installation note:*

Once disassembled, a torsion splined shaft must not be reused.

Reset adaptation values after replacing the torsion splined shaft.

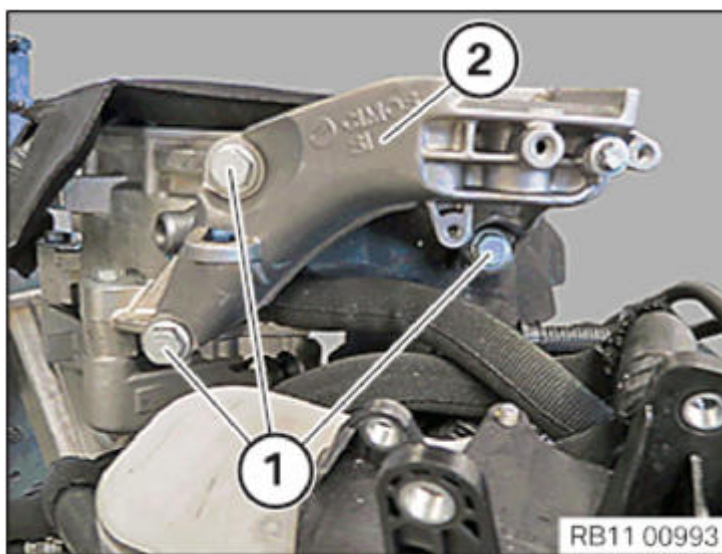
Risk of damage to engine and range extender electrical machine during operation.

Release screws (1) and take off engine support arm (2).



**Fig. 226: Identifying Engine Support Arm With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

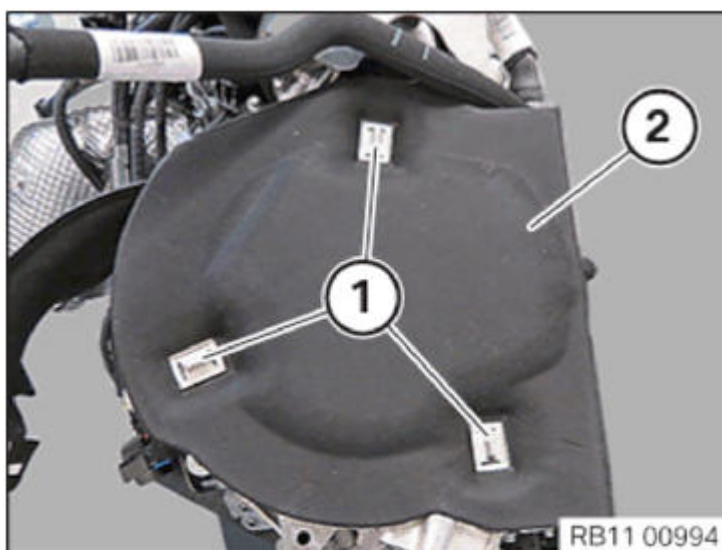
Release screws (1) and take off engine support arm (2).



**Fig. 227: Identifying Engine Support Arm With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

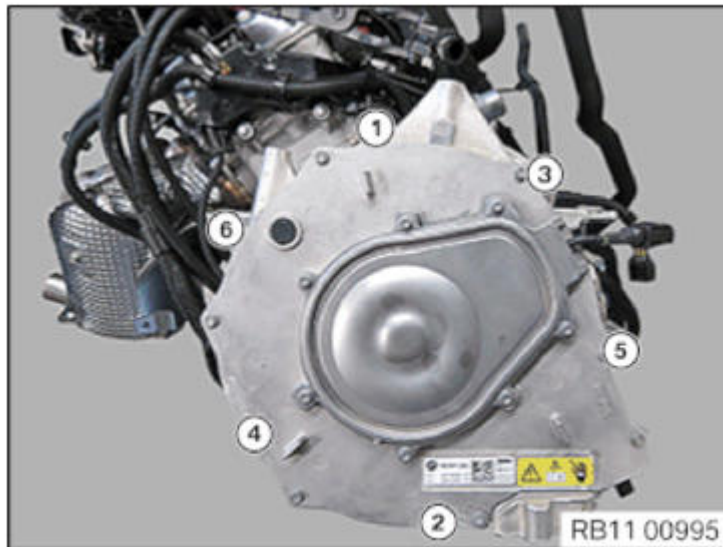
Lever out holding clamps (1).

Remove sound insulation (2).



**Fig. 228: Identifying Sound Insulation And Holding Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws in sequence (1 to 6).



**Fig. 229: Torsion Splined Shaft Screws Tightening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tool [2 285 548](#) M10 into bolting points (1, 4 and 5), hand-tight, as far as it will go.



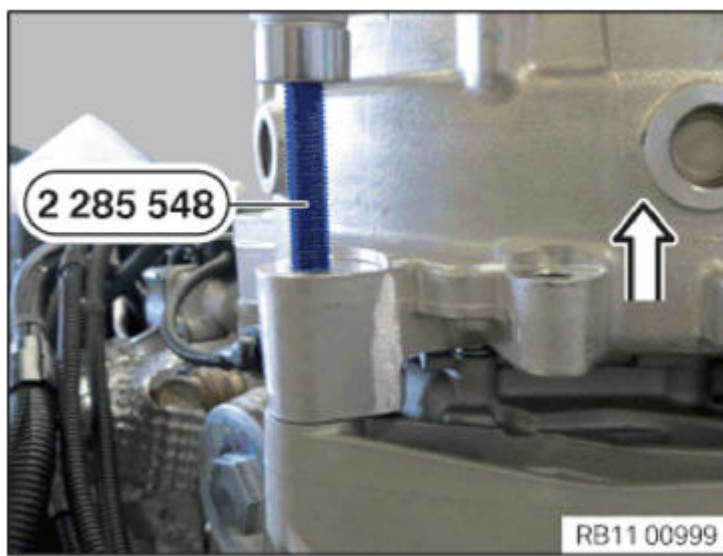
**Fig. 230: Screwing Special Tool (2 285 548) Into Bolting Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

To extract the range extender electrical machine, screw the special tool [2 285 548](#) into bolting points (1, 4 and 5).

Special tool

Uniformly pull off range extender electrical machine in 360° steps until the torsion splined shaft releases.

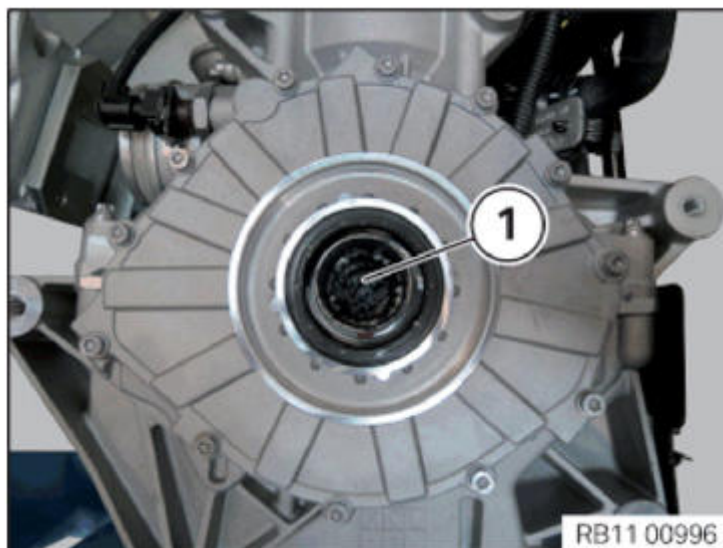




**Fig. 231: Pulling Off Range Extender Electrical Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check crankshafts and generator gearing for damage and if necessary clean metal residues (debris) on the tooth flanks.

Replace **RADIAL SHAFT SEAL** .



**Fig. 232: Identifying Radial Shaft Seal**  
Courtesy of BMW OF NORTH AMERICA, INC.

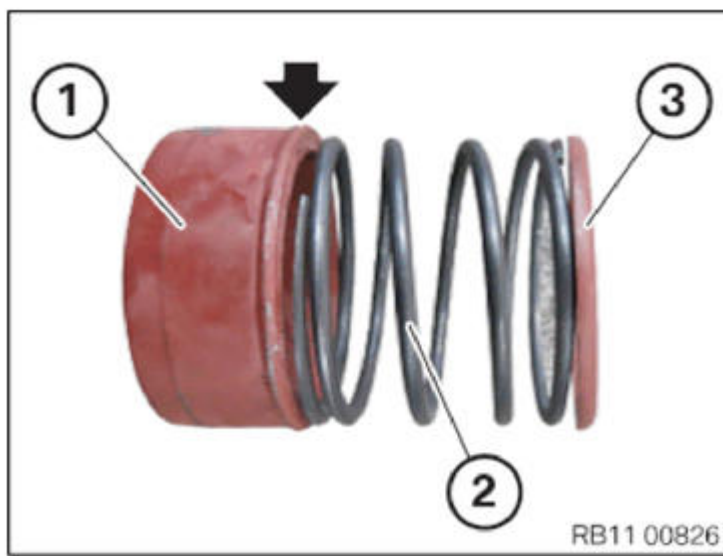
Sealing sleeve (1) with clamping ring

Length compensation spring (2)

Valve seat insert (3)

*Installation note:*

Always renew sealing sleeve (1) and valve seat insert (3).



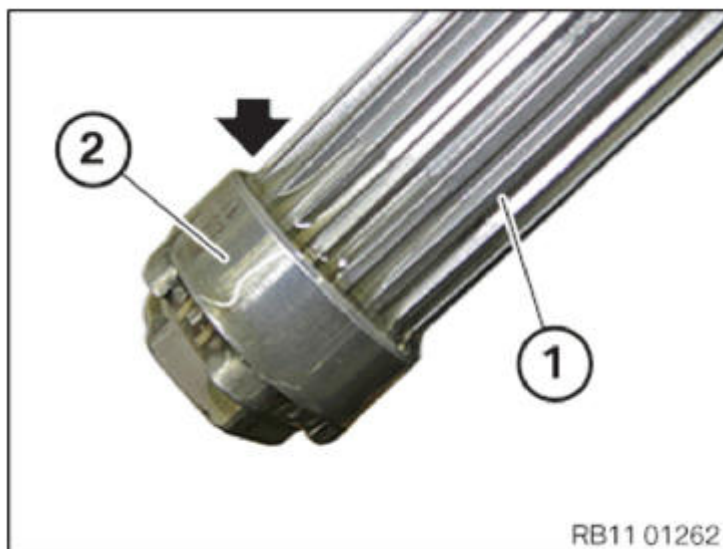
**Fig. 233: Locating Sealing Sleeve**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace torsion splined shaft (1).

Coat torsion splined shaft (1) at both ends (2) with sufficient engine oil.

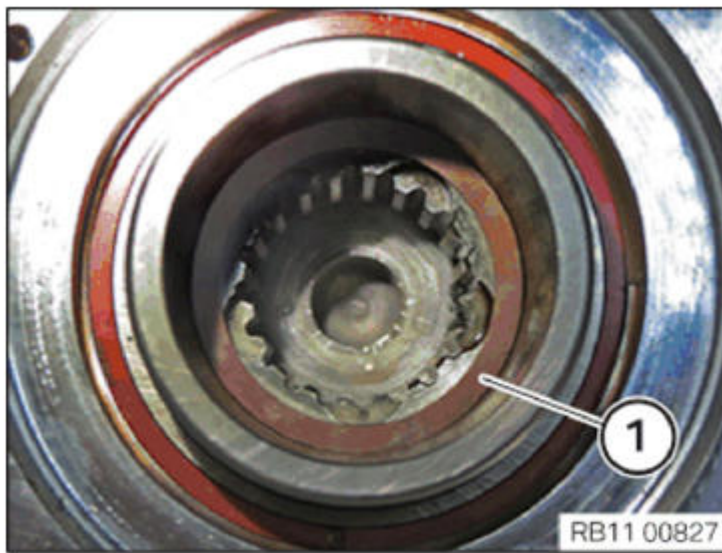


**Fig. 234: Locating Torsion Splined Shaft End**

Courtesy of BMW OF NORTH AMERICA, INC.

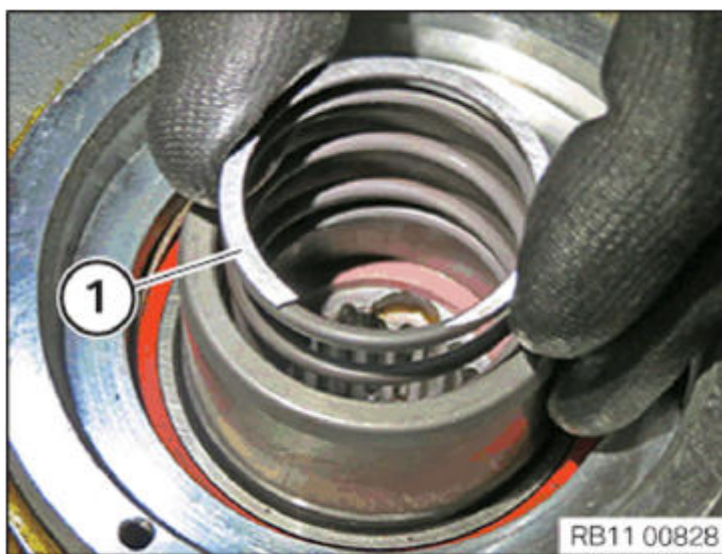
Insert valve seat insert (1) in the alternator with the rounded area downwards.





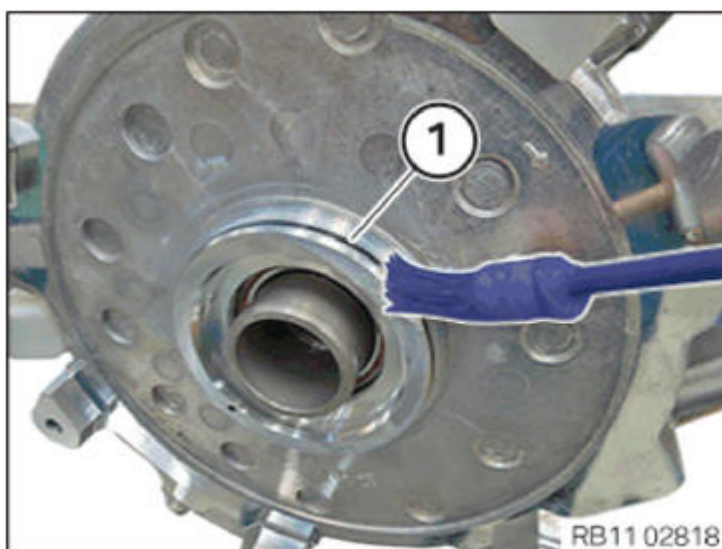
**Fig. 235: Identifying Valve Seat Insert**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert length compensation spring (1).



**Fig. 236: Inserting Length Compensation Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

Grease the O-ring on the alternator (1) with **4.9 GREASE**.

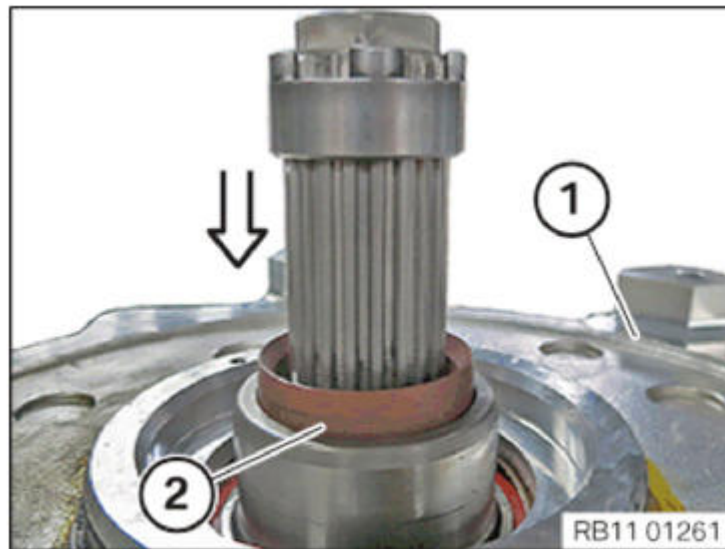


**Fig. 237: Greasing O-Ring On Alternator**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push sealing sleeve (2) and clamping ring down in the alternator (1).

Insert torsion splined shaft in direction of arrow.

During joining, position in such a way that the 5 crowns of the clamping sleeve match the 5 alternator shaft pockets.

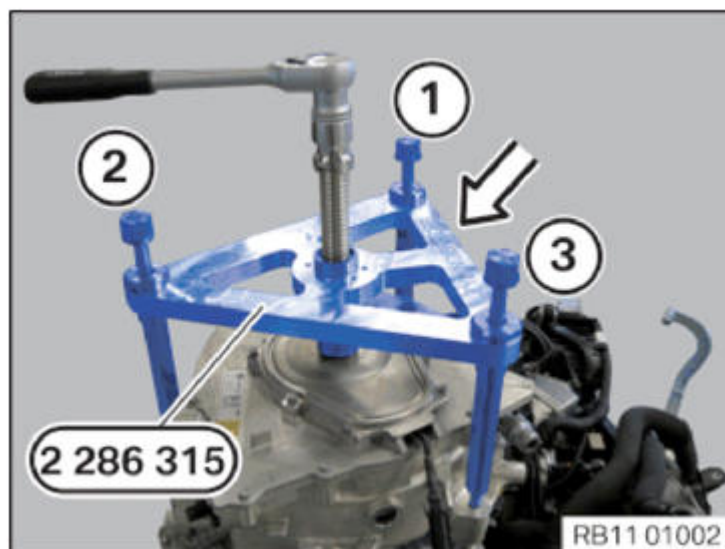


**Fig. 238: Pushing Sealing Sleeve And Clamping Ring Down In Alternator**  
Courtesy of BMW OF NORTH AMERICA, INC.

Mount range extender electrical machine and torsion splined shaft.

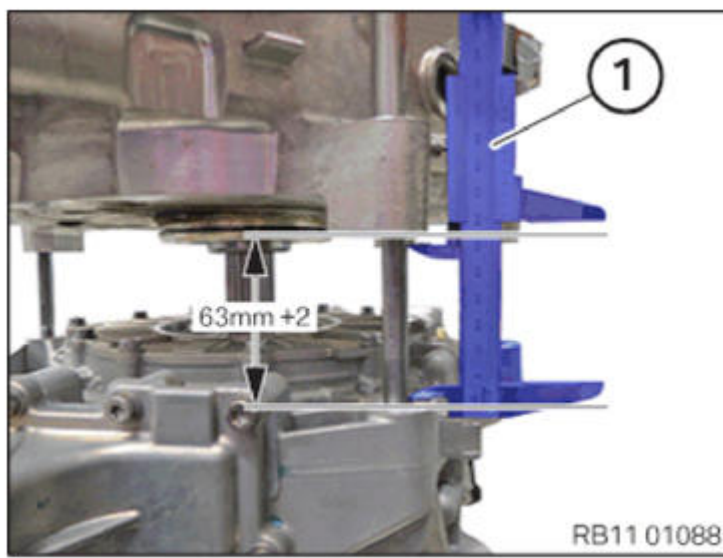
Position the range extender electrical machine during joining in such a way that the 5 crowns of the clamping sleeve match the 5 crankshaft pockets.

Align special tool [2 286 315](#) with notch on housing facing cylinder head and screw in at crankcase until hand-tight.



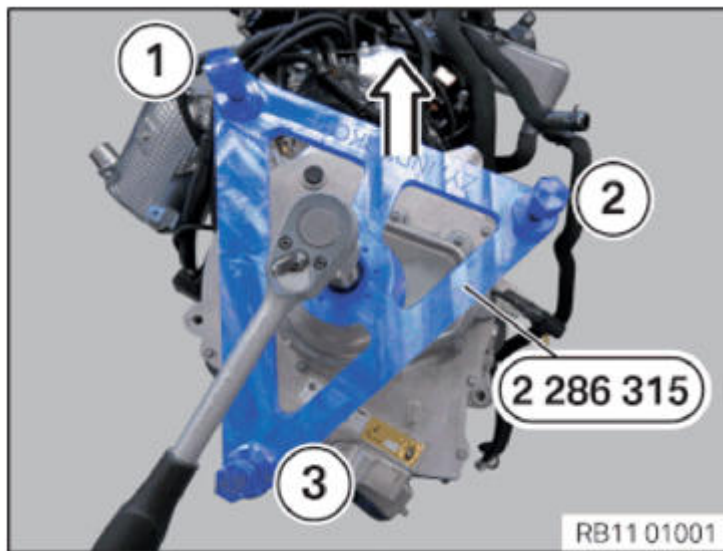
**Fig. 239: Aligning Special Tool (2 286 315) With Notch On Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Measure distance between both housing halves by means of a caliper gauge (1) **63 mm** and re-align the range extender electrical machine if necessary.



**Fig. 240: Measuring Distance Between Both Housing Halves With Caliper Gauge**  
Courtesy of BMW OF NORTH AMERICA, INC.

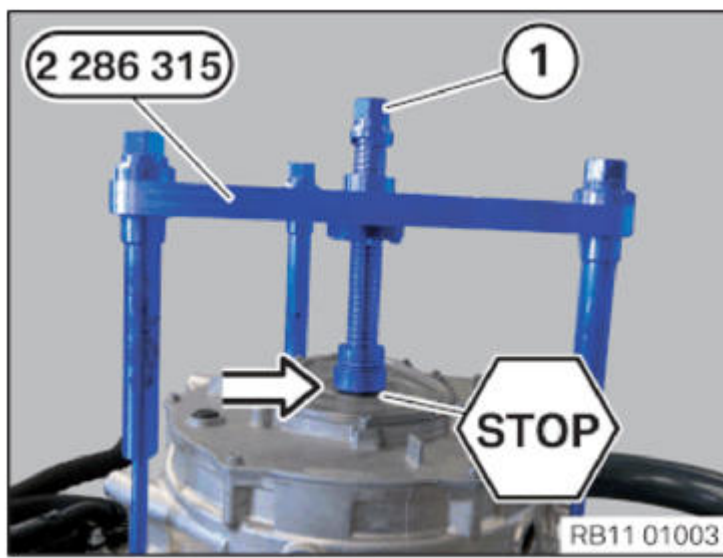
Screw in mounting bolts 1, 2 and 3 on engine block with 15 Nm.



**Fig. 241: Screwing Mounting Bolts On Engine Block**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage! On range extender electrical machine.

Join engine and range extender electrical machine with a torque of **12.5 Nm** by means of special tool [2 286 315](#) to a distance of **5 mm** .



**Fig. 242: Joining Engine And Range Extender Electrical Machine With Special Tool (2 286 315).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Connect range extender electrical machine to spindle (1) with special tool [2 286 315](#) with **MAXIMUM 7.5 Nm** , leaving no gap.

Insert 3 x screws (1) and tighten with 10 Nm.

Remove special tool [2 286 315](#) .

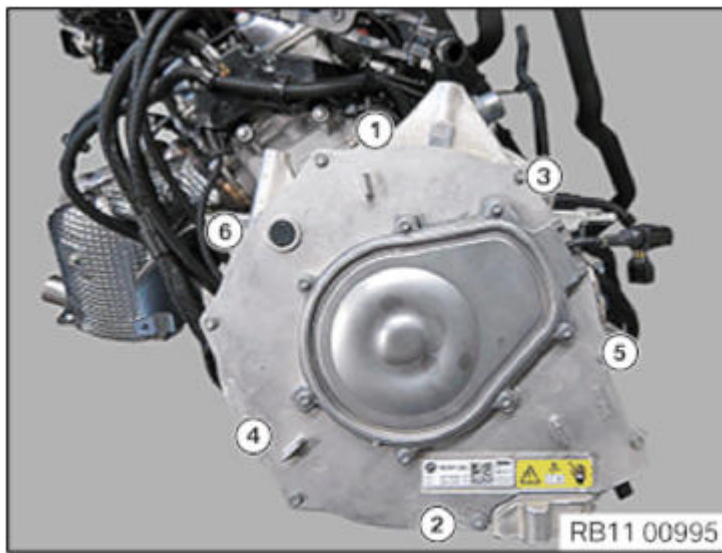


**Fig. 243: Removing Special Tool (2 286 315).**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws in sequence (1 to 6).

Tightening torque: [12 35 9AZ](#) .





**Fig. 244: Torsion Splined Shaft Screws Tightening Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Reset adaptation values.

### **27 21 615 REPLACING RADIAL SHAFT SEAL FOR DRIVE SHAFT**

Special tools required:

- 23 0 490
- [2 285 546](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

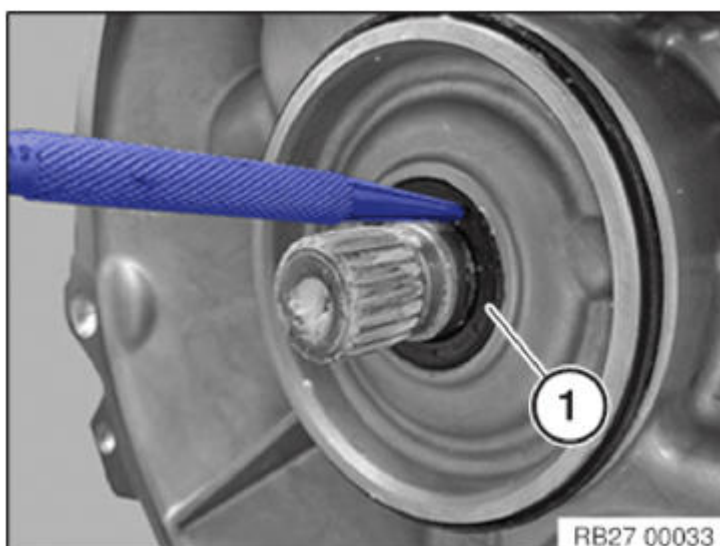
- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

Necessary preliminary tasks:

- Remove [E-TRANSMISSION](#)

Drive a hole into radial shaft seal (1) using a center punch.

IMPORTANT: Do not use a drill as drillings may result in transmission malfunction.

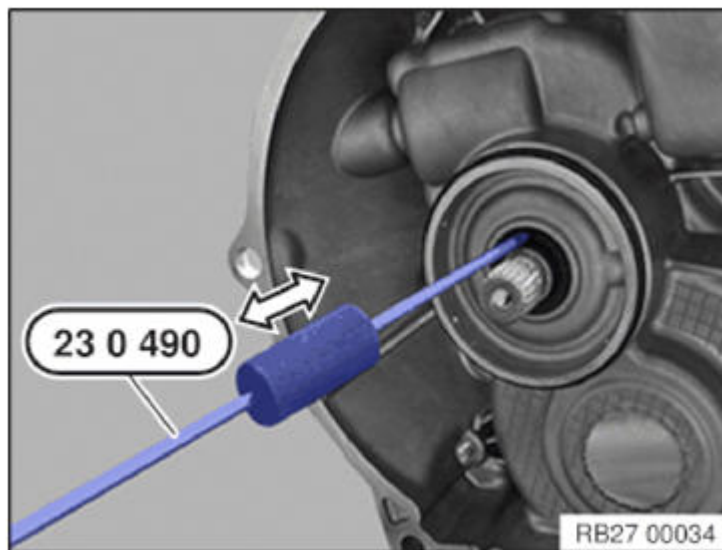




**Fig. 245: Driving Hole Into Radial Shaft Seal Using Center Punch**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tool 23 0 490 into radial shaft seal.

Withdraw radial shaft seal from transmission housing with aid of impact weight.

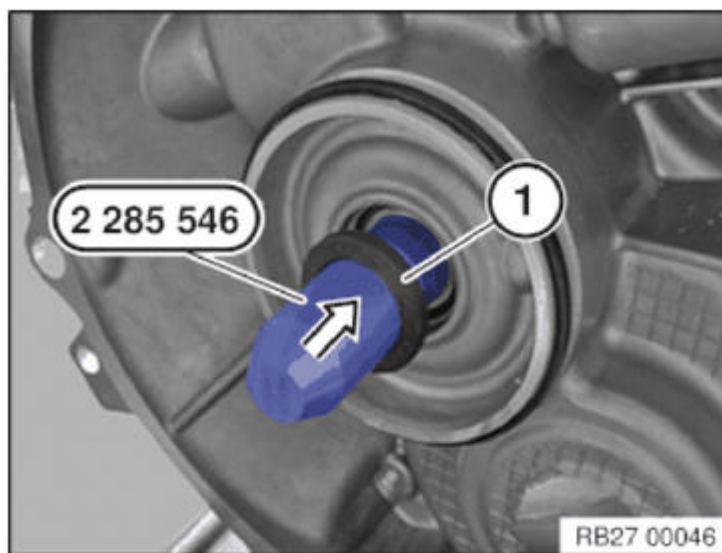


**Fig. 246: Screwing Special Tool (23 0 490) Into Radial Shaft Seal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply a light coat of grease SYN-setral-INT/250 A-2 all around the sealing lips of the radial shaft seal.

Push radial shaft seal (1) onto guide sleeve of special tool [2 285 546](#).

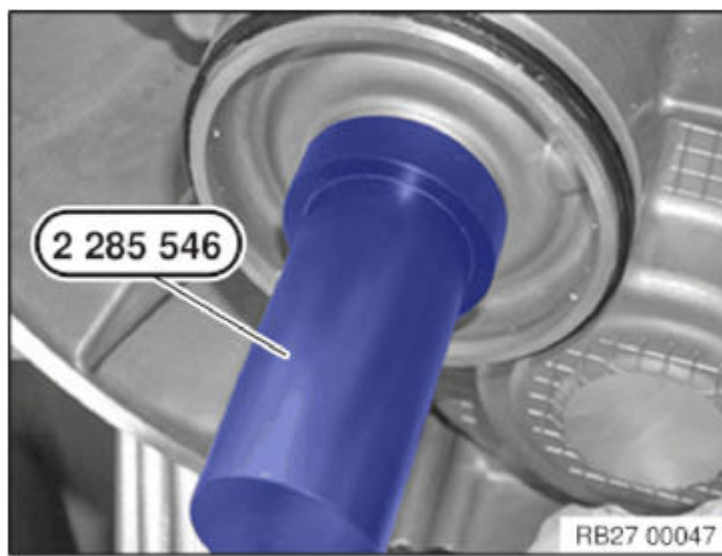
Slide guide sleeve with radial shaft seal all the way onto transmission input shaft.



**Fig. 247: Pushing Radial Shaft Seal Onto Guide Sleeve Of Special Tool (2 285 546)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide impactor of special tool [2 285 546](#) onto guide sleeve.

Drive in radial shaft seal with plastic hammer as far as it will go.



**Fig. 248: Sliding Impactor Of Special Tool (2 285 546) Onto Guide Sleeve**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **ELECTRIC MACHINE CONTROL**

### **12 36 516 REMOVING AND INSTALLING/REPLACING RANGE EXTENDER ELECTRICAL MACHINE ELECTRONICS (REME)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe **SAFETY INFORMATION** for working with electric vehicles.
- Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS** .

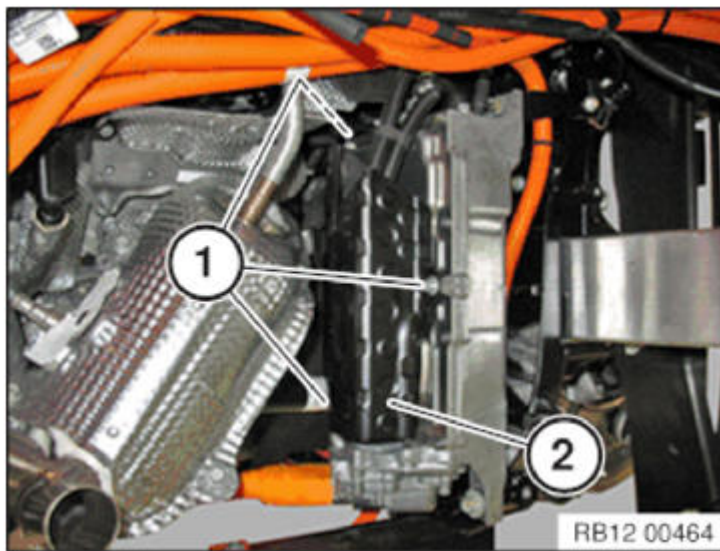
#### **Necessary preliminary tasks:**

- Remove VERTICAL STRUT
- Remove REAR CROSS STRUT
- Drain **COOLANT**

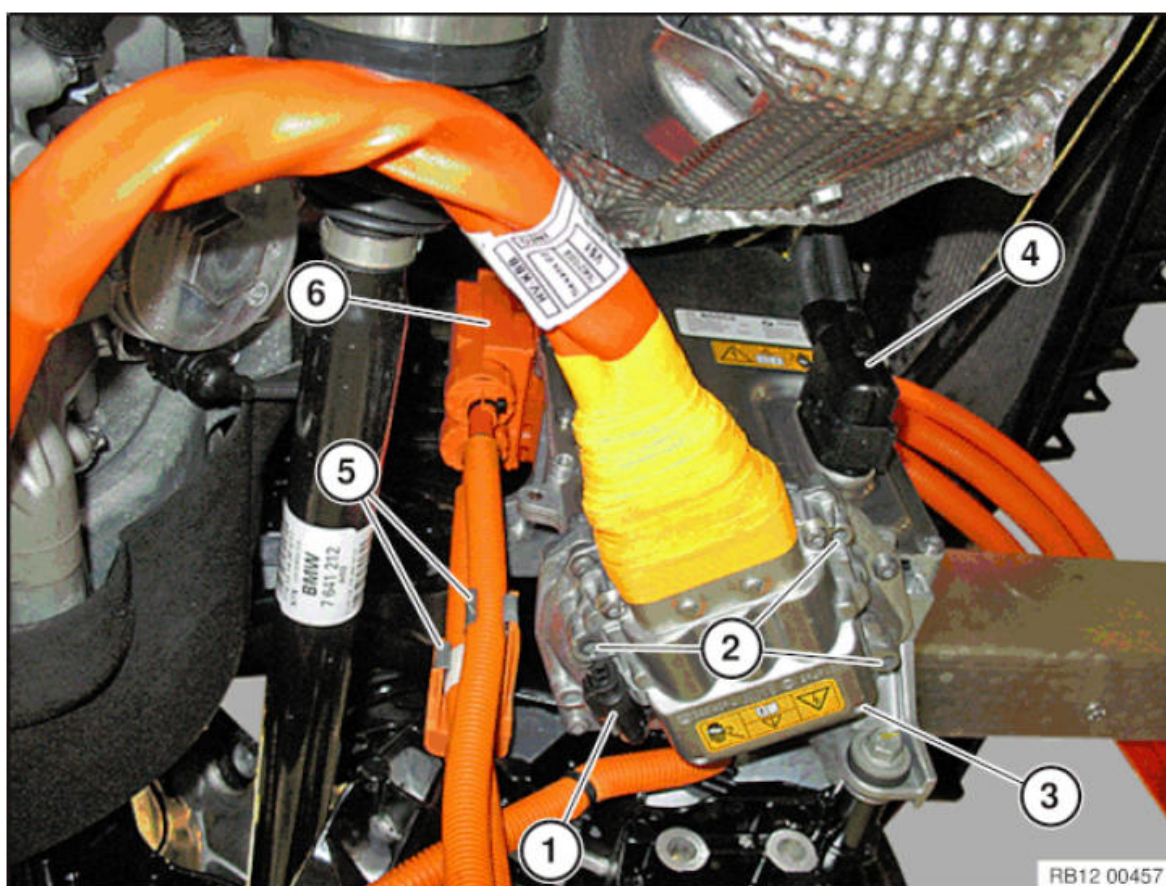
#### **REMOVAL:**

Release screws (1) from heat shield (2).

Feed out heat shield (2) and remove.



**Fig. 249: Identifying Heat Shield And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 250: Identifying High-Voltage Safety Connector, Plug Connection, Signal Connector, Screws And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect high-voltage safety connector (1).

Release screws (2) and disconnect high-voltage plug connection (3).

Unlocking and disconnect signal connector (4).

Detach high-voltage cables from clamps (5).

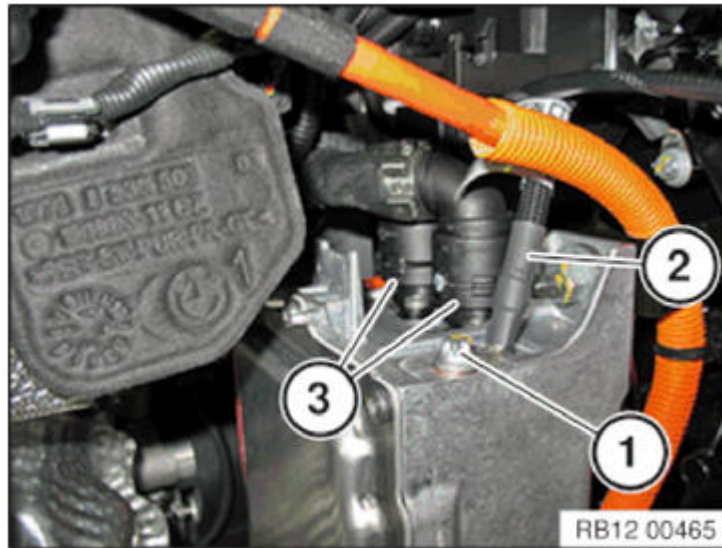
**IMPORTANT:** Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Unlock and disconnect connector (6) from high-voltage cable.



Release screw (1) from equipotential bonding line (2).

Unfasten and detach the coolant hoses (3).



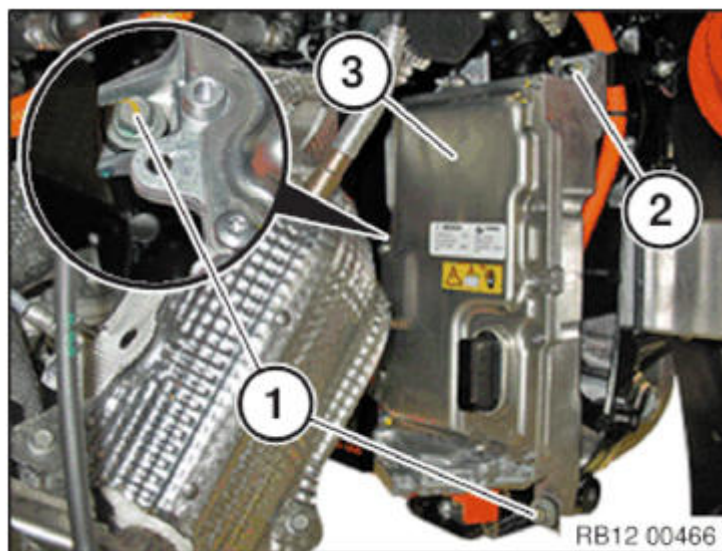
**Fig. 251: Identifying Equipotential Bonding Line, Coolant Hoses And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Slacken nut (2).

Feed out range extender electrical machine electronics (3).

**NOTE:** Drain residual coolant from range extender electrical machine electronics (3) into coolant collecting vessel.



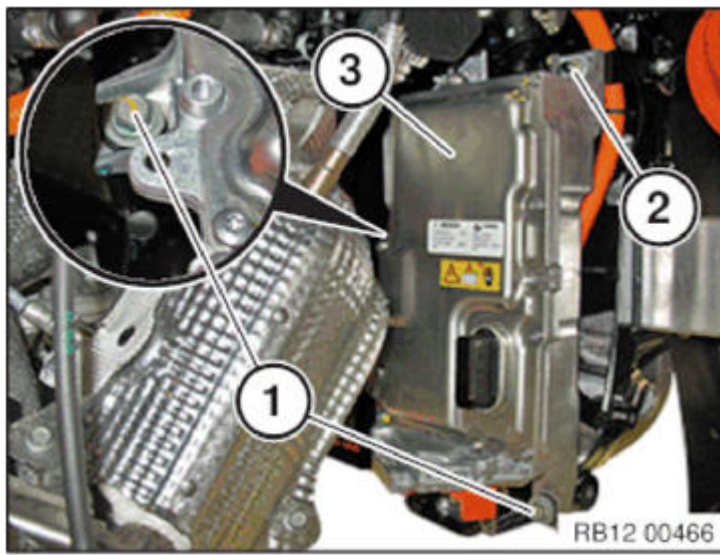
**Fig. 252: Identifying Range Extender Electrical Machine Electronics, Nut And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### INSTALLATION:

Feed in range extender electrical machine electronics (3).

Tighten screws (1) and nuts (2).

Tightening torque [12 36 8AZ](#) .

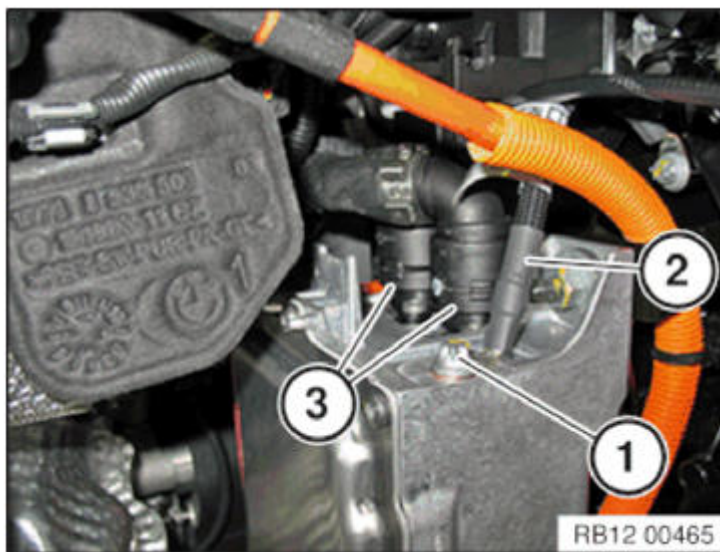


**Fig. 253: Identifying Range Extender Electrical Machine Electronics, Nut And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect and lock coolant hoses (3).

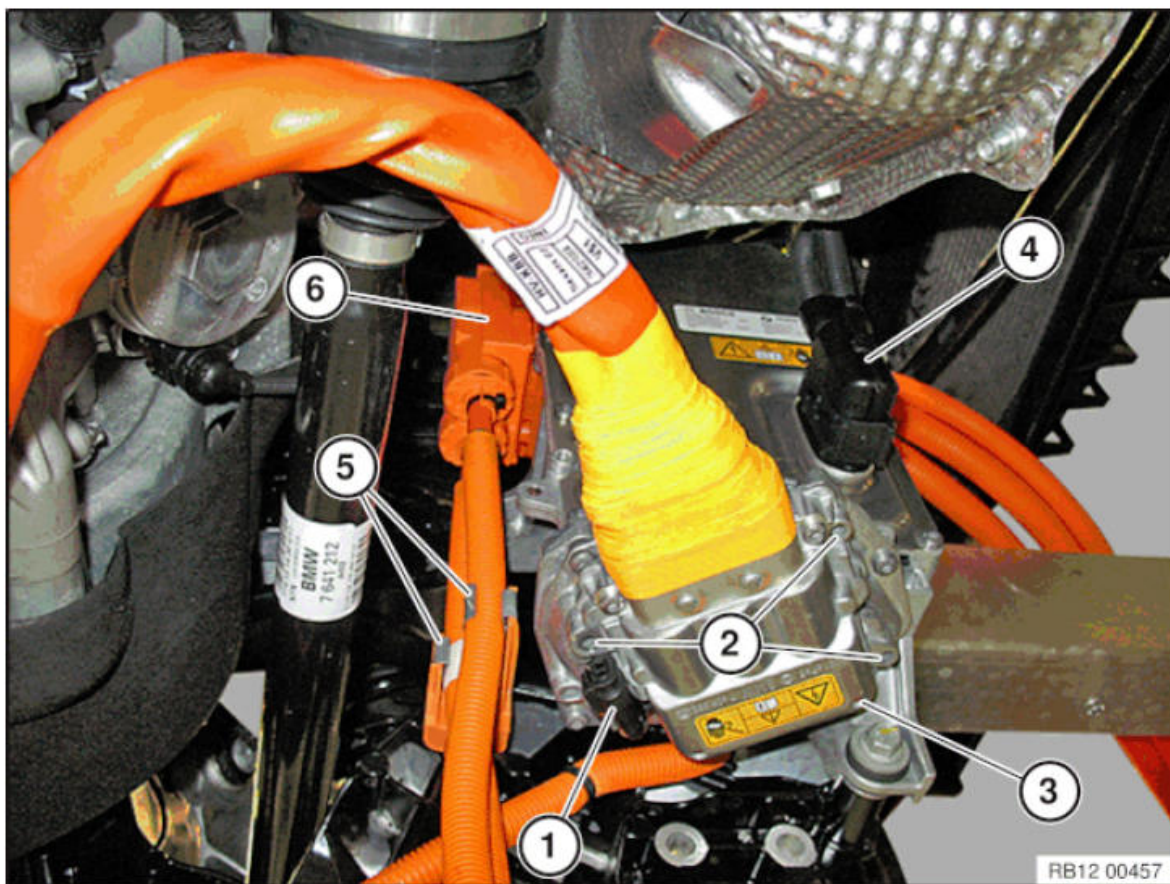
Tighten equipotential bonding line (2) with screw (1).

IMPORTANT: Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS !**  
 Tightening torque **12 36 9AZ** .



**Fig. 254: Identifying Equipotential Bonding Line, Coolant Hoses And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.





**Fig. 255: Identifying High-Voltage Safety Connector, Plug Connection, Signal Connector, Screws And Clamps**

Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Connect connector (6) of high-voltage cable and lock.

Attach high-voltage cables to holder (5).

Connect and lock connector (4) of signal line.

Connect connector (3) of high-voltage cable to range extender electrical machine electronics and tighten screws (2).

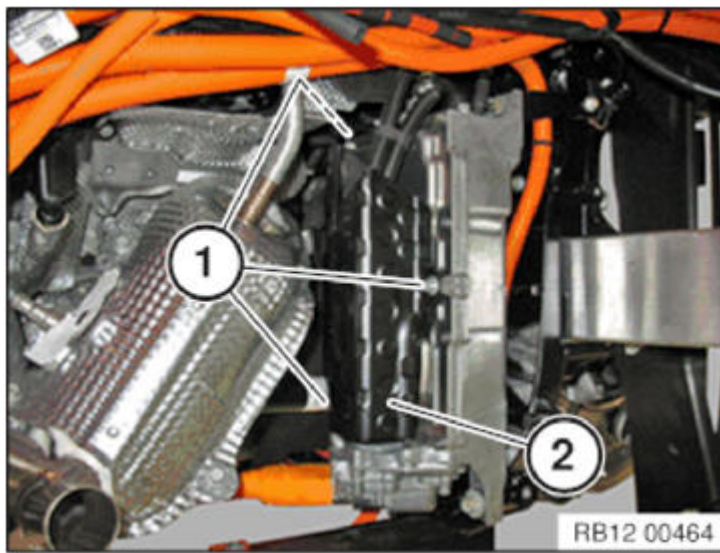
Tightening torque **12 36 10AZ** .

Connect and lock high-voltage safety connector (1).

Feed in heat shield (2).

Tighten down screws (1).

Tightening torque **12 36 11AZ** .



**Fig. 256: Identifying Heat Shield And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Required reworking:**

- Fill and bleed [COOLING SYSTEM](#) .

**Replacement:**

Carry out [VEHICLE PROGRAMMING/ENCODING](#) .

**12 36 018 REMOVING/INSTALLING ELECTRICAL MACHINE ELECTRONICS**

**Special tools required:**

- [2 356 938](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

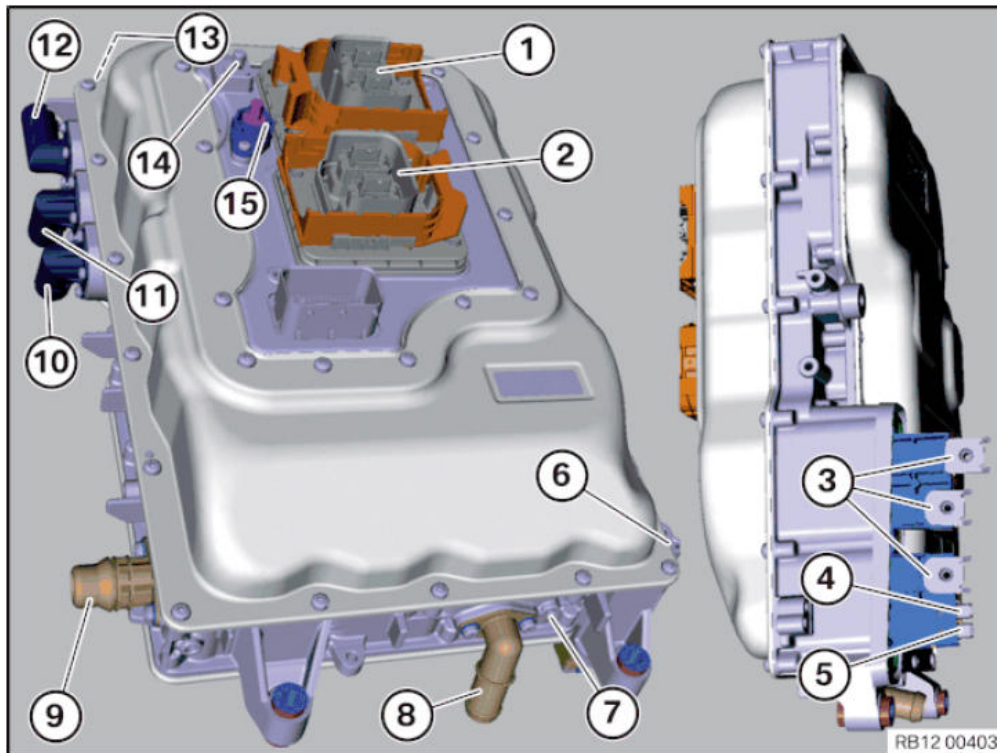
- Observe [SAFETY INFORMATION](#) for working with electric vehicles.
- Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) .
- The workbay required for the repair of the drive unit must be clean (free of grease, dirt and debris), dry (no leaking fluid) and free of flying sparks. Therefore, avoid close vicinity to areas intended for cleaning of vehicles and to workbays intended for repair work relating to the body. Use movable walls and high-voltage barrier tapes for separation, if needed.
- It is absolutely essential to remove all small parts/screws that fell into the electrical machine.
- Perform a visual inspection for contamination and damage of the housing, connections and gaskets or sealing surfaces of the electrical machine and electrical machine electronics.
- Replacement: Remove electrical machine electronics immediately before removing the packaging.
- For handling of the electrical machine electronics, always install protection connector (part number: 12 5 7 620 458).

**Attention!**

Read and comply with notes on protection against electrostatic damage ([ESD PROTECTION](#) ).

## Necessary preliminary tasks:

- Remove complete drive unit. See [REMOVING COMPLETE DRIVE UNIT](#) or [REMOVING COMPLETE DRIVE UNIT \(RANGE EXTENDER\)](#).



1. High-voltage connection to high-voltage battery unit
2. High-voltage connection to convenience charging electronics (only with optional equipment for direct current and/or alternating current rapid charging)
3. High-voltage connection to electrical machine (stator winding 1 to 3)
4. Rotor position sensor
5. Temperature sensor
6. Equipotential bonding line to drive module
7. Equipotential bonding line to electrical machine (only in vehicles with range extender)
8. Cooling water connection (electrical machine electronics return flow to electrical machine)
9. Cooling water connection (radiator feed, electrical machine electronics)
10. High-voltage connection of electric A/C compressor (EKK)
11. High-voltage connection to electrical heating
12. High-voltage connection, charging
13. Ground connection 12-V wiring harness
14. Battery earth lead
15. Positive battery cable
16. Signal line

**Fig. 257: Connection Overview Of Electrical Machine Electronics (EME)**  
Courtesy of BMW OF NORTH AMERICA, INC.

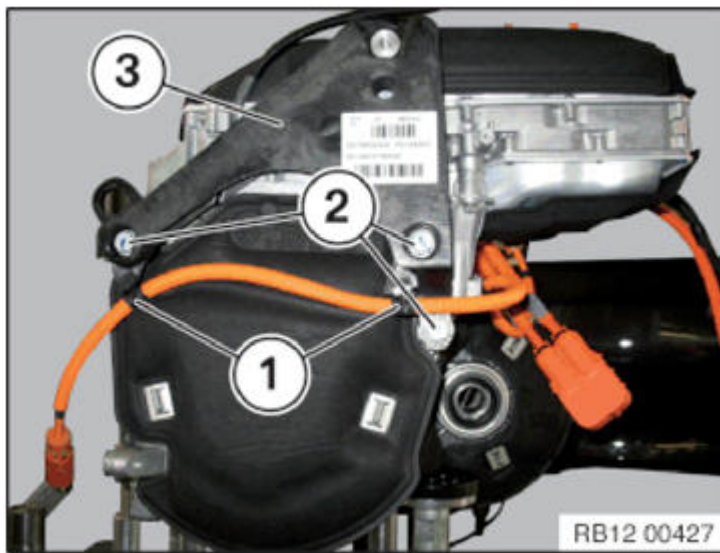
### Connection overview of electrical machine electronics (EME):

#### Removal:

Detach high-voltage cable from attachment points (1).

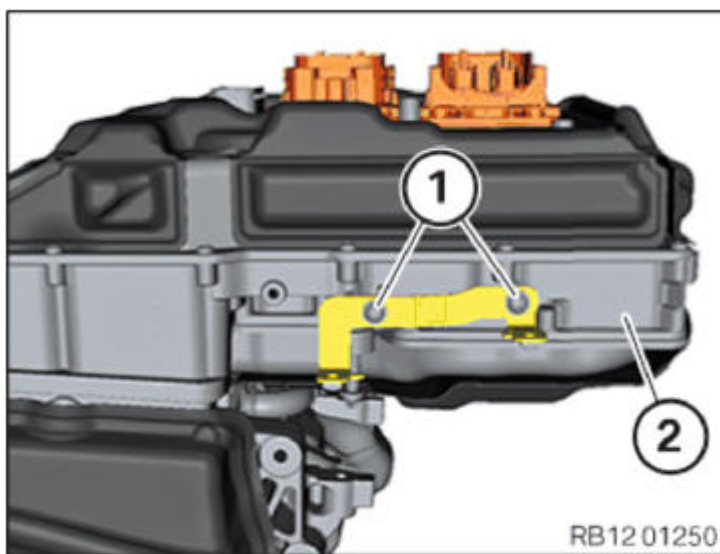
Release screws (2) and remove engine mounting bracket (3).





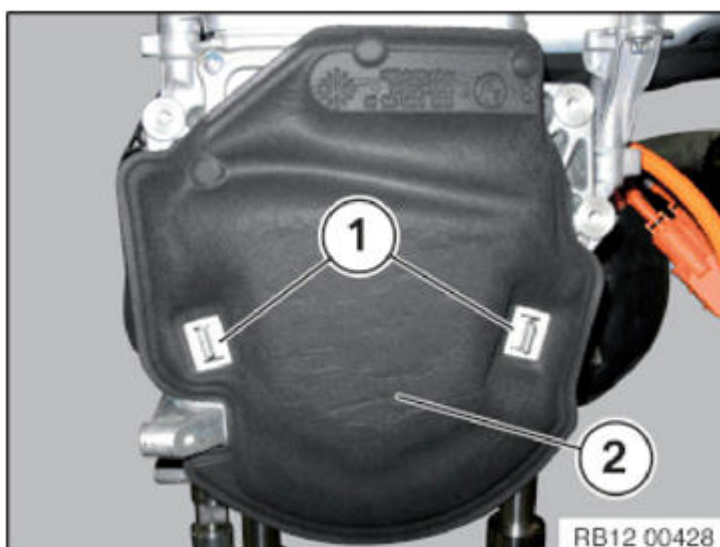
**Fig. 258: Identifying High-Voltage Cable Attachment Points, Mounting Bracket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

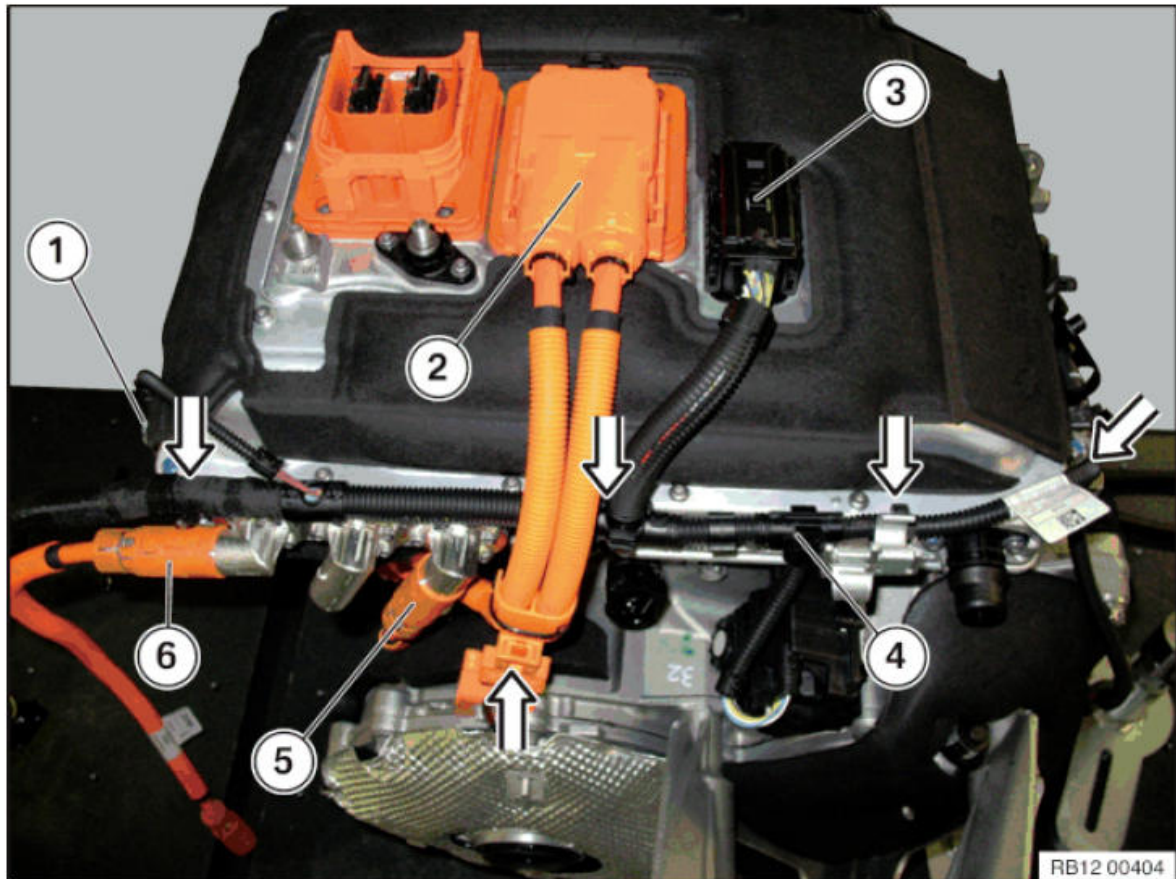
Loosen the screws (1) and remove the sheet metal bracket from the electrical machine electronics (2).



**Fig. 259: Identifying Electrical Machine Electronics And Sheet Metal Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pry out clamps (1) and remove sound insulation (2).





**Fig. 261: Detaching Wiring Harness From Attachment Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) of wiring harness ground connection.

Only with rapid charging equipment (SA4U7 and/or SA4U8): Disconnect high-voltage cable (2) for convenience charging electronics. Unclip and unthread the high-voltage cable (2).

Disconnect signal line (3).

Detach wiring harness (4) from attachment points.

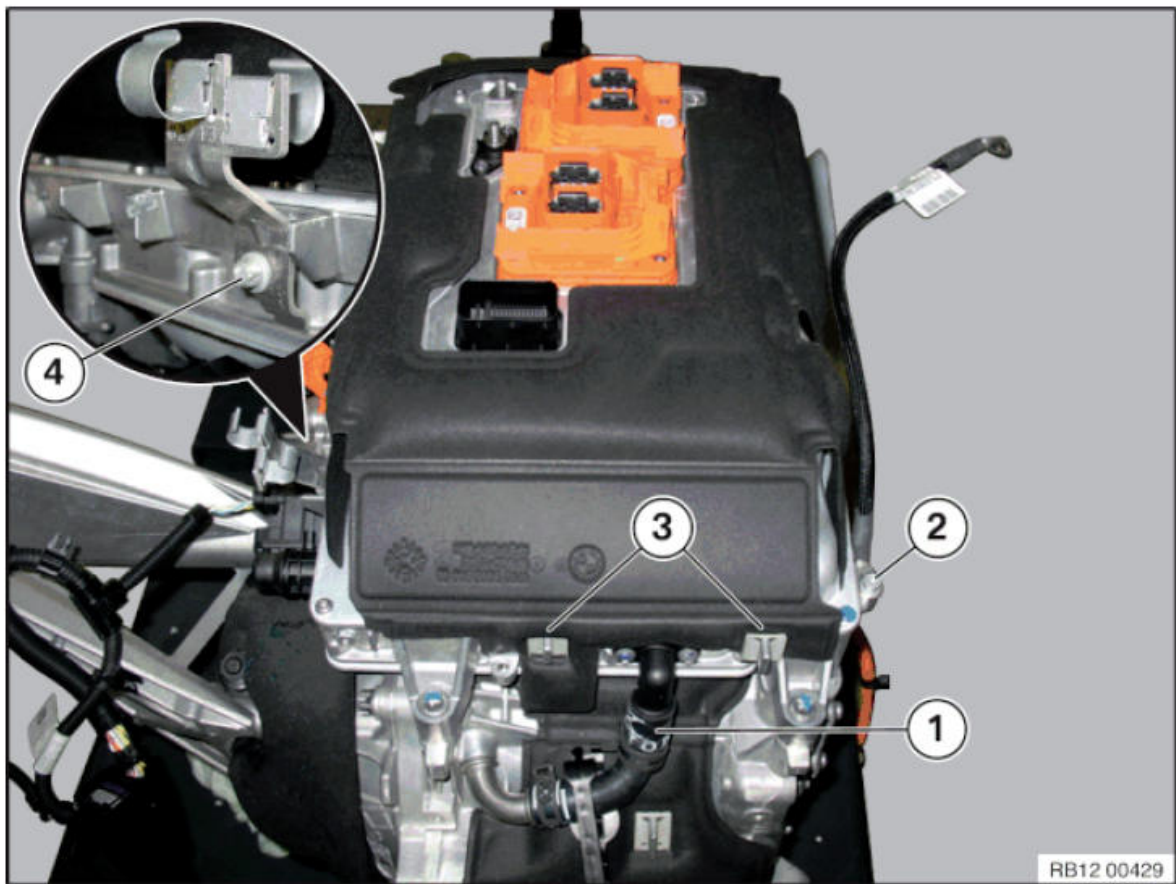
Disconnect high-voltage cable (5) for electric A/C compressor.

Only with alternating current rapid charging equipment (SA4U8): Disconnect high-voltage cable (6) for convenience charging electronics.

Attention!

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.





**Fig. 262: Identifying Coolant Hose And Sound Insulation Clamps, Holder And Equipotential Bonding Line Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Open clamp (1) and detach coolant hose.

Release screw (2) and remove equipotential bonding line.

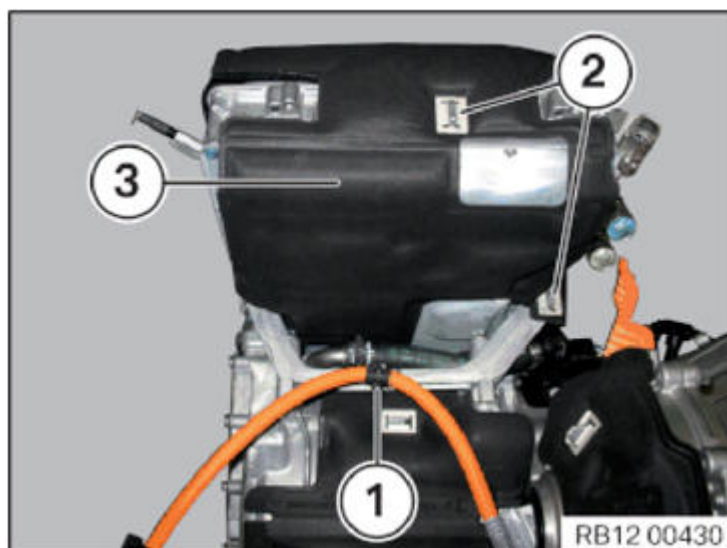
Pry off clamps (3) from sound insulation.

Release screw (4) and remove holder.

Detach and remove high-voltage cable for electric A/C compressor on attachment point (1).

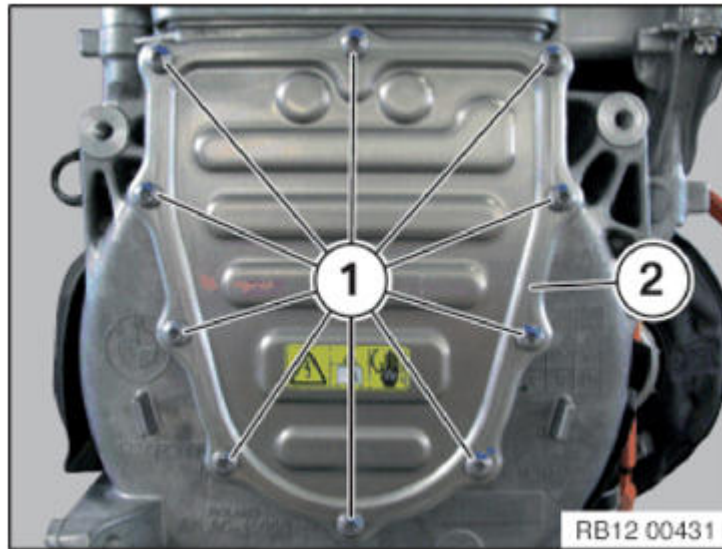
Pry off clamps (2) of sound insulation (3).

Feed out and remove sound insulation (3).



**Fig. 263: Identifying Sound Insulation, Clamps And High-Voltage Cable Attachment Point**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and remove service cap (2).



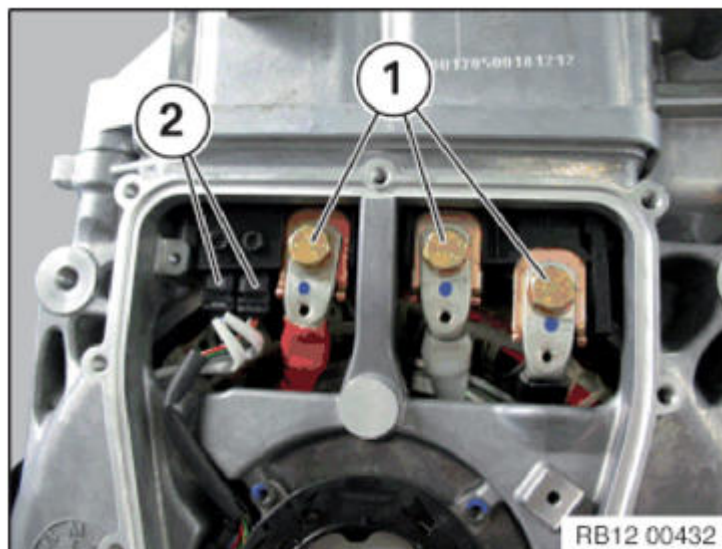
**Fig. 264: Identifying Service Cap With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) from high-voltage cables.

**Attention!**

Do not leave screws/small parts in the electrical machine.

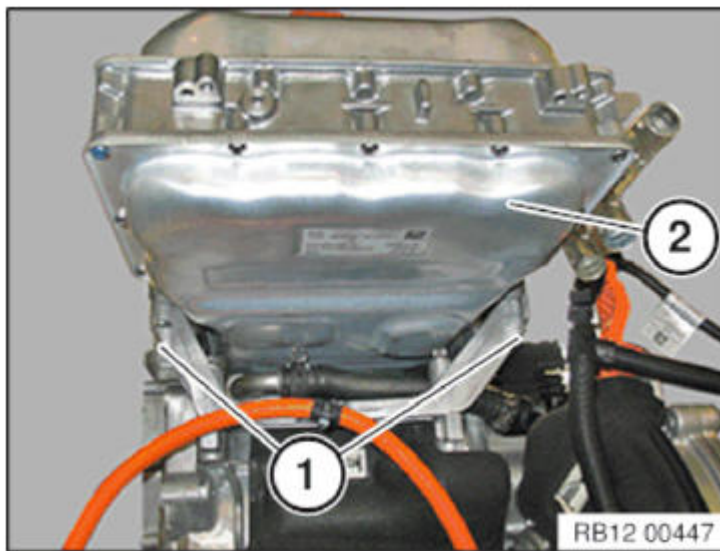
It is essential to adhere to conditions of absolute cleanliness. After the electrical machine electronics is disassembled, the connection face of the electrical machine must be covered.



**Fig. 265: Identifying High-Voltage Cable Screws And Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

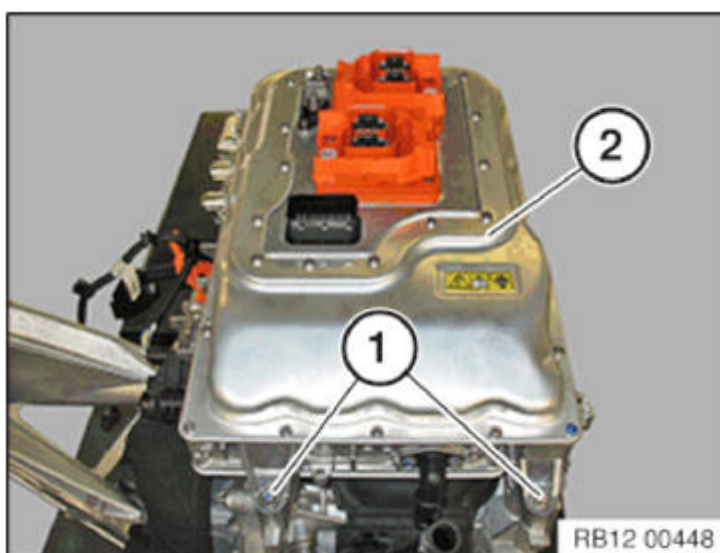
Disconnect plug connections (2).

Release screws (1) from electrical machine electronics (2).



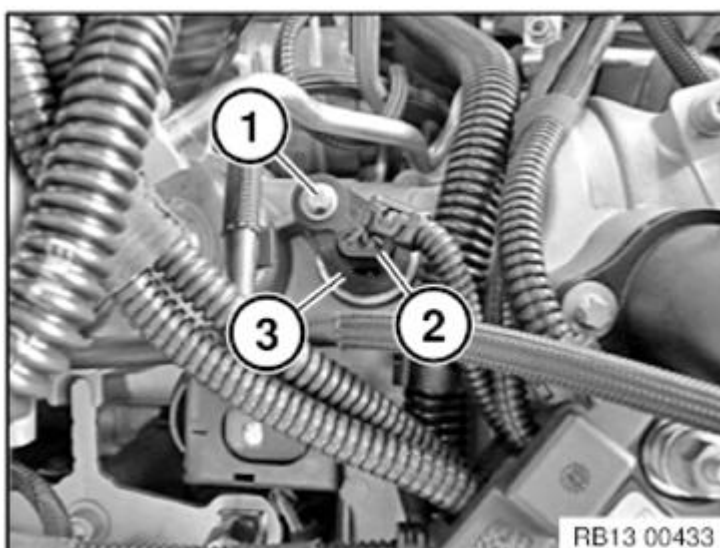
**Fig. 266: Identifying Electrical Machine Electronics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) from electrical machine electronics (2).



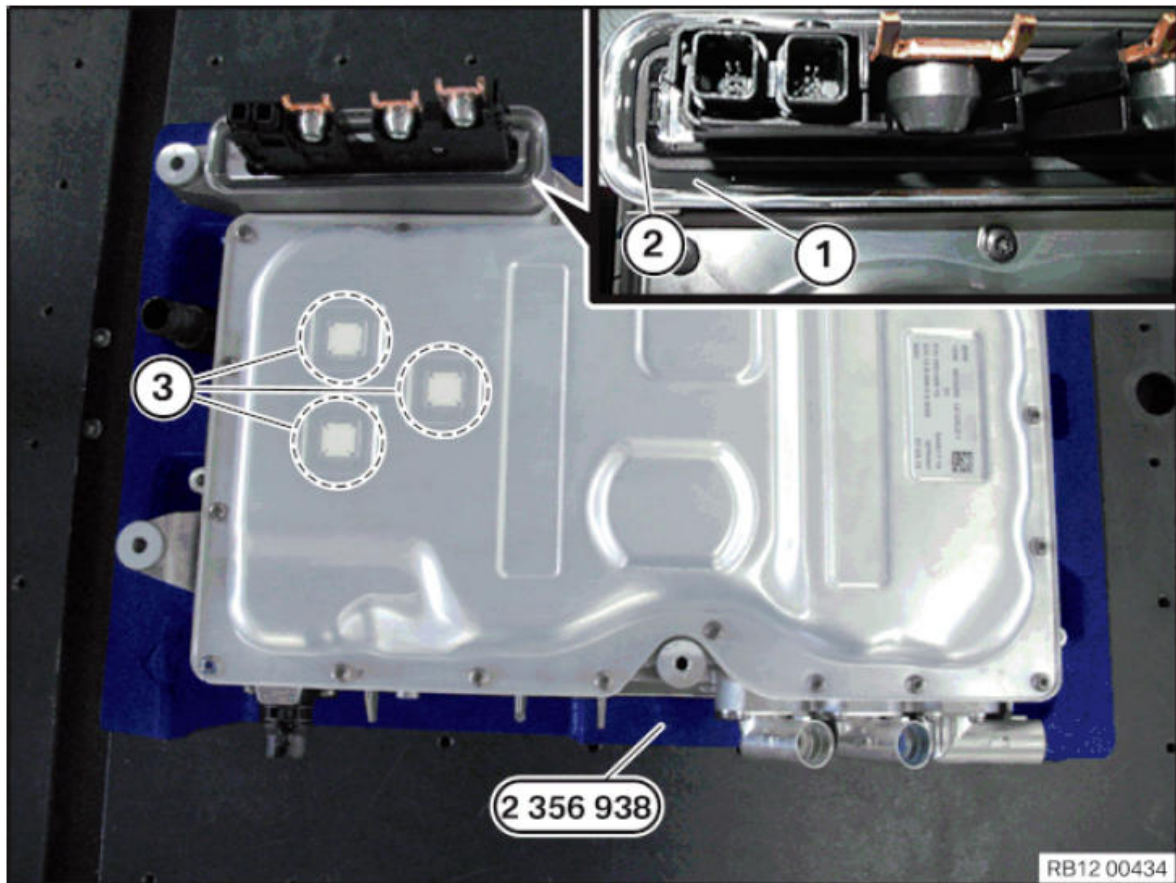
**Fig. 267: Identifying Electrical Machine Electronics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully place electrical machine electronics (1) in special tool [2 356 938](#) .





**Installation:**



**Fig. 269: Identifying Special Tool (2 356 938), Electrical Machine Electronics Gaskets And Diaphragm**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

Check gaskets (1, 2) and diaphragm (3) for damage.

1. Place electrical machine electronics inverted in special tool [2 356 938](#) .

**NOTE:** High-voltage connections must not be damaged.

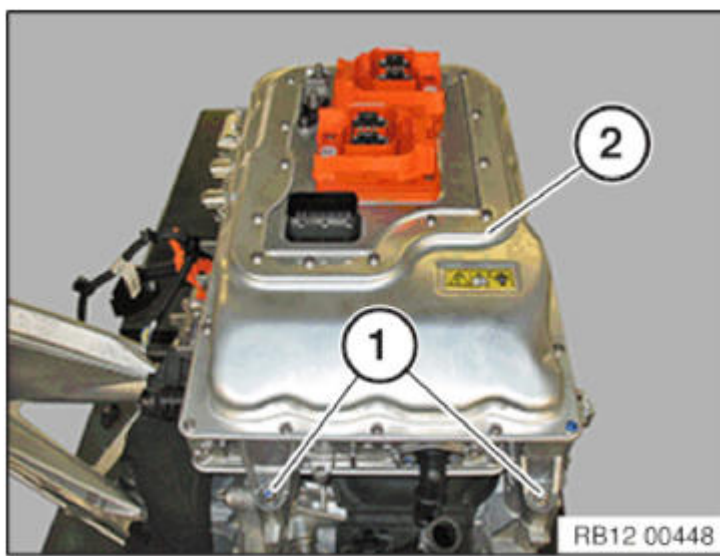
2. Check gasket (1) for damage. If damaged, the electrical machine electronics must be replaced.
3. Check gasket (2) for damage. If damaged, the electrical machine electronics must be replaced.
4. Check diaphragm (3) for damage. If damaged, the electrical machine electronics must be replaced.

Tighten screws (1) on electrical machine electronics (2).

Attention!

Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) !

Tightening torque [12 36 7AZ](#) .



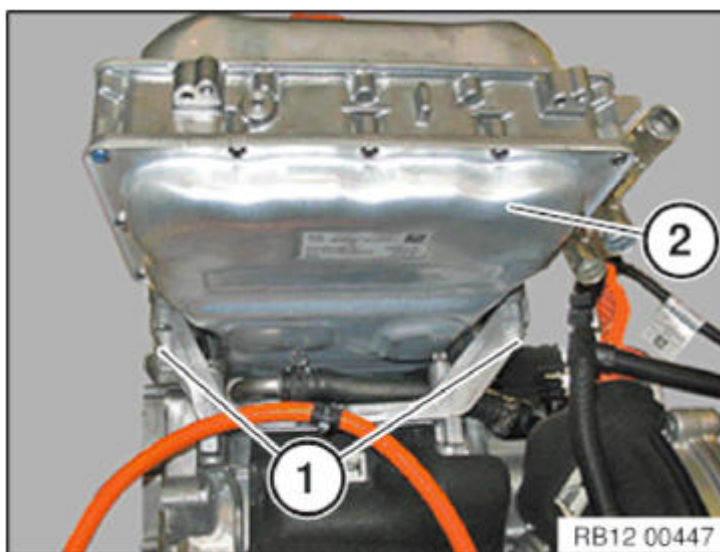
**Fig. 270: Identifying Electrical Machine Electronics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws (1) on electrical machine electronics (2).

Attention!

Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS !**

Tightening torque **12 36 7AZ** .



**Fig. 271: Identifying Electrical Machine Electronics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down screws (1) on high-voltage cables.

**Attention!**

Do not leave screws/small parts in the electrical machine.

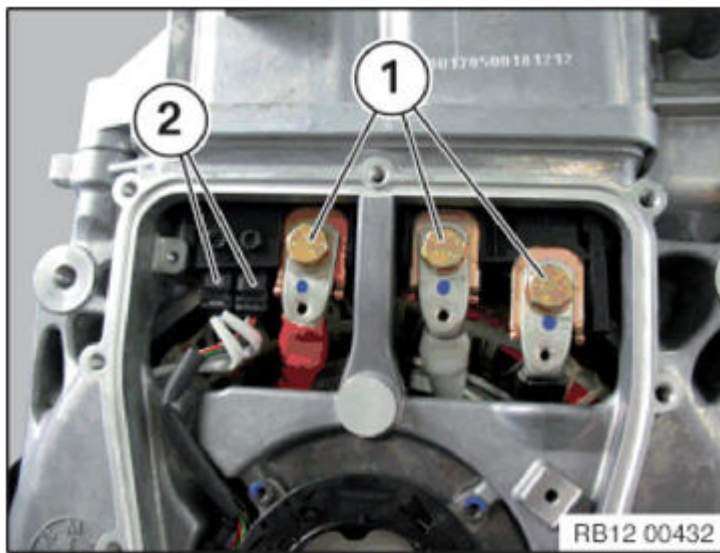
It is essential to adhere to conditions of absolute cleanliness.

Replace screws.

Observe **NOTES ON SAFETY SCREW CONNECTIONS** .

Tightening torque **12 35 3AZ** .





**Fig. 272: Identifying High-Voltage Cable Screws And Plug Connections**  
 Courtesy of BMW OF NORTH AMERICA, INC.

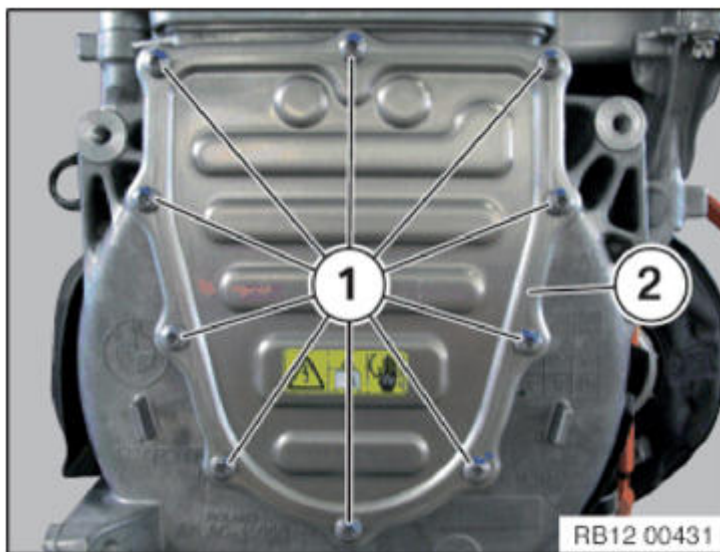
Connect and lock connectors (2) of temperature sensor and rotor position sensor.

**Attention!**

Replace service cap (2).

Check gasket of new service cap (2) for damage and contamination.

Attach new label on service cap (2) if necessary.



**Fig. 273: Identifying Service Cap With Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws (1) on service cap (2).

Tightening torque **12 35 2AZ**.

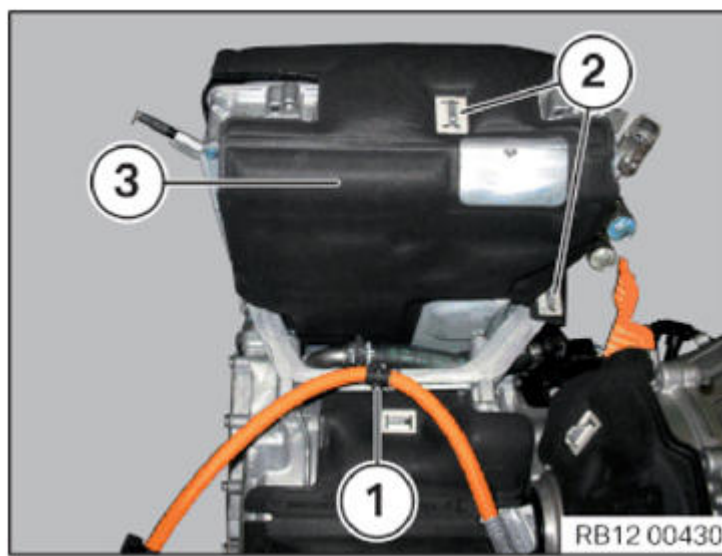
Feed in and position sound insulation (3).

Connect clamps (2) of sound insulation (3).

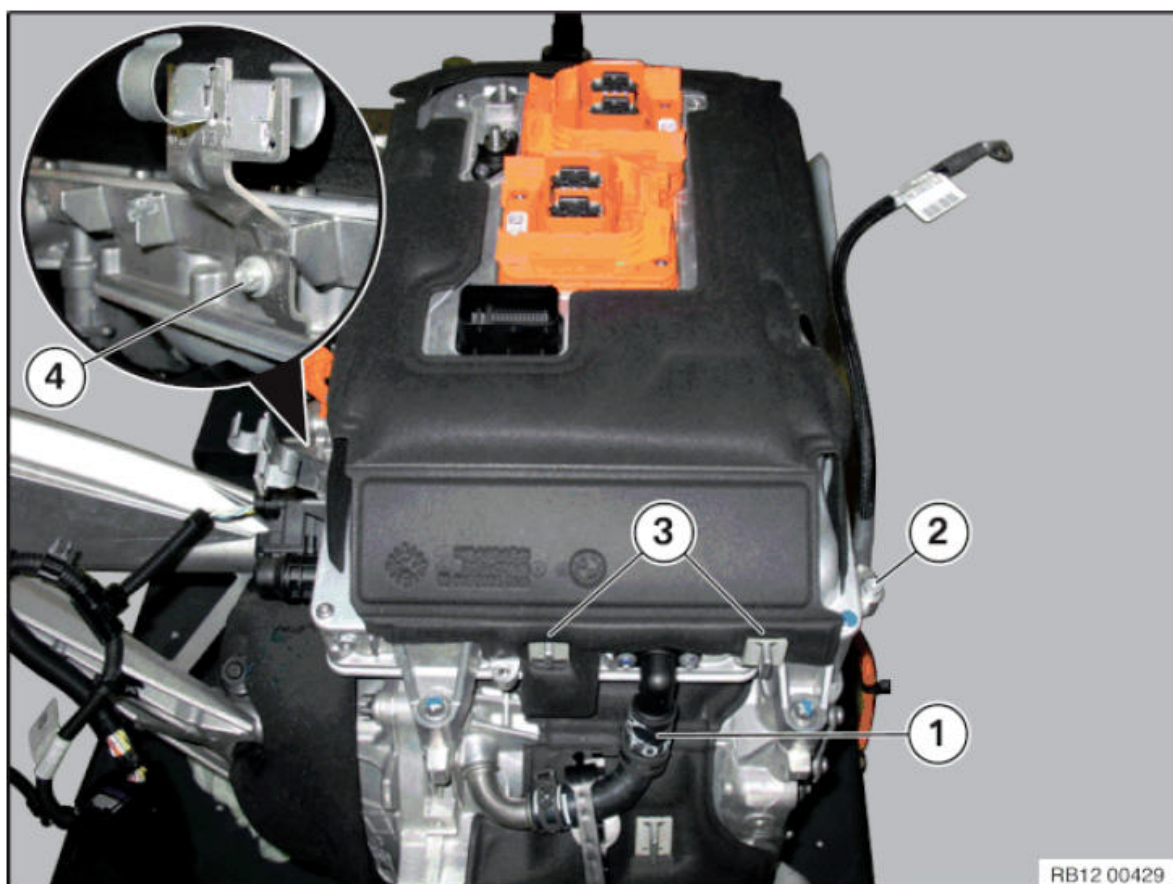
**Attention!**

Replace clamps.

Attach high-voltage cable for electric A/C compressor to attachment point (1).



**Fig. 274: Identifying Sound Insulation, Clamps And High-Voltage Cable Attachment Point**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 275: Identifying Coolant Hose And Sound Insulation Clamps, Holder And Equipotential Bonding Line Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect clamps (3) of sound insulation.

Attention!

Replace clamps.

Tighten screw (4) on holder.

Tightening torque **12 36 6AZ** .

Tighten equipotential bonding line with screw (2).

Attention!

Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS !](#)

Tightening torque [12 36 5AZ](#) .

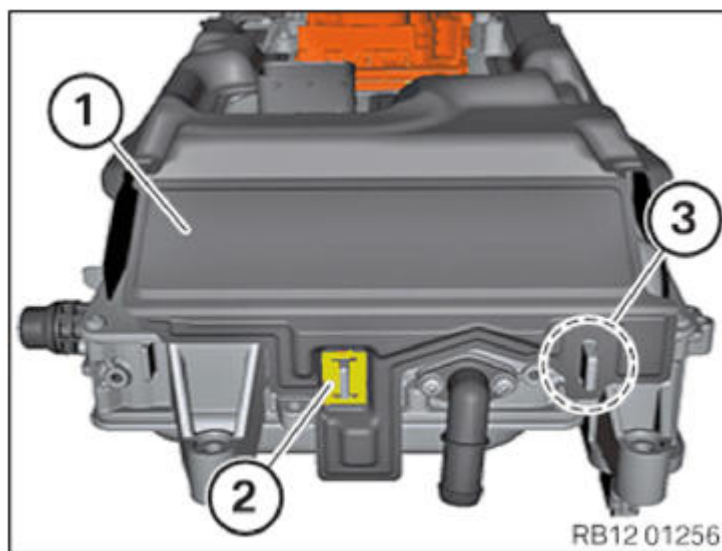
Connect coolant hose and close clamp (1).

### Attention!

One retaining lug may be too thin.

The sound insulation (1) has been secured with only one clamp (2).

The right-hand retaining lug (3) does not feature a clamp. The sound insulation (1) has been secured using window glass adhesive in this area.



**[Fig. 276: Identifying Sound Insulation, Clamp And Retaining Lug](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**For electrical machine electronics where the retaining lug is too thin only (see above):**

Fold sound insulation (1) upwards.

Clean the adhesive area of the electrical machine electronics using [R2 SOLVENT CLEANER](#) .

Apply [WINDOW GLASS ADHESIVE](#) (2) to the electrical machine electronics as shown.

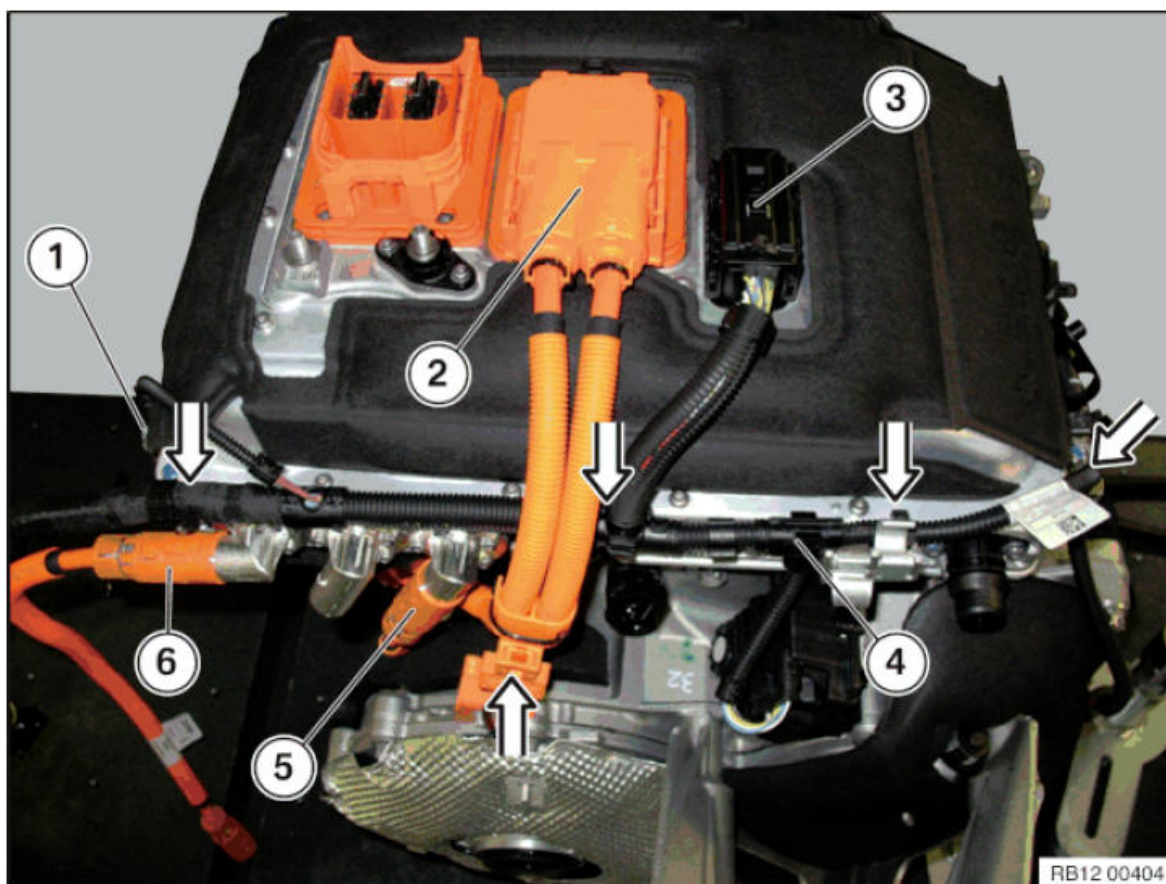
- Height: 4 mm to 6 mm
- Width: 6 mm to 8 mm





Securely press on the sound insulation (1) to the electrical machine electronics in the adhesive area.

Connect the left-hand clamp to the electrical machine electronics retaining lug.



**Fig. 278: Detaching Wiring Harness From Attachment Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Only with rapid charging equipment (SA4U7 and/or SA4U8): Connect connector (6) of high-voltage cable to convenience charging electronics and lock.

Connect connector (5) of high-voltage cable to electric A/C compressor and lock.

Attach wiring harness (4) to attachment points.

Tighten screw (1) on wiring harness ground connection.

Tightening torque **12 36 4AZ** .

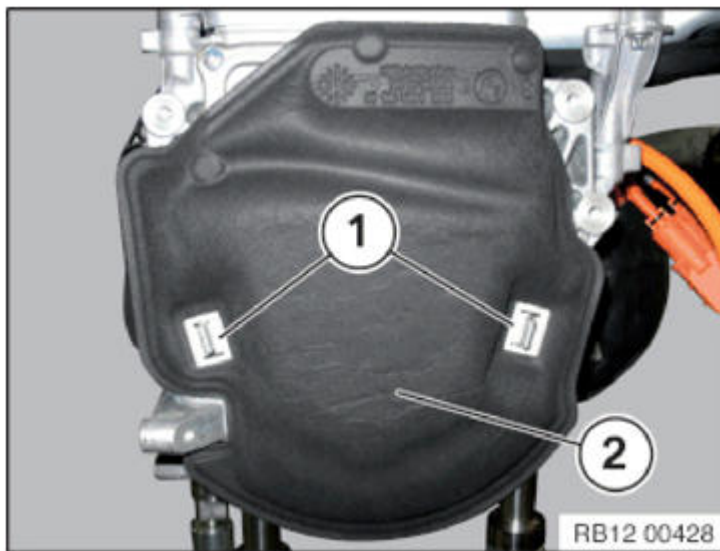
Connect connector (3) of signal line and lock.

Only with rapid charging equipment (SA4U8): Mount and clip in the high-voltage cable (2). Connect connector (2) of high-voltage cable to convenience charging electronics and lock.

Position sound insulation (2) and connect clamps (1).

**Attention!**

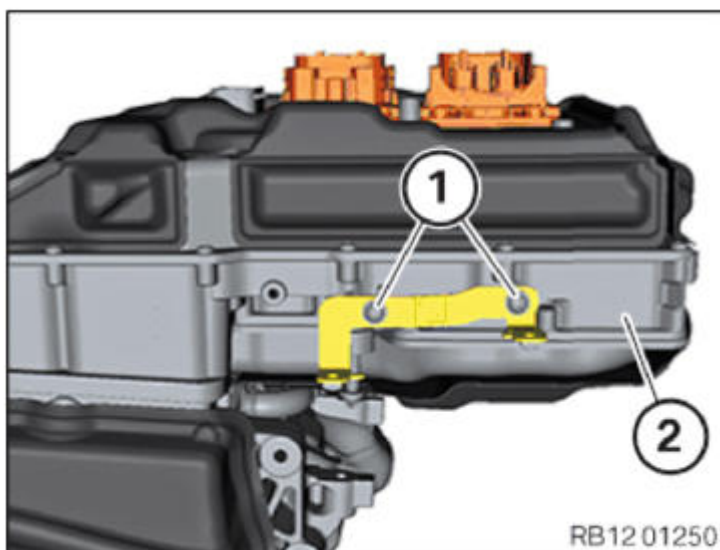
Replace clamps (1).



**Fig. 279: Identifying Sound Insulation And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position the sheet metal bracket on the electrical machine electronics (2) and tighten the screws (1).

Tightening torque [61 12 6AZ](#) .



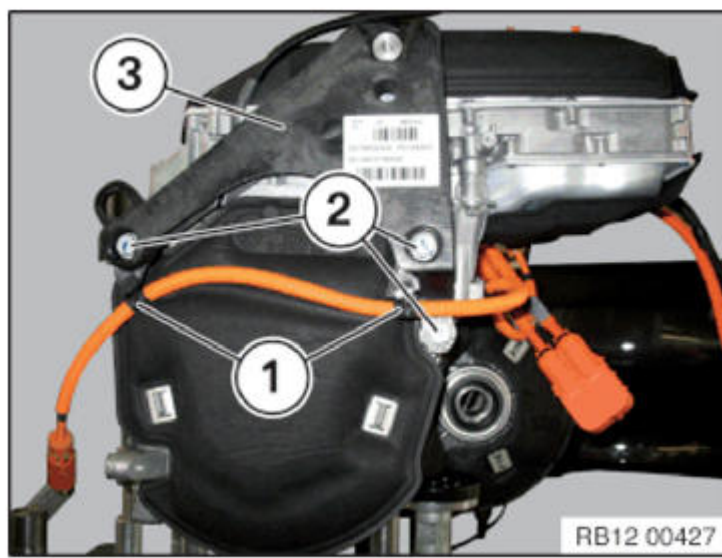
**Fig. 280: Identifying Electrical Machine Electronics And Sheet Metal Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws (2) on engine mounting bracket (3).

Tightening torque [27 00 5AZ](#) .

Attach high-voltage cable to attachment points (1).





**Fig. 281: Identifying High-Voltage Cable Attachment Points, Mounting Bracket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **12 36 610 REPLACE ELECTRICAL MACHINE ELECTRONICS**

Special tools required:

- [2 356 938](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe **[SAFETY INFORMATION](#)** for working with electric vehicles.
- Observe **[NOTES ON EARTH BONDING SCREW CONNECTIONS](#)** .
- The workbay required for the repair of the drive unit must be clean (free of grease, dirt and debris), dry (no leaking fluid) and free of flying sparks. Therefore, avoid close vicinity to areas intended for cleaning of vehicles and to workbays intended for repair work relating to the body. Use movable walls and high-voltage barrier tapes for separation, if needed.
- It is absolutely essential to remove all small parts/screws that fell into the electrical machine.
- Perform a visual inspection for contamination and damage of the housing, connections and gaskets or sealing surfaces of the electrical machine and electrical machine electronics.
- Replacement: Remove electrical machine electronics immediately before removing the packaging.
- For handling of the electrical machine electronics, always install protection connector (part number: 12 5 7 620 458).

**Attention!**

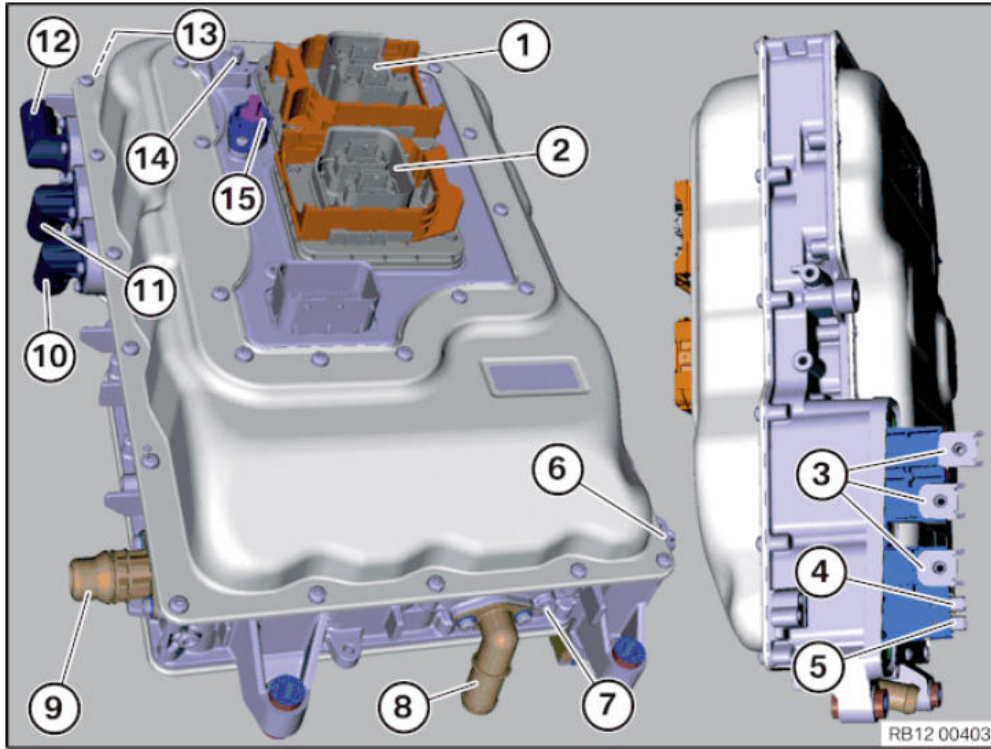
Read and comply with notes on protection against electrostatic damage (**[ESD PROTECTION](#)** ).

**Necessary preliminary tasks:**

- Connect the programming system and perform an individual data recovery.

If individual data recovery is not possible, the adaptation value of the rotor position sensor must be read from the type plate of the electrical machine and noted down. See **[REPLACE ELECTRICAL MACHINE](#)** or **[REPLACING ELECTRICAL MACHINE \(RANGE EXTENDER\)](#)**.

- Remove complete drive unit. See **REMOVING COMPLETE DRIVE UNIT** or **REMOVING COMPLETE DRIVE UNIT (RANGE EXTENDER)**.



1. High-voltage connection to high-voltage battery unit
2. High-voltage connection to convenience charging electronics (only with optional equipment for direct current and/or alternating current rapid charging)
3. High-voltage connection to electrical machine (stator winding 1 to 3)
4. Rotor position sensor
5. Temperature sensor
6. Equipotential bonding line to drive module
7. Equipotential bonding line to electrical machine (only in vehicles with range extender)
8. Cooling water connection (electrical machine electronics return flow to electrical machine)
9. Cooling water connection (radiator feed, electrical machine electronics)
10. High-voltage connection of electric A/C compressor (EKK)
11. High-voltage connection to electrical heating
12. High-voltage connection, charging
13. Ground connection 12-V wiring harness
14. Battery earth lead
15. Positive battery cable
16. Signal line

**Fig. 282: Connection Overview Of Electrical Machine Electronics (EME)**

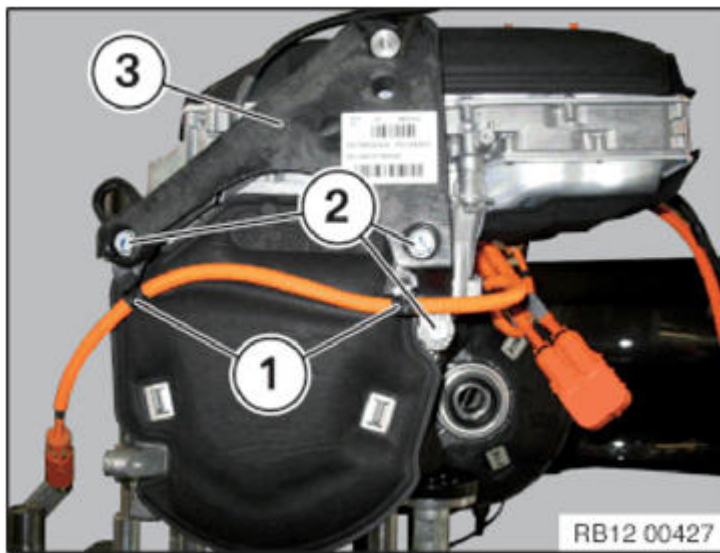
Courtesy of BMW OF NORTH AMERICA, INC.

**Connection overview of electrical machine electronics (EME):**

**Removal:**

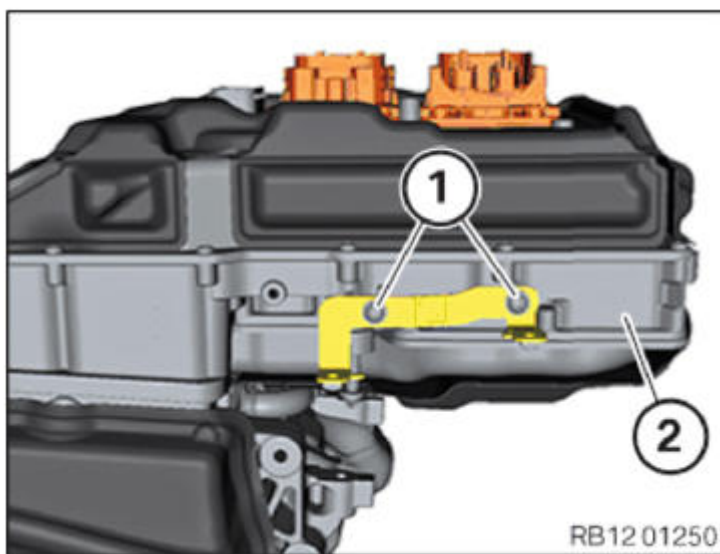
Detach high-voltage cable from attachment points (1).

Release screws (2) and remove engine mounting bracket (3).



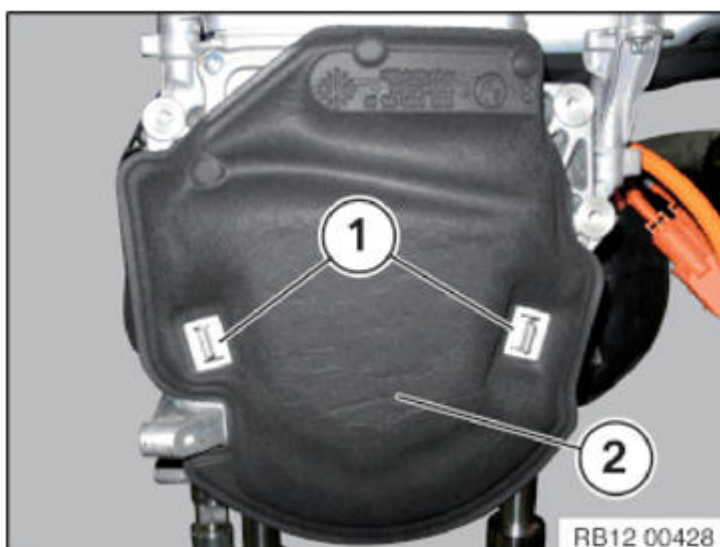
**Fig. 283: Identifying High-Voltage Cable Attachment Points, Mounting Bracket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Loosen the screws (1) and remove the sheet metal bracket from the electrical machine electronics (2).

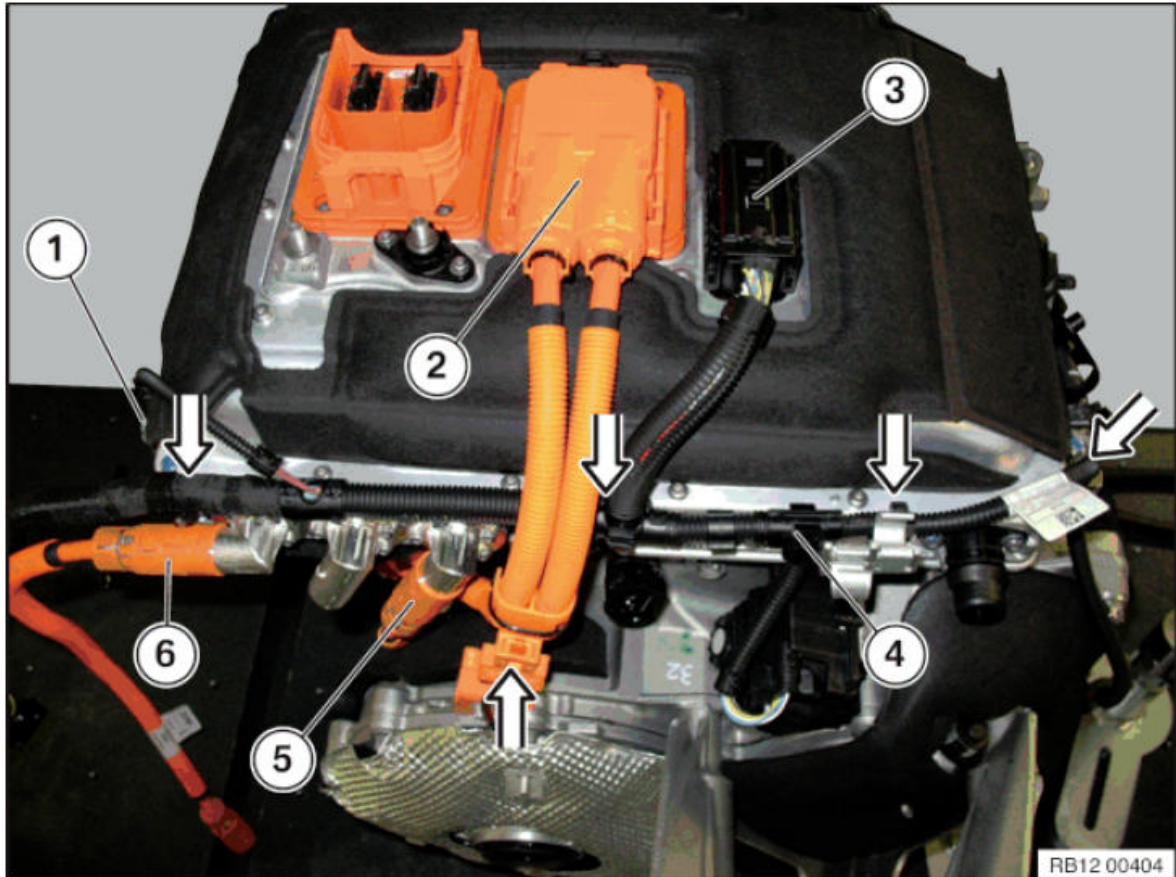


**Fig. 284: Identifying Electrical Machine Electronics And Sheet Metal Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pry out clamps (1) and remove sound insulation (2).







**Fig. 286: Detaching Wiring Harness From Attachment Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) of wiring harness ground connection.

Only with rapid charging equipment (SA4U7 and/or SA4U8): Disconnect high-voltage cable (2) for convenience charging electronics. Unclip and unthread the high-voltage cable (2).

Disconnect signal line (3).

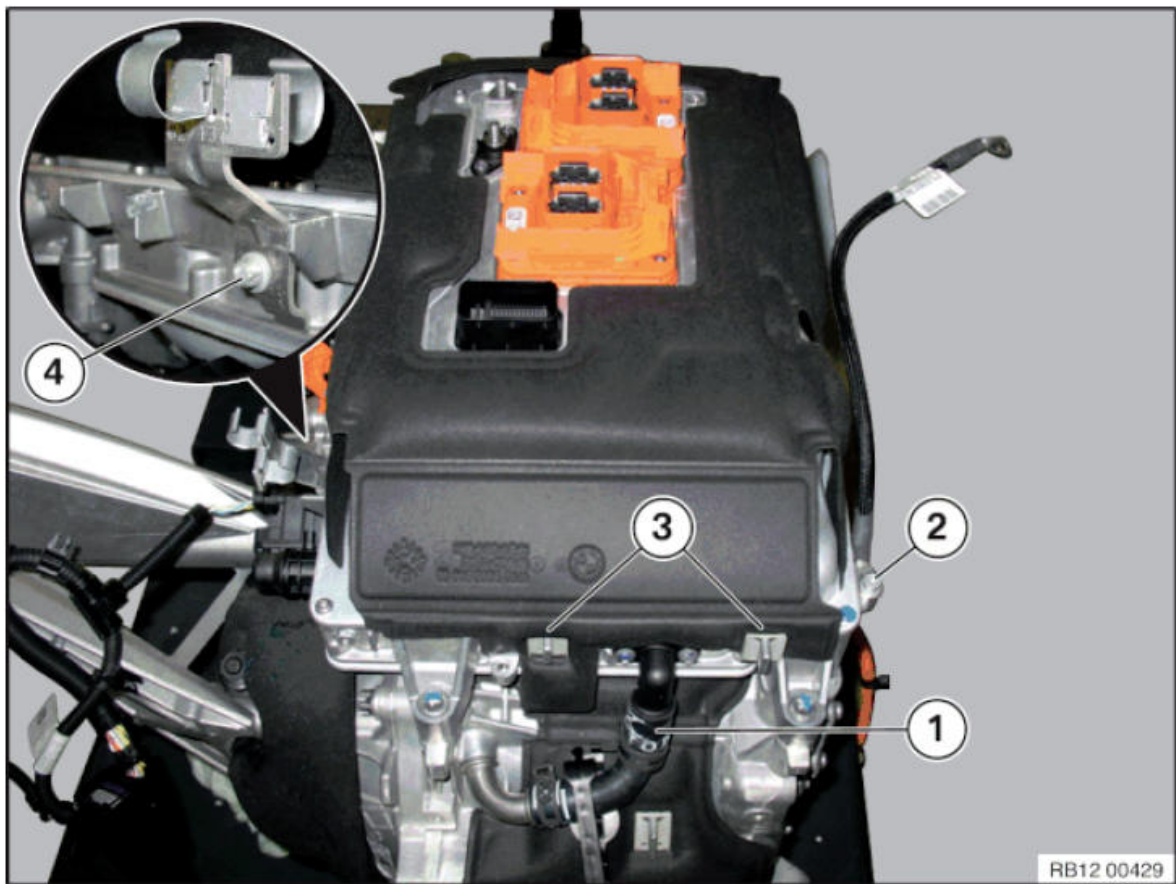
Detach wiring harness (4) from attachment points.

Disconnect high-voltage cable (5) for electric A/C compressor.

Only with alternating current rapid charging equipment (SA4U8): Disconnect high-voltage cable (6) for convenience charging electronics.

Attention!

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.



**Fig. 287: Identifying Coolant Hose And Sound Insulation Clamps, Holder And Equipotential Bonding Line Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Open clamp (1) and detach coolant hose.

Release screw (2) and remove equipotential bonding line.

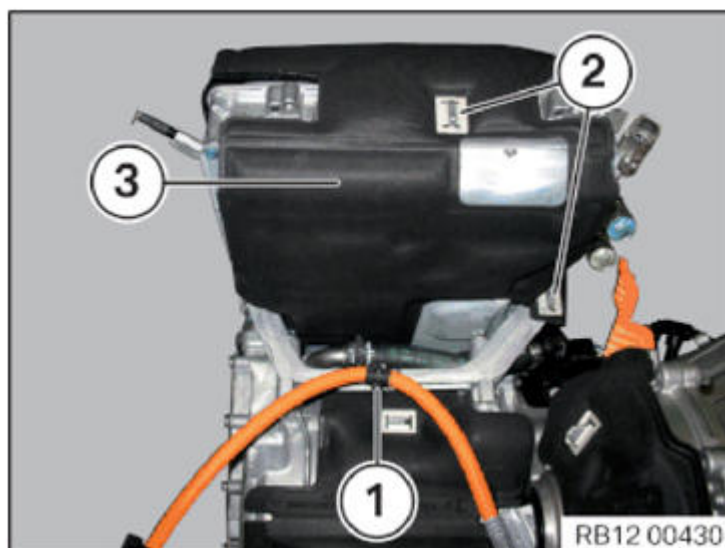
Pry off clamps (3) from sound insulation.

Release screw (4) and remove holder.

Detach and remove high-voltage cable for electric A/C compressor on attachment point (1).

Pry off clamps (2) of sound insulation (3).

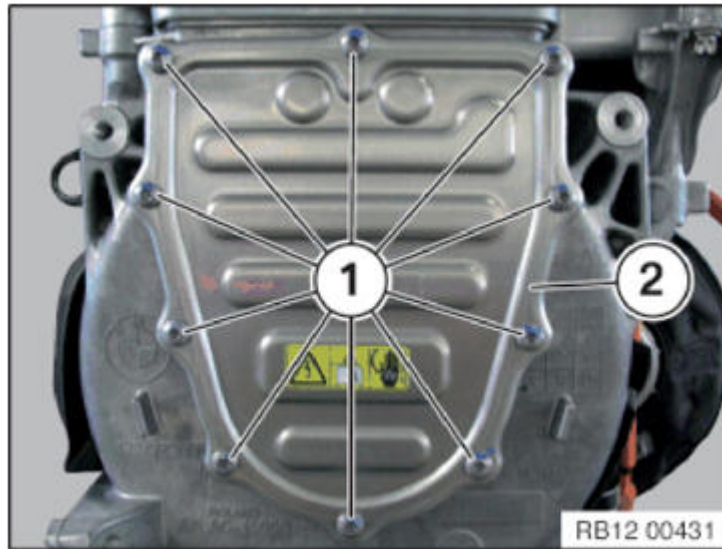
Feed out and remove sound insulation (3).



**Fig. 288: Identifying Sound Insulation, Clamps And High-Voltage Cable Attachment Point**  
 Courtesy of BMW OF NORTH AMERICA, INC.



Release screws (1) and remove service cap (2).



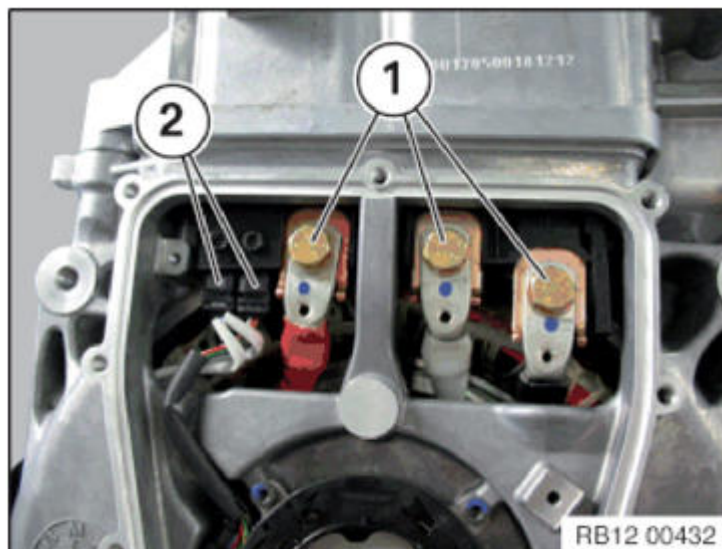
**Fig. 289: Identifying Service Cap With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) from high-voltage cables.

**Attention!**

Do not leave screws/small parts in the electrical machine.

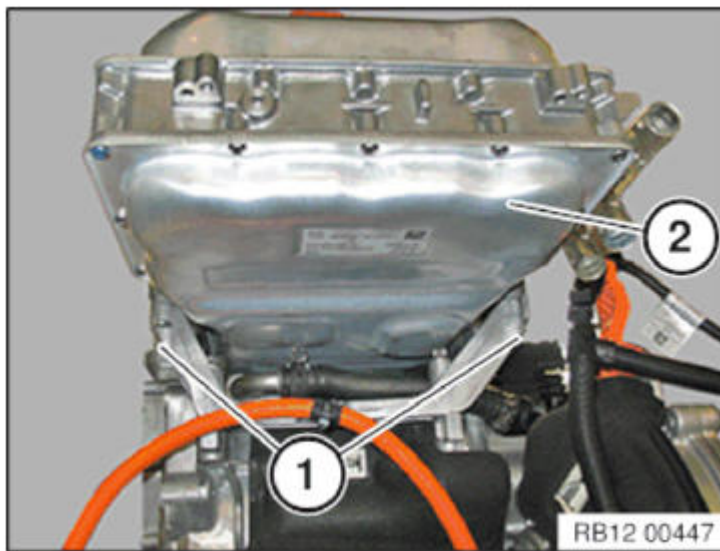
It is essential to adhere to conditions of absolute cleanliness. After the electrical machine electronics is disassembled, the connection face of the electrical machine must be covered.



**Fig. 290: Identifying High-Voltage Cable Screws And Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

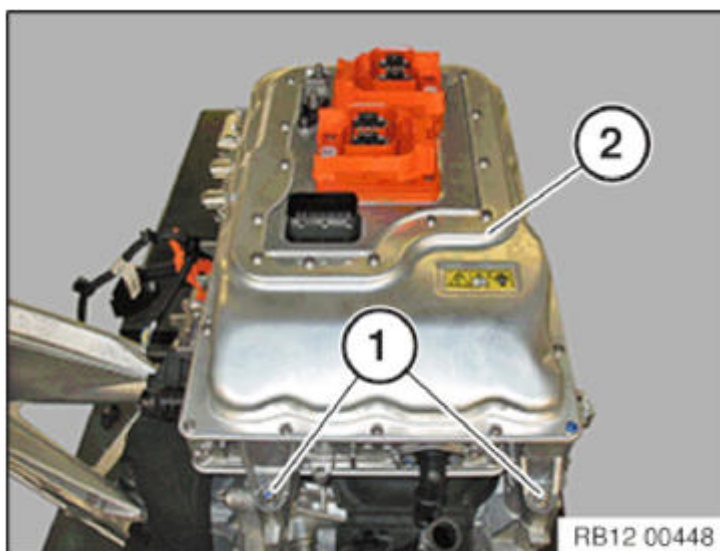
Disconnect plug connections (2).

Release screws (1) from electrical machine electronics (2).



**Fig. 291: Identifying Electrical Machine Electronics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) from electrical machine electronics (2).

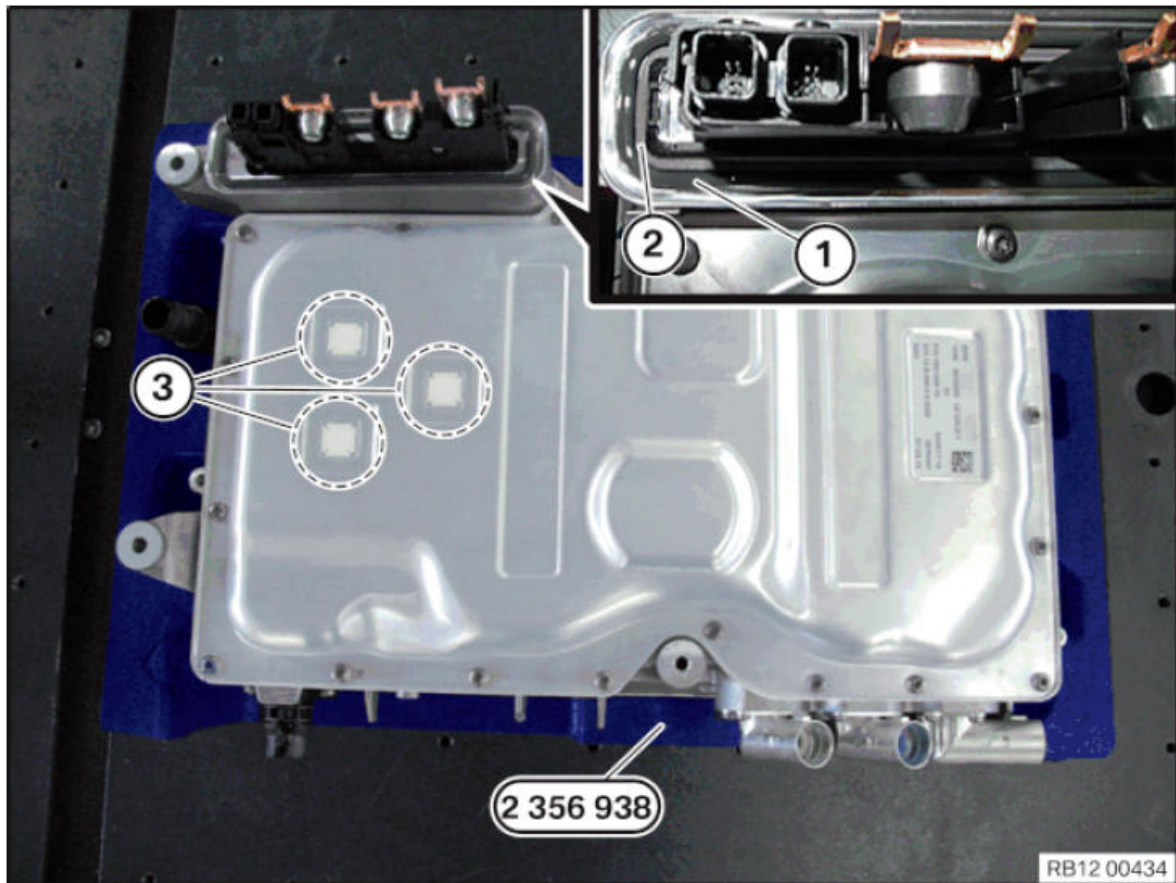


**Fig. 292: Identifying Electrical Machine Electronics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Carefully place electrical machine electronics (1) in special tool [2 356 938](#).



**Installation:**



**Fig. 294: Identifying Special Tool (2 356 938), Electrical Machine Electronics Gaskets And Diaphragm**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

Check gaskets (1, 2) and diaphragm (3) for damage.

1. Place electrical machine electronics inverted in special tool [2 356 938](#) .

**NOTE:** High-voltage connections must not be damaged.

2. Check gasket (1) for damage. If damaged, the electrical machine electronics must be replaced.
3. Check gasket (2) for damage. If damaged, the electrical machine electronics must be replaced.
4. Check diaphragm (3) for damage. If damaged, the electrical machine electronics must be replaced.

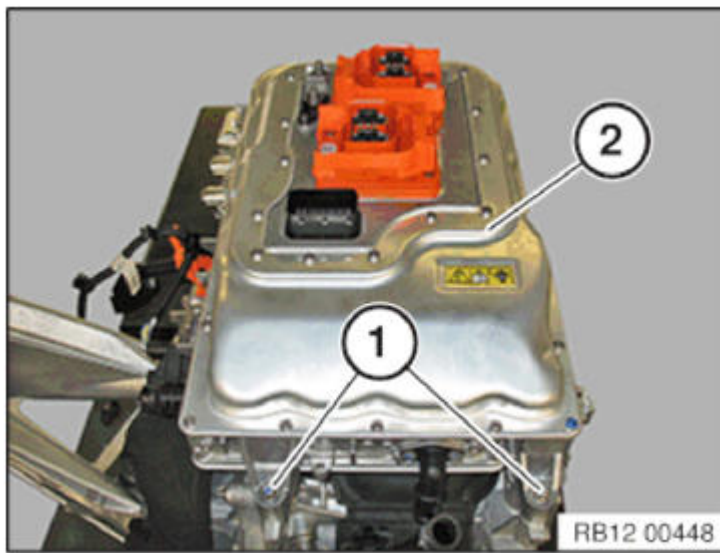
Tighten screws (1) on electrical machine electronics (2).

Attention!

Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS](#) !

Tightening torque [12 36 7AZ](#) .





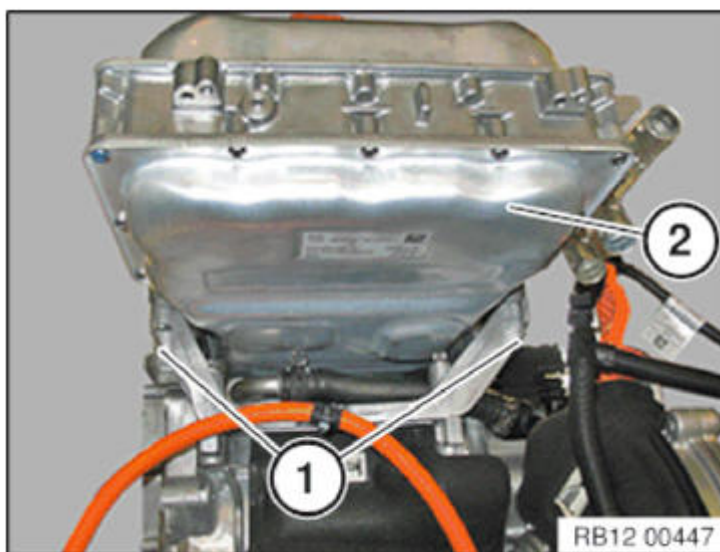
**Fig. 295: Identifying Electrical Machine Electronics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws (1) on electrical machine electronics (2).

**Attention!**

Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS !**

Tightening torque **12 36 7AZ** .



**Fig. 296: Identifying Electrical Machine Electronics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down screws (1) on high-voltage cables.

**Attention!**

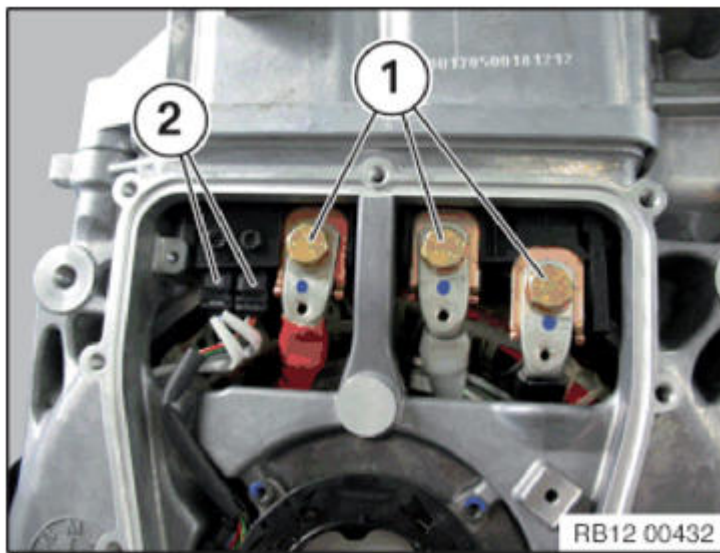
Do not leave screws/small parts in the electrical machine.

It is essential to adhere to conditions of absolute cleanliness.

Replace screws.

Observe **NOTES ON SAFETY SCREW CONNECTIONS** .

Tightening torque **12 35 3AZ** .



**Fig. 297: Identifying High-Voltage Cable Screws And Plug Connections**  
Courtesy of BMW OF NORTH AMERICA, INC.

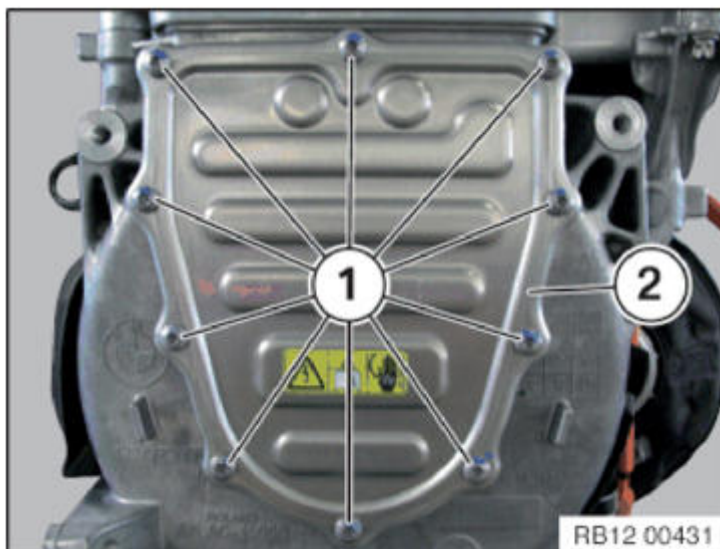
Connect and lock connectors (2) of temperature sensor and rotor position sensor.

**Attention!**

Replace service cap (2).

Check gasket of new service cap (2) for damage and contamination.

Attach new label on service cap (2) if necessary.



**Fig. 298: Identifying Service Cap With Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws (1) on service cap (2).

Tightening torque [12 35 2AZ](#).

Feed in and position sound insulation (3).

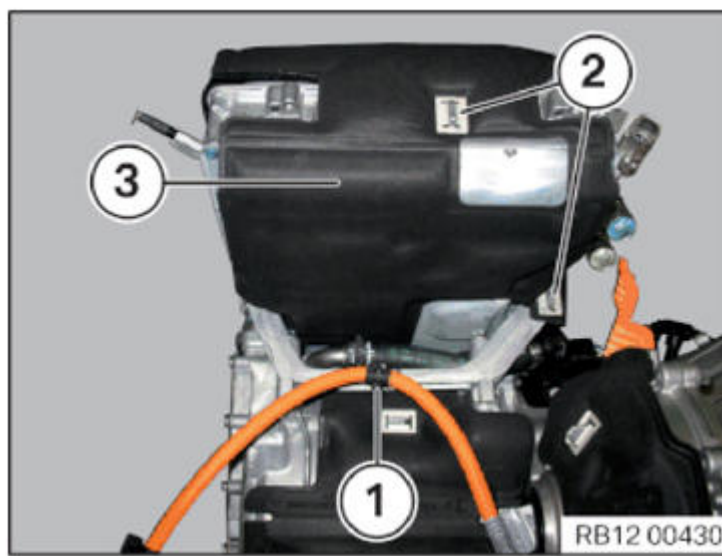
Connect clamps (2) of sound insulation (3).

**Attention!**

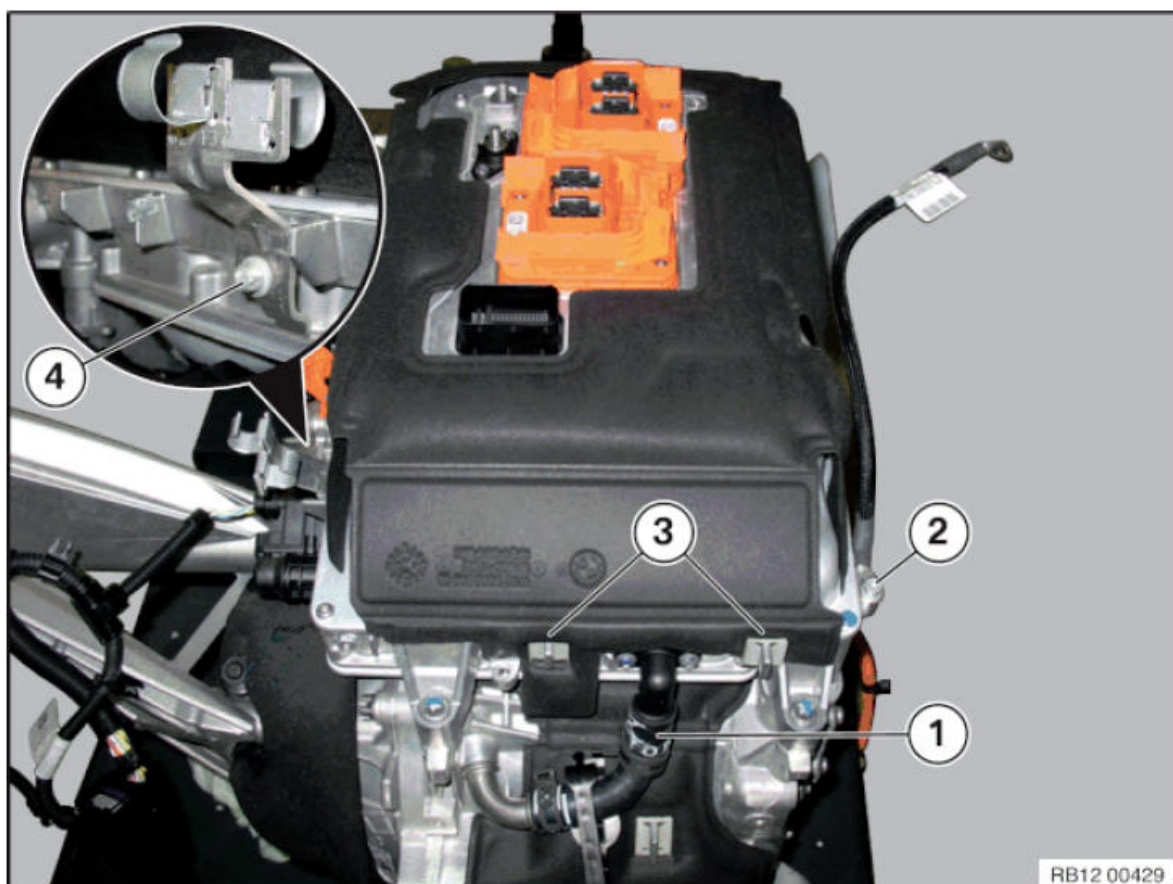
Replace clamps.

Attach high-voltage cable for electric A/C compressor to attachment point (1).





**Fig. 299: Identifying Sound Insulation, Clamps And High-Voltage Cable Attachment Point**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 300: Identifying Coolant Hose And Sound Insulation Clamps, Holder And Equipotential Bonding Line Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Connect clamps (3) of sound insulation.

Attention!

Replace clamps.

Tighten screw (4) on holder.

Tightening torque **12 36 6AZ** .

Tighten equipotential bonding line with screw (2).

Attention!

Observe [NOTES ON EARTH BONDING SCREW CONNECTIONS !](#)

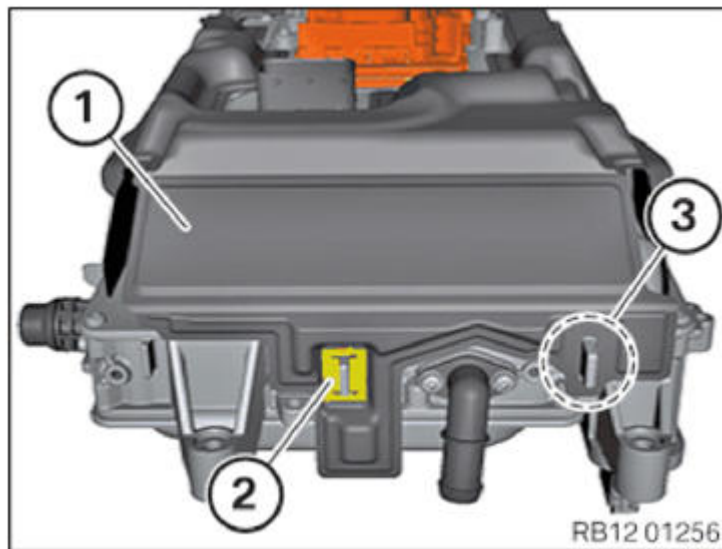
Tightening torque [12 36 5AZ](#) .

Connect coolant hose and close clamp (1).

**Attention!**

One retaining lug on the electrical machine electronics may be too thin.

The sound insulation (1) cannot be attached in this area (3) using the clamp (2).



**Fig. 301: Identifying Sound Insulation, Clamp And Retaining Lug**  
Courtesy of BMW OF NORTH AMERICA, INC.

For electrical machine electronics where the retaining lug is too thin only (see above):

Fold sound insulation (1) upwards.

Clean the adhesive area of the electrical machine electronics using [R2 SOLVENT CLEANER](#) .

Apply [WINDOW GLASS ADHESIVE](#) (2) to the electrical machine electronics as shown.

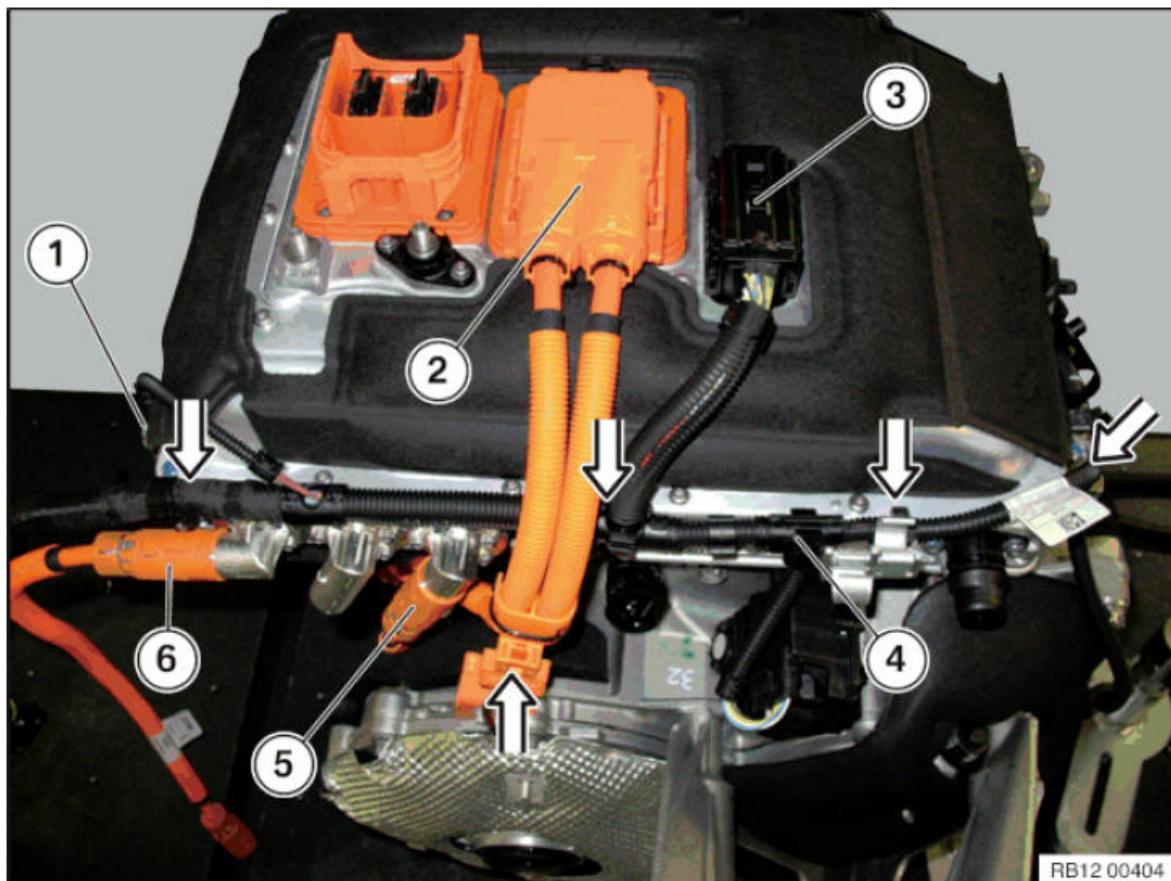
- Height: 4 mm to 6 mm
- Width: 6 mm to 8 mm



**Fig. 302: Identifying Sound Insulation And Window Glass Adhesive**  
Courtesy of BMW OF NORTH AMERICA, INC.

Securely press on the sound insulation (1) to the electrical machine electronics in the adhesive area.

Connect the left-hand clamp to the electrical machine electronics retaining lug.



**Fig. 303: Detaching Wiring Harness From Attachment Points**

Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Only with rapid charging equipment (SA4U7 and/or SA4U8): Connect connector (6) of high-voltage cable to convenience charging electronics and lock.

Connect connector (5) of high-voltage cable to electric A/C compressor and lock.

Attach wiring harness (4) to attachment points.

Tighten screw (1) on wiring harness ground connection.

Tightening torque **12 36 4AZ** .

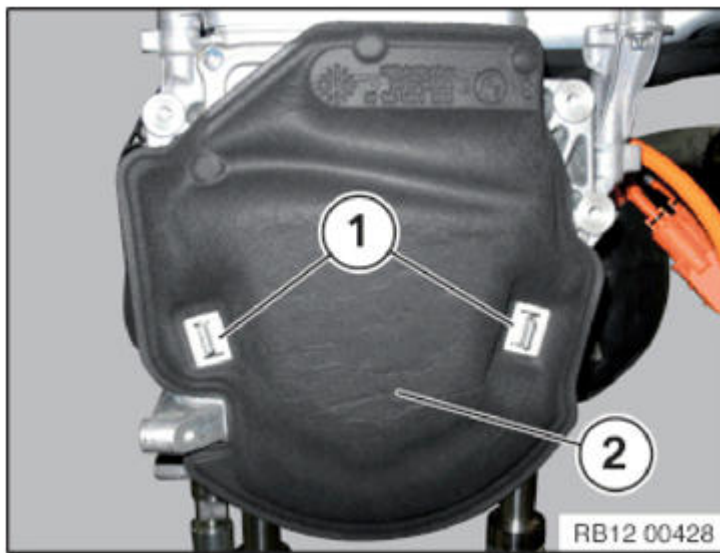
Connect connector (3) of signal line and lock.

Only with rapid charging equipment (SA4U8): Mount and clip in the high-voltage cable (2). Connect connector (2) of high-voltage cable to convenience charging electronics and lock.

Position sound insulation (2) and connect clamps (1).

**Attention!**

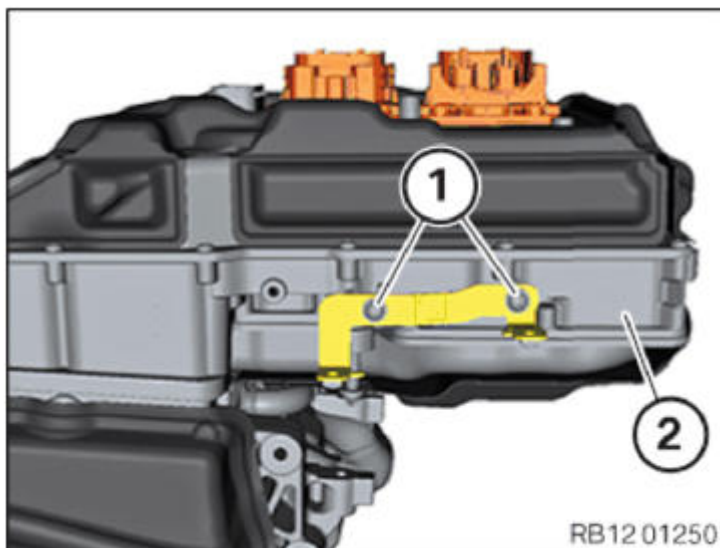
Replace clamps (1).



**Fig. 304: Identifying Sound Insulation And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position the sheet metal bracket on the electrical machine electronics (2) and tighten the screws (1).

Tightening torque [61 12 6AZ](#) .



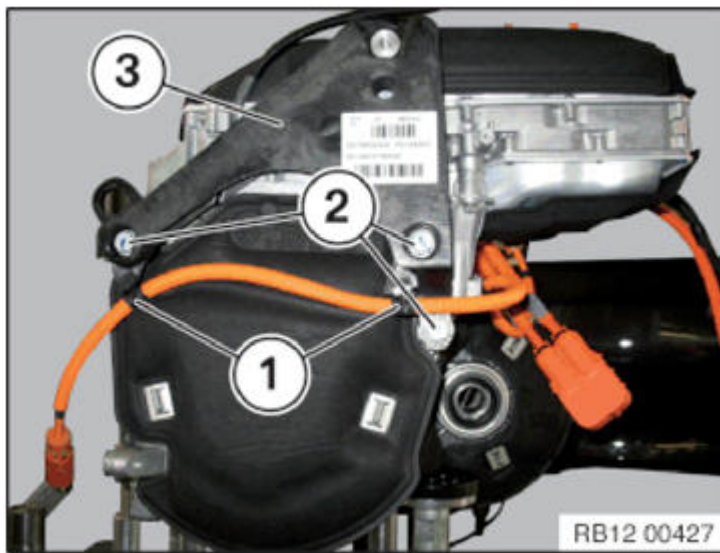
**Fig. 305: Identifying Electrical Machine Electronics And Sheet Metal Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws (2) on engine mounting bracket (3).

Tightening torque [27 00 5AZ](#) .

Attach high-voltage cable to attachment points (1).





**Fig. 306: Identifying High-Voltage Cable Attachment Points, Mounting Bracket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

Carry out **PROGRAMMING/ENCODING** .

- Reading in the adaptation value of rotor position sensor for the electrical machine and adjusting the rotor position sensor:
  1. Service functions
  2. Power train
  3. Electrical machine electronics
  4. Motor position sensor adjustment
- Teaching in parking lock module:
  1. Service functions
  2. Power train
  3. Electrical machine electronics
  4. Teach in parking lock module
- Teaching in KLE, only with alternating current rapid charging equipment (SA4U8>):
  1. Service functions
  2. Power train
  3. Electrical machine electronics
  4. Teach in KLE

**HIGH-VOLTAGE CABLE AND DISTRIBUTOR**

**12 43 002 REMOVING AND INSTALLING/REPLACING HIGH-VOLTAGE CABLE (VEHICLES WITH RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!

**WARNING:** The following points must be strictly observed prior to starting work :

- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe the **SAFETY INFORMATION** for working with electric vehicles.

**Necessary preliminary tasks:**

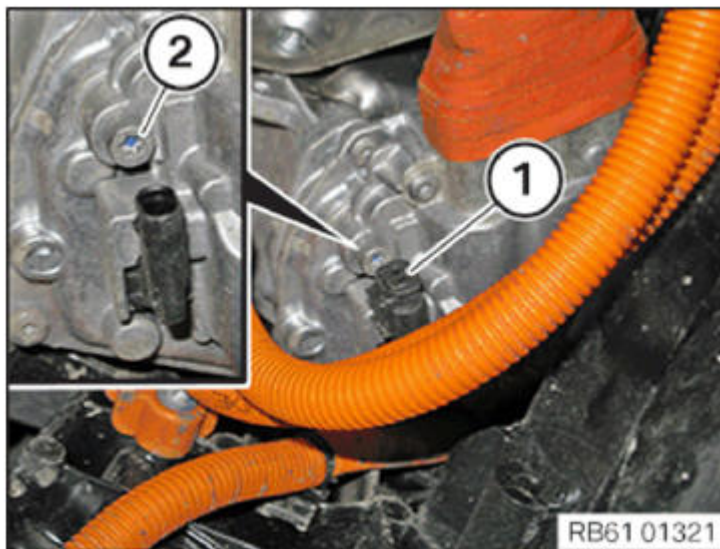
- Remove REAR CROSS STRUT



**Removal:**

Unlock and disconnect high-voltage safety connector (1).

Release screw (2).

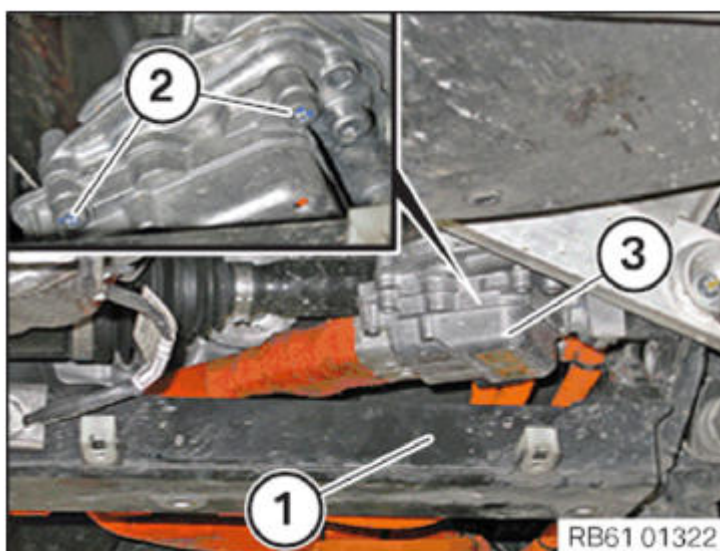


**Fig. 307: Identifying High-Voltage Safety Connector And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Slightly pull down the crossmember (1) if necessary.

Release screws (2) and disconnect high-voltage plug connection (3).



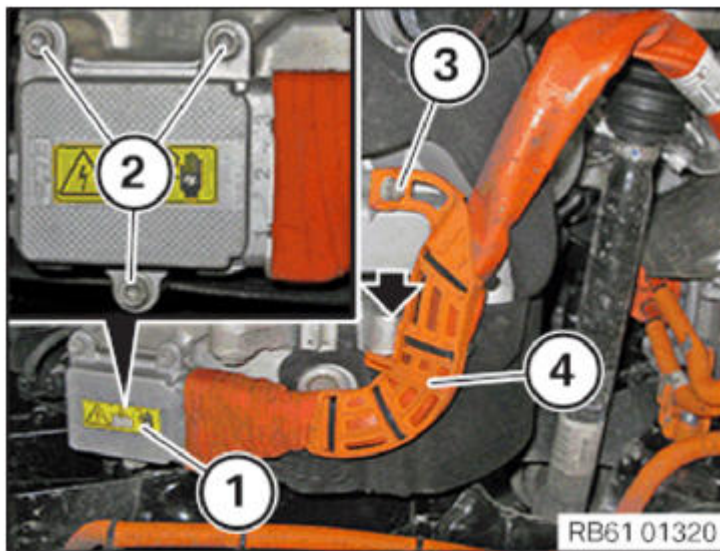
**Fig. 308: Identifying High-Voltage Plug Connection, Cross-Member And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release high-voltage connector (1) on screws (2).

Disconnect high-voltage connector.

Unscrew nut (3).

Pull high-voltage cable (4) out of holder and remove.



**Fig. 309: Pulling High-Voltage Cable Out Of Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

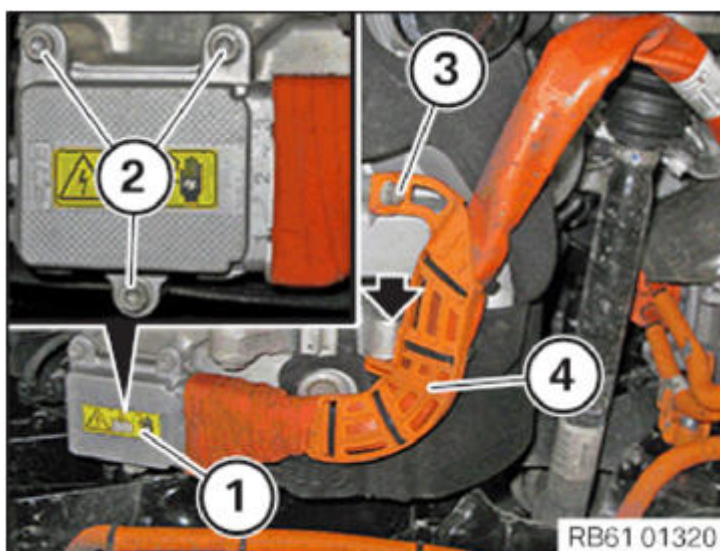
**Installation:**

IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Join high-voltage cable (4) into holder.

Tighten nut (3).

Tightening torque **12 35 8AZ** .



**Fig. 310: Pulling High-Voltage Cable Out Of Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect high-voltage connector.

Tighten high-voltage connector (1) on screws (2).

Tightening torque **12 35 7AZ** .

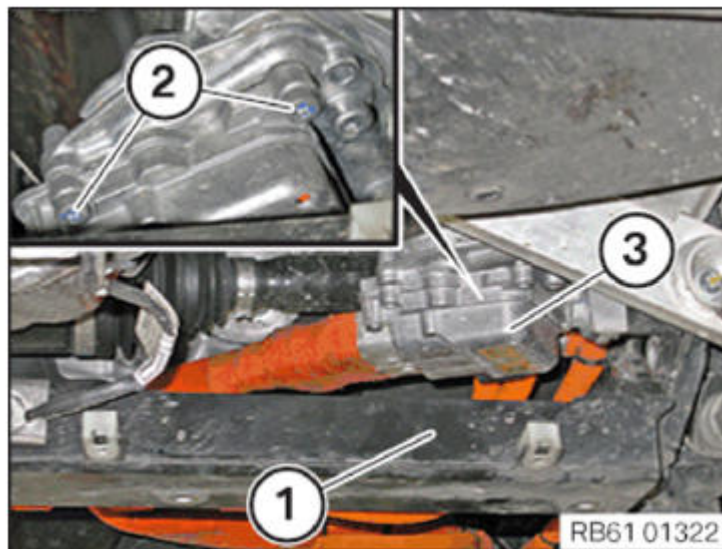
IMPORTANT: Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Slightly pull down the crossmember (1) if necessary.

Connect high-voltage plug connection (3).

Tighten down screws (2).

Tightening torque [12 36 10AZ](#) .

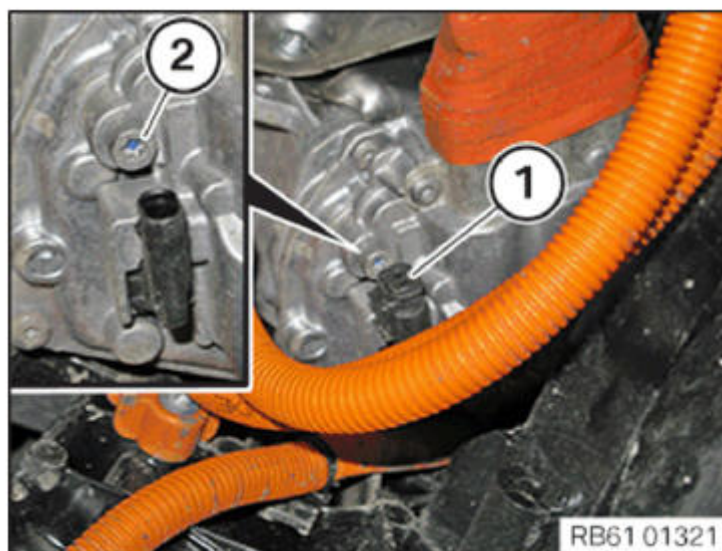


**Fig. 311: Identifying High-Voltage Plug Connection, Cross-Member And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screw (2).

Tightening torque [12 36 10AZ](#) .

Connect high-voltage service disconnect (1).



**Fig. 312: Identifying High-Voltage Safety Connector And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

**61 12 451 REPLACING THE HIGH-VOLTAGE CABLE BETWEEN ELECTRICAL MACHINE ELECTRONICS AND HIGH-VOLTAGE BATTERY UNIT (PRODUCTION DATE FROM 12/2014)**

**WARNING:** High-voltage system - danger to life!

**WARNING:** The following points must be strictly observed prior to starting work :

- De-energize the **HIGH-VOLTAGE SYSTEM**.



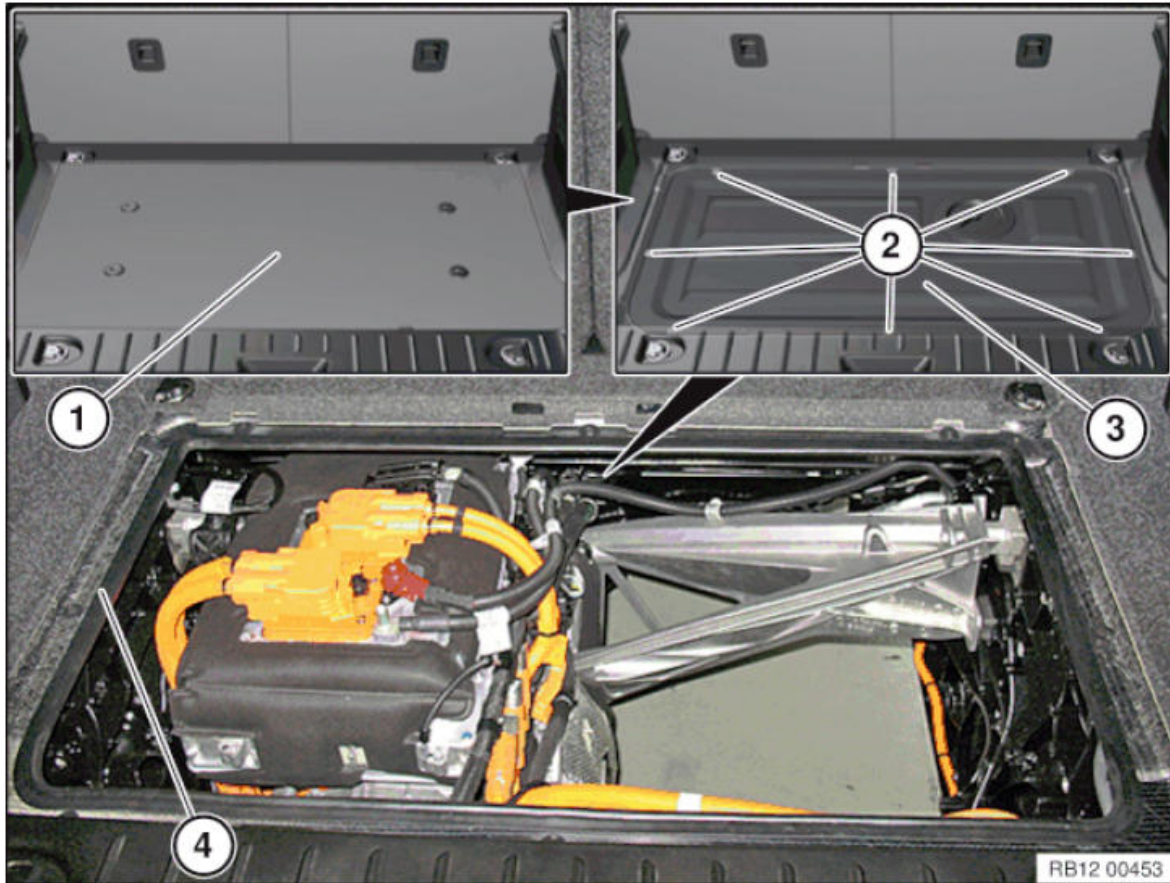
- Observe the [SAFETY INFORMATION](#) for working with electric vehicles.

### Necessary preliminary tasks:

- Remove LEFT HORIZONTAL STRUT
- Remove vertical strut. See VERTICAL STRUT or VERTICAL STRUT (RANGE EXTENDER) .
- In vehicles with convenience charging electronics:

Remove the convenience charging electronics. See [REPLACING CONVENIENCE CHARGING ELECTRONICS](#) .

### Removal:



**Fig. 313: Identifying Floor Trim Panel, Service Cap, Gasket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

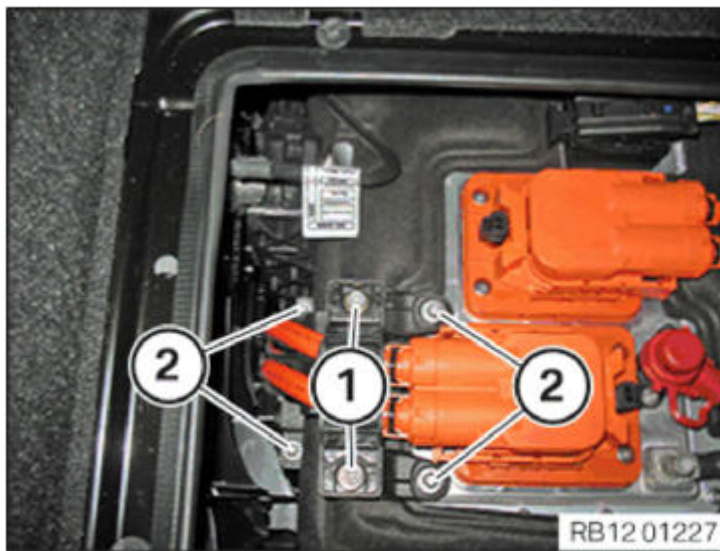
Release screws (2) and remove service cap (3) towards top.

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

Release the screws (1) and remove the tension relief.

Loosen the screws (2) from the bracket for tension relief.



**Fig. 314: Identifying Tensioner Relief And Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Unlock and disconnect the connector for the high-voltage cable (1).

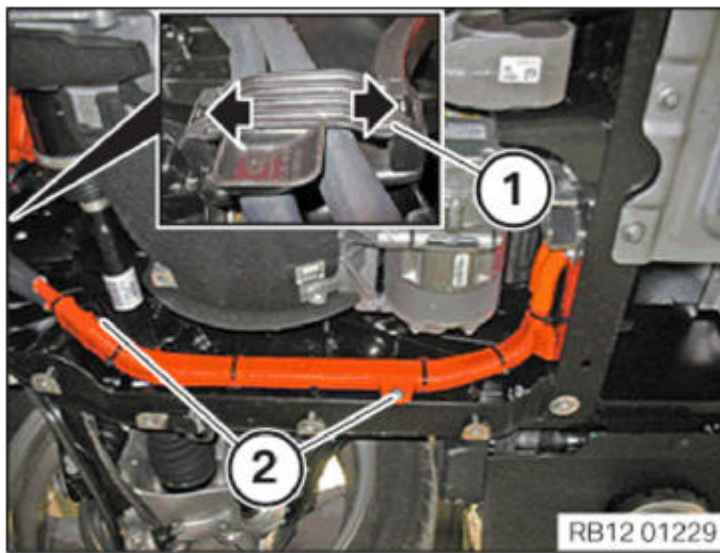


**Fig. 315: Identifying High-Voltage Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Press the retaining lugs towards the outside and pull off the line clip (1).

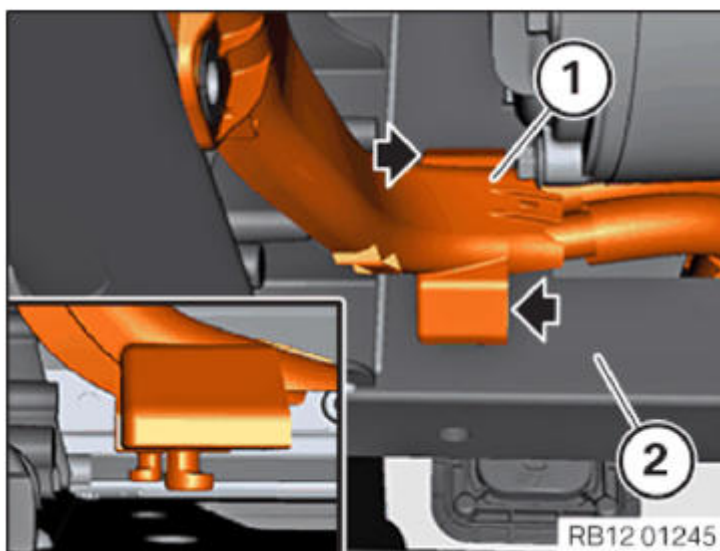
Unfasten screws (2).





**Fig. 316: Pressing Line Clip Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

Detach the retaining lugs from the cable channel (1) of the Drive module (2) in the direction of the arrow.



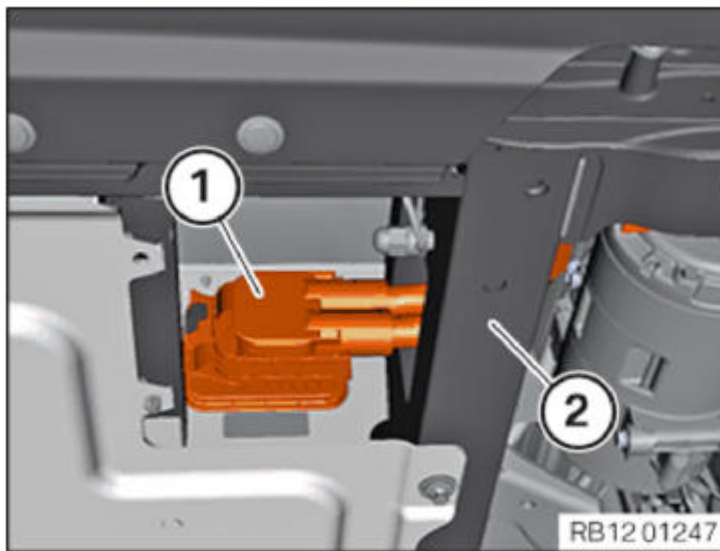
**Fig. 317: Detaching Retaining Lugs From Cable Channel Of Drive Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Unlock and disconnect the connector for the high-voltage cable (1).

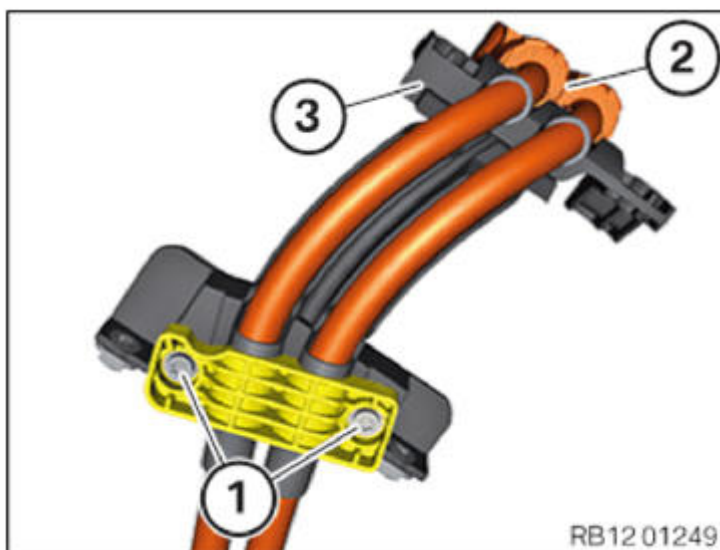
Remove the high-voltage cable (1) through the rear axle module (2).



**Fig. 318: Identifying High-Voltage Cable And Rear Axle Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release the screws (1) and remove the tension relief.

Remove the high-voltage cable (2) from the bracket for tension relief (3).



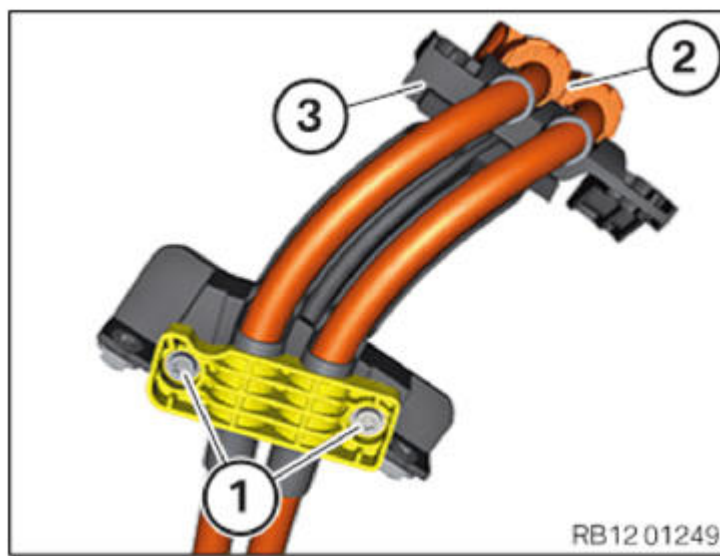
**Fig. 319: Identifying High-Voltage Cable And Tension Relief Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Position the high-voltage cable (2) on the bracket for tension relief (3).

Position the tension relief and tighten the screws (1).

Tightening torque [61 12 8AZ](#) .



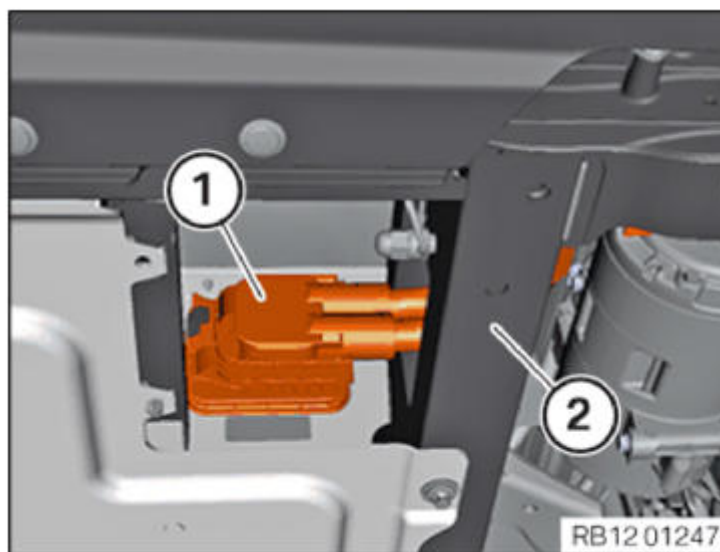
**Fig. 320: Identifying High-Voltage Cable And Tension Relief Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert the high-voltage cable (1) through the Drive module (2).

**Attention!**

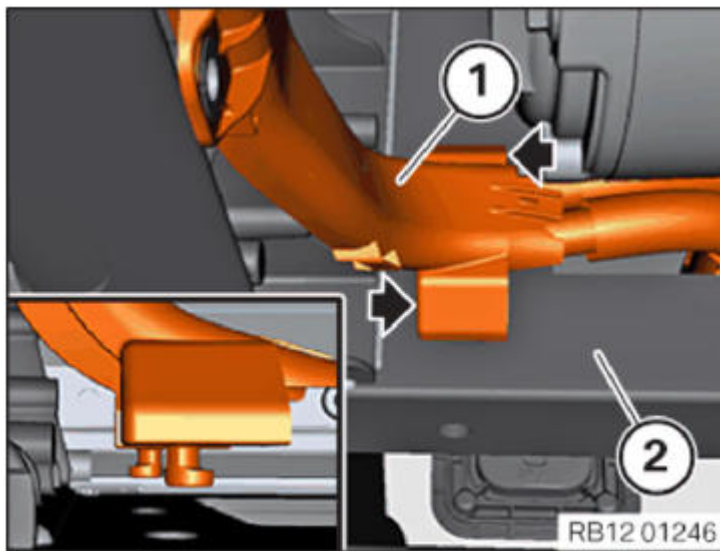
Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Connect and lock the connector for the high-voltage cable (1) on the high-voltage battery unit.



**Fig. 321: Identifying High-Voltage Cable And Rear Axle Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

Attach the retaining lugs of the cable channel (1) in the direction of the arrow at the Drive module (2).

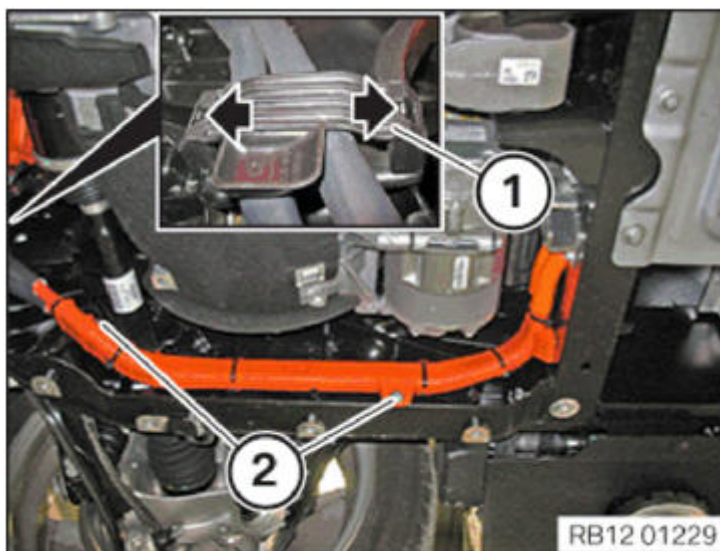


**Fig. 322: Attaching Retaining Lugs Of Cable Channel At Drive Module**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position the high-voltage cable and clip in the line clip (1).

Tighten down screws (2).

Tightening torque [61 12 4AZ](#) .



**Fig. 323: Pressing Line Clip Retaining Lugs**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Observe notes on [UNLOCKING AND DISCONNECTING PLUG CONNECTIONS](#) on electric vehicles.

Connect and lock the connector for the high-voltage cable (1).





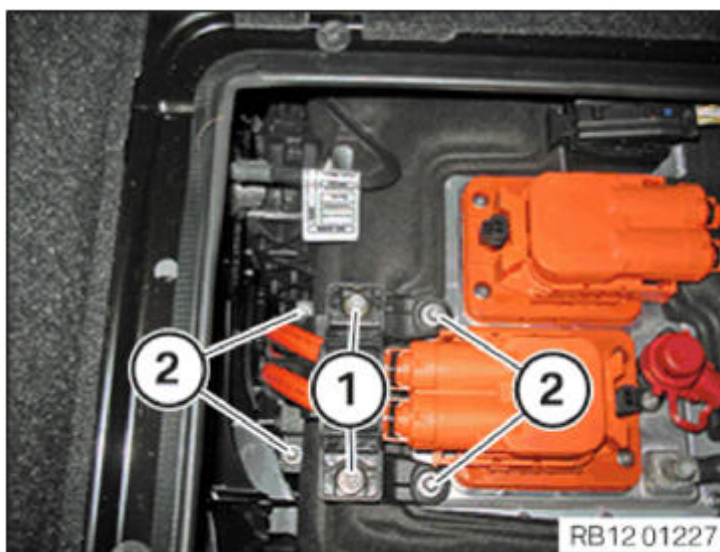
**Fig. 324: Identifying High-Voltage Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten the screws (2) of the tension relief bracket.

Tightening torque [61 12 7AZ](#) .

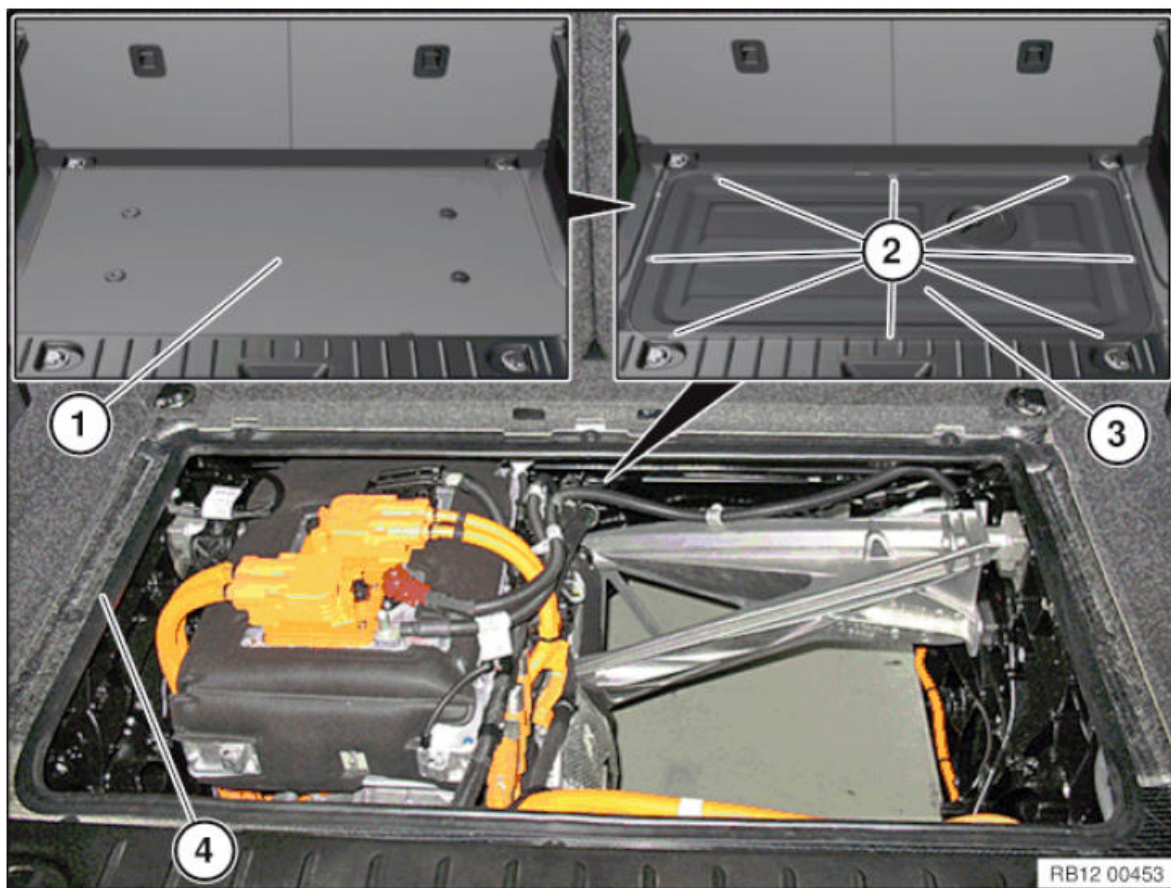
Position tension relief and tighten screws (1).

Tightening torque [61 12 8AZ](#) .



**Fig. 325: Identifying Tensioner Relief And Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.





**Fig. 326: Identifying Floor Trim Panel, Service Cap, Gasket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Attention!

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

Position service cap and tighten screws (2).

Tightening torque **51 47 4AZ** .

Insert luggage compartment floor trim panel (1).

## **ENGINE WIRING HARNESS**

### **12 51 235 REMOVING AND INSTALLING/REPLACING ENGINE SENSOR SYSTEM MODULE 1 WIRING HARNESS**

**WARNING:** High-voltage system - danger to life  
 Compliance with the following points is mandatory before beginning work:

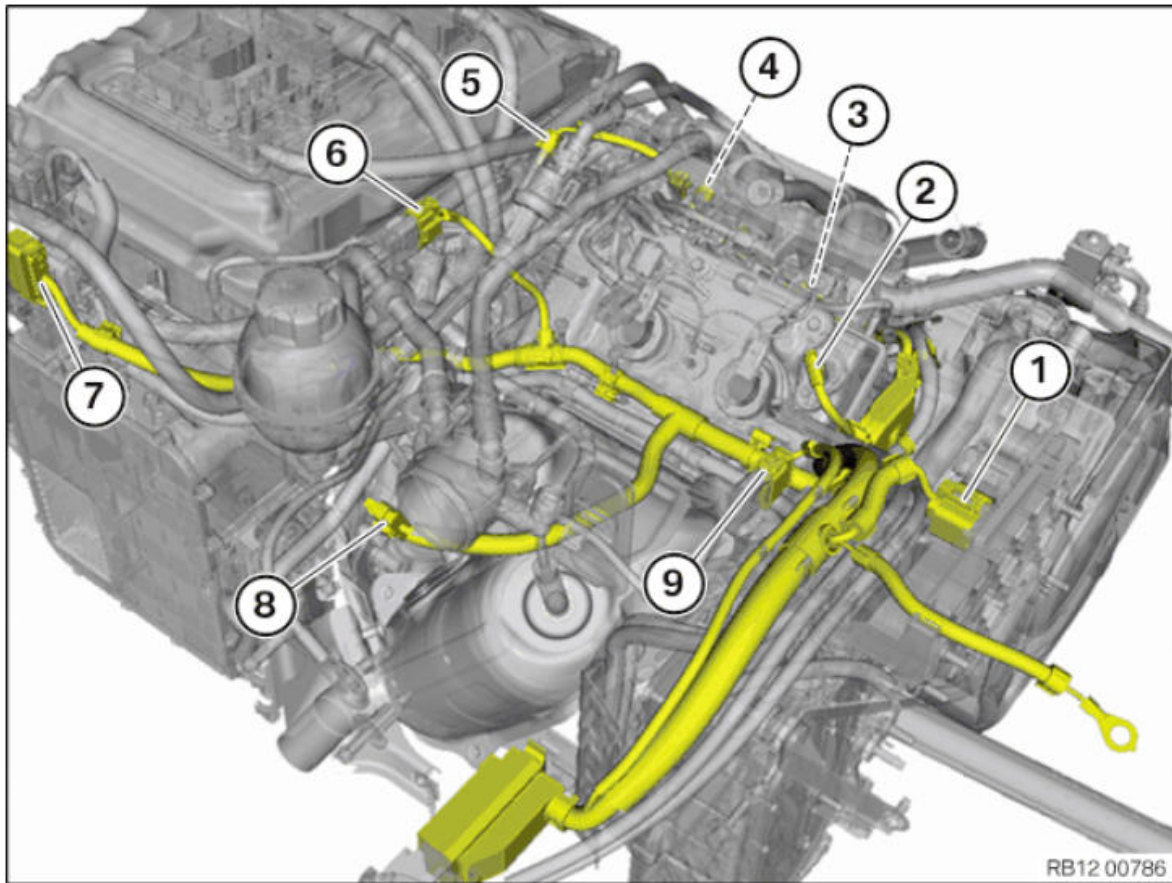
- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe **SAFETY INFORMATION** for handling electric vehicles.
- Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS**

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)** .

*Necessary preliminary tasks:*

- Read out the fault memory of the DME control unit.
- Switch off ignition.

- Remove **DRIVE UNIT**.
- Remove **INTAKE PLENUM**.
- Remove **HEAT EXCHANGER FOR ENGINE COOLANT**.



**Fig. 327: Identifying Engine Sensor System Module Wiring Harness**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock connector (1) and pull off from the power distribution box.

Unlock connector (2) and pull off from pulse sensor on intake camshaft.

Unlock connector (3) and pull off from pulse sensor to crankshaft.

Unlock connector (4) and pull off from coolant temperature sensor.

Unlock connector (5) and pull off from tank vent valve.

Unlock connector (6) and pull off from monitoring sensor.

Unlock connector (7) and pull off from main wiring harness.

Unlock connector (8) and pull off from throttle valve.

Unlock connector (9) and pull off from control sensor.

Release wiring harness if necessary from existing clips and clamps.

Feed out wiring harness and remove.

*Installation note:*

Check the wiring harness installation arrangement.

Check that the plug connections are correctly fitted.

Check fault code entry.

Clear diagnostic fault entries from fault memory.

## 12 51 240 REMOVING AND INSTALLING/REPLACING ENGINE SENSOR SYSTEM MODULE 2 WIRING HARNESS

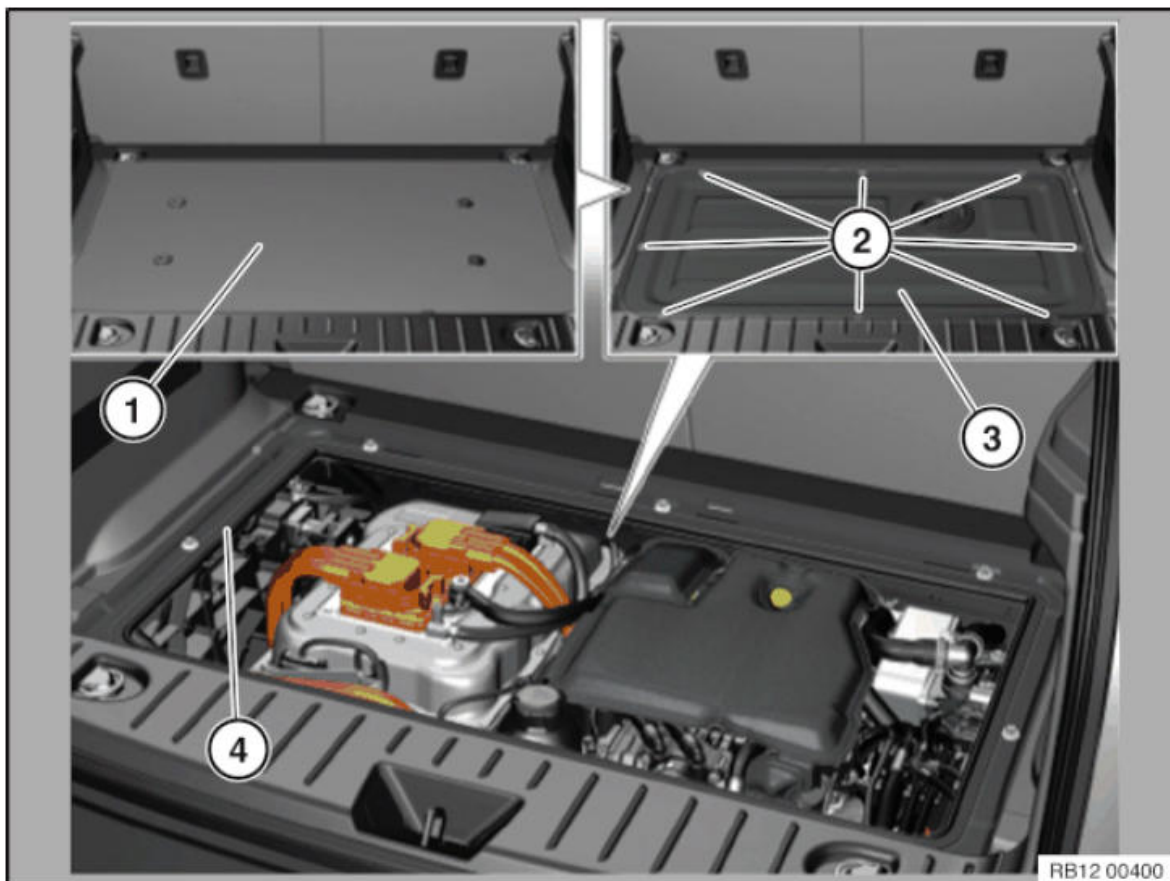
**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM**..
- Observe **SAFETY INFORMATION** for handling electric vehicles.
- Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS**

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)** .

*Necessary preliminary tasks:*

- Read out the fault memory of the DME control unit.
- Switch off ignition.
- Remove **INTAKE PLENUM** .
- Partially loosen **HEAT EXCHANGER FOR ENGINE COOLANT** (do not drain coolant).



**Fig. 328: Identifying Floor Trim Panel, Service Cap, Screws And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

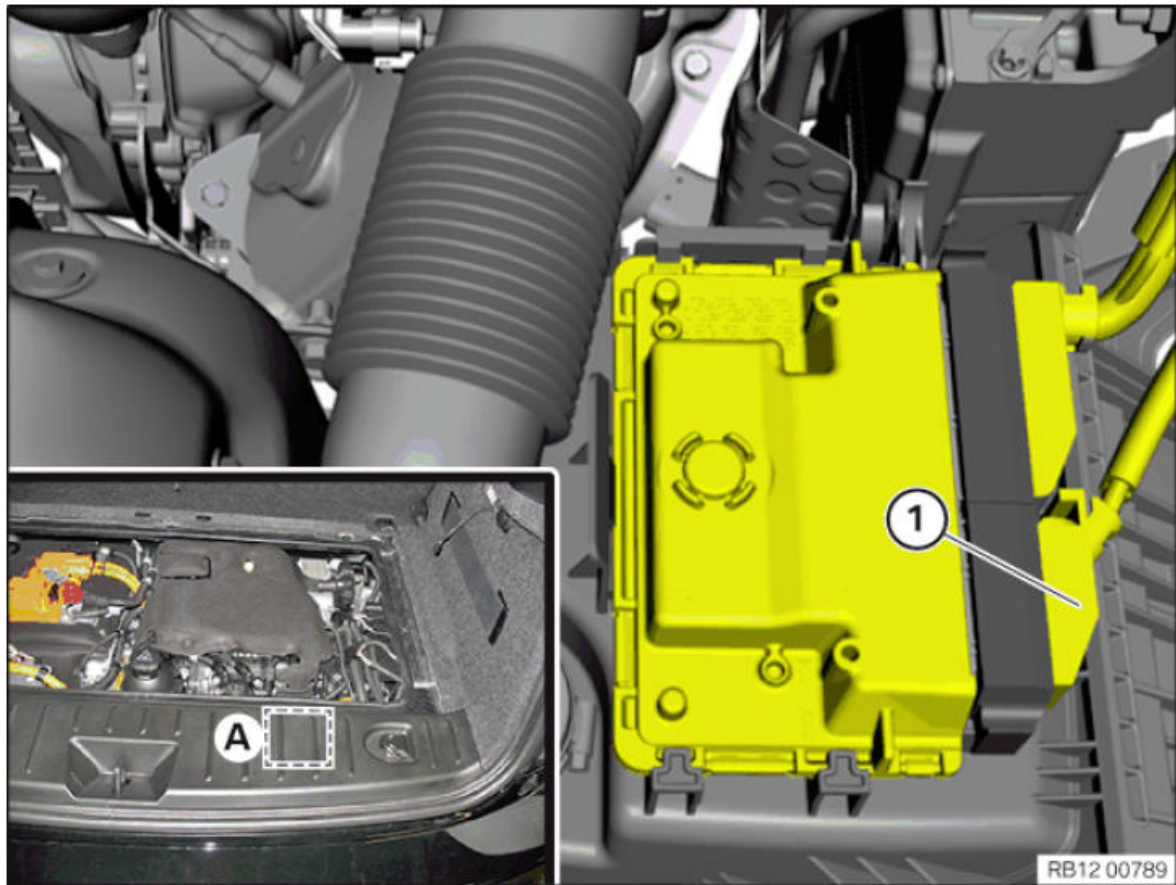
Release screws (2) and remove service cap (3) towards top.

Tightening torque **51 47 4AZ** .

Installation note:



Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.



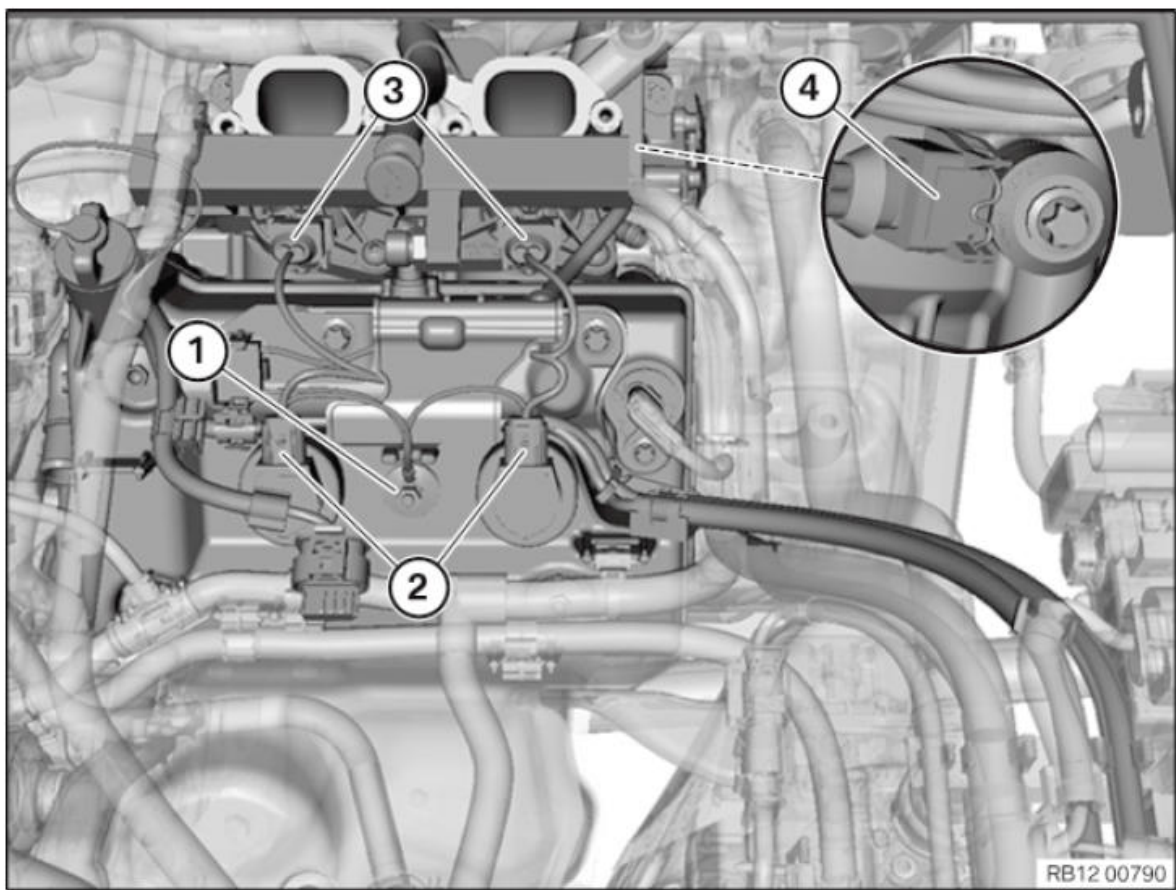
**Fig. 329: Identifying Control Unit (RDME) Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

Control unit (RDME) is positioned in marked area (A).

Unlock plug connection (1) and disconnect from control unit (RDME).

Expose wiring harness.



**Fig. 330: Identifying Ignition Coils, Fuel Injector And Knock Sensor Connectors And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Release ground cable from cylinder head cover.

Unlock connectors (2) and pull off from ignition coils.

Unlock connectors (3) and pull off from fuel injectors.

Unlock connector (4) and pull off from knock sensor (the knock sensor is installed on the back of the cylinder head).

Release wiring harness if necessary from existing clips and clamps.

Feed out wiring harness and remove.

*Installation note:*

Check the wiring harness installation arrangement.

Check that the plug connections are correctly fitted.

Check fault code entry.

Clear diagnostic fault entries from fault memory.

### **12 51 040 REMOVING AND INSTALLING/REPLACING WIRING HARNESS SECTION FOR RANGE EXTENDER ELECTRICAL MACHINE ELECTRONICS (REME)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe **SAFETY INFORMATION** for handling electric vehicles.

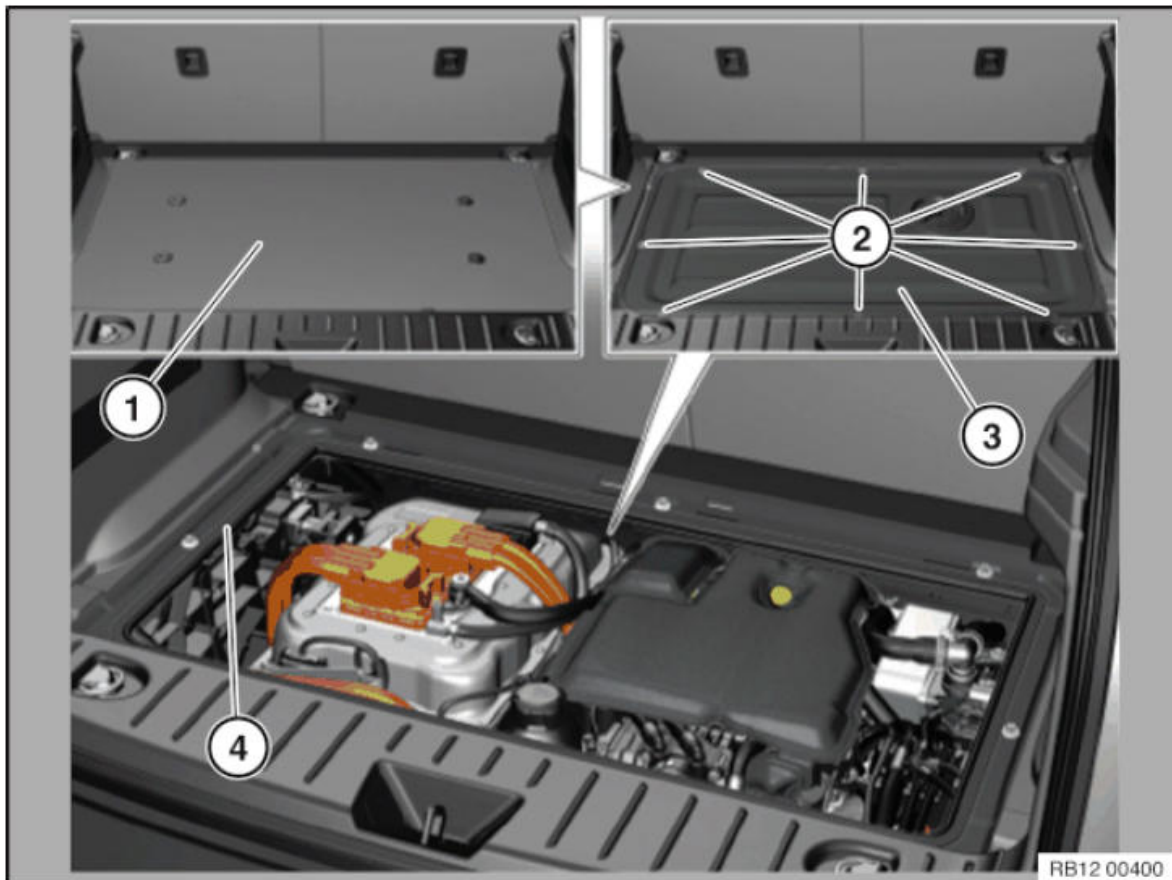


- Observe NOTES ON EARTH BONDING SCREW CONNECTIONS

IMPORTANT: Read and comply with notes on PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION) !

#### Necessary preliminary tasks:

- Read out the fault memory of the DME control unit.
- Switch off ignition.
- Observe notes on UNLOCKING AND DISCONNECTING PLUG CONNECTIONS on electric vehicles.
- Remove INTAKE PLENUM .
- Remove HEAT EXCHANGER FOR ENGINE COOLANT .
- Remove SUPPORT FOR REAR BUMPER PANEL .
- Remove VERTICAL STRUT .



**Fig. 331: Identifying Floor Trim Panel, Service Cap, Screws And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

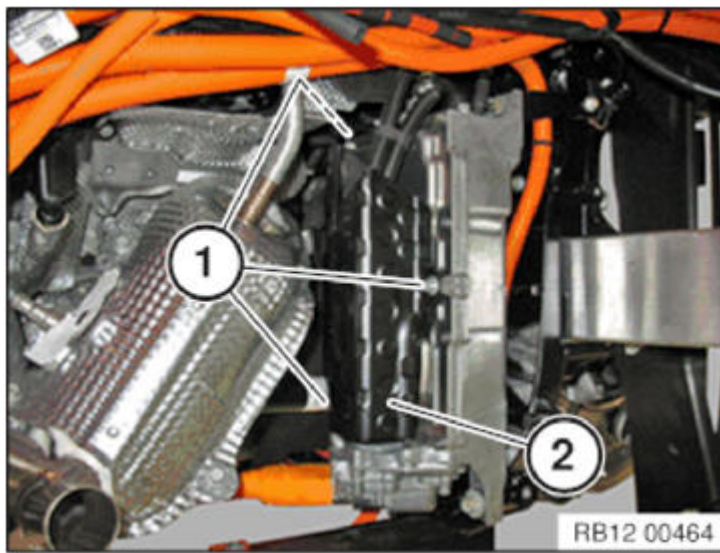
Release screws (2) and remove service cap (3) toward the top.

Tightening torque 51 47 4AZ .

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.

Release screws (1) on heat shield (2).

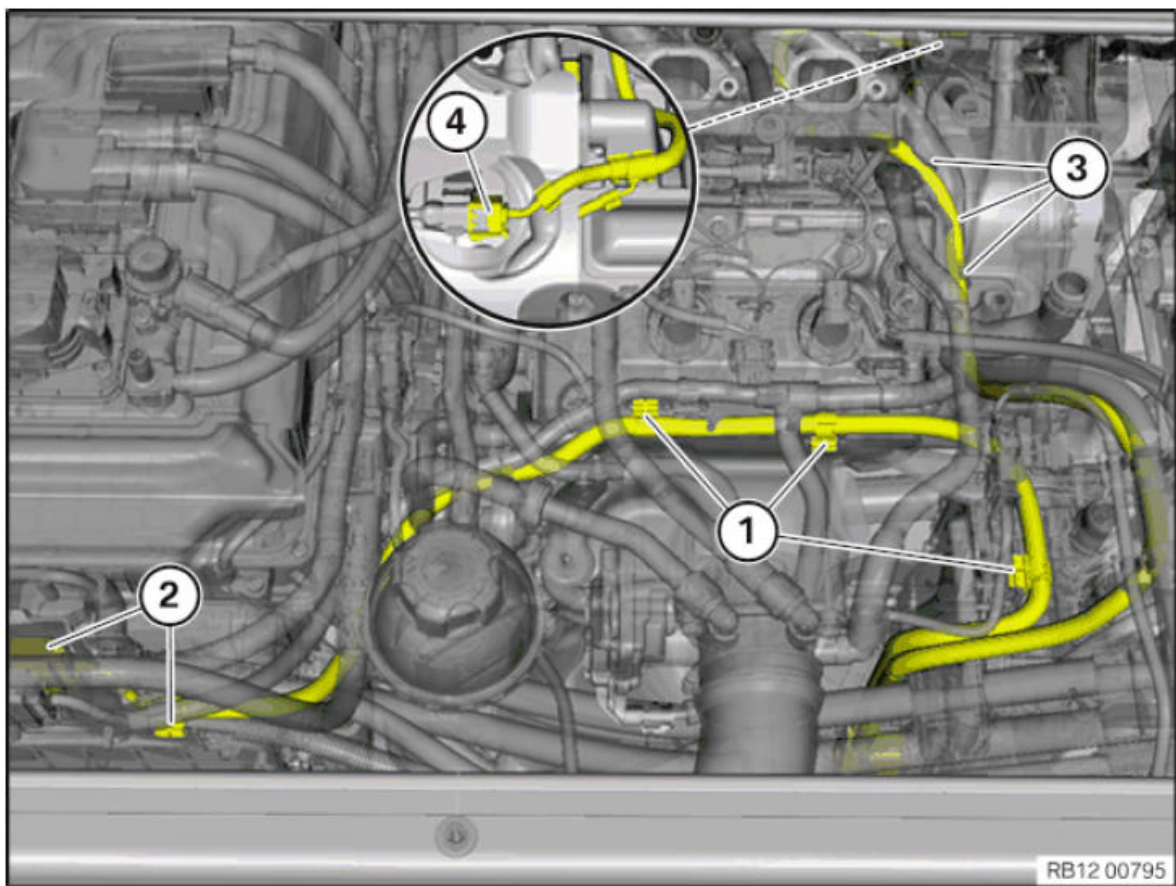


**Fig. 332: Identifying Heat Shield And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlocking and disconnect signal connector (1).



**Fig. 333: Identifying Signal Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 334: Identifying Rotor Position Sensor Connector, Bracket And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release wiring harness at clamps (1).

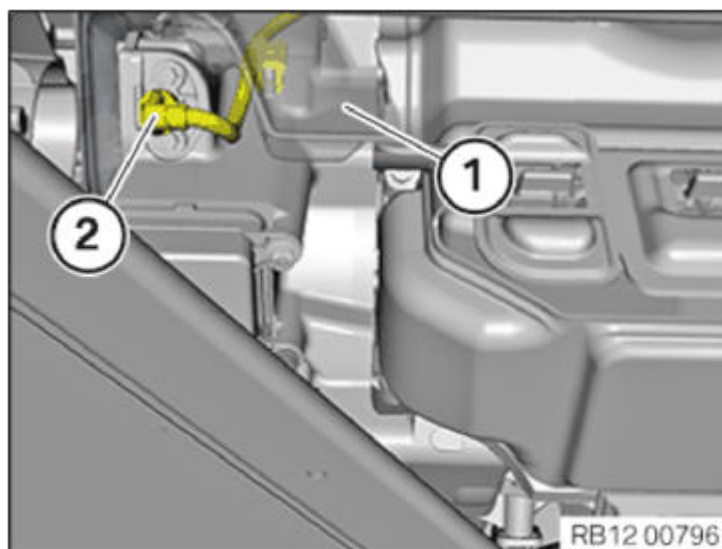
Unlock connector (2) and remove.

Release wiring harness from the bracket (3).

Unlock connector (4) from rotor position sensor at the front on the starter motor generator and pull off.

Release acoustic cover (1) partially.

Unlock connector (2) at the bottom on the starter motor generator and pull off.



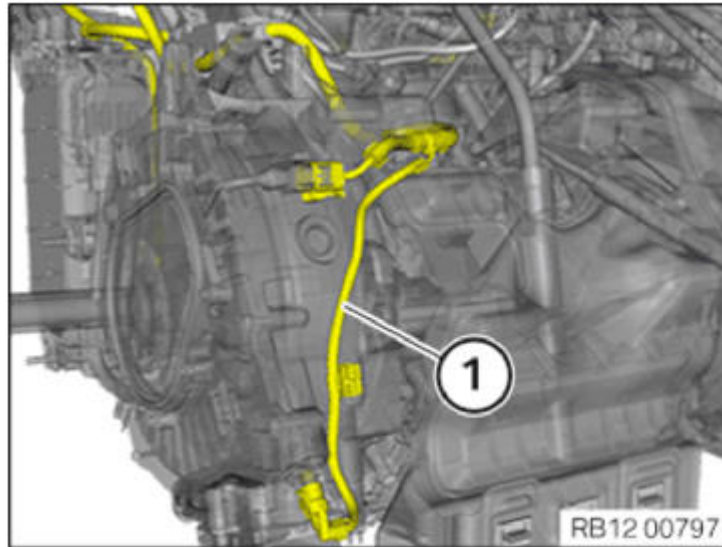
**Fig. 335: Identifying Acoustic Cover And Starter Motor Generator Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, release the wiring harness from the existing clips and clamps.

Feed out wiring harness and remove.

*Installation note:*

Make sure wiring harness (1) is laid and attached correctly.



**Fig. 336: Identifying Wiring Harness**

Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Check that the plug connections are correctly fitted.
- Check fault code entry.
- Delete the fault memory.

### **12 51 045 REMOVING AND INSTALLING/REPLACING WIRING HARNESS SECTION OF THE SENSOR SYSTEM MODULE ELECTRICAL MACHINE ELECTRONICS (EME)**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

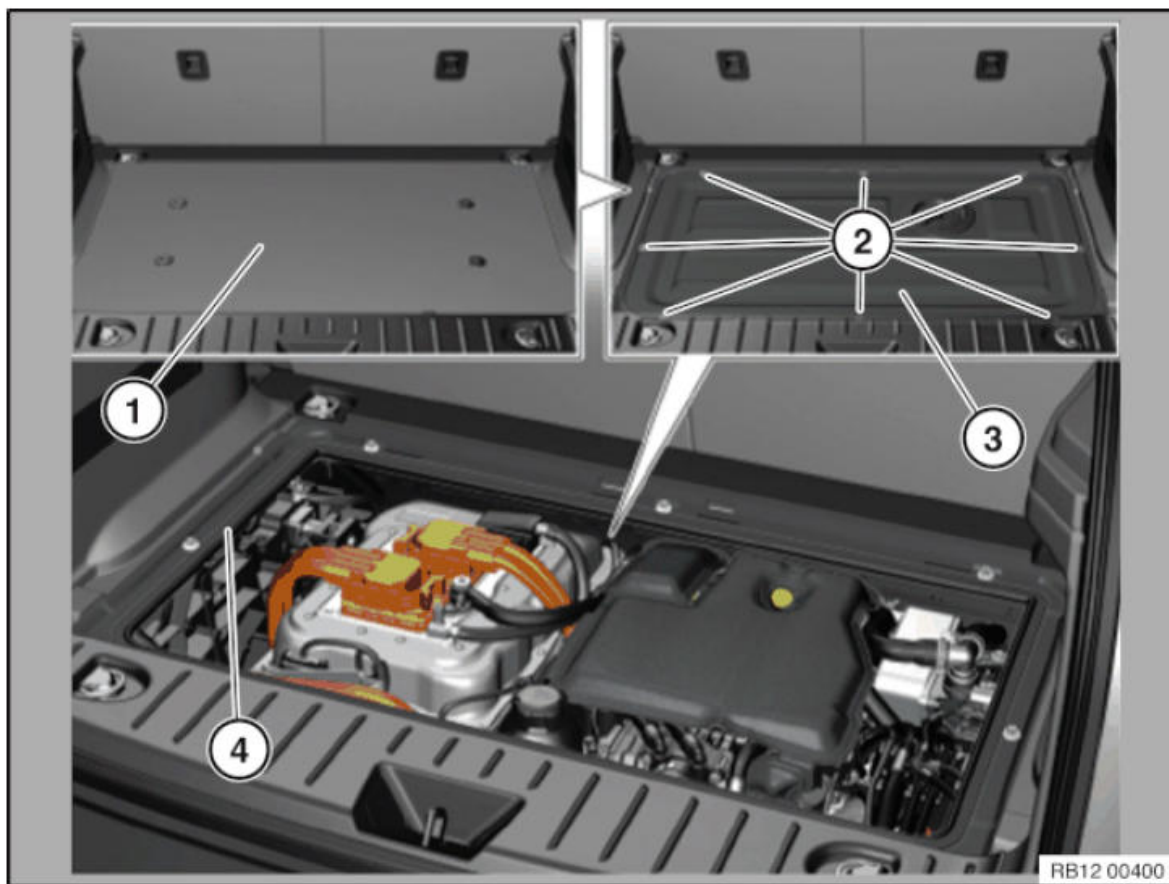
- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe **SAFETY INFORMATION** for handling electric vehicles.
- Observe **NOTES ON EARTH BONDING SCREW CONNECTIONS**

**IMPORTANT:** Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)**.

*Necessary preliminary tasks:*

- Read out the fault memory of the DME control unit.
- Switch off ignition.
- Observe notes on **UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.





**Fig. 337: Identifying Floor Trim Panel, Service Cap, Screws And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

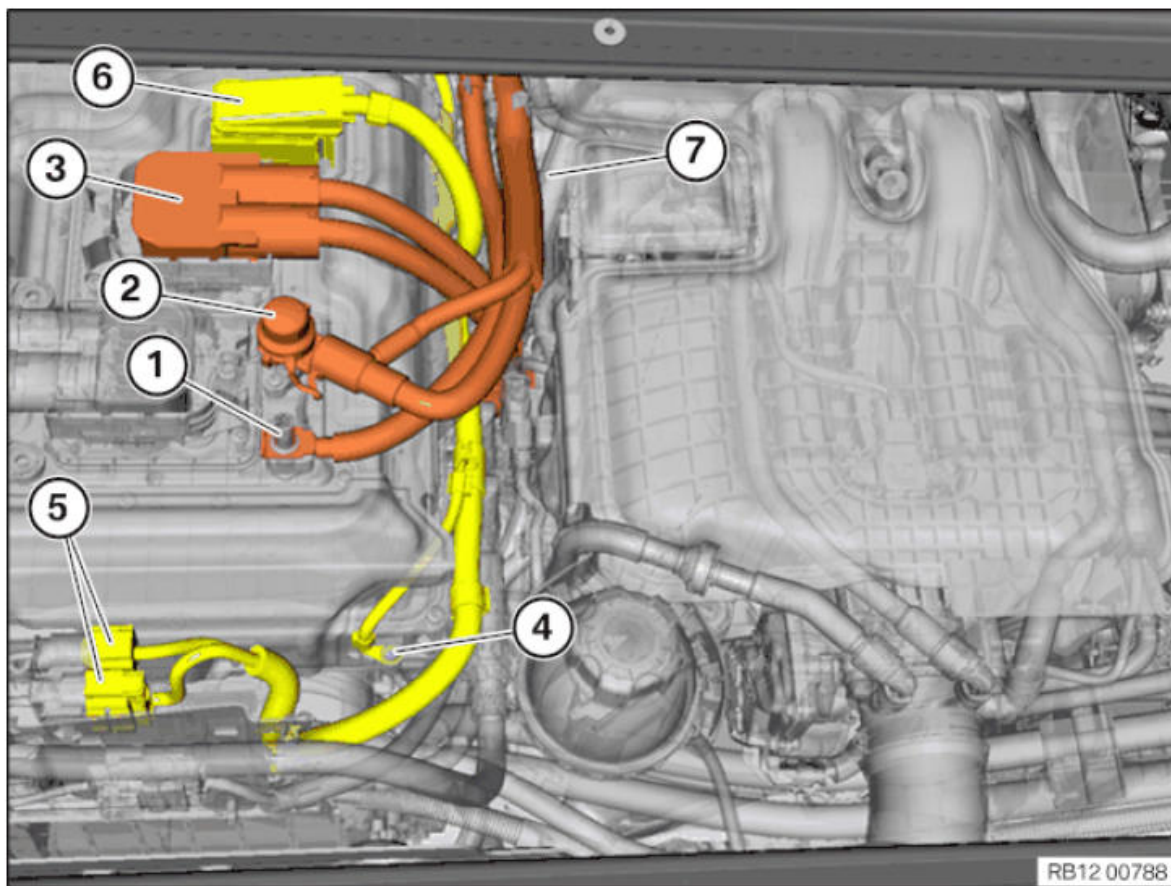
Release screws (2) and remove service cap (3) towards top.

Tightening torque **51 47 4AZ** .

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.





**Fig. 338: Identifying High Voltage Cable, Battery Earth Lead, Ground Cable And Battery Positive Cable Nut**

Courtesy of BMW OF NORTH AMERICA, INC.

Release nut (1) from battery earth lead on electrical machine electronics.

Tightening torque [12 36 2AZ](#) .

Take off cover and release nut (2) from positive battery cable on electrical machine electronics.

Tightening torque [12 36 3AZ](#) .

Disconnect high-voltage cable (3) from high-voltage battery unit on electrical machine electronics.

Lay the battery earth lead, positive battery cable and high-voltage cable to one side.

Release nut (4) from grounding cable.

Remove grounding cable.

Unlock connector (5) and remove.

Release connector (6) and remove.

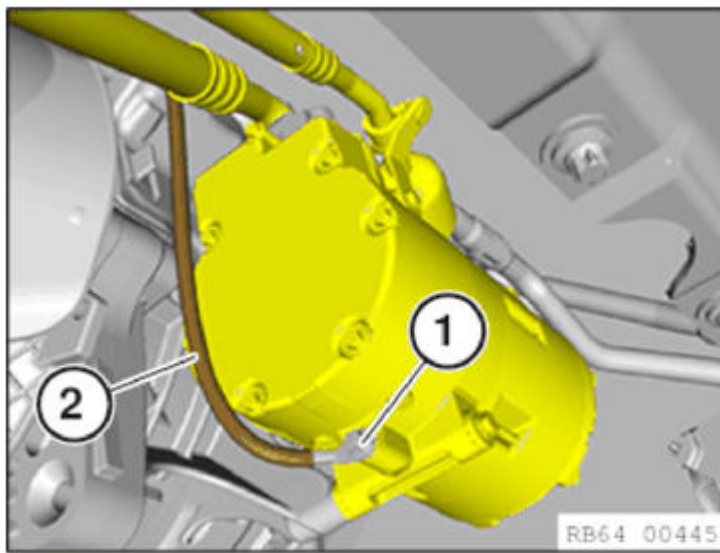
Unlock connector (7) and pull off from transmission.

Release screw (1).

Remove equipotential bonding line (2).

Observe [NOTES ON SCREW CONNECTIONS FOR EQUIPOTENTIAL BONDING](#) !

Tightening torque [64 52 3AZ](#) .



**Fig. 339: Identifying Equipotential Bonding Line And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) on air conditioning compressor (2).

Tightening torque [64 52 2AZ](#) .

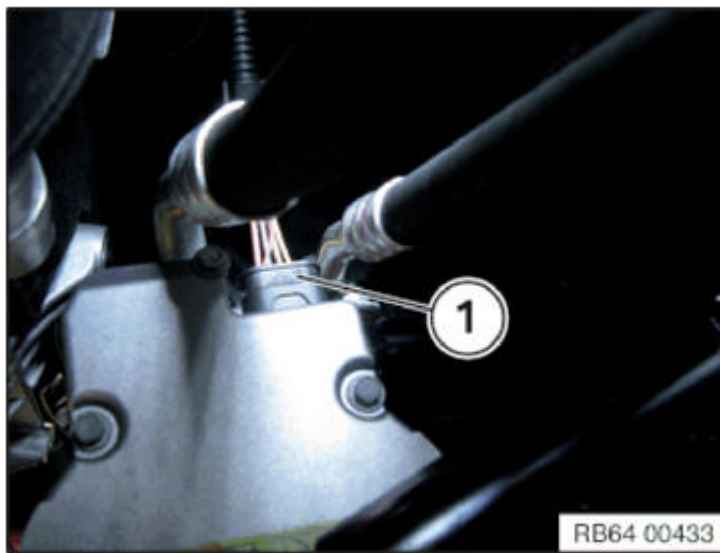
*Installation note:*

Remember isolating rings.



**Fig. 340: Identifying Air Conditioning Compressor And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.



**Fig. 341: Identifying Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

Release wiring harness if necessary from existing clips and clamps.

Feed out wiring harness and remove.

*Installation note:*

Check the wiring harness installation arrangement.

Check that the plug connections are correctly fitted.

Check fault code entry.

Clear diagnostic fault entries from fault memory.

## **OIL PRESSURE SENSOR**

### **12 61 280 REMOVING AND INSTALLING/REPLACING OIL PRESSURE SENSOR**

**WARNING:** High-voltage system - danger to life  
Compliance with the following points is mandatory before beginning work:

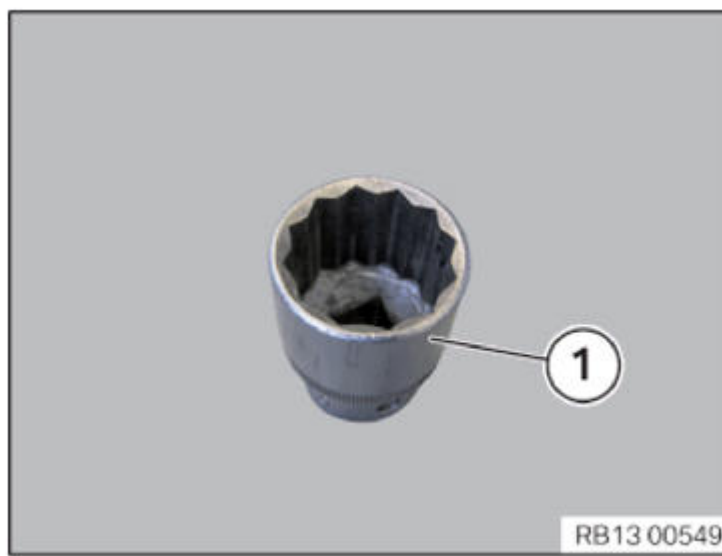
- De-energize the **HIGH-VOLTAGE SYSTEM**.
- Observe **SAFETY INFORMATION** for working with electric vehicles.

*Necessary preliminary tasks:*

- Remove **SERVICE CAP IN LUGGAGE COMPARTMENT**.
- Remove right HORIZONTAL STRUT.

**WARNING:** Risk of burning!  
Only perform this repair work on an engine that has cooled down.

**NOTE:** Use a SW24 bihexagonal socket to release and tighten the oil pressure sensor.



**Fig. 342: Identifying SW24 Bihexagonal Socket**  
Courtesy of BMW OF NORTH AMERICA, INC.

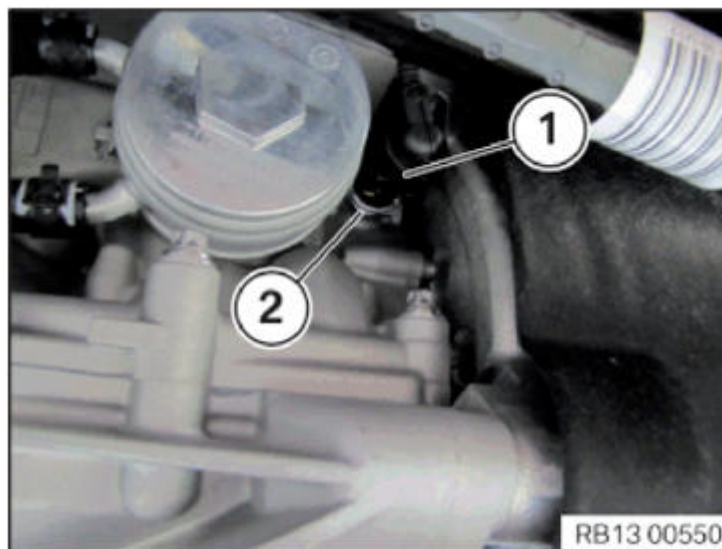
Unlock connector (1) and remove.

Release oil pressure sensor (2).

Tightening torque **12 61 1AZ** .

*Installation note:*

Check engine oil level. Top up engine oil if level is too low.



**Fig. 343: Identifying Oil Pressure Sensor And Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

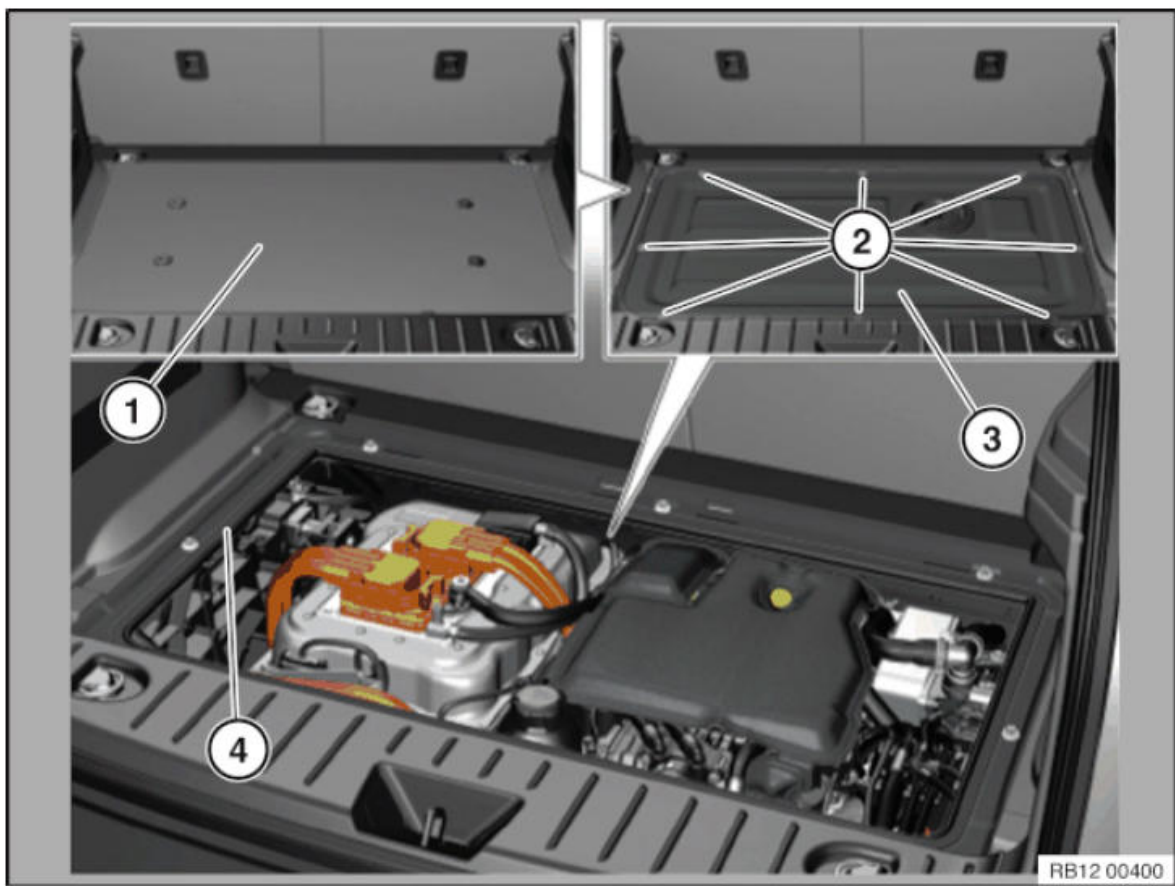
## **ENGINE COMPARTMENT FUSE BOX**

### **12 63 586 REPLACING POWER DISTRIBUTION BOX**

Necessary preliminary tasks:

- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**

**NOTE:** Before disconnecting the battery cable, it must be ensured that the vehicle goes to sleep.



**Fig. 344: Identifying Floor Trim Panel, Service Cap, Screws And Gasket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove luggage compartment floor trim panel (1).

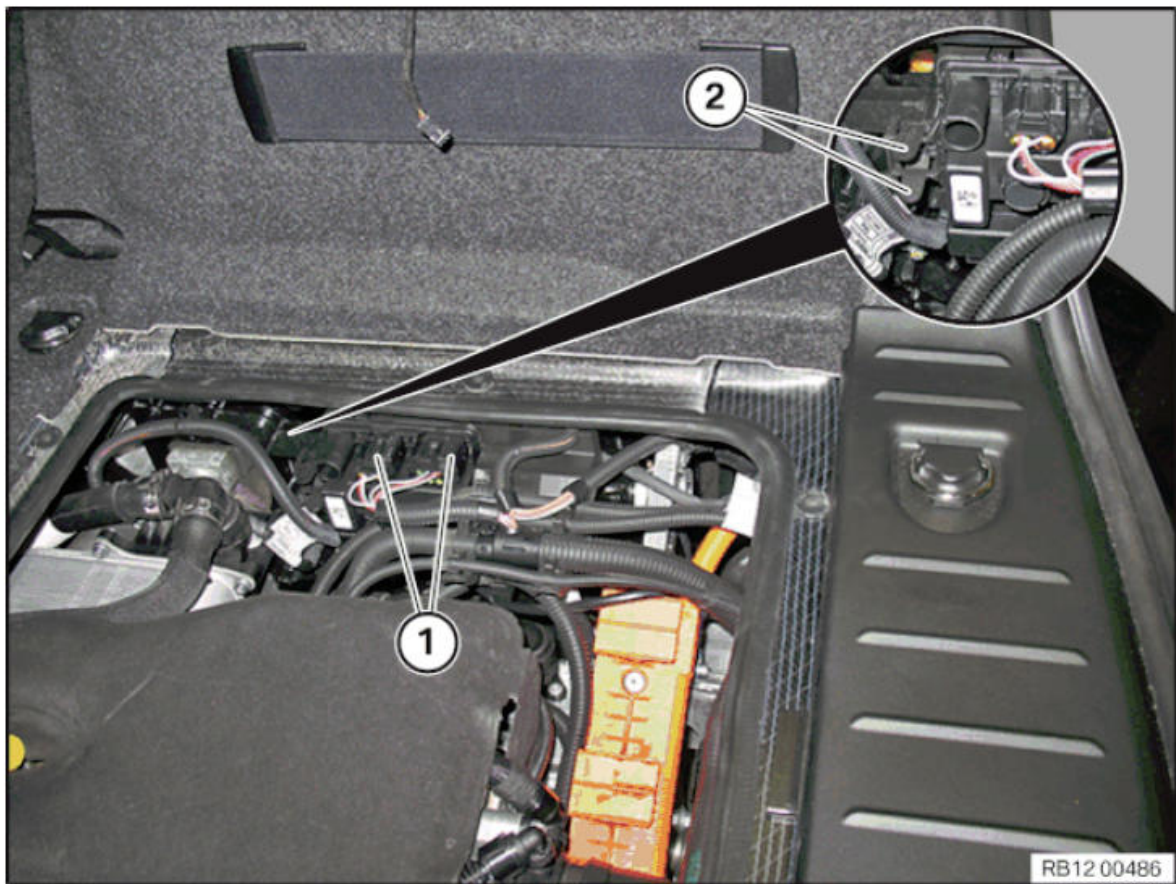
Release screws (2) and remove service cap (3) towards top.

Tightening torque [51 47 04AZ](#) .

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.





**Fig. 345: Identifying Plug Connections And Power Distribution Box Locks**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connections (1) and disconnect, depending on equipment version.

Push together locks (2) and feed out power distribution box.

Unfasten plug connection (1) and disconnect.

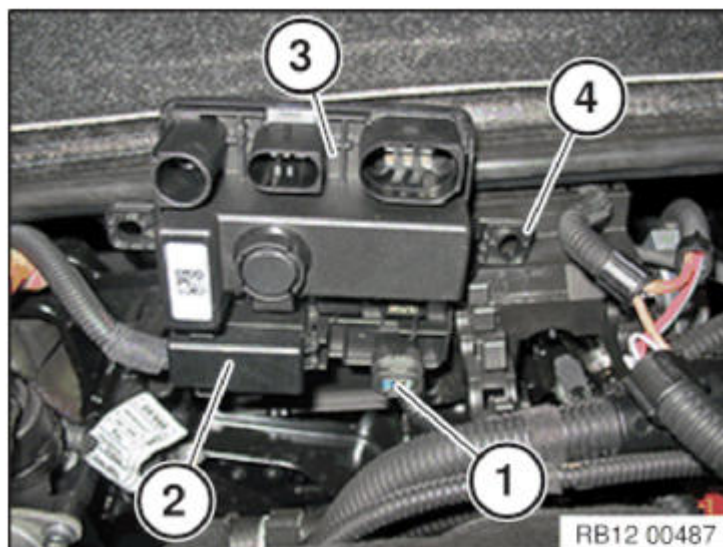
Fold open cover (2) and release the nut beneath.

Tightening torque [61 12 1AZ](#) .

Remove power distribution box (3).

*Installation note:*

Ensure power distribution box (3) is seated properly.



**Fig. 346: Identifying Power Distribution Box, Plug Connection, Cover And Guide Lug**  
Courtesy of BMW OF NORTH AMERICA, INC.

Power distribution box (3) must be seated with guide lug (4) correctly positioned in holder for power distribution box.

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[Back To Article](#)

## ENGINE

Engine Electrical System - Special Tools - All I3 Models - i3

### ENGINE ELECTRICAL SYSTEM

#### 2286332 EYE BOLT AM

**NOTE:** Ring eyelets M8 for handling electrical machine applies to: BMW i Aftersales Basic

#### Storage Location

Individual

#### SI number

01 47 13 (038)



**Fig. 1: Identifying Eye Bolt (2286332)**

Courtesy of BMW OF NORTH AMERICA, INC.

#### 2288986 GUARD MINIMUM SET: MECHANICAL TOOLS AM

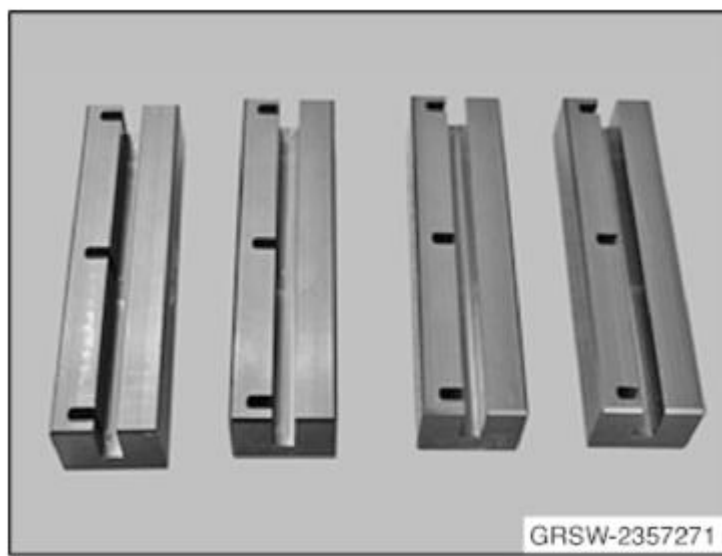
**NOTE:** This set replaces the set 83 30 2 357 271 after technical modifications to the HV battery.

#### Storage Location

Individual

#### SI number

01 19 13 (985)



**Fig. 2: Identifying Guard (2288986)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2286319 LIFTING GEAR MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Valid for BMW i Aftersales Basic Lifting gear for lifting of electrical machine.

**Storage Location**

Individual

**SI number**

01 46 13 (035)



**Fig. 3: Identifying Lifting Gear (2286319)**

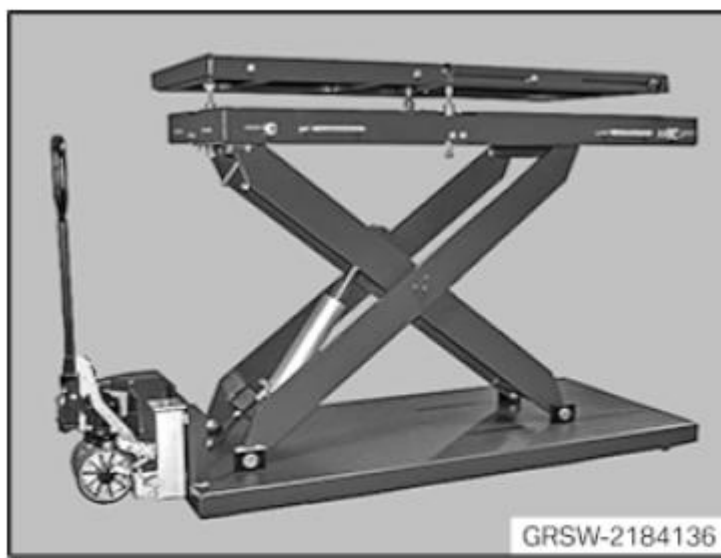
Courtesy of BMW OF NORTH AMERICA, INC.

**2184136 MOBILE EQUIPMENT TABLE LIFT AM**

**NOTE:** Table lift MHT 1200

**SI number**

06 01 10 (649)



**Fig. 4: Identifying Mobile Equipment Table Lift (2184136)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**123621 PULLER AM**

**NOTE:** For dismantling ignition coils.

**Storage Location**

B36

C36

**SI number**

01 03 14 (070)



**Fig. 5: Identifying Puller (123621)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**121220 SOCKET WAF 46 MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** For removing and installing the spark plugs (WAF 14 bihexal).

**Storage Location**

A20

A86



**SI number**

01 20 06 (299)



**Fig. 6: Identifying Socket WAF 46 (121220).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356938 ODDMENTS TRAY MINIMUM SET: MECHANICAL TOOLS AM**

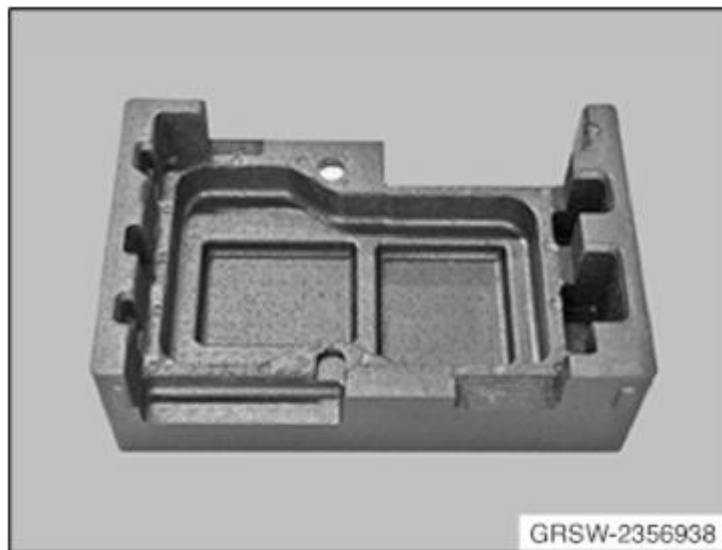
**NOTE:** Applies to: BMW i Aftersales Basic oddments tray for electrical machine electronics EME

**Storage Location**

Individual

**SI number**

01 16 13 (982)



**Fig. 7: Identifying Oddments Tray (2356938).**  
Courtesy of BMW OF NORTH AMERICA, INC.

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**ENGINE****Engine Electrical System - Tightening Torques - All I3 Models - i3****CONTROL UNITS FOR ELECTRIC MACHINE (POWERTRAIN)****12 36 CONTROL UNITS, ELECTRIC MACHINE****TIGHTENING TORQUE SPECIFICATION - CONTROL UNITS (ELECTRIC MACHINES)**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Equipotential bonding line to Drive module	I01/I01 REX	M6	Â	12 Nm
2AZ Battery earth lead to EME	I01/I01 REX	M8	Â	15 Nm
3AZ Positive battery cable on EME	I01/I01 REX	M8	Â	15 Nm
4AZ Wiring harness ground connection to EME	I01/I01 REX	M6	Â	8 Nm
5AZ Equipotential bonding line to EME	I01/I01 REX	M6	Â	8 Nm
6AZ cable clip to the electrical machine electronics	I01/I01 REX	M6	Â	8 Nm
7AZ EME to electrical machine	I01/I01 REX	M8	Â	19 Nm
8AZ REME to Drive module	I01 REX	M8	Â	28 Nm
9AZ Equipotential bonding line to REME	I01 REX	M6	Â	12 Nm
10AZ High-voltage cable to REME	I01 REX	M6	Â	8 Nm
11AZ Heat shield to REME	I01 REX	M6	Â	12 Nm
12AZ Equipotential bonding line on transmission mounting bracket	I01	M6	Â	12 Nm

**ELECTRIC MOTOR/ALTERNATOR****12 35 ELECTRIC MOTOR/ALTERNATOR****TIGHTENING TORQUE SPECIFICATION - ELECTRIC MOTOR AND ALTERNATOR**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Stop pad to Drive module	I01/I01 M6 REX	Â	Â	12 Nm
2AZ Service cap to electrical machine	I01/I01 REX	M6	Â	10 Nm
3AZ High-voltage cables to EME	I01/I01 REX	M8	Renew screws.	14 Nm
4AZ EME support to electrical machine	I01/I01 REX	M8	Â	19 Nm
5AZ Equipotential bonding line to electrical machine	I01/I01 REX	M6	Â	8 Nm
6AZ Equipotential bonding line to engine mounting bracket	I01 REX	M6	Â	12 Nm
7AZ High-voltage cable to range extender electrical machine	I01 REX	M6	Â	8 Nm
8AZ Cable routing to range extender	I01 REX	M6	Â	8 Nm

Â	Type	Thread	Tightening specifications	Dimension
9AZ Range extender electrical machine to range extender	I01 REX	M10	Â	60 Nm

## GROUNDING CABLE

### 12 42 GROUNDING CABLE

#### TIGHTENING TORQUE SPECIFICATION - GROUNDING CABLE

Â	Type	Thread	Tightening specifications	Dimension
1AZ Bracket, negative supply line	I01	M8	Â	15 Nm
2AZ High-voltage safety ground between EME and electrical machine	I01	M6	Â	8 Nm
3AZ High-voltage safety ground to engine mounting bracket	I01	M6x16	Â	11.8 Nm
4AZ Ground cable to electrical machine electronics (EME)	I01	M6	Â	8 Nm

## OIL PRESSURE, OIL LEVEL INDICATOR

### 12 61 OIL PRESSURE, OIL LEVEL INDICATOR

#### TIGHTENING TORQUE SPECIFICATION - OIL PRESSURE AND OIL LEVEL INDICATOR

Â	Type	Thread	Tightening specifications	Dimension
1AZ Engine oil pressure switch	I01 REX	Â	Jointing torque Angle of rotation	10 Nm 22 Â°

## SPARK PLUGS

### 12 12 SPARK PLUGS

#### TIGHTENING TORQUE SPECIFICATION - SPARK PLUGS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Spark plugs (ungreased)	I01 REX M10S x 1	Â	Â	12 Nm

## ENGINE

### Engine Operating Fluids

#### 1.0 GENERAL INFORMATION

Use of engine oil that meets the specifications for a vehicle is important for the operation and service life of an engine.

Engine oil requirements will depend on the engine design, operating conditions, oil change intervals and, in the case of diesel engines, the fuel grade.

A modern engine oil provides more than just a lubrication function. The following qualities are required:

##### **GOOD WEAR PROTECTION AND FRICTION REDUCTION**

Frictional losses will lead to a reduction of engine power and efficiency. An appropriate engine oil will minimize frictional losses. Excessive wear will lead to a reduction in service life (e. g. wear of bearings, piston rings, cam lobes) or to mechanical failure.

##### **LIMITED TENDENCY TO PRODUCE COMBUSTION RESIDUE**

During engine operation, a limited amount of oil enters the combustion chamber, where it is burned. Combustion residues or deposits, which build up in the combustion chamber, lead to unwanted increases in compression and promote surface ignition ("pinging"). Any appropriate engine oil will help prevent such a condition.

##### **FAVORABLE VISCOSITY TEMPERATURE BEHAVIOR**

Viscosity is the tendency of oil to resist flowing. Engine oil, when cold, should be thin enough so that the engine can be cranked over. Hot oil should be thick enough to maintain proper lubrication.

##### **ANTI-FOAMING**

The oil is forcefully mixed with air during engine operation. Heavy foaming will lead to impaired lubrication and reduction in oil flow rate. To prevent foaming, anti-foaming additives are mixed with the oil.

##### **GOOD CORROSION INHIBITION**

The engine oil must prevent corrosion on engine components under all circumstances. Corrosion and rust inhibitors are added to displace water and acids from metal surfaces so that oil coats them.

##### **MIXING ABILITY/COMPATIBILITY**

It must be possible to mix all engine oils with each other, even synthetic with mineral oils, without causing any incompatibility problems. A further requirement is the compatibility with all materials contacted by oil, in particular oil seals, hoses and paint.

##### **GOOD THERMAL CONDUCTIVITY/GOOD COOLING PROPERTY**

Engine oil makes an important contribution to the cooling of an engine. It must transfer heat from friction surfaces, and combustion heat away from affected areas. The oil absorbed heat is carried back to the oil pan where it is transferred to the surrounding air.

##### **GOOD DISPERSANT/DETERGENT QUALITIES**

To limit or slow down the formation of combustion deposits and acidic components, together with abrasive particles and dirt from the intake air, good engine oils contain a detergent additive. Deposits of carbon and dirt are loosened and suspended in the oil, being drained away at the next oil change.

## OXIDATION INHIBITORS AND AGING STABILITY

Oxidation can be described as the oxygen absorption of hydrocarbons formed in the oil. The results of oxidation have a negative impact on viscosity causing corrosion on certain metals and the formation of sludge. Inhibitors are added to prevent oxidation from occurring. A good engine oil must maintain its stability during the required oil change intervals.

Good Lubricating Oil Must:

1. Lubricate moving parts to minimize wear.
2. Lubricate moving parts to minimize loss from friction.
3. Remove heat from engine parts by acting as a cooling agent.
4. Absorb shocks between bearings and other engine parts, reducing engine noise and extending engine life.
5. Form a good seal between piston rings and cylinder walls.
6. Act as a cleaning agent.

## 2.0 GRADING OF OILS

### VISCOSITY NUMBER

A method of classifying an oil by number, based on its resistance to flow at a high temperature.

These numbers are usually prefixed by SAE which is the abbreviation for the Society of Automotive Engineers.

A lower SAE Number (i. e. SAE 5W) indicates a thinner oil with a higher flow rate, for use at lower temperatures.

A higher SAE Number (i. e. SAE 30) indicates a thicker oil with a slower flow rate, for use at higher temperatures.

### MULTIGRADE OILS

A multigrade, or multiviscosity oil has the qualities of a lower number oil at low temperatures and those of a higher number oil at high temperatures. Multigrade oils have numbers such as SAE 5W- 30 and SAE 10W-40. For reliable engine performance in all temperature ranges mineral based engine oil viscosity must be matched to the temperature range at which the vehicle will be operated.

### SINGLE GRADE OILS

A single grade viscosity oil has a limited temperature/viscosity range compared with multigrade oils. Due to the limited temperature/viscosity range of these oils they are no longer used in BMW engines and thus no longer listed in the BMW Engine Oil Temperature/Viscosity Table.

### OIL CLASSIFICATIONS

A method of classifying oil was jointly developed by the SAE, API (American Petroleum Institute), and ASTM (American Society for Testing and Materials). Engine oils are rated according to two engine use categories:

**C** = Compression Ignition (i. e. CC)

**Compression Ignition (C)** oils are those that are used for diesel engines. The current service ratings for diesel-engine lubricating oils are: CA, CB, CC, CD, CE, CF and CG. The oils differ in their properties and in the additives they contain.

**S** = Spark Ignition (i. e. SE)

**Spark Ignition (S)** oils are those that are used for gasoline engines. The current service ratings for gasoline-engine lubricating oils are: SA, SB, SC, SD, SE, SF, SG, SH and SJ. These oils differ in their properties and in the additives they contain.



Another method of classifying minimum performance standards for gasoline-fueled engine oils has been developed through ILSAC (International Lubrication Standardization Approval Committee). Oils that meet ILSAC GF-1 performance standards must have a "starburst" certification mark displayed on the print of the oil product packaging.

### 3.0 GASOLINE ENGINE OIL REQUIREMENTS AND SPECIFICATIONS

#### 2016 MODEL YEAR AND NEWER - FROM BULLETIN SI B11 01 15 (10/2015)

**NOTE:** As of approximately 7/2015 production, gasoline-engine-equipped vehicles have a new engine oil viscosity label (located on underside of engine compartment lid) recommending 0W-20, 0W-30 or 0W-40 engine oils. Further information on these oils will become available at a later time.

The 0W-20, 0W-30 and 0W-40 engine oils are fully interchangeable and compatible with the currently available 5W-30 engine oils (BMW High Performance Synthetic Oil SAE 5W-30).

When topping-up the engine oil, performing engine repairs and performing engine oil services, use the currently available BMW High Performance Synthetic Oil SAE 5W-30 until further information becomes available.

Refer to the most recent BMW service bulletins for any updates as they become available.

#### APPROVED ENGINE OILS

- For BMW gasoline engines with two valves per cylinder, all reputable multiple grade engine oils which meet or exceed the API classification of SH. (Combination with diesel oil specifications CD or CE quality classifications are also permitted, e. g. SH/CE etc.)

For the **Special Oils** category, use of **BMW High Performance Synthetic** Engine Oil (5W-30) is recommended. It eliminates the need for seasonal oil changes since it covers all ambient temperature ranges.

Starting with the introduction of the 1999 3 Series (E46), BMW introduced an extended oil change interval of approximately 15, 000 miles depending on engine operating conditions.

The engine oil change interval of approximately 15, 000 miles has been carried over to all 2001 BMW models. However, engine oil should be changed at least once a year. This revision (annual oil change) is retroactive to earlier model years and is included in the BMW Maintenance Plan.

To coincide with the increased oil change interval, BMW also introduced "BMW High Performance Synthetic Oil" SAE 5W- 30.

Castrol, the supplier of the High Performance Synthetic Oil SAE 5W-30, is now producing this oil domestically to ensure supply to the growing demand. The oil color may appear to be lighter due to different additive pack and base stocks used, however the performance specifications remain the same. It is fully compatible with other stock of the familiar amber color.

BMW recommends the use of BMW High Performance Synthetic Oil SAE 5W-30 **or** Castrol RS SAE 10W-60 Synthetic Oil on all models as outlined below whenever a service is necessary.

#### BMW Engines (All E and F Series Vehicles - Non-Motorsport)

##### BMW part numbers:

BMW High Performance Synthetic Oil SAE 5W-30	07 51 0 017 866 - 1 quart
07 51 0 038 678 - 6 gallon enviropack	
07 51 0 017 954 - 55 gallon drum	

## **Motorsport Engines**

### **Motorsport engines using BMW High Performance Synthetic Oil SAE 5W-30, BMW Part No. 07 51 0 017 866:**

- E70 X5M / S63 from start of production
- E71 X6M / S63 from start of production
- F06 M6 Gran Coupe / S63T from start of production
- F10 M5 / S63T from start of production
- F12 M6 / S63T from start of production
- F13 M6 / S63T from start of production
- E39 M5 / S62 from 3/2000
- E52 Z8 / S62 from 3/2000

### **Motorsport engines using Castrol RS SAE 10W-60 BMW High Performance Synthetic Oil, BMW Part No. 07 51 0 009 420:**

*(also called "Castrol Edge Professional TWS 10W-60", "Castrol TWS Motorsport SAE 10W-60", or "Synthetic Oil 420")*

- E46 M3 / S54 E36 M roadster, M coupe / S54 from start of production
- E90 M3 / S65 M3 from start of production
- E92 M3 / S65 M3 from start of production
- E93 M3 / S65 M3 from start of production
- E39 M5 / S62 up to 3/2000
- E52 Z8 / S62 up to 3/2000
- E60 M5 / S85 from start of production
- E63 M6 / S85 from start of production
- E64 M6 / S85 from start of production
- E85 Z4 / S54 M Coupe / Z4 M Roadster from start of production

## **SUPERIOR THERMAL STABILITY**

The synthetic based oil resists thickening at very low ambient temperatures providing improved flow, lubrication and less internal engine resistance during cold starts.

Under high heat conditions, the oil resists thermal breakdown/shearing which causes a loss of lubrication quality compared with conventional oils.

## **1999 MODEL YEAR AND LATER OIL RECOMMENDATION**

BMW recommends use of BMW High Performance Synthetic oil on all 1999 and later BMW vehicles which have oil change intervals of approximately 15, 000 miles (except M5 produced up to 3/00 and E46 M3, E36 M roadster and M coupe with S54 engines).

## **M5 AND Z8 OIL RECOMMENDATION**

The M5 up to 3/00 production requires a specially formulated synthetic engine oil - Castrol Formula RS SAE 10W-60 or Castrol TWS Motorsport SAE 10W-60 and is the BMW recommended oil for this

engine.

**Castrol Formula RS SAE 10W-60 Synthetic Oil or Castrol TWS Motorsport SAE 10W-60 Synthetic Oil is recommended for use on M5 models produced up to 3/00 whenever a service is necessary and is available under BMW part number 07 51 0 009 420 (1 liter bottle).**

**NOTE:** For logistical reasons Castrol Formula SAE RS 10W-60 Synthetic Oil has been renamed and is now called Castrol TWS Motorsport SAE 10W-60 Synthetic Oil. Since the formulation has remained the same it is sold under the same BMW part number 07 51 0 009 420.

**NOTE:** If a customer needs to top up oil between oil changes and Castrol Formula RS 10W-60 Synthetic Oil or Castrol TWS Motorsport SAE 10W-60 Synthetic Oil is not available it is recommended that they use synthetic engine oils with a lower viscosity which conforms to the API classification SL or higher. It should be noted that engine oil consumption will increase when Castrol Formula RS 10W-60 Synthetic Oil or Castrol TWS Motorsport SAE 10W-60 Synthetic is diluted (topped up with other low viscosity synthetic engine oils).

### **M5 (S62 ENGINE) PRODUCED FROM 3/00 AND ALL Z8**

The S62 engine incorporates redesigned piston rings from 3/00 which permit the use of BMW High Performance Synthetic Engine Oil SAE 5W-30.

The recommended engine oil for all Z8 vehicles and M5 vehicles (produced from 3/00) is BMW High Performance Synthetic Engine Oil SAE 5W-30.

**NOTE:** The race bred engines incorporated in BMW M vehicles include increased power output and maximum engine speeds compared to conventional BMW engines.

**Due to their high performance design characteristics all M engines may exhibit slightly higher oil consumption compared to conventional BMW engines.**

**A spirited driving style (especially during the critical engine break in period) will lead to further increased engine oil consumption.**

**BMW recommends checking the oil level and if necessary topping up using the correct viscosity whenever refueling is required to maintain the value of your BMW throughout its service life.**

BMW High Performance Synthetic Oil is recommended where BMW Special Oils had been recommended in earlier service information.

The oil change intervals should not be extended due to the greater durability of a fully synthetic engine oil. The engine oil and filter should always be changed as per the vehicle's Service Indicator when the "Oil Service" or the "Inspection" display appears regardless of the type of oil being used.

BMW mineral based High Performance engine oil is also offered for model year 1998 and earlier BMW models. For reliable engine performance in all temperature ranges mineral based engine oil viscosity must be matched to the temperature range at which the vehicle will be operated.

### **ENGINE OIL ADDITIVES**

The use of engine oil additives is not recommended and not necessary on BMW engines. Instead, use of BMW High Performance Synthetic Oil in 1999 model year and later BMW models, Castrol Formula RS SAE 10W-60 Synthetic Oil or Castrol TWS Motorsport SAE 10W-60 Synthetic Oil in M5 S62 models produced up to 3/00 and E46 M3, E36 M roadster and M coupe with S54 engines is recommended. Also recommended is the use of either BMW High Performance Synthetic Oil, BMW High Performance Mineral Oil or one of today's highly advanced brand name lubricating oils conforming to API classification SH or higher in 1998 and earlier BMW models.

## 4.0 DIESEL ENGINE OIL REQUIREMENTS AND SPECIFICATIONS

The BMW recommended motor oil for the diesel powered vehicles with the M57, N47 and N57 is the "low-ash" synthetic Castrol SLX Professional OE SAE 5W-30. This oil is available through BMW via the virtual warehouse with Castrol under part number 07 51 0 037 195 (1 qt. bottles, quantity 6).

## 5.0 ENGINE OIL CHANGE INTERVALS

With the introduction of the 1999 Model Year vehicles BMW has introduced an extended oil change interval of approximately 15, 000 miles (depending on engine operating conditions) on most models.

To coincide with the increased oil change interval, BMW has also introduced "BMW High Performance Synthetic Oil" which must be used on all 1999 Model Year vehicles (except E36 318ti, 323is/iC, 328is/iC, M3, M Roadster and M Coupe models) whenever a service is necessary.

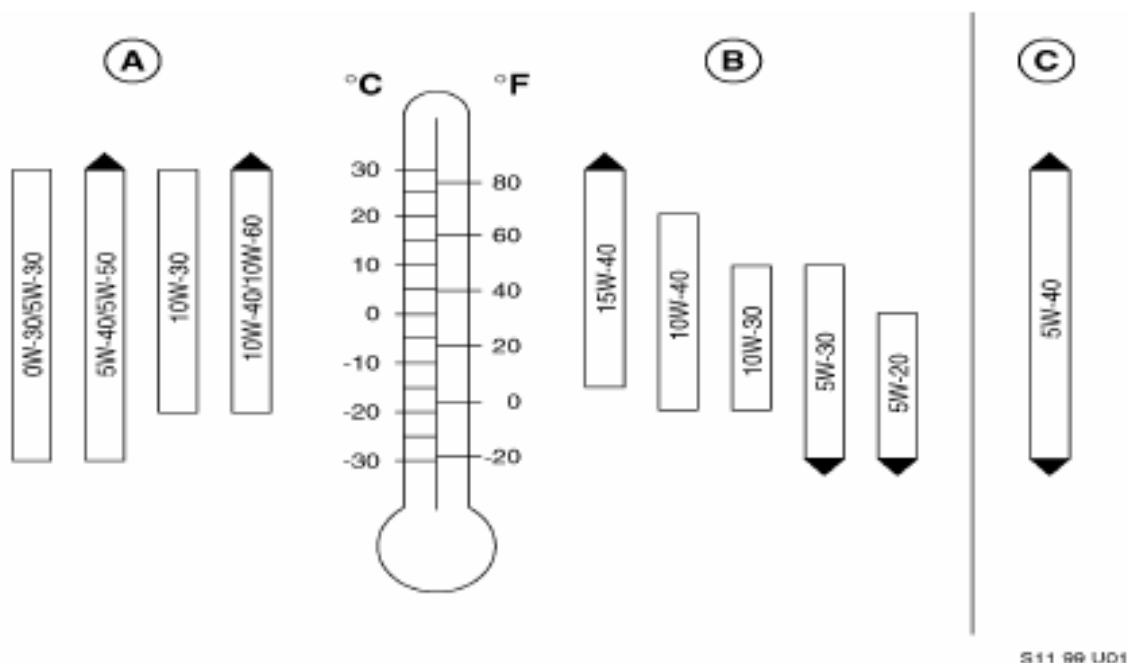
**NOTE:** If it is necessary to top up the engine oil between oil changes use of synthetic low viscosity engine oils which conform to the API classification SL or higher is recommended.

BMW High Performance Synthetic Engine Oil may also be used on Model Year 1999 E36 (3-Series and M models) as well as Model Year 1998 and earlier BMW models.

The oil change intervals should not be extended due to the greater durability of a fully synthetic engine oil. The engine oil and filter should always be changed as per the vehicle's Service Interval Indicator when the "Oil Service" or the "Inspection" display appears regardless of the type of oil being used.

BMW mineral-based High Performance engine oil is also offered for model year 1998 and earlier BMW models. For reliable engine performance in all temperature ranges mineral-based engine oil viscosity must be matched to the temperature range at which the vehicle will be operated. See [ENGINE OIL TEMPERATURE/VISCOSITY TABLE](#).

### BMW ENGINE OIL TEMPERATURE/VISCOSITY TABLE



**A/B: Brand name oils approved per API or ACEA (CCMC)**

A = Diesel engines

B = Spark-ignition engines

**C: BMW High Performance Synthetic Oil**

C = Valid for spark-ignition and diesel engines

## **OTHER OIL CHANGES FOR CARS WITHOUT SERVICE INDICATOR**

<b>Model Year(s)</b>	<b>Mileage</b>
1980 and later	7, 500
1975 thorough 1979	6, 500
1974 or earlier	4, 000

Including oil filter. However, at least twice annually, preferably before and after the winter season.

Under severe driving conditions it is recommended to increase the number of oil services.

## **6.0 CONDITION BASED SERVICE**

Condition Based Service measures, monitors, and determines the required maintenance of several service items independent from each other. This technology prompts the customer to bring the vehicle for service whenever one of the CBS items requires maintenance or replacement. CBS strikes a compromise between too frequent maintenance and too rigid service intervals that call for the replacement of service items which may still have substantial remaining useful life. CBS also details the recommended, due, and overdue required maintenance during and after the BMW Vehicle Maintenance Program Agreement. Thus, CBS allows BMW customers to experience a technology that makes service more convenient, transparent and structured.

## **7.0 ENGINE OIL ADDITIVES**

The use of engine oil additives is not recommended and not necessary on BMW engines. Instead, use of BMW High Performance Synthetic Oil in 1999 model year and later BMW models is recommended and use of either BMW High Performance Synthetic Oil, BMW High Performance Mineral Oil or one of today's highly advanced brand name lubricating oils conforming to API classification SH or higher in 1998 and earlier BMW models is recommended.

Today's modern oils and fluids for engines are already formulated by the manufacturer and/or BMW NA with sophisticated additive packages designed to reduce sludge build-up, keep contaminants in suspension and maintain viscosity of the oil. Additional additives can compromise the manufacturer's or BMW NA's developed formulation.

BMW NA does not endorse or recommend the use of engine oil beyond the additives already included in the operating fluid manufacturer's additive package.

The use of engine crankcase flushing detergent chemicals and/or automated crankcase flushing machines is not a BMW recommended procedure.

Since the inclusion of such additional additives may lead to component damage or compromise the longevity or function of BMW components, warranty coverage may be affected on any component where the failure is caused by inappropriate oil or operating fluids or the use of add-on additives.

## **8.0 BREAK-IN INSTRUCTIONS**

During the break-in period of a new engine or parts of a reconditioned engine (new bearings, crankshaft, pistons, etc.) BMW engines do not require special break-in oils.

A multiple grade engine oil that conforms with BMW specifications can be used for this purpose.

## **9.0 NG6 FRONT AND REAR RADIAL SEAL SEALANT**

When replacing the front or rear radial crankshaft seals on new generation 6 cylinder engines, use of a special Loctite® sealant is recommended to fill the seal grooves at the bedplate seam. Follow the appropriate repair instruction:

RA 11 14 005 - Front radial crankshaft seal replacement



**Required Materials:**

P/N 83 19 7 536 051 - Loctite® 128357 sealant compound\

P/N 83 19 7 515 683 - Loctite® 171000 primer

P/N 83 19 7 515 684 - Stamp

## **10.0 LUBRICANT FOR OXYGEN SENSOR**

Application of Bostik NEVER-SEEZ® (Part No. NSBT-16) to threads of oxygen sensor is recommended.

## **11.0 OIL CONSUMPTION**

All engines normally consume a certain amount of engine oil. This is necessary in order to properly lubricate the cylinder walls, pistons, piston rings, valves and turbocharger(s), if equipped.

In addition, engines with less than 6, 000 miles will generally consume additional engine oil because the internal engine components are not fully seated (break-in). Therefore, engine oil consumption complaints received prior to 6, 000 miles cannot be considered.

Once a new or remanufactured engine has accumulated 6, 000 miles, oil consumption can be considered if there is a drastic change in the engine oil consumption rate (e.g., the engine oil consumption rate triples) under similar driving conditions.

Engines equipped with a turbocharger(s) will consume more engine oil than normally aspirated engines (non-turbocharged). The additional oil that is consumed in a turbocharged engine is mainly due to the turbocharger lubrication requirements. Some of the engine oil normally migrates past the turbocharger turbine bearing seals and will enter the intake tract of the engine. All turbocharged engines also require a complex crankcase ventilation system. The crankcase ventilation system needs to maintain a small vacuum on the crankcase and not allow the crankcase to be pressurized.

Pressurizing the engine crankcase can lead to external engine oil leaks and increased engine oil consumption via the piston rings and valve seals. When the load and the boost level of a turbocharged engine is varied, the path of the crankcase pressure is changed. During the crankcase ventilation path transition, a small amount of engine oil will pass through the crankcase ventilation system and is additionally consumed. The additional engine oil consumption of a turbocharged engine, as compared to a normally aspirated engine, is normal and not a defect.

## **OIL CONSUMPTION SPECIFICATION**

All BMW engines (excluding Motorsport) can consume up to 1 quart of engine oil per 750 miles at any time.

Due to the increased engine power, all Motorsport engines can consume up to 2.5 quarts of engine oil per 1, 000 miles at any time.

## **DIAGNOSTIC HINTS**

When an oil consumption complaint is received, it may be possible to correct it without performing extensive engine repairs. Check the following frequent causes of excessive oil consumption prior to undertaking any engine consumption analysis or repairs. Submit a PuMA case for assistance.

### **Proper Maintenance:**

Has the vehicle received proper maintenance? Certain external conditions (mainly city driving style and/or high engine loads; poor fuel quality; and extreme ambient temperatures), combined with excessively long oil service intervals, may accelerate engine oil degradation, which may cause premature wear of the engine components. Continuous city driving (stop-and-go traffic); fuels with high

olefin content; sulfur and certain aromatic fractions; and very high ambient temperatures are the most influential factors causing premature oil aging and consecutive engine mechanical deterioration.

## EXTERNAL LEAKAGE

The engine should be leak-free before starting any engine oil consumption analysis.

## OVERFILLING

If the oil level is too high, oil in the crankcase will be thrown against the cylinder walls and consumed. Check the dipstick markings or electronic measurement (as equipped) to be sure of accuracy. The oil level must not be higher than the upper mark.

## ENGINE OIL VISCOSITY/QUALITY

The use of oil with the wrong viscosity rating for operating conditions can cause high oil consumption. Check the Owner's Manual to determine the proper viscosity for prevailing conditions.

## ENGINE SPEED AND LOAD

If vehicle operating conditions are severe, oil consumption will be higher than normal. Extreme load or continuous high engine speed will result in increased oil consumption.

## CRANKCASE VENTILATION

The crankcase ventilation systems use various different crankcase ventilation valves, depending on the engine type. Although the valves all look different, they function similarly, using a spring and diaphragm assembly to control the crankcase pressure. A properly functioning pressure control valve is designed to maintain a slight vacuum (underpressure) in the crankcase, which assures reliable crankcase venting during all engine operating conditions. One of the results of a malfunctioning crankcase ventilation system can be increased engine oil consumption.

## TURBOCHARGED ENGINES

Engines that are fitted with a turbocharger(s) will consume more engine oil than naturally aspirated engines (non-turbocharged engines). In this case, a turbocharged engine could require topping of engine oil more frequently. For vehicles with N63 and N63T engines, refer to BMW service bulletin SI B11 01 13 for additional details.

## 12.0 ENGINE OIL CAPACITIES - QUICK REFERENCE CHARTS

### E SERIES VEHICLES

Series	M50/52/54/56	M57Y	M60/62	N20/N26	N62/N62TU	N63	N73/N73TU/N74	N51/N52/N52K/N54	N55	S50/52/54	S62	S63/S63T	S65	S85
	E36/M3/Z3	6.9 (6.5)									6.9 (6.5)			
M 23										b) 6.3 (6.0) c) 5.25 (5.0)				
E38			8.0 (7.5)											
E39/M5	6.9 (6.5)		8.0 (7.5)								6.9 (6.5)			
E46	6.9 (6.5) a) 8.0 (7.5)									c) 5.25 (5.0)				
E52											8.0 (7.5)			
E52 ALPINA			8.0 (7.5)											
E53	8.0 (7.5)		8.5 (8.0)		8.5 (8.0)									
E60	6.9 (6.5)				8.5 (8.0)			6.9 (6.5)						d) 9.8 (9.3)
E61								6.9 (6.5)						
E63					8.5 (8.0)									d) 9.8 (9.3)
E64					8.5 (8.0)									d) 9.8 (9.3)
E65					8.5 (8.0)									
E65 ALPINA B7					9.2 (8.75)									
E66					8.5 (8.0)		9.0 (8.5)							
E70		7.7 (7.3)			8.5 (8.5)	9.5 (9.0)		6.9 (6.5)	6.9 (6.5)			9.0 (8.5)		
E71						9.5 (9.0)		6.9 (6.5)	6.9 (6.5)			9.0 (8.5)		
E72						9.0 (8.5)								
E82								6.9 (6.5)	6.9 (6.5)					
E83	6.5 (6.2)							6.9 (6.5)						
E84 w/O awd				5.25 (5.0)										
E84 w/awd				5.8 (5.5)					6.9 (6.5)					
E85	6.9 (6.5)							6.9 (6.5)		5.8 (5.5)				
E86								6.9 (6.5)		5.8 (5.5)				
E88								6.9 (6.5)	6.9 (6.5)					
E89				5.3 (5.0)				6.9 (6.5)						
E90/E91/E92/E93		8.0 (7.5)						6.9 (6.5)	6.9 (6.5)					9.3 (8.8)
	M10	M20	M21	M30	M42/44	M70/S70	M73	S14	S38					
E24/M6				6.0 (5.75)					6.0 (5.75)					
E28/M5	4.50 (4.25)		6.0 (5.7)	6.0 (5.75)					6.0 (5.75)					
E30/M3	4.25 (4.0)	4.50 (4.25)			5.25 (5.0)			4.65 (4.40)						
E31						8.0 (7.5)	8.5 (8.0)							
E32				6.0 (5.75)		8.0 (7.5)								
E34/M5		4.50 (4.25)		6.0 (5.75)					6.0 (5.75)					

Revised 2.25.2015

**Fig. 2: Engine Oil Capacities - E Series Vehicles**  
 Courtesy of BMW OF NORTH AMERICA, INC.

# F & I SERIES VEHICLES

Oil Capacities in U.S. quarts (liters)	Series	N47	N57	N20/N25	N63	N63TU	N73/N73 TU/N74	N51/N52/N52K/N54	N55	S55	S63/S63T	B38	IB1	
	F01, F02				9.5 (9.0)	9.5 (9.0)	11.0 (10.5)	6.9 (6.5)	6.9 (6.5)					
	F04				9.0 (8.5)									
	F06					9.5 (9.0)			6.9 (6.5)					
	F07				9.5 (9.0)	9.5 (9.0)			6.9 (6.5)					
	F10 without AWD		6.9 (6.5)	5.0 (4.75)	9.5 (9.0)	9.5 (9.0)			6.9 (6.5)					
	F10 with AWD		6.9 (6.5)	5.3 (5.0)	9.5 (9.0)	9.5 (9.0)		6.9 (6.5)	6.9 (6.5)			9.0 (8.5)		
	F12, F13				9.5 (9.0)	9.5 (9.0)			6.9 (6.5)			9.0 (8.5)		
	F15, F16		6.9 (6.5)			10.0 (9.5)			6.9 (6.5)					
	F25	5.5 (5.2)		5.1 (4.8)				6.9 (6.5)	6.9 (6.5)					
	F22			5.3 (5.0)					6.9 (6.5)					
	F30, F31, F32, F33, F34, F35, F36 without AWD	5.5 (5.2)		5.3 (5.0)					6.9 (6.5)					
	F30, F31, F32, F33, F34, F35, F36 with AWD	5.5 (5.2)		5.1 (4.8)					6.9 (6.5)					
	F80, F82, F83									6.9 (6.5)				
F85, F86										10.0 (9.5)				
I03 (I3)												2.6 (2.5)		
I12 (I8)											4.5 (4.25)			

Revised 3.16.15

**Fig. 3: Engine Oil Capacities - F & I Series Vehicles**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

## ENGINE

### Exhaust System - Repair - Only I3 Models With Range Extender - i3

## EXHAUST SYSTEM, COMPLETE

### 18 00 020 REMOVING AND INSTALLING COMPLETE EXHAUST SYSTEM (I01)

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- Observe the [SAFETY INFORMATION](#) for working with electric vehicles.

**WARNING:** Risk of burning!  
Only perform this repair work after engine has cooled down.

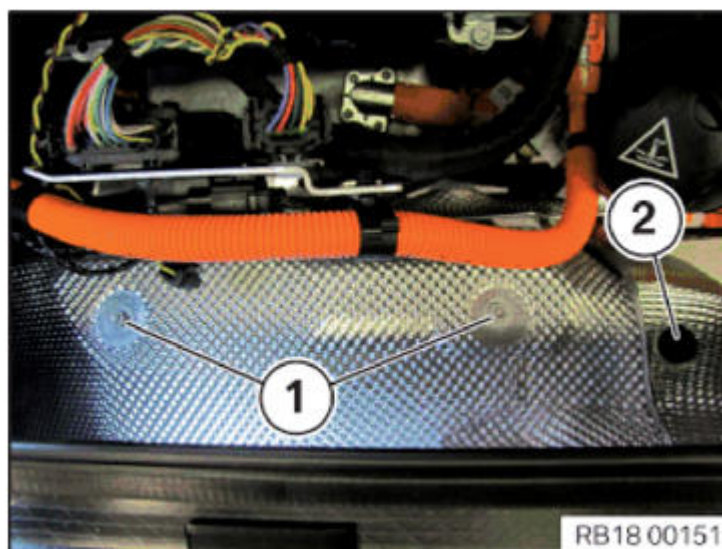
*Necessary preliminary tasks:*

- Remove [SERVICE CAP IN LUGGAGE COMPARTMENT](#) .
- Remove [SUPPORT FOR BUMPER PANEL](#) at rear.
- Remove [UNDERBODY PANELLING](#) at rear.

Removal:

Unscrew nuts (1).

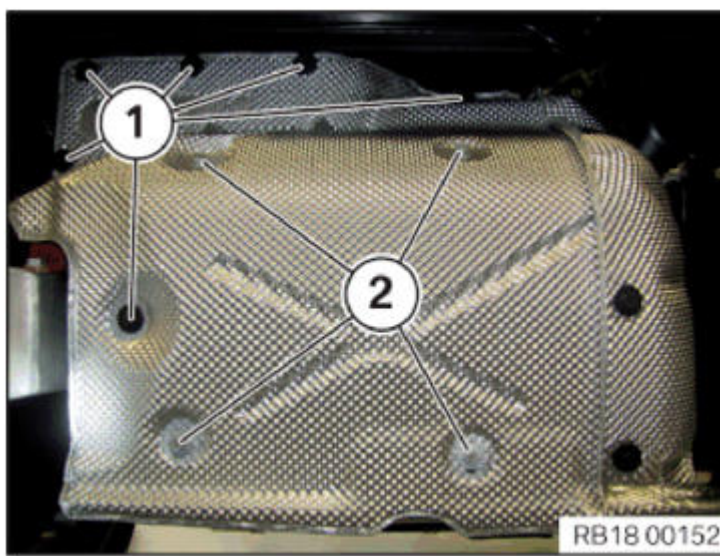
Unfasten screws (2).



**Fig. 1: Identifying Exhaust System Nuts And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Unscrew nuts (2).

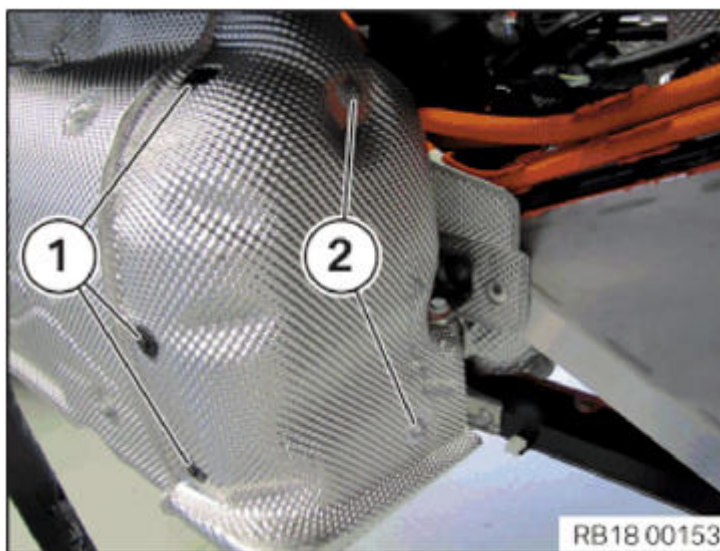


**Fig. 2: Identifying Exhaust System Screws And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Unscrew nuts (2).

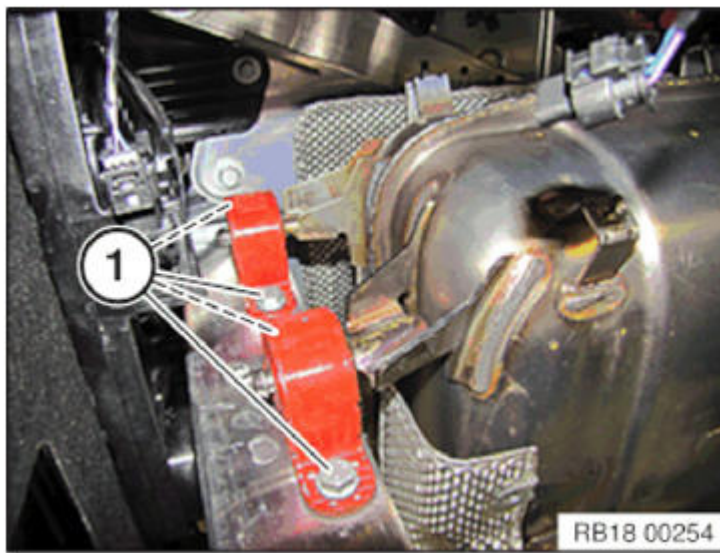
Remove heat shields.



**Fig. 3: Identifying Exhaust System Heat Shield Screw And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

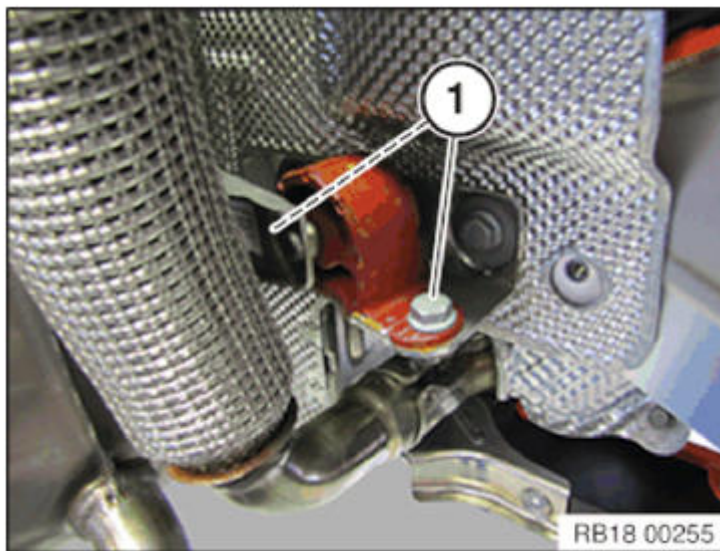
Release screws (1).





**Fig. 4: Identifying Exhaust System Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

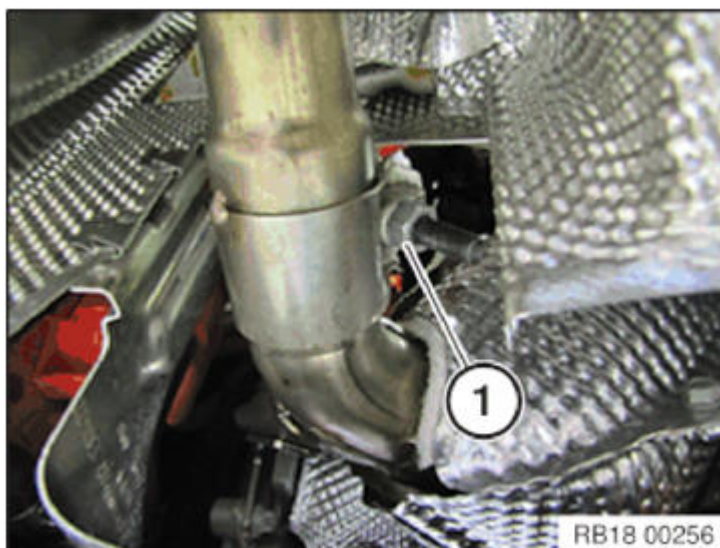
Release screws (1).



**Fig. 5: Identifying Exhaust System Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release clamp (1).

Remove exhaust system.

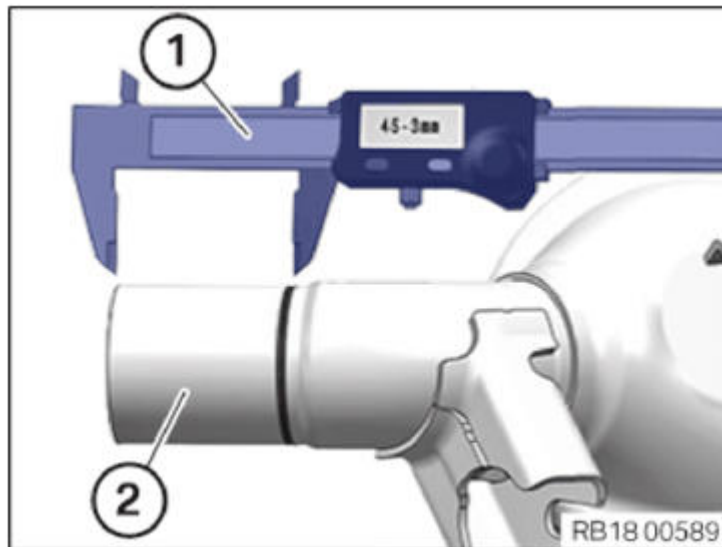


**Fig. 6: Identifying Exhaust System Clamp**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Preparation for installation:**

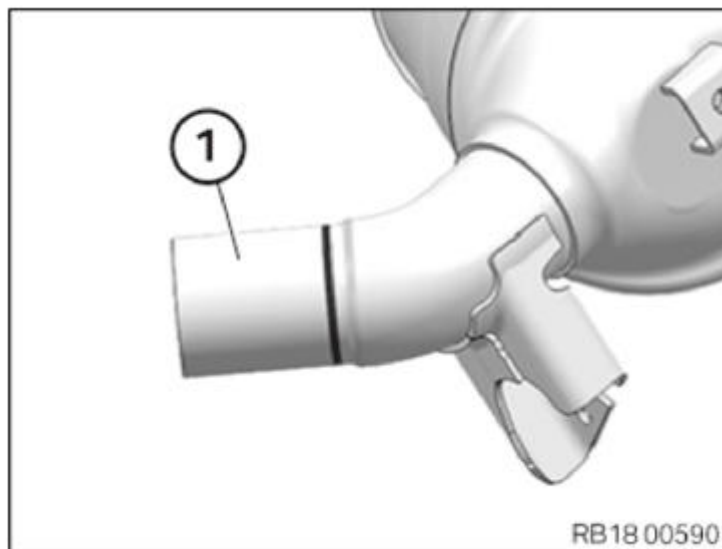
Check rubber mount for damage, replace if necessary.

Center 45 mm at the exhaust pipe of the catalytic converter using a measuring tool and mark the area with a paint pen (if necessary with temperature-resistant ink).



**Fig. 7: Checking Catalytic Converter Exhaust Pipe Mark Using Measuring Tool**  
Courtesy of BMW OF NORTH AMERICA, INC.

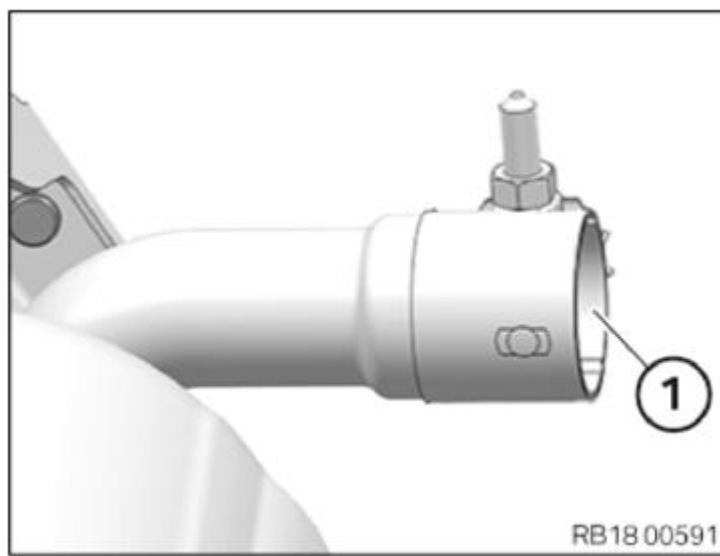
Clean the catalytic converter exhaust pipe using a wire brush.



**Fig. 8: Identifying Catalytic Converter Exhaust Pipe**  
Courtesy of BMW OF NORTH AMERICA, INC.

**When reinstalling the previous rear silencer:**

Clean the rear silencer exhaust pipe using a wire brush.

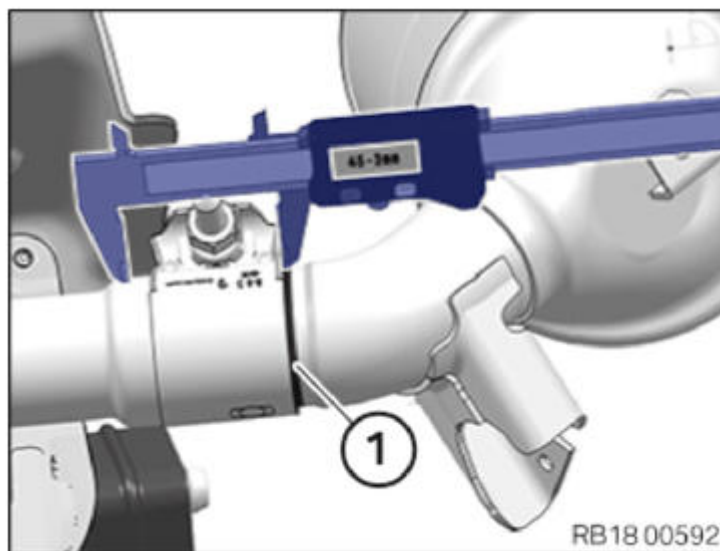


**Fig. 9: Identifying Rear Silencer Exhaust Pipe**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

If necessary, renew clamp.

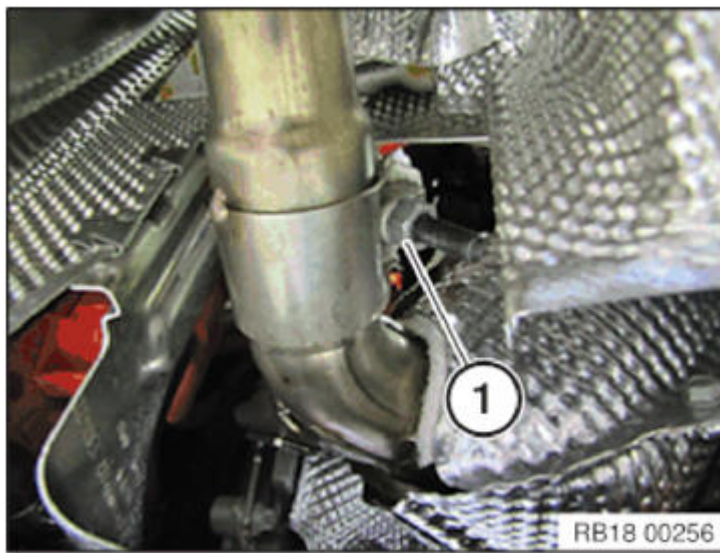
Push the rear silencer onto the catalytic converter up to the beginning of the mark (1).



**Fig. 10: Installing Rear Silencer Onto Catalytic Converter**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten clamp (1).

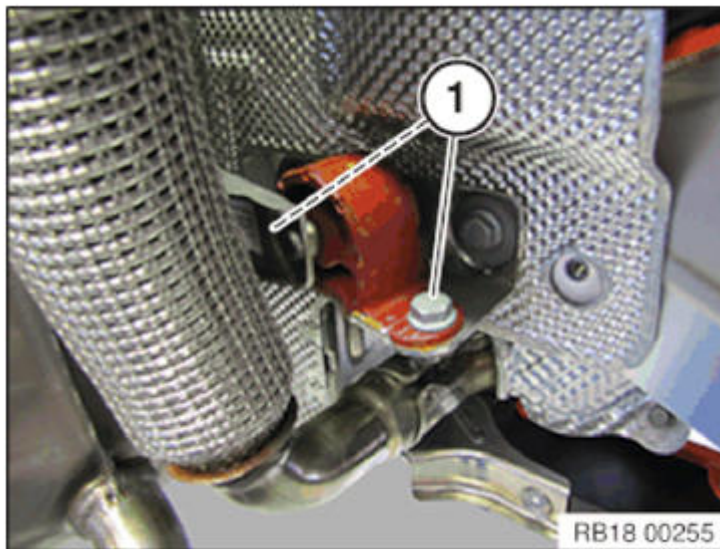
Tightening torque [18 30 3AZ](#) .



**Fig. 11: Identifying Exhaust System Clamp**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down screws (1).

Tightening torque [18 20 2AZ](#) .

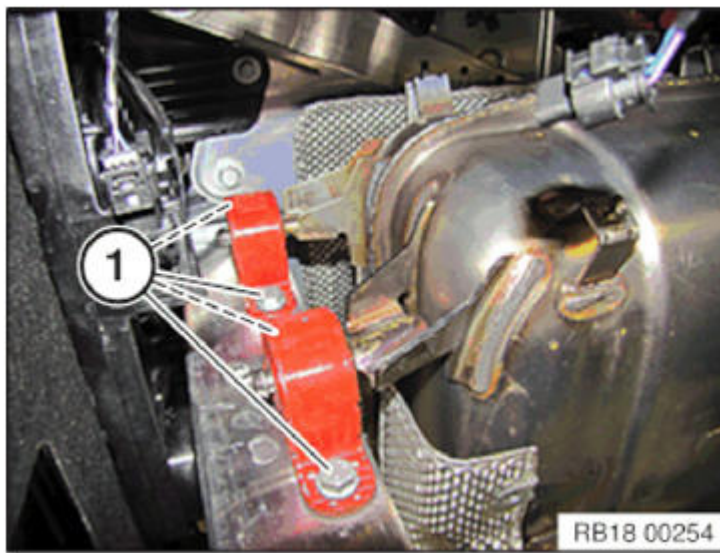


**Fig. 12: Identifying Exhaust System Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down screws (1).

Tightening torque [18 20 2AZ](#) .





**Fig. 13: Identifying Exhaust System Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

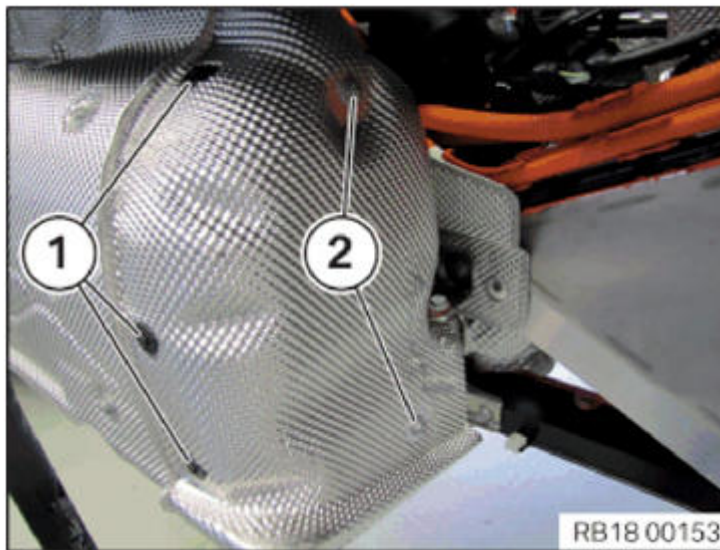
Mount the heat shields.

Tighten screw (1).

Tightening torque [18 30 6AZ](#) .

Tighten down nuts (2).

Tightening torque [18 30 5AZ](#) .



**Fig. 14: Identifying Exhaust System Heat Shield Screw And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

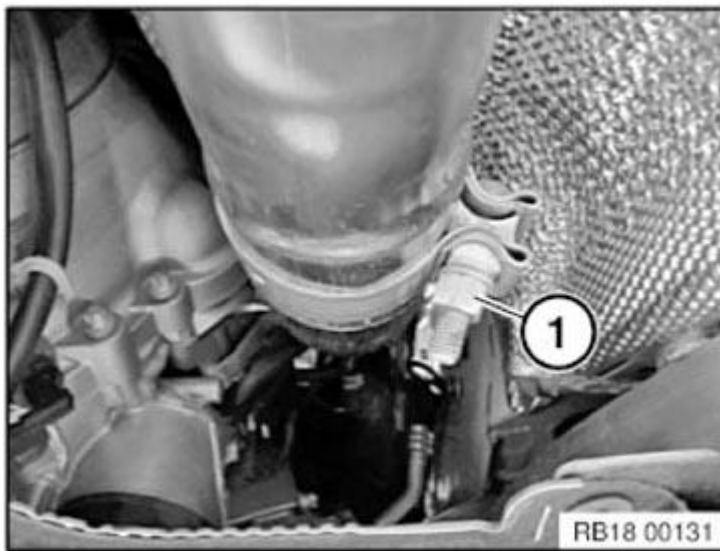
Tighten down nuts (1).

Tightening torque [18 30 5AZ](#) .

Tighten down screws (2).

Tightening torque [18 30 6AZ](#) .





**Fig. 15: Identifying Exhaust System Heat Shield Screws And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Check the tightness of the exhaust system and check for a sufficient distance to neighboring components.

## **EXHAUST CATALYTIC CONVERTER**

### **18 32 050 REMOVING AND INSTALLING/REPLACING CATALYTIC CONVERTER (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM** .
- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:** Risk of burning!  
Only perform this repair work after the exhaust system has cooled down.

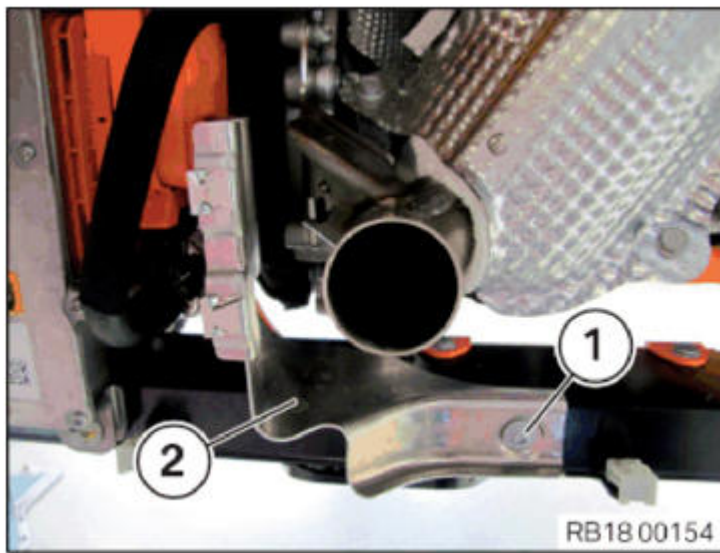
*Necessary preliminary tasks:*

- Remove **SERVICE CAP IN LUGGAGE COMPARTMENT** .
- Remove VERTICAL STRUT .
- Remove **OXYGEN SENSOR** .
- Remove **MONITORING SENSOR** .

Release screw (1).

Tightening torque **18 20 3AZ** .

Release heat shield (2) from cross bridge.

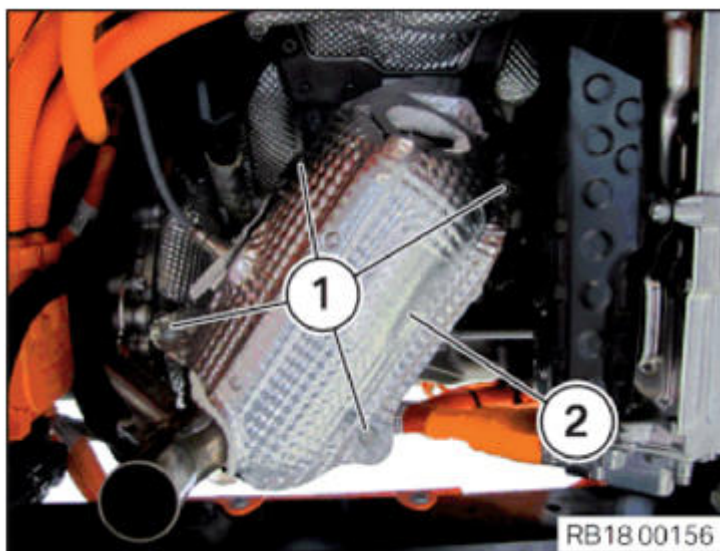


**Fig. 16: Identifying Catalytic Converter Cross Bridge Heat Shield And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [18 30 9AZ](#) .

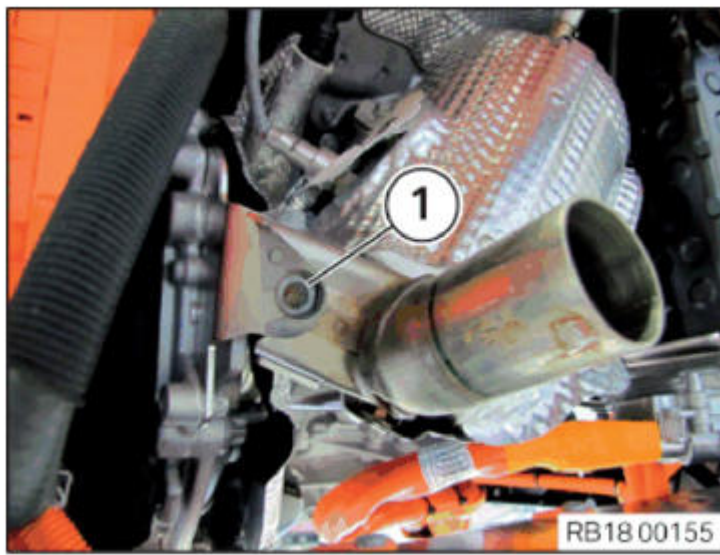
Remove heat shield (2).



**Fig. 17: Identifying Catalytic Converter Heat Shield And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque [18 30 2AZ](#) .



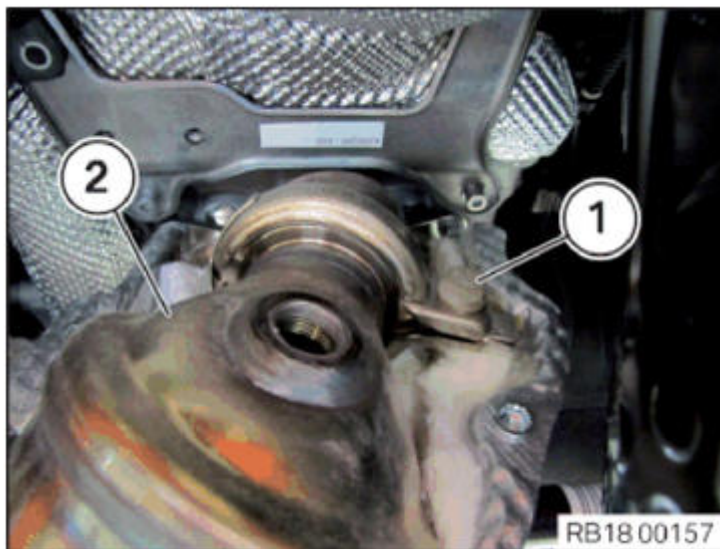
**Fig. 18: Identifying Catalytic Converter Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release clamp (1).

Tightening torque **18 30 1AZ** .

Renew clamp and gasket.

Feed out catalytic converter (2) and remove.



**Fig. 19: Identifying Catalytic Converter And Clamp**  
Courtesy of BMW OF NORTH AMERICA, INC.

Reassemble the vehicle.

Check exhaust system for leak tightness.

### **18 32 050 REMOVING AND INSTALLING/REPLACING CATALYTIC CONVERTER (W20)**

**WARNING:** Risk of burning!  
Only perform this repair work after the exhaust system has cooled down.

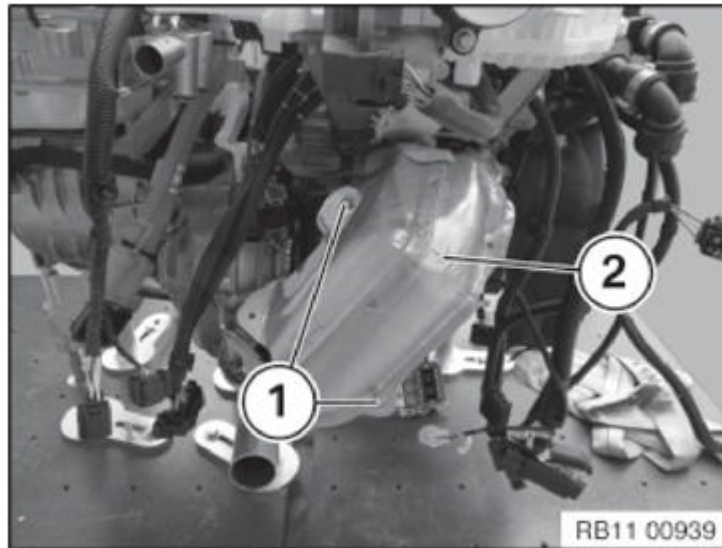
*Necessary preliminary tasks:*

- Remove VERTICAL STRUT .

Release screws (1).

Remove heat shield (2).

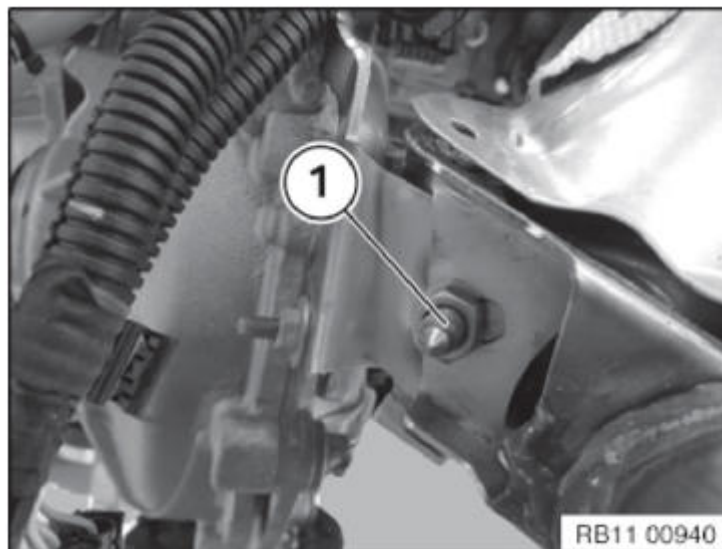
Tightening torque [11 00 2AZ](#) .



**Fig. 20: Identifying Catalytic Converter Heat Shield And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque [11 00 5AZ](#) .



**Fig. 21: Identifying Catalytic Converter Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

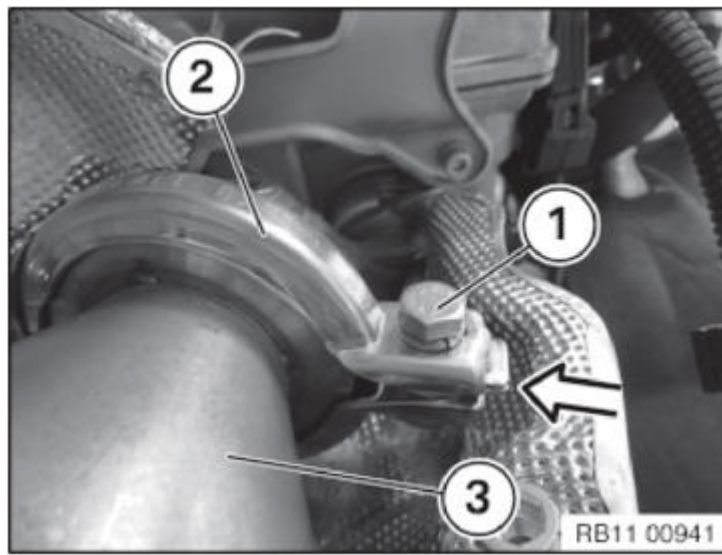
Release nut (1) on V band clamp (2).

Bend up V band clamp (2).

Raise catalytic converter (3) slightly and feed out toward rear.

*Installation note:*

Clean sealing surface. Replace gasket and V band clamp.



**Fig. 22: Removing Catalytic Converter V Band Clamp Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tightening torque. **18 30 1AZ** .

Reassemble the vehicle.

Check exhaust system for leak tightness.

## **EXHAUST MANIFOLD WITH INTEGRATED CATALYTIC CONVERTER**

### **18 40 040 REMOVING AND INSTALLING, SEALING/REPLACING EXHAUST MANIFOLD (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**WARNING:** Risk of burning!  
Only perform this repair work on an engine that has cooled down.

Necessary preliminary tasks:

- Remove the **CATALYTIC CONVERTER**.

Unscrew nuts (1).

Tightening torque **18 30 8AZ** .

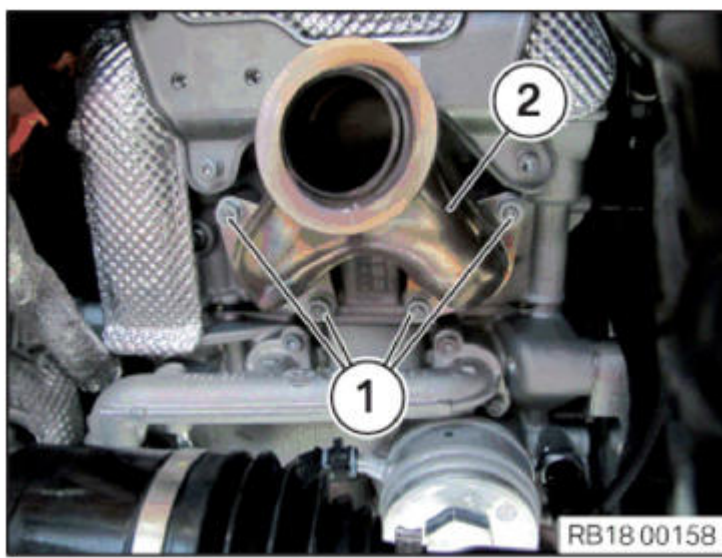
Remove exhaust manifold (2) from cylinder head.

*Installation note:*

Clean connection points.

Replace gaskets.





**Fig. 23: Identifying Exhaust Manifold And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Check exhaust system for leak tightness.

### **11 21 515 REPLACE TORSION SPLINED SHAFT (W20)**

**Special tools required:**

- [2 285 548](#)
- [2 286 315](#)

**Necessary preliminary tasks:**

- Mount [ENGINE ON ASSEMBLY STAND](#).

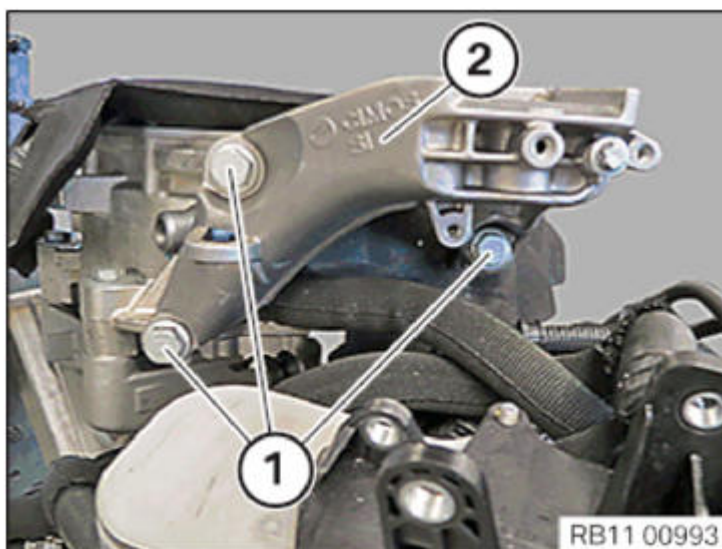
*Installation note:*

Once disassembled, a torsion splined shaft must not be reused.

Reset adaptation values after replacing the torsion splined shaft.

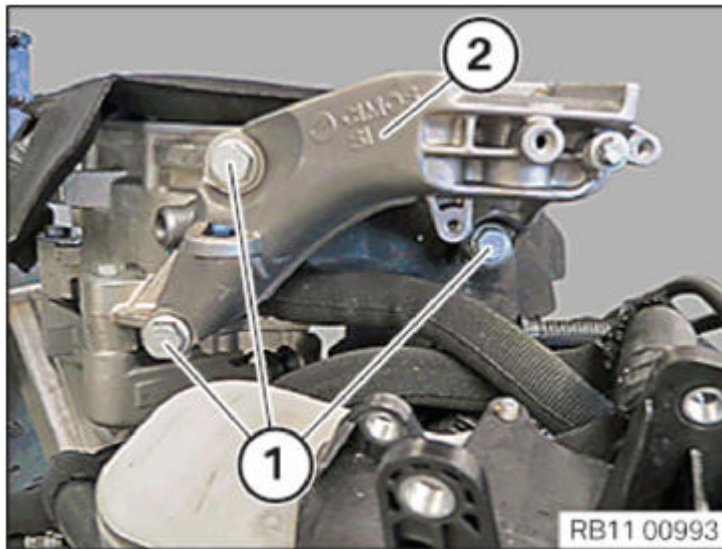
Risk of damage to engine and range extender electrical machine during operation.

Release screws (1) and take off engine support arm (2).



**Fig. 24: Identifying Torsion Splined Shaft Screws And Engine Support Arm**  
Courtesy of BMW OF NORTH AMERICA, INC.

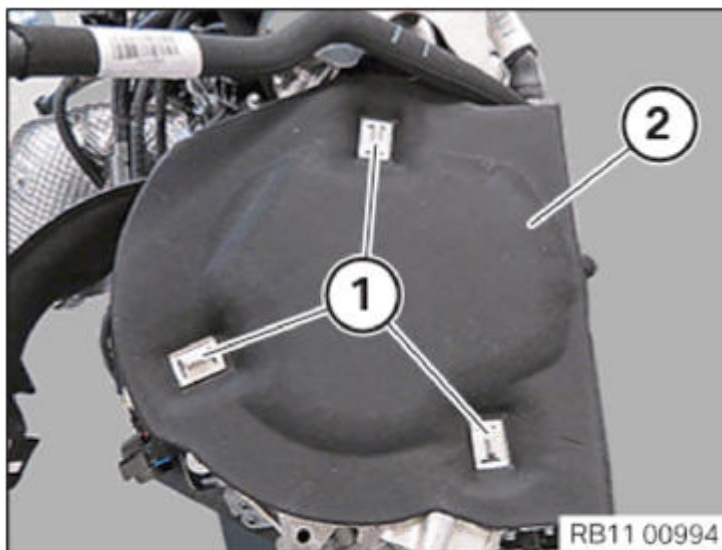
Release screws (1) and take off engine support arm (2).



**Fig. 25: Identifying Torsion Splined Shaft Screws And Engine Support Arm**  
Courtesy of BMW OF NORTH AMERICA, INC.

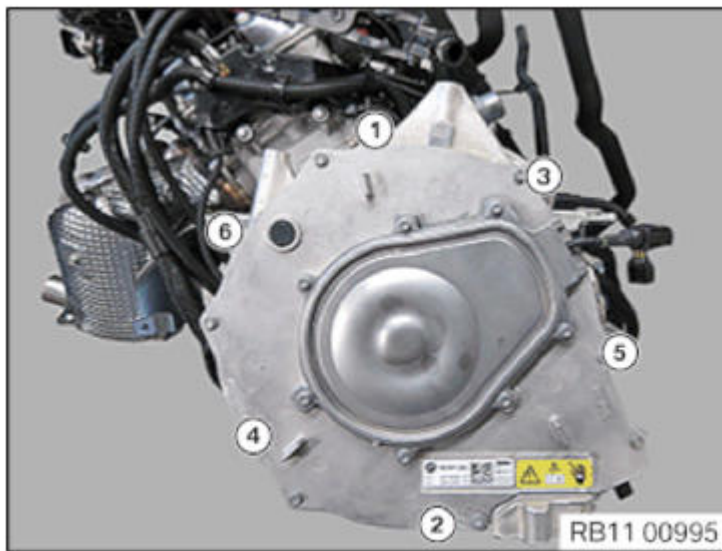
Lever out holding clamps (1).

Remove sound insulation (2).



**Fig. 26: Identifying Torsion Splined Shaft Sound Insulation And Holding Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws in sequence (1 to 6).



**Fig. 27: Identifying Torsion Splined Shaft Screw Releasing Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tool [2 285 548](#) M10 into bolting points (1, 4 and 5), hand-tight, as far as it will go.

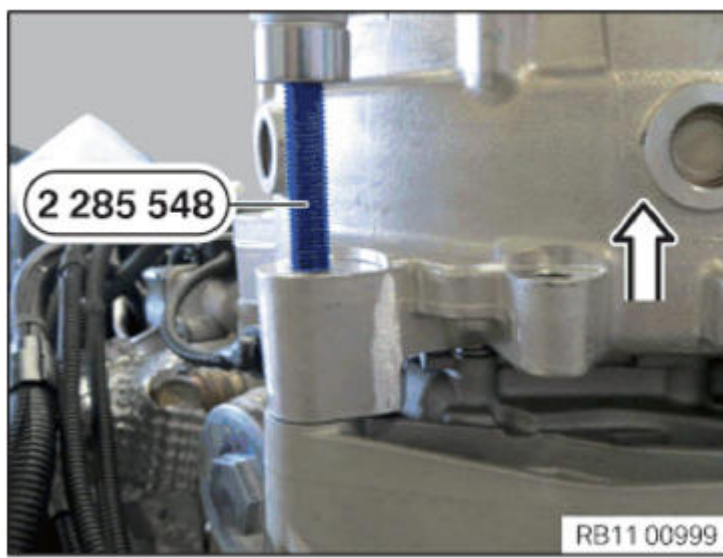


**Fig. 28: Screwing Special Tool (2 285 548) M10 Into Torsion Spline Shaft Bolting Point**  
Courtesy of BMW OF NORTH AMERICA, INC.

To extract the range extender electrical machine, screw the special tool [2 285 548](#) into bolting points (1, 4 and 5).

Special tool

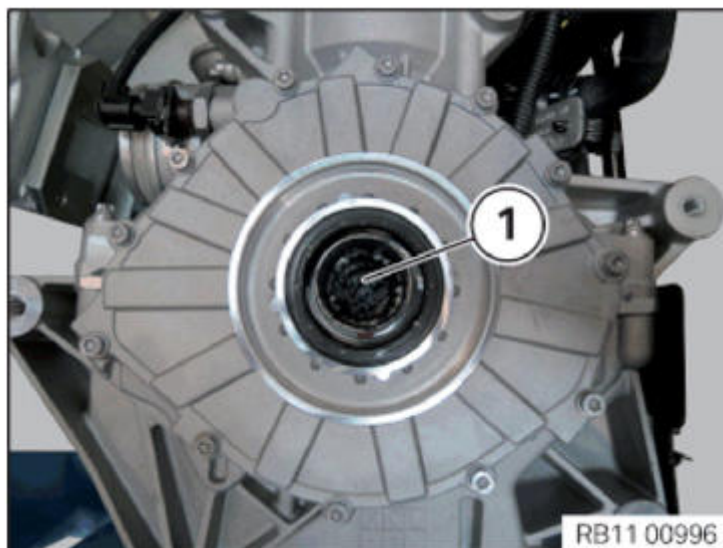
Uniformly pull off range extender electrical machine in 360° steps until the torsion splined shaft releases.



**Fig. 29: Removing Range Extender Electrical Machine From Torsion Splined Shaft**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check crankshafts and generator gearing for damage and if necessary clean metal residues (debris) on the tooth flanks.

Replace **RADIAL SHAFT SEAL** .



**Fig. 30: Identifying Torsion Spline Shaft**  
Courtesy of BMW OF NORTH AMERICA, INC.

Sealing sleeve (1) with clamping ring

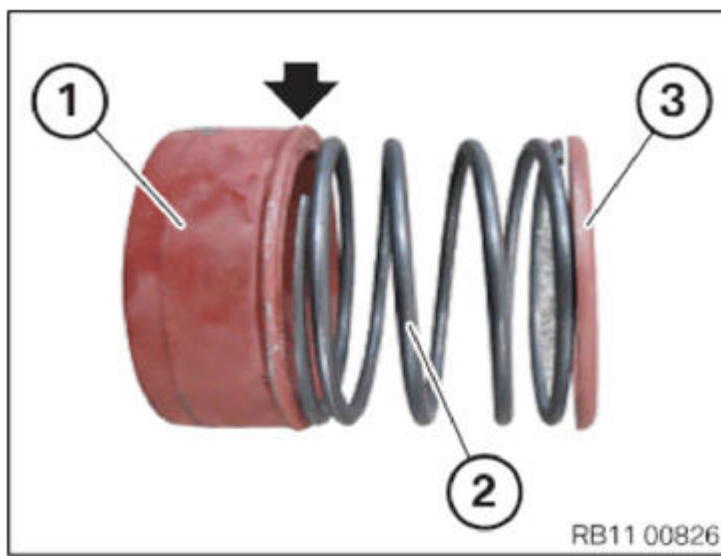
Length compensation spring (2)

Valve seat insert (3)

*Installation note:*

Always renew sealing sleeve (1) and valve seat insert (3).



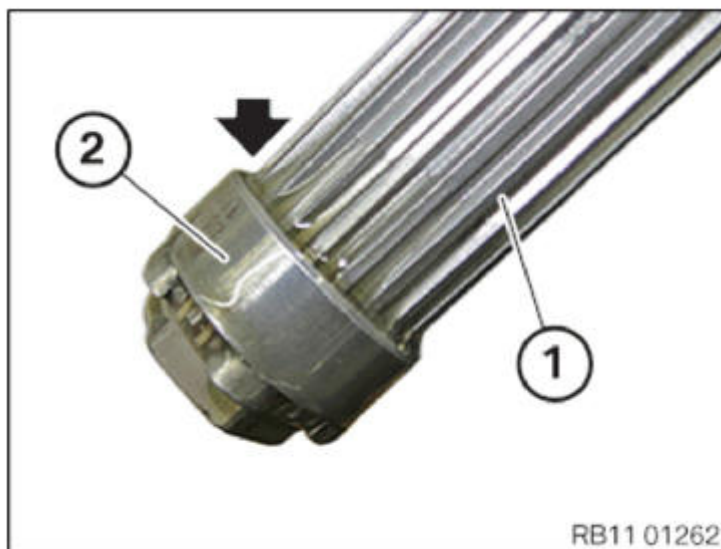


**Fig. 31: Identifying Sealing Sleeve, Compensation Spring And Valve Seat Insert**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace torsion splined shaft (1).

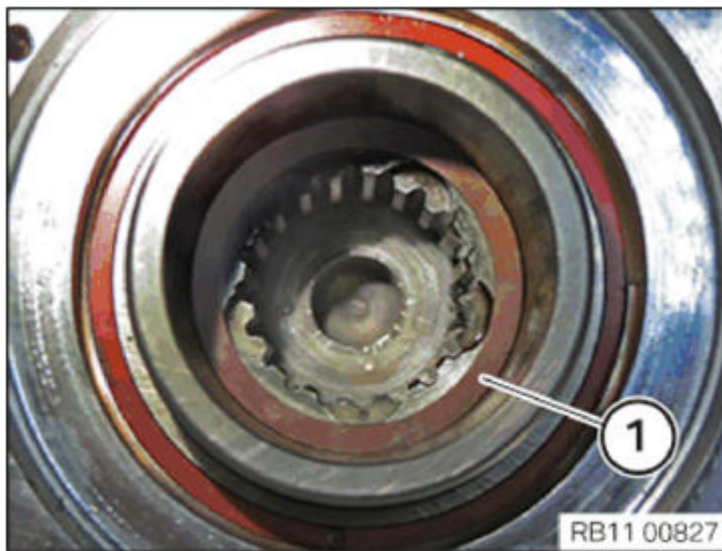
Coat torsion splined shaft (1) at both ends (2) with sufficient engine oil.



**Fig. 32: Identifying Torsion Spline Shaft End Engine Oil Coating**  
Courtesy of BMW OF NORTH AMERICA, INC.

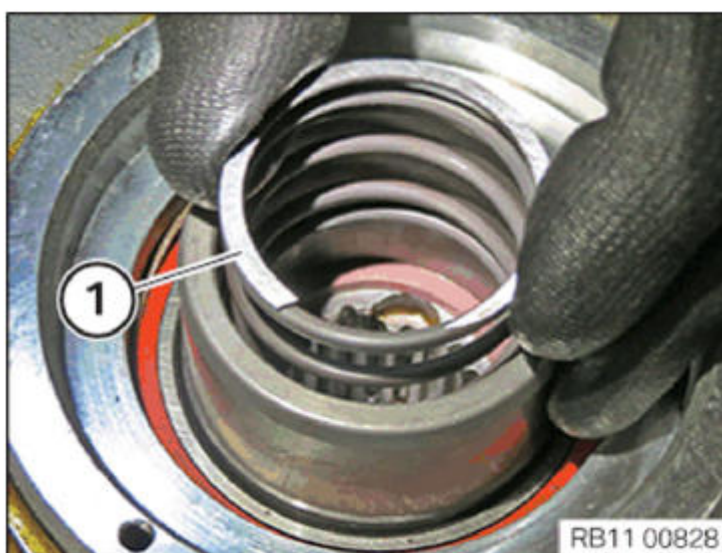
Insert valve seat insert (1) in the alternator with the rounded area downwards.





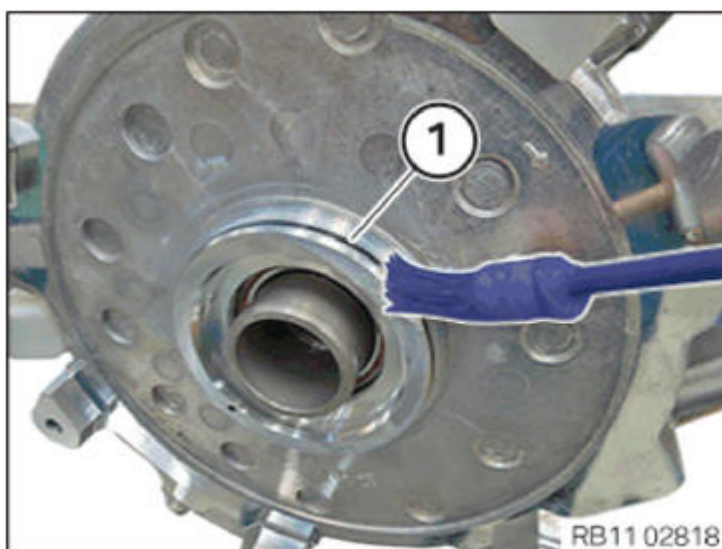
**Fig. 33: Identifying Torsion Spline Shaft Valve Seat Insert**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert length compensation spring (1).



**Fig. 34: Inserting Length Compensation Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

Grease the O-ring on the alternator (1) with [4.9](#) grease.

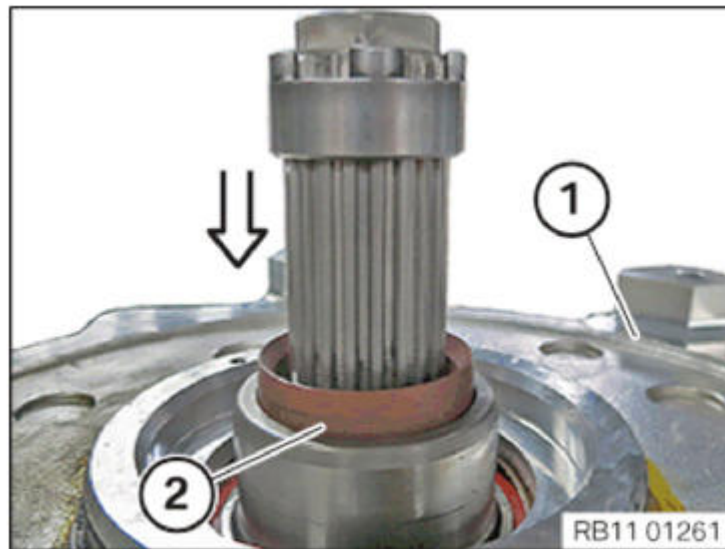


**Fig. 35: Applying Grease On Alternator O-Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

Push sealing sleeve (2) and clamping ring down in the alternator (1).

Insert torsion splined shaft in direction of arrow.

During joining, position in such a way that the 5 crowns of the clamping sleeve match the 5 alternator shaft pockets.

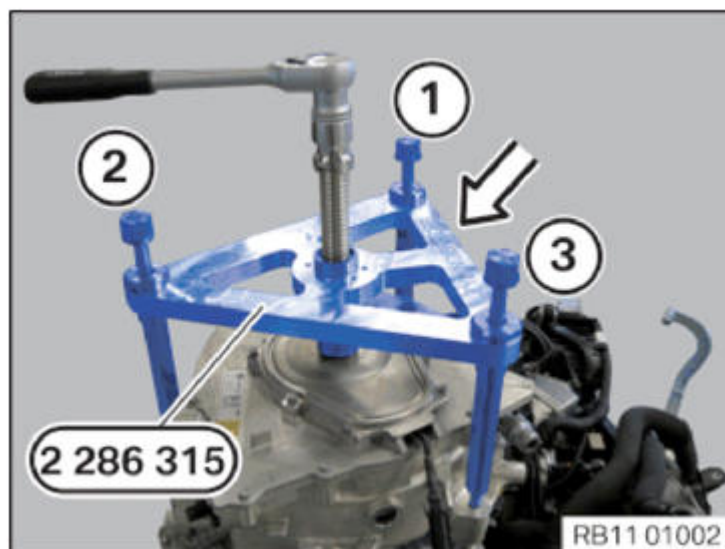


**Fig. 36: Installing Sealing Sleeve And Clamping Ring Into Alternator**  
Courtesy of BMW OF NORTH AMERICA, INC.

Mount range extender electrical machine and torsion splined shaft.

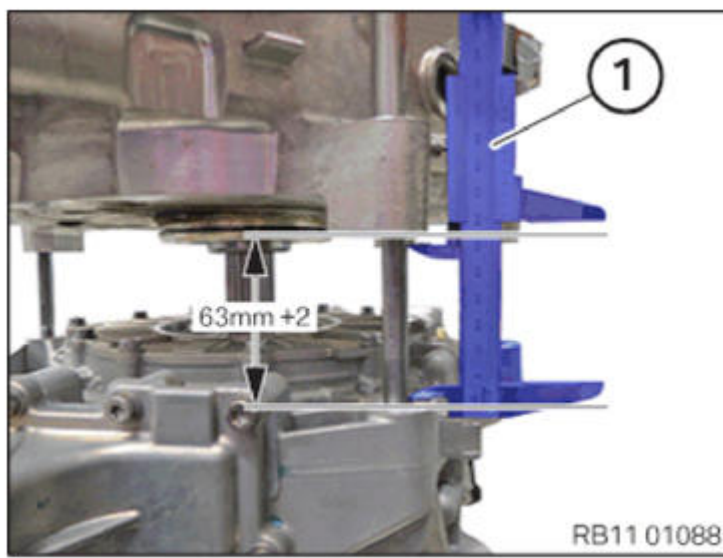
Position the range extender electrical machine during joining in such a way that the 5 crowns of the clamping sleeve match the 5 crankshaft pockets.

Align special tool [2 286 315](#) with notch on housing facing cylinder head and screw in at crankcase until hand-tight.



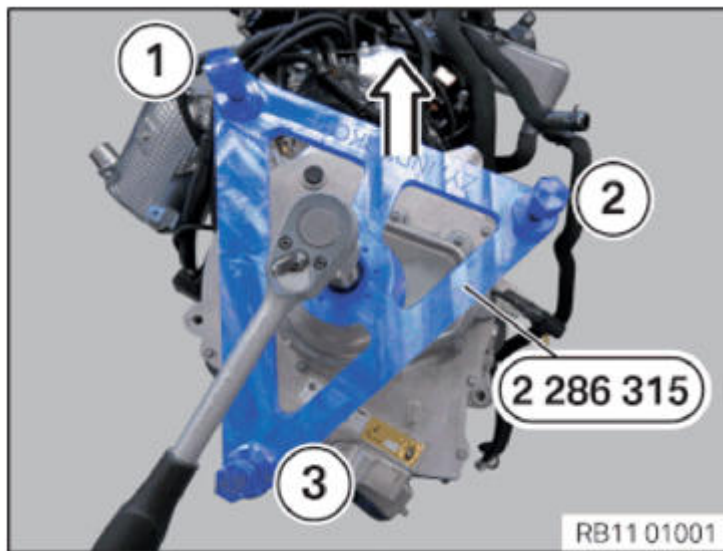
**Fig. 37: Aligning Special Tool (2 286 315) With Housing Facing Cylinder Head Notch**  
Courtesy of BMW OF NORTH AMERICA, INC.

Measure distance between both housing halves by means of a caliper gauge (1) 63 mm and re-align the range extender electrical machine if necessary.



**Fig. 38: Checking Housing Halves Distance Using Caliper Gauge**  
Courtesy of BMW OF NORTH AMERICA, INC.

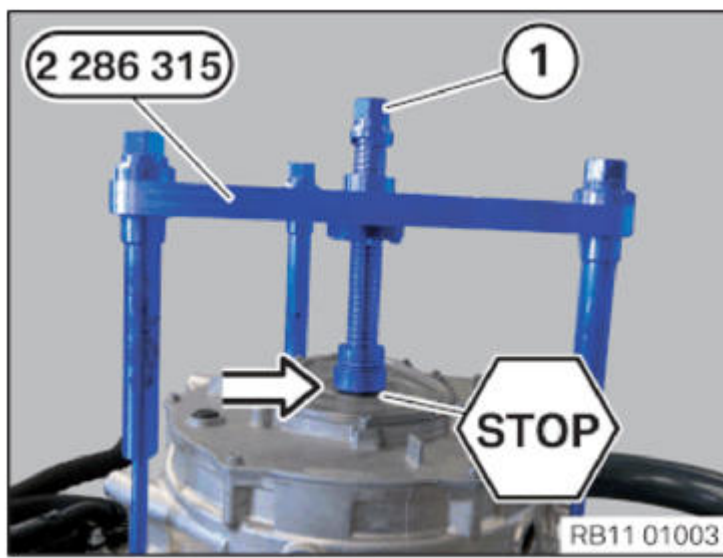
Screw in mounting bolts 1, 2 and 3 on engine block with 15 Nm.



**Fig. 39: Tightening Engine Block Mounting Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage! On range extender electrical machine.

Join engine and range extender electrical machine with a torque of 12.5 Nm by means of special tool [2 286 315](#) to a distance of 5 mm .



**Fig. 40: Joining Engine And Range Extender Electrical Machine Using Special Tool (2 286 315)**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Connect range extender electrical machine to spindle (1) with special tool [2 286 315](#) with **MAXIMUM 7.5 Nm** , leaving no gap.

Insert 3 x screws (1) and tighten with 10 Nm.

Remove special tool [22 86 315](#) .

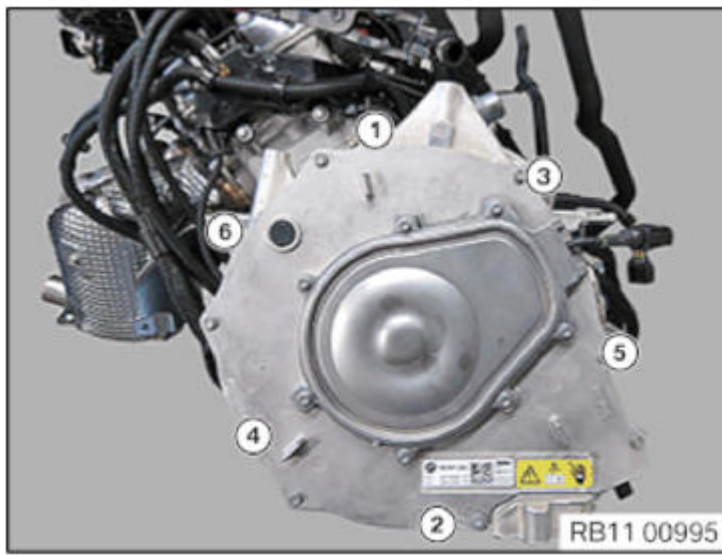


**Fig. 41: Inserting Torsion Splined Shaft Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tighten screws in sequence (1 to 6).

Tightening torque: [12 35 9AZ](#) .





**Fig. 42: Identifying Torsion Splined Shaft Screw Releasing Sequence**  
Courtesy of BMW OF NORTH AMERICA, INC.

Assemble engine.

Reset adaptation values.

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**ENGINE****Exhaust System - Tightening Torques - Only I3 Models With Range Extender - i3****CATALYTIC CONVERTER****18 30 CATALYTIC CONVERTER****TIGHTENING TORQUE SPECIFICATION - CATALYTIC CONVERTER**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Catalytic converter to exhaust manifold	I01 REX	V-band clamp	Renew V-clamp.	13 Nm
2AZ Catalytic converter to holder	I01 REX	M8	Replace screws.	19 Nm
3AZ Exhaust system to catalytic converter	I01 REX	Ribbon cable clamp	If necessary, replace clamp.	33 Nm
4AZ Catalytic converter to bracket on transmission	I01 REX	M8	Replace nut.	19 Nm
5AZ Heat shield to exhaust system	I01 REX	Â	Â	3 Nm
6AZ Heat shield to exhaust system	I01 REX	M6	Â	8 Nm
7AZ Holder, catalytic converter to transmission	I01 REX	M8	Â	19 Nm
8AZ Exhaust manifold to cylinder head	I01 REX	Â	Â	14 Nm
9AZ Heat shield to catalytic converter	I01 REX	M6	Â	10 Nm

**EXHAUST SYSTEM SUSPENSION****18 20 EXHAUST SYSTEM SUSPENSION****TIGHTENING TORQUE SPECIFICATION - EXHAUST SYSTEM SUSPENSION**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Holder, body side	I01 REX	M8	Â	13 Nm
2AZ Exhaust system to holder/side member	I01 REX	M8	Â	13 Nm
3AZ Heat shield to cross bridge	I01 REX	Â	Â	6 Nm

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## ENGINE

### Fuel Supply System - Repair - Only I3 Models With Range Extender - i3

## GENERAL INFORMATION

### 16 00 005 DRAWING OFF AND TOPPING UP FUEL FROM/IN THE FUEL TANK (I01 RANGE EXTENDER)

#### Special tools required:

- 16 1 080

#### **WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

Observe country-specific safety regulations.

Ensure adequate ventilation in the workbay!

**IMPORTANT:** The electric fuel pump must not operate without fuel! After completing repairs but before starting the engine for the first time, fill the fuel tank with min. 5 l fuel through the fuel filler pipe.  
Do not damage non-return valve when pulling out suction hose.

#### Drawing off fuel:

**NOTE:** Fuel can be drawn out of left and right sides of tank through fuel filler neck, leaving only a small residue. The residual amount is drawn off via the sensor opening.

Insert special tool 16 1 080 into fuel filler neck.

Slide suction hose of extractor unit through special tool 16 1 080 into the fuel filler pipe, turning in the process if necessary.

**Insertion length approx. 135 cm.**

Draw off fuel with extractor unit as far as possible.



**Fig. 1: Inserting Special Tool (16 1 080) Into Fuel Filler Neck**  
Courtesy of BMW OF NORTH AMERICA, INC.

Follow drawing off of fuel on fuel gauge in instrument cluster.

**Drawing off residual fuel quantity:**

Drawing off residual fuel amount is not included in the time value of this operation.

**IMPORTANT:** Ensure passenger compartment is adequately ventilated.  
Catch dripping fuel in a suitable container.

Remove **FLANGE COVER**.

Draw off residual fuel quantity through sensor openings.

**Fuel filling:**

Insert special tool 16 1 080 into fuel filler neck.

Slide suction hose of extractor unit approx. 40 cm into fuel filler pipe.

Fill fuel from suction extractor unit.



**Fig. 2: Inserting Special Tool (16 1 080) Into Fuel Filler Neck**  
Courtesy of BMW OF NORTH AMERICA, INC.

**FUEL TANK**

**16 11 060 REMOVING AND INSTALLING/REPLACING FUEL FILLER PIPE (I01 RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**Recycling**

Fuel escapes when fuel lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

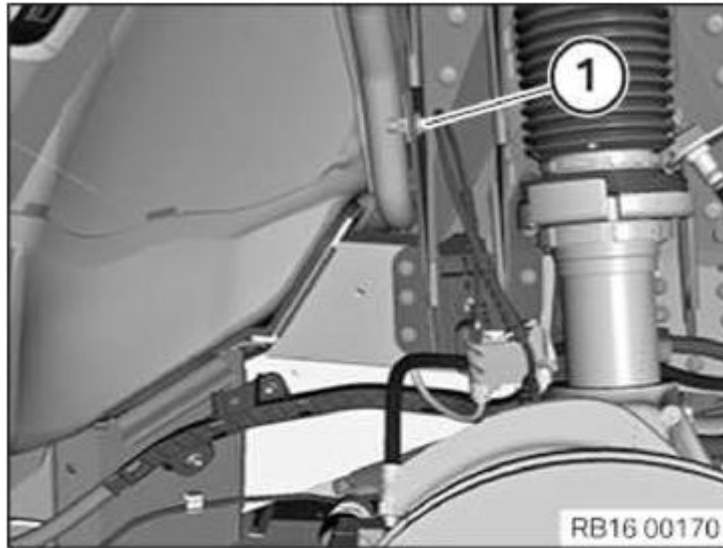
**IMPORTANT:** Ensure adequate ventilation in the workbay!

Avoid skin contact (wear gloves)!

### Necessary preliminary tasks:

- Remove **LUGGAGE COMPARTMENT WELL** at front.
- Remove PROTECTION COVER FOR FUEL FILLER NECK .
- Release SIDE PANEL AT FRONT RIGHT along A-pillar.
- Open fuel filler cap.

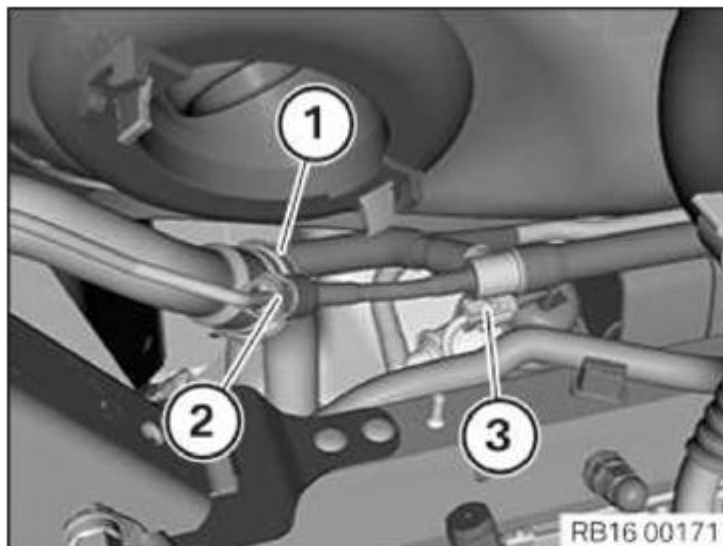
Release screw (1) on fuel filler pipe.



**Fig. 3: Identifying Fuel Filler Pipe Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock retaining clip (1) and loosen fuel filler pipe from fuel tank.

Unlock and disconnect snap fastener (2).



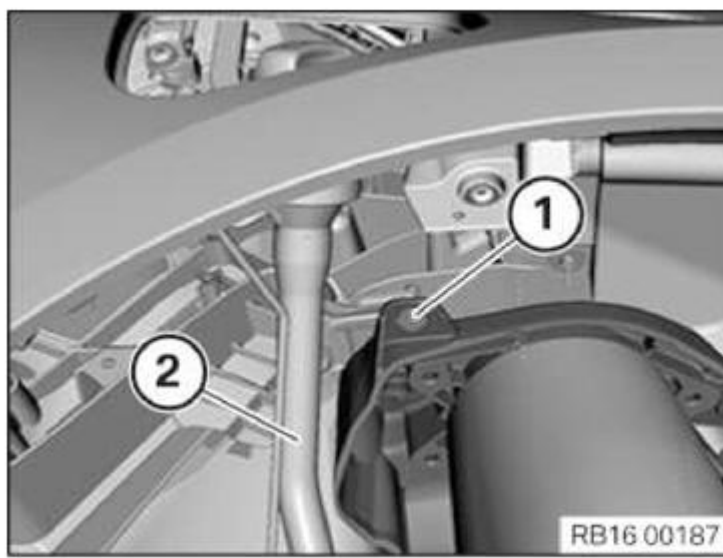
**Fig. 4: Identifying Fuel Filler Pipe Retaining Clip And Snap Fastener**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

*Installation note:*

Tightening torque: **16 12 2AZ** .

**IMPORTANT:** To prevent damage to the side panel, tape off side panel along wheel arch.



**Fig. 5: Identifying Fuel Filler Pipe And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull side panel slightly outward at bottom and feed out fuel filler pipe (2).

### **16 11 030 REMOVING AND INSTALLING/REPLACING FUEL TANK (I01 US VERSION RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

#### **Recycling**

Fuel escapes when fuel lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

Ensure adequate ventilation in the workbay!

Avoid skin contact (wear gloves)!

**IMPORTANT:** After installation of fuel tank/prior to first engine start-up:

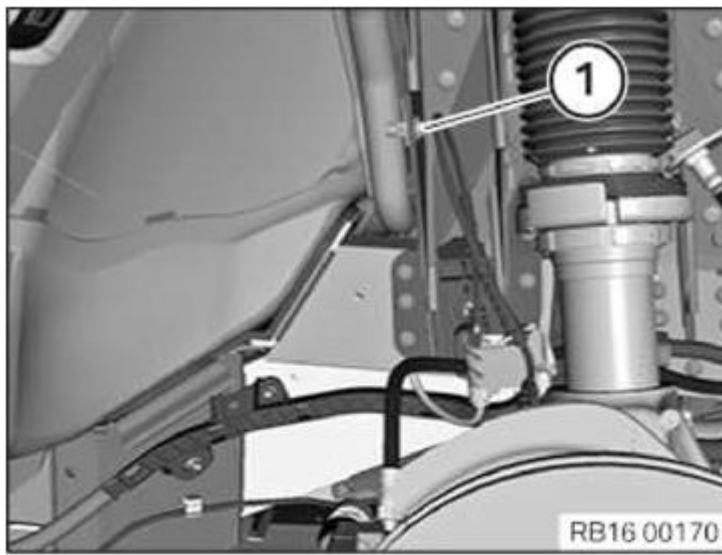
- Fill fuel tank with at least 5 liters of fuel.

#### **Necessary preliminary tasks:**

- Extract **FUEL FROM FUEL TANK**
- Remove **STIFFENING PLATE**
- Remove front **LUGGAGE COMPARTMENT WELL** .
- Remove front right **WHEEL ARCH PANEL** .

Release screw (1) on fuel filler pipe.



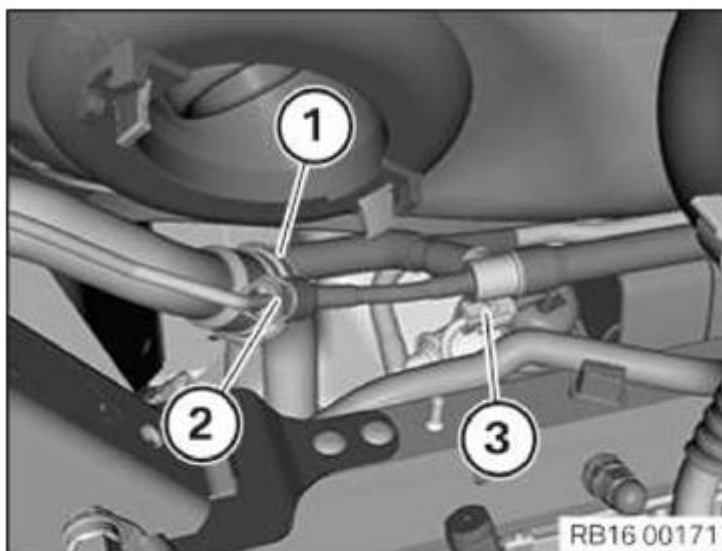


**Fig. 6: Identifying Fuel Filler Pipe Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock retaining clip (1) and loosen fuel filler pipe from fuel tank.

Unlock and disconnect snap fastener (2).

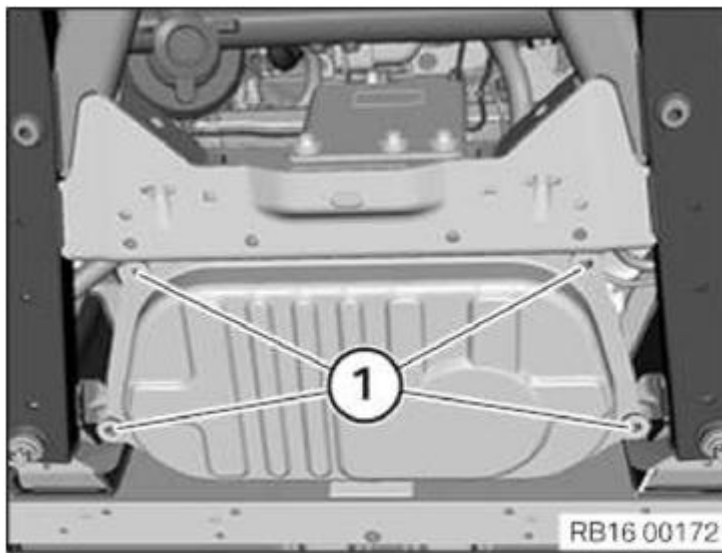
Disconnect plug connection (3) on fuel tank non-return valve.



**Fig. 7: Identifying Fuel Filler Pipe Retaining Clip And Snap Fastener**  
Courtesy of BMW OF NORTH AMERICA, INC.

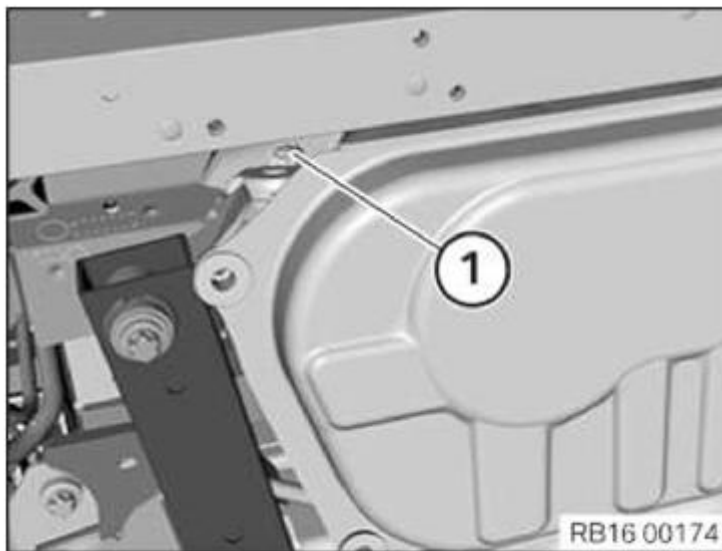
IMPORTANT: Support fuel tank with workshop jack across a large area!

Release screws (1) and lower fuel tank approx. 10 cm.



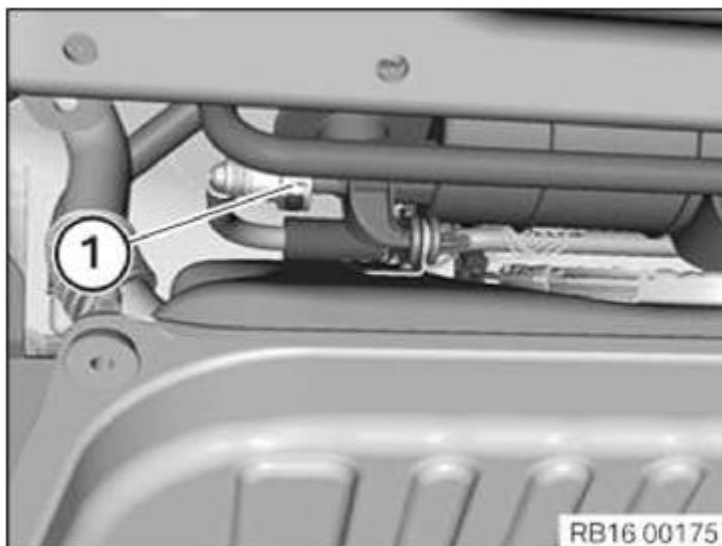
**Fig. 8: Identifying Lower Fuel Tank Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1).



**Fig. 9: Identifying Fuel Tank Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

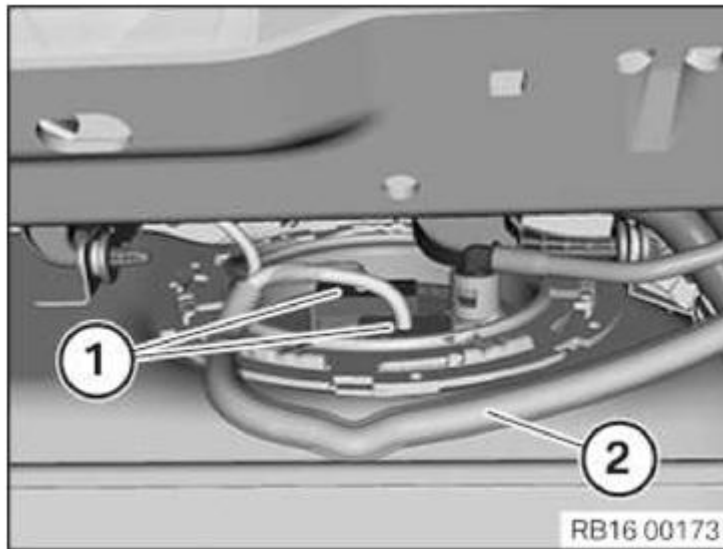
Unlock and disconnect snap fastener (1).



**Fig. 10: Identifying Fuel Tank Snap Fastener**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1).

Detach wiring harness from brackets (2).



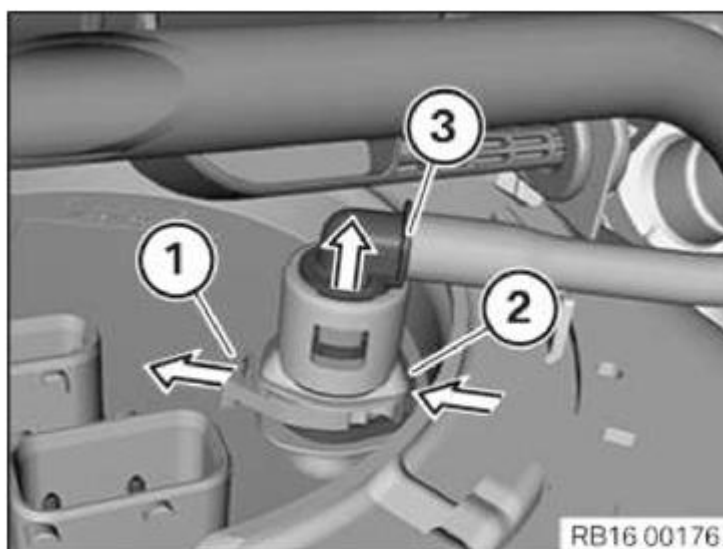
**Fig. 11: Identifying Fuel Tank Plug Connection And Wiring Harness Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock locking tab (1) in direction of arrow.

Operate lock (2) in direction of arrow and pull off upwards from fuel delivery line (3).

Lower and remove fuel tank.

**IMPORTANT:** Make sure the snap fastener is correctly locked!  
Check locks for damage and replace if necessary!



**Fig. 12: Removing Fuel Delivery Line From Fuel Tank**  
Courtesy of BMW OF NORTH AMERICA, INC.

The following components must be remounted when the fuel tank is replaced:

- **CARBON CANISTER WITH DUST FILTER.**
- Tank ventilation line.

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

## Recycling

Fuel escapes when fuel lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

Ensure adequate ventilation in the workbay!

Avoid skin contact (wear gloves)!

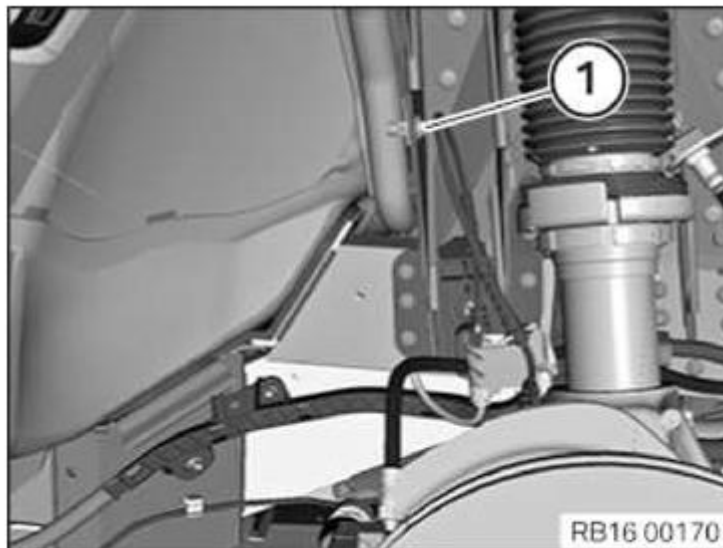
IMPORTANT: After installation of fuel tank/prior to first engine start-up:

- Fill fuel tank with at least 5 liters of fuel.

## Necessary preliminary tasks:

- Extract [FUEL FROM FUEL TANK](#)
- Remove [STIFFENING PLATE](#)
- Remove front [LUGGAGE COMPARTMENT WELL](#) .
- Remove front right [WHEEL ARCH PANEL](#) .

Release screw (1) on fuel filler pipe.

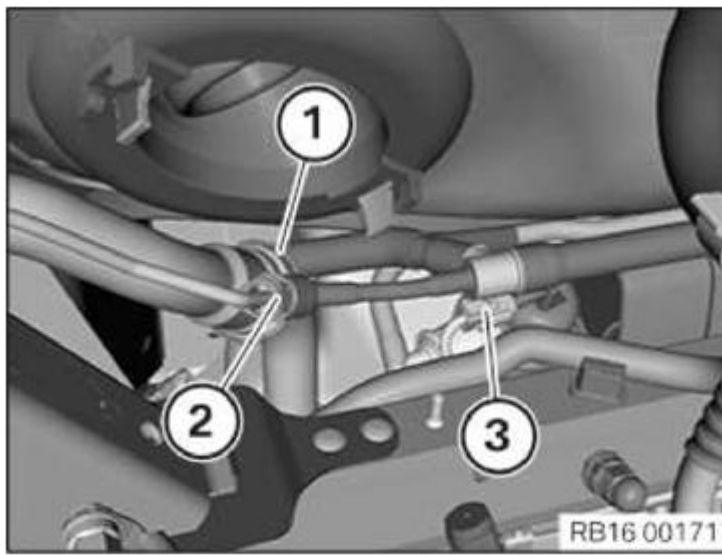


**Fig. 13: Identifying Fuel Filler Pipe Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock retaining clip (1) and loosen fuel filler pipe from fuel tank.

Unlock and disconnect snap fastener (2).

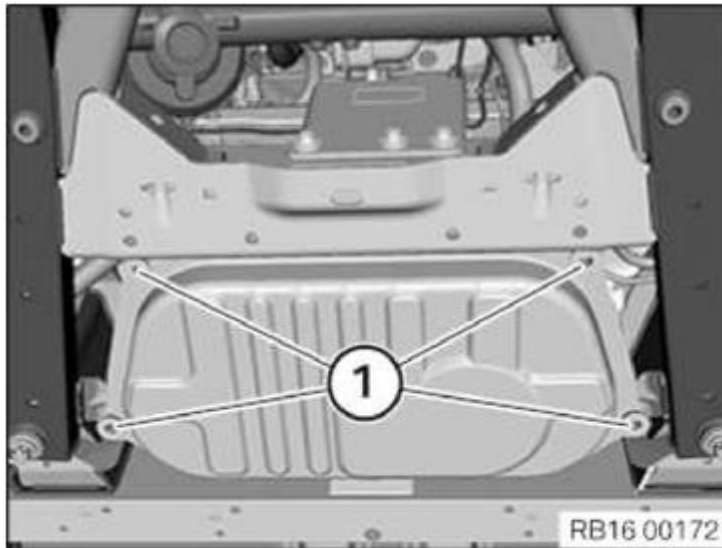
Disconnect plug connection (3) on fuel tank non-return valve.



**Fig. 14: Identifying Fuel Filler Pipe Retaining Clip And Snap Fastener**  
Courtesy of BMW OF NORTH AMERICA, INC.

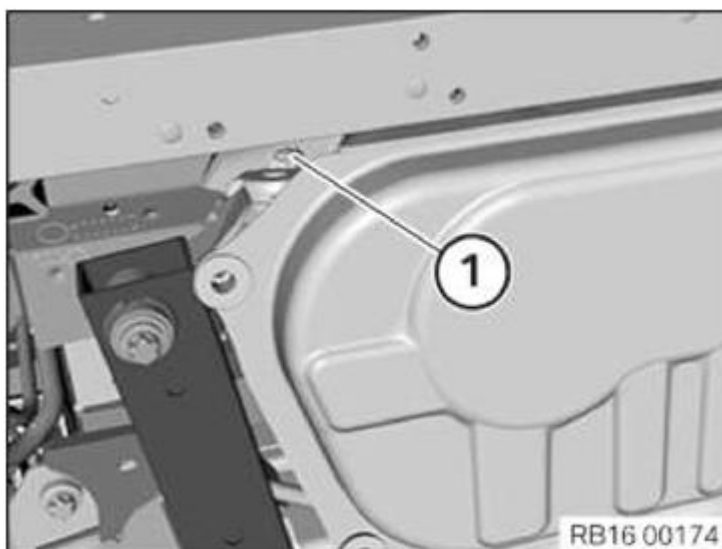
IMPORTANT: Support fuel tank with workshop jack across a large area!

Release screws (1) and lower fuel tank approx. 10 cm.



**Fig. 15: Identifying Lower Fuel Tank Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

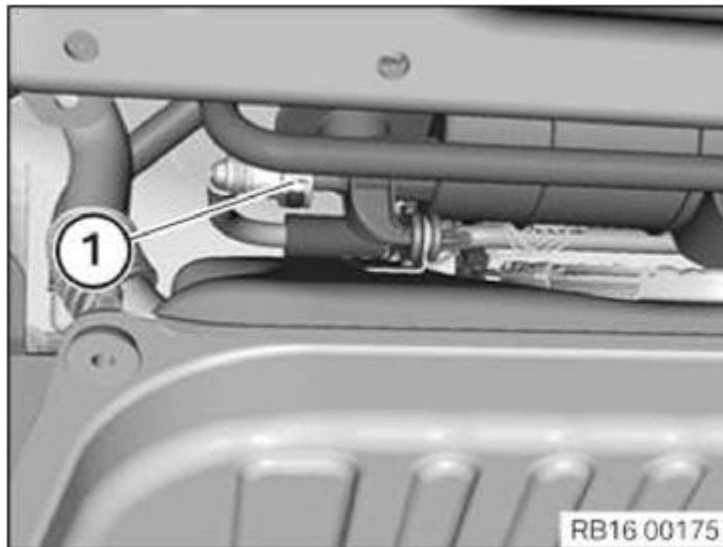
Disconnect plug connection (1).





**Fig. 16: Identifying Fuel Tank Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

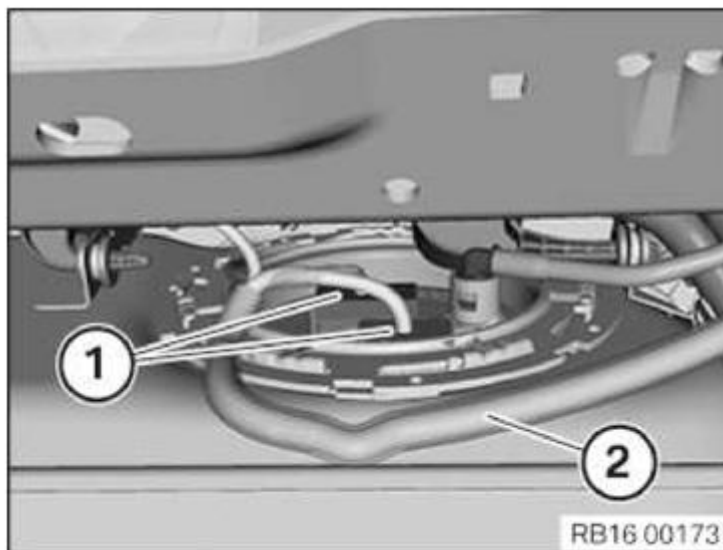
Unlock and disconnect snap fastener (1).



**Fig. 17: Identifying Fuel Tank Snap Fastener**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1).

Detach wiring harness from brackets (2).



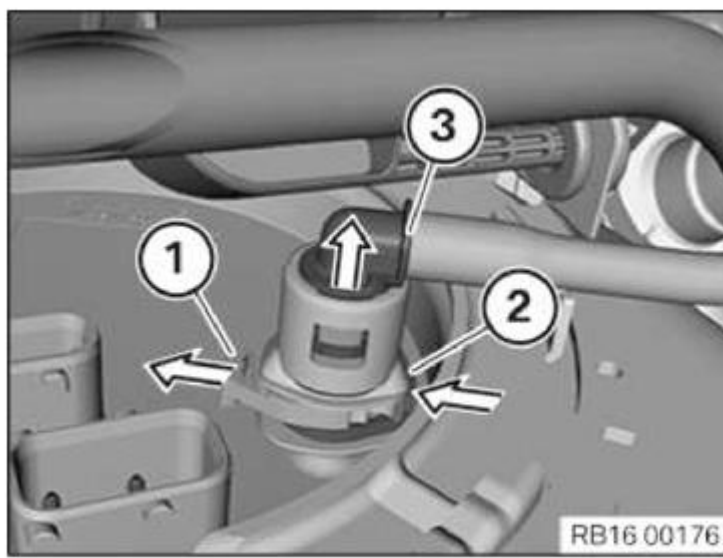
**Fig. 18: Identifying Fuel Tank Plug Connection And Wiring Harness Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock locking tab (1) in direction of arrow.

Operate lock (2) in direction of arrow and pull off upwards from fuel delivery line (3).

Lower and remove fuel tank.

**IMPORTANT:** Make sure the snap fastener is correctly locked!  
Check locks for damage and replace if necessary!



**Fig. 19: Removing Fuel Delivery Line From Fuel Tank**  
Courtesy of BMW OF NORTH AMERICA, INC.

The following components must be remounted when the fuel tank is replaced:

- **CARBON CANISTER.**
- Tank ventilation line.

### **16 11 895 REMOVING AND INSTALLING/REPLACING PRESSURE-TEMPERATURE SENSOR (I01 RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

#### **Recycling**

Fuel escapes when fuel lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

**IMPORTANT:** Ensure adequate ventilation in the workbay!  
Avoid skin contact (wear gloves)!

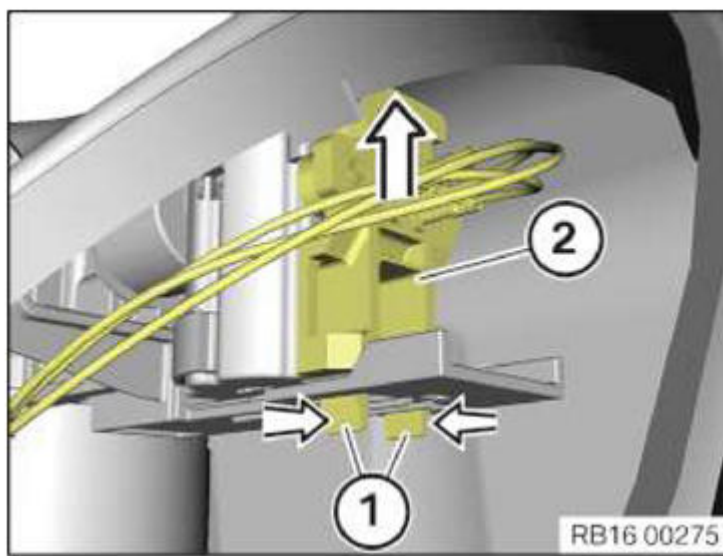
#### **Necessary preliminary tasks:**

- Remove **DELIVERY UNIT.**

#### **Removal:**

Squeeze retaining tabs (1) together in direction of arrow.

Remove the pressure-temperature sensor upwards in the direction of the arrow.

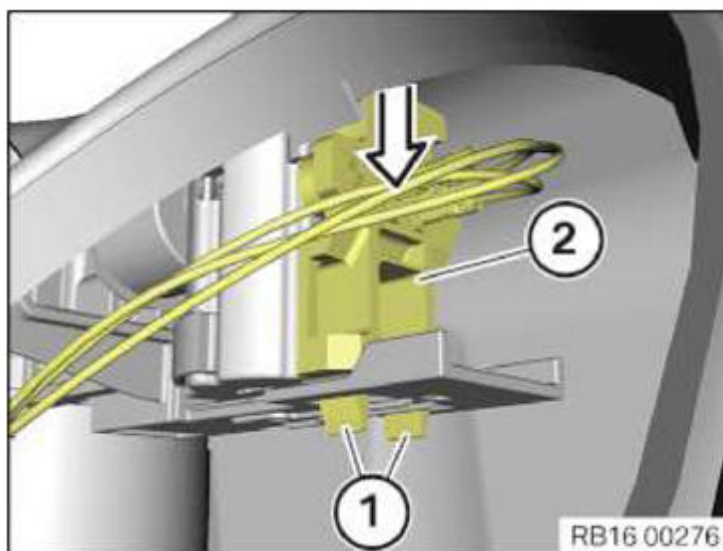


**Fig. 20: Removing Pressure Temperature Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

Install the pressure-temperature sensor from upwards in the direction of the arrow.

IMPORTANT: Make sure retaining tabs (1) are correctly latched.



**Fig. 21: Installing Pressure Temperature Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Install **DELIVERY UNIT**.
- Carry out the adjustment of the pressure-temperature sensor.

**FUEL LEVEL SENSOR AND CARBON CANISTER**

**16 12 010 REMOVING AND INSTALLING/REPLACING CARBON CANISTER (I01 US VERSION, RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**Necessary preliminary tasks:**

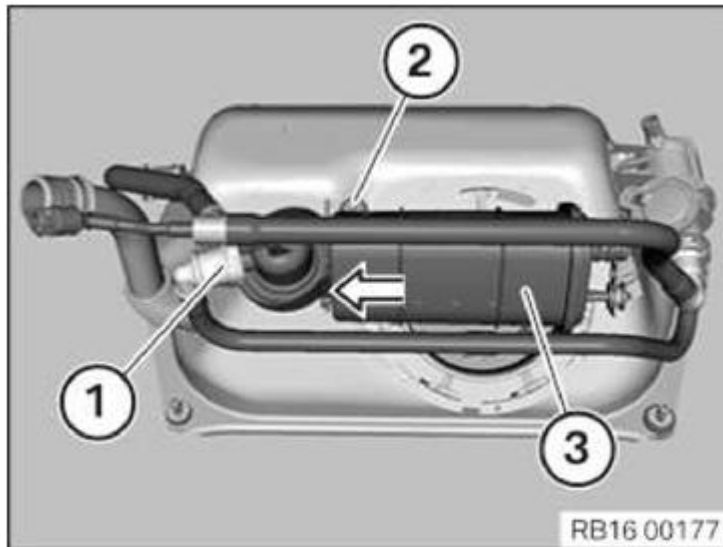
- Remove **FUEL TANK**.
- Remove **DUST FILTER**.

Unlock and disconnect snap fastener (1).

Release screw (2) and remove carbon canister in direction of arrow.

*Installation note:*

Tightening torque: **16 13 1AZ** .



**Fig. 22: Removing Carbon Canister**

Courtesy of BMW OF NORTH AMERICA, INC.

### **16 12 010 REMOVING AND INSTALLING/REPLACING CARBON CANISTER (I01 RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**Necessary preliminary tasks:**

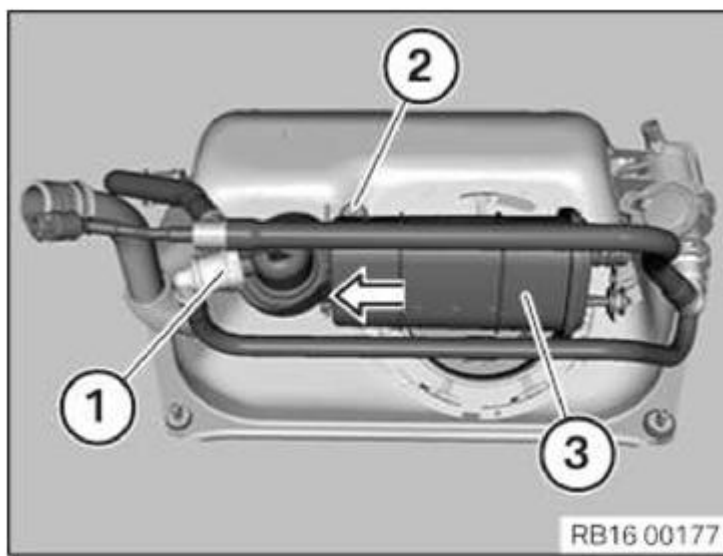
- Remove **FUEL TANK**.

Unlock and disconnect snap fastener (1).

Release screw (2) and remove carbon canister in direction of arrow.

*Installation note:*

Tightening torque: **16 13 1AZ** .



**Fig. 23: Removing Carbon Canister**

Courtesy of BMW OF NORTH AMERICA, INC.

**16 12 001 REMOVING AND INSTALLING/REPLACING SENSOR FOR FUEL LEVEL SENSOR (I01 RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

Necessary preliminary tasks:

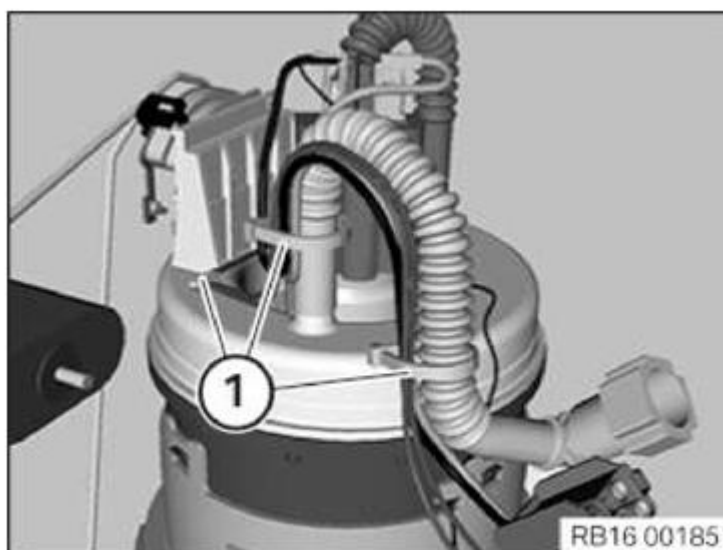
- Remove **DELIVERY UNIT**.

Release cable from brackets (1).

Disconnect connector housing.

*Installation note:*

Replace cable straps.



**Fig. 24: Identifying Fuel Level Sensor Cable Brackets**

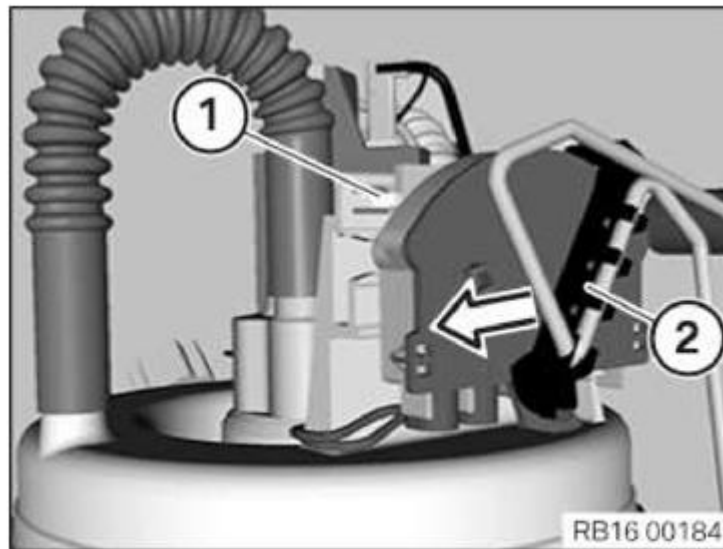
Courtesy of BMW OF NORTH AMERICA, INC.

Press locking tab (1) and remove fuel level sensor (2) in direction of arrow.

*Installation note:*



Make sure the fuel level sensor latches correctly.



**Fig. 25: Removing Fuel Level Sensor**

Courtesy of BMW OF NORTH AMERICA, INC.

## FUEL TANK ISOLATION VALVE

### 16 13 100 REMOVING AND INSTALLING FUEL TANK ISOLATION VALVE (I01 RANGE EXTENDER)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

#### Necessary preliminary tasks:

- Remove fuel tank. See [REPLACING FUEL TANK \(I01 US VERSION RANGE EXTENDER\)](#) or [REPLACING FUEL TANK \(I01 RANGE EXTENDER\)](#).

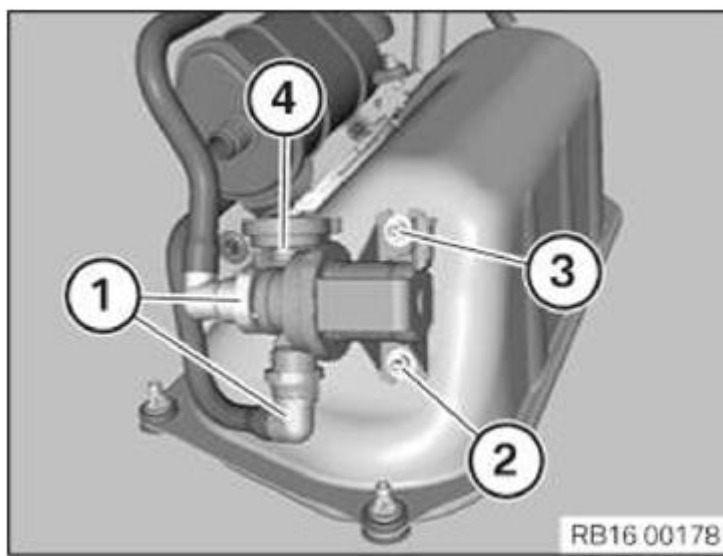
Unlock and disconnect snap fasteners (1).

Slacken nut (2).

Slacken nut (3) and remove fuel tank non-return valve (4).

*Installation note:*

Tightening torque: [16 13 2AZ](#) .



**Fig. 26: Identifying Fuel Tank Non Return Valve, Nuts And Snap Fasteners**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **FUEL PUMP**

### **16 14 090 REMOVING AND INSTALLING/REPLACING DELIVERY UNIT (I01 RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

### **Recycling**

Fuel escapes when fuel lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

Ensure adequate ventilation in the workbay!

Avoid skin contact (wear gloves)!

**IMPORTANT:** Ensure absolute cleanliness when performing repair work on the open fuel system. Dirt contamination in the fuel tank may impair driving or may even result in vehicle breakdown.

### **Necessary preliminary tasks:**

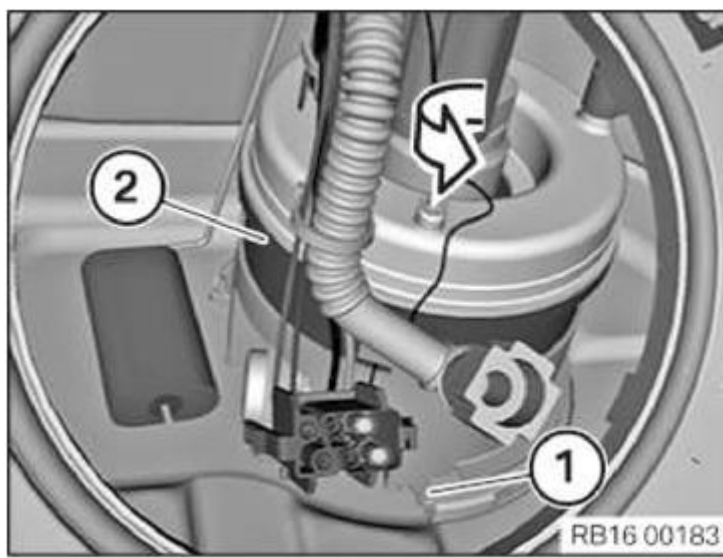
- Remove **FLANGE COVER**.

Press locking tab (1) downwards and turn delivery unit (2) out of bracket in direction of arrow.

Remove delivery unit through sensor opening.

*Installation note:*

Ensure bracket is correctly placed and locked!



**Fig. 27: Turning Delivery Unit Out Of Bracket**  
Courtesy of BMW OF NORTH AMERICA, INC.

**16 14 060 REMOVING AND INSTALLING/REPLACING DUST FILTER (I01 US VERSION, RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

Necessary preliminary tasks:

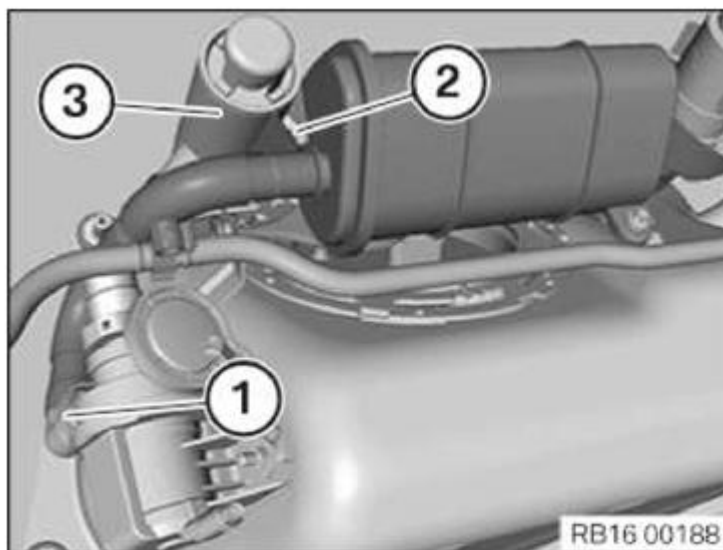
- Remove **FUEL TANK**.

Unlock and disconnect snap fastener (1).

Release screw (2) and remove dust filter (3).

*Installation note:*

Tightening torque: **16 13 3AZ** .



**Fig. 28: Identifying Dust Filter, Snap Fastener And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

**16 14 010 REMOVING AND INSTALLING/REPLACING ELECTRIC FUEL PUMP (I01 RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

**NOTE:** The fuel pump can not be replaced separately.  
The entire delivery unit must be replaced.  
This operation is described in: [REMOVE AND INSTALL THE DELIVERY UNIT](#)

## 16 14 200 REMOVING AND INSTALLING/REPLACING FLANGE COVER(I01 RANGE EXTENDER)

Special tools required:

- 16 1 190
- 33 5 070

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

### Recycling

Fuel escapes when fuel lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

Ensure adequate ventilation in the workbay!

Avoid skin contact (wear gloves)!

**IMPORTANT:** Ensure absolute cleanliness when performing repair work on the open fuel system. Dirt contamination in the fuel tank may impair driving or may even result in vehicle breakdown.

Necessary preliminary tasks:

- Remove fuel tank. See [REPLACING FUEL TANK \(I01 US VERSION RANGE EXTENDER\)](#) or [REPLACING FUEL TANK \(I01 RANGE EXTENDER\)](#).
- Remove carbon canister. See [REPLACING CARBON CANISTER \(I01 US VERSION, RANGE EXTENDER\)](#) or [REPLACING CARBON CANISTER \(I01 RANGE EXTENDER\)](#).

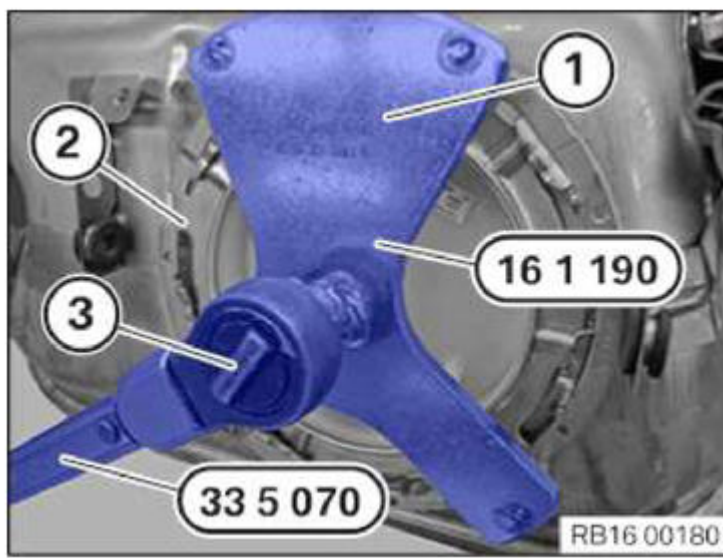
Fit special tool 16 1 190 with wide crank web (1) towards top onto locking ring (2).

Connect special tool 33 5 070 with reversible ratchet head 1/2" (3) and place on special tool 16 1 190.

Release locking ring (2) in counterclockwise direction.

*Installation note:*

Make sure that latch mechanism of locking ring for fuel tank is correctly engaged!

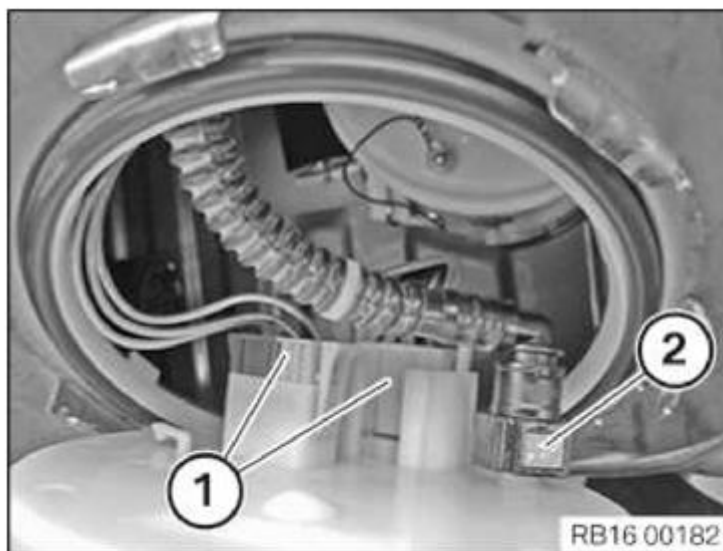


**Fig. 29: Installing Special Tool (16 1 190) With Wide Crank Web Onto Flange Cover Locking Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lift off flange cover upwards.

Disconnect plug connection (1).

Unlock and detach fuel line (2).



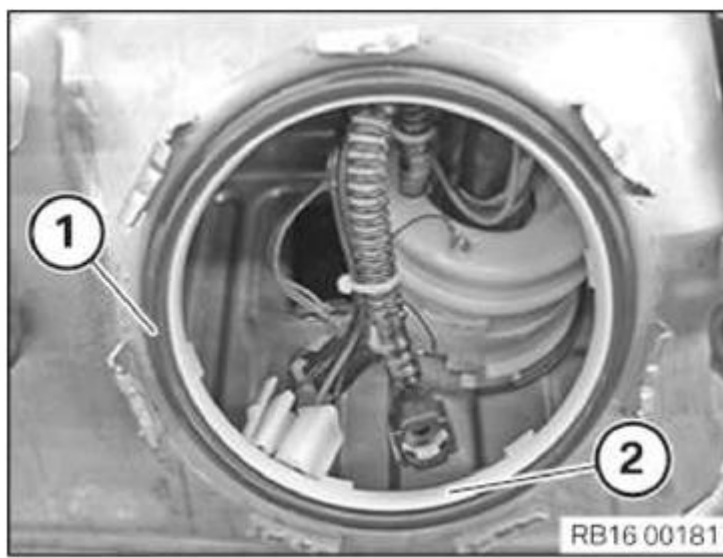
**Fig. 30: Identifying Fuel Line And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

After every disassembly of flange cover, the flange cover repair kit must be installed.

Replace gasket (1) and support ring (2).





**Fig. 31: Identifying Flange Cover Gasket And Support Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

**16 14 750 REMOVING AND INSTALLING/REPLACING HYBRID PRESSURE REFUELLING ELECTRONIC CONTROL UNIT (I01 RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

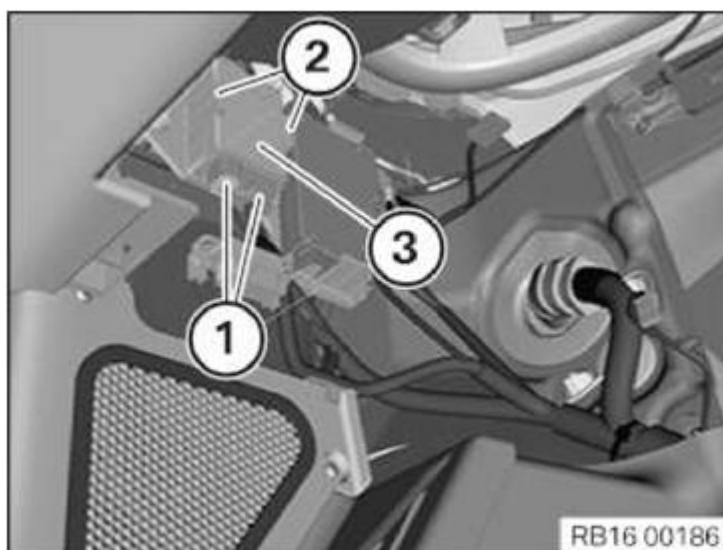
IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION)**.

**Necessary preliminary tasks:**

- Remove **PEDAL MECHANISM TRIM PANEL**.

Disconnect plug connection (1).

Push retaining tabs (2) apart and remove hybrid pressure refuelling electronic control unit (3).



**Fig. 32: Identifying Hybrid Pressure Refuelling Electronic Control Unit, Retaining Tabs And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

- Carry out programming/encoding.
-

## ENGINE

### Fuel Supply System - Special Tools - Only I3 Models With Range Extender - i3

## FUEL SUPPLY

### 2353954 LEAK DETECTOR MP

**NOTE:** "BMW Smoke diagnosis tester" leak detector for the tightness diagnosis of closed systems such as fuel tanks, intake air passages, etc. (1) "BMW Smoke diagnosis tester", (2) "UltraTracer", (3) cylinder with pressure reducer, (4) diverse adapter, (5) coupling kit for compressed air connection, (6) torch with white and UV light including special glasses, (7) power pack note: (2) "UltraTracer".

#### Storage Location

Alternatively

#### SI number

02 11 13 (958)



**Fig. 1: Identifying Leak Detector (2353954).**  
Courtesy of BMW OF NORTH AMERICA, INC.

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**ENGINE****Fuel Supply System - Tightening Torques - Only I3 Models With Range Extender - i3****FUEL DELIVERY****16 12 FUEL DELIVERY****TIGHTENING TORQUE SPECIFICATION - FUEL DELIVERY**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Hose clamps 42-48 mm dia.	I01/I12	Â	Â	4 Nm
2AZ Fuel filler pipe to body	I01	M6	Hexagon screw	8 Nm
3AZ Fuel filler pipe to body	I12	M6	Hexagon screw	8 Nm

**FUEL TANK AND MOUNTING PARTS****16 11 FUEL TANK AND MOUNTING PARTS****TIGHTENING TORQUE SPECIFICATION - FUEL TANK AND MOUNTING PARTS**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Fuel tank to front axle support	I01	M6x35	Replace microencapsulated screws.	8 Nm
2AZ Fuel tank to body	I12	M8	Replace microencapsulated screws.	19 Nm
3AZ Ground strap to fuel tank	I12	M6	Renew nut.	3 Nm
4AZ Ground strap on rear axle module	I12	M10	Renew nut.	17 Nm

**TANK VENTILATION SYSTEM****16 13 TANK VENTILATION SYSTEM****TIGHTENING TORQUE SPECIFICATION - TANK VENTILATION SYSTEM**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Carbon canister to holder	I01/I12	M6	Â	8 Nm
2AZ Fuel tank non-return valve to fuel tank	I01/I12	M6	Â	8 Nm
3AZ Dust filter to carbon canister	I01	Â	Â	2.5 Nm
4AZ Tank ventilation line retaining plate to rear axle module	I12	M6x16	Â	8 Nm

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## ENGINE

### Fuel System - Repair - Only I3 Models With Range Extender - i3

## FUEL DELIVERY PRESSURE

### 13 31 029 CHECKING FUEL DELIVERY PRESSURE (I01)

#### Special tools required:

- 13 5 270
- 11 4 310
- 11 5 364
- 13 3 060

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

IMPORTANT: Lines are under pressure!

Wear safety goggles and gloves.

Fuel can emerge spontaneously at high velocity when the fuel line is released!

#### Recycling:

Catch and dispose of escaping fuel with auxiliary materials.

Observe country-specific waste disposal regulations.

*Necessary preliminary tasks:*

- Connect BMW diagnosis system
- Remove [WHEEL ARCH COVER](#) at the rear left.

Unlock orange lock (1) toward the top.

Unlock black lock (2) toward the top.

Disconnect fuel delivery line (3).

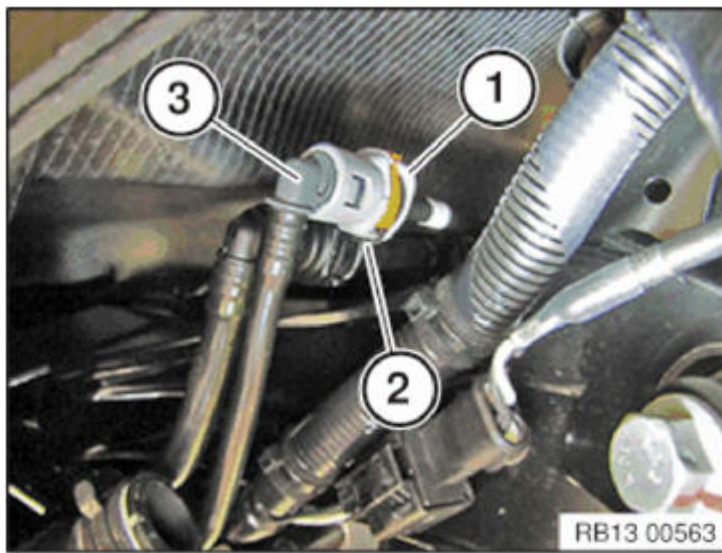
Catch and dispose of escaping fuel in a suitable container.

*Installation note:*

Ensure the fuel delivery line is installed correctly (no chafing points).

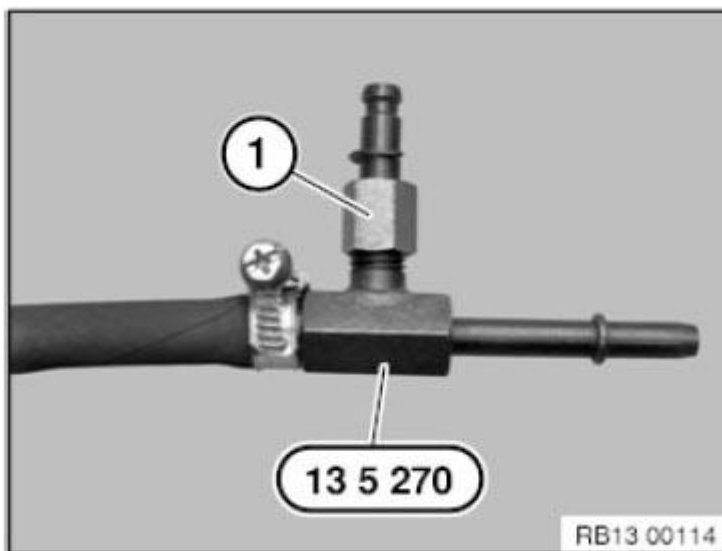
Make sure retaining tabs latch correctly.





**Fig. 1: Identifying Fuel Delivery Line, Orange And Black Lock**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unscrew adapter (1) from special tool 13 5 270.



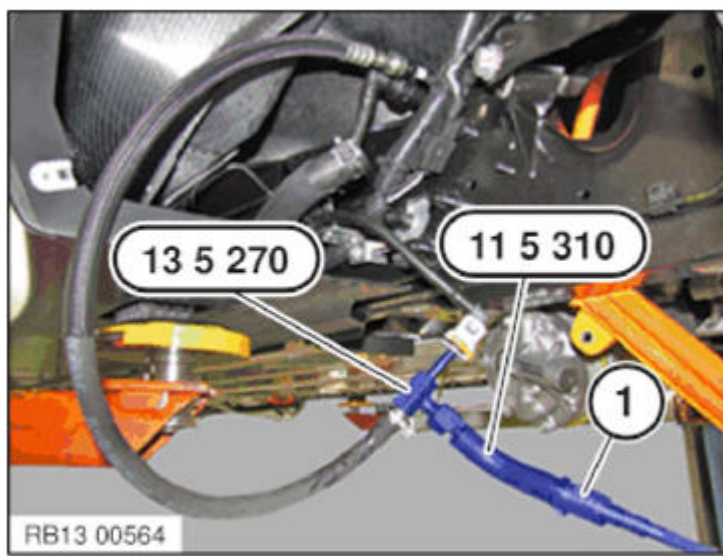
**Fig. 2: Identifying Adapter And Special Tool (13 5 270)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert special tool 13 5 270 into disconnected fuel line.

Screw onto special tool 13 5 270, the special tool 11 4 310.

Screw IMIB 100 bar pressure sensor (1) on the special tool 11 4 310.

**NOTE:** As an alternative to the 100 bar IMIB pressure sensor (1), the 25 bar pressure sensor can also be used. For this, screw on special tool 11 5 364 instead of special tool 11 4 310 onto special tool 13 5 270. Or directly screw the pressure manometer from the set of special tools 13 3 060 onto the special tool 13 5 270.



**Fig. 3: Installing Special Tool (13 5 270) Onto Special Tool (11 4 310)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Establish fuel delivery pressure. Read off fuel delivery pressure on IMIB and compare with values in diagnosis system.

Assemble engine.

Check fuel system for tightness.

## **FUEL INJECTION PIPE**

### **13 53 243 REMOVING AND INSTALLING/REPLACING FUEL INJECTION PIPE (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for handling electric vehicles.

IMPORTANT: Wear safety goggles and protective gloves when releasing the fuel line.

### **Recycling**

Fuel escapes when fuel line is detached. Catch and dispose of escaping fuel.

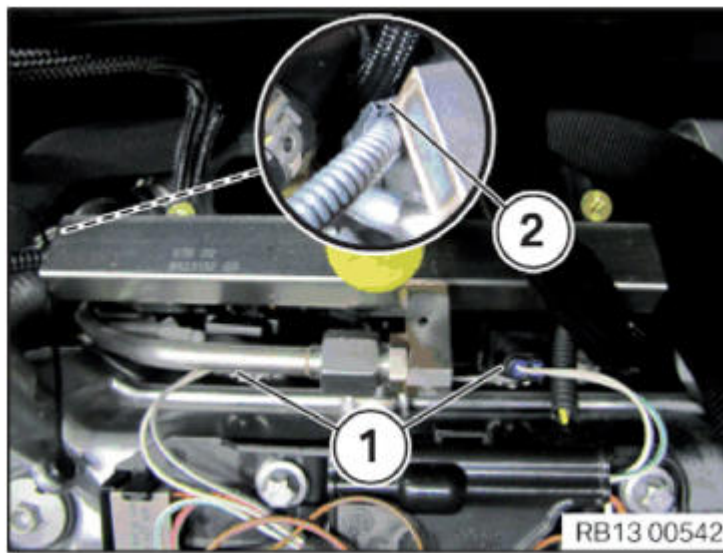
Observe country-specific waste disposal regulations.

### **Necessary preliminary tasks:**

- Remove **INTAKE PLENUM** .

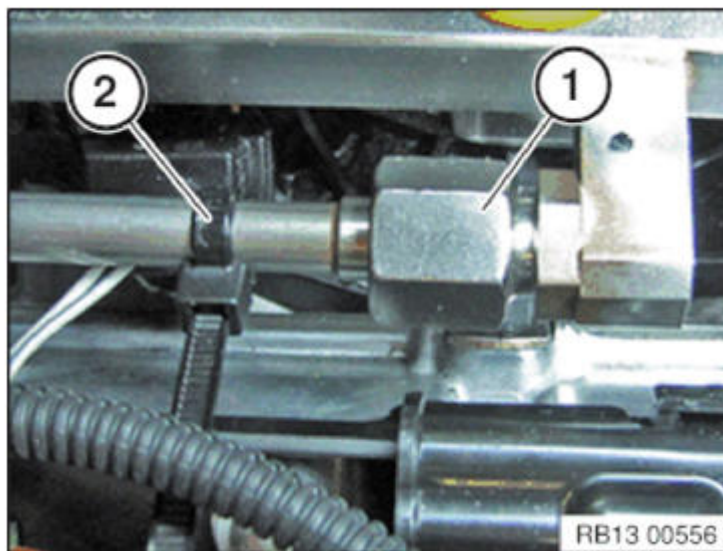
Unlock plug connections (1) of fuel injectors and pull off.

Unclip cable (2) from fuel injection pipe.



**Fig. 4: Identifying Fuel Injector Plug Connections And Fuel Injection Pipe Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Before releasing union nut (1), secure union nut against sliding down with cable strap (2).



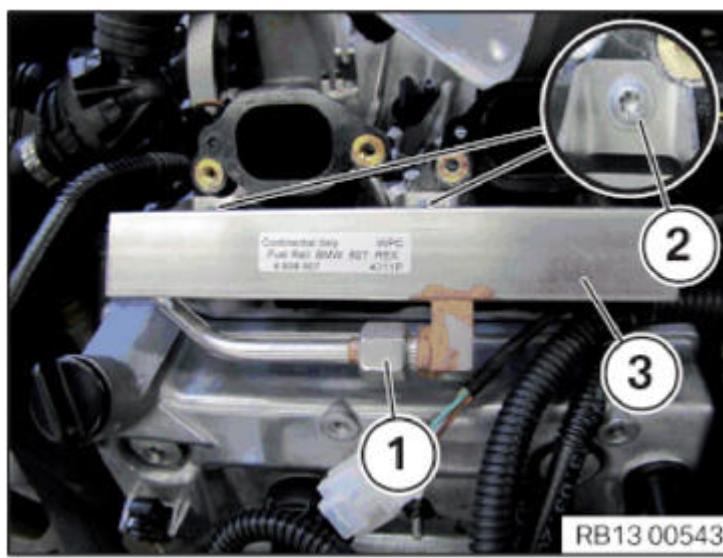
**Fig. 5: Identifying Fuel Injection Pipe Union Nut And Cable Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release union nut (1).

Tightening torque **13 53 1AZ** .

Unfasten screws (2).

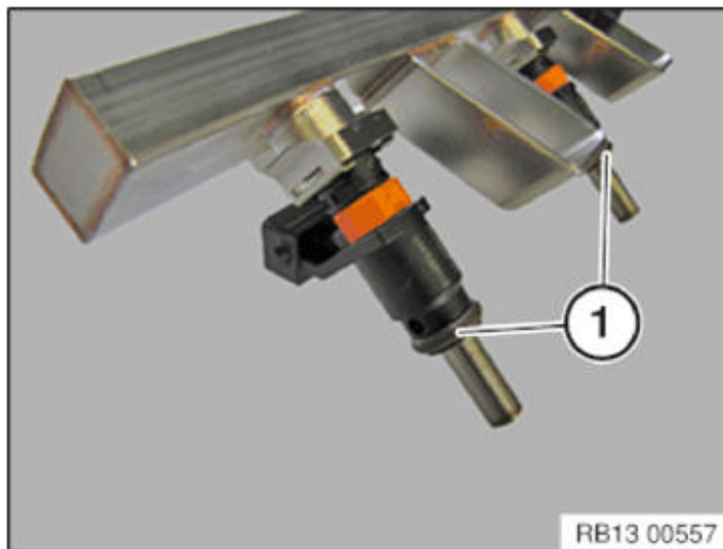
Remove fuel injection pipe (3).



**Fig. 6: Identifying Fuel Injection Pipe, Union Nut And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Replace sealing rings on fuel injectors.

**NOTE:** Only on replacement of fuel injection pipe, remount **FUEL INJECTORS**.



**Fig. 7: Identifying Fuel Injectors**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Check stored fault message.  
 Clear diagnostic fault entries from fault memory.  
 Check injection system for leak tightness.

## **THROTTLE BODY**

### **13 54 030 REMOVING AND INSTALLING/SEALING THROTTLE BODY (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM** .
- Observe **SAFETY INFORMATION** for handling electric vehicles.



IMPORTANT: Read and comply with notes on PROTECTION AGAINST ELECTROSTATIC DISCHARGE (ESD PROTECTION) .

### Necessary preliminary tasks:

- Remove SERVICE CAP IN LUGGAGE COMPARTMENT .

Release clamp (1) and pull clean air pipe off from adapter on throttle body.

Tightening torque 13 71 4AZ .

Unlock connector (2) and remove.

Release screws (3).

Tightening torque 13 54 1AZ .

Feed out and remove the throttle body.

### Installation note:

Replace sealing ring on throttle body.



**Fig. 8: Identifying Throttle Body Clamp, Connector And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Check stored fault message.

Clear diagnostic fault entries from fault memory.

## SENSORS

### 13 62 670 REMOVING AND INSTALLING/REPLACING AIR TEMPERATURE SENSOR IN ENGINE COMPARTMENT (I01)

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- De-energize the HIGH-VOLTAGE SYSTEM .
- Observe SAFETY INFORMATION for working with electric vehicles.



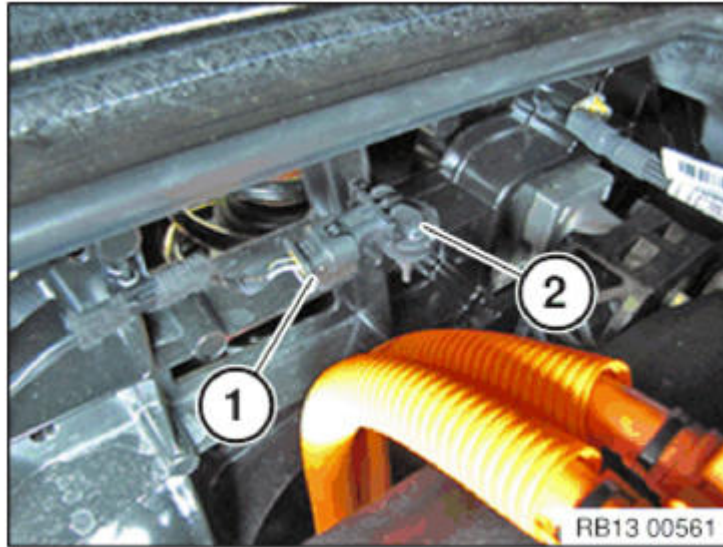
*Necessary preliminary tasks:*

- Remove **SERVICE CAP IN LUGGAGE COMPARTMENT** .

Unlock connector (1) and remove.

Remove temperature sensor (2) in engine compartment together with holder.

Replace temperature sensor and holder after disassembly.



**Fig. 9: Identifying Temperature Sensor And Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Reassemble the vehicle.

### **13 62 671 REMOVING AND INSTALLING/REPLACING AIR TEMPERATURE SENSOR ON ENGINE COMPARTMENT FAN (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

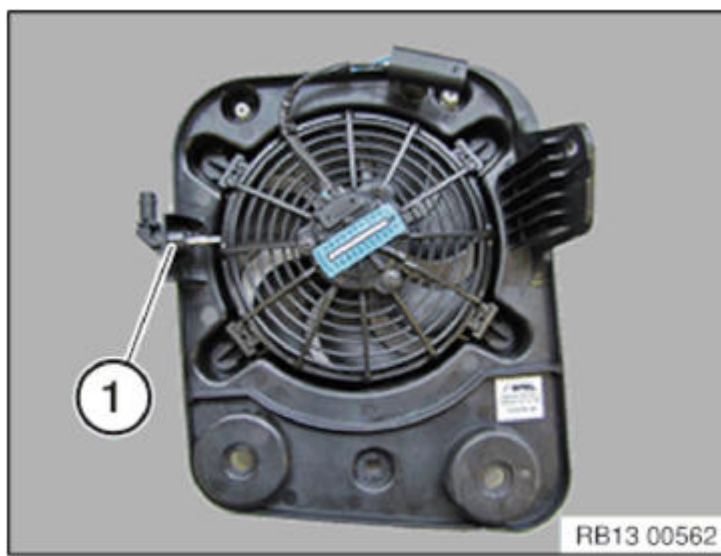
- De-energize the **HIGH-VOLTAGE SYSTEM** .
- Observe **SAFETY INFORMATION** for working with electric vehicles.

*Necessary preliminary tasks:*

- Remove **ENGINE COMPARTMENT FAN** .

Unclip temperature sensor from engine compartment fan.

Replace damaged temperature sensor.



**Fig. 10: Identifying Engine Compartment Fan Temperature Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Reassemble the vehicle.

### **13 62 615 REMOVING AND INSTALLING/REPLACING PRESSURE SENSOR ON INTAKE PLENUM (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- De-energize the **HIGH-VOLTAGE SYSTEM** .
- Observe **SAFETY INFORMATION** for working with electric vehicles.

Necessary preliminary tasks:

- Remove **SERVICE CAP IN LUGGAGE COMPARTMENT** .

Unclip cable (1) from clamps.

Release clamps (2).

Remove soundproofing (3).



**Fig. 11: Identifying Intake Plenum Pressure Sensor Soundproofing, Clamps And Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (2).

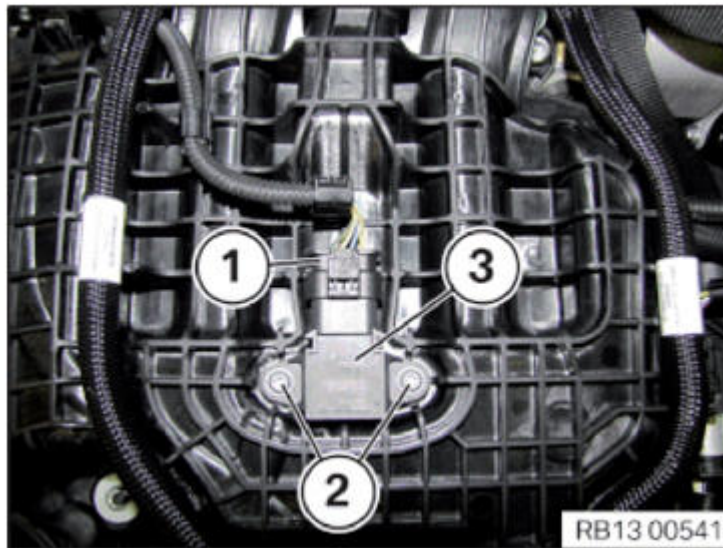
Unfasten screws (2).

Tightening torque: **13 62 1AZ**

Remove pressure sensor (3).

*Installation note:*

Replace O-ring.



**Fig. 12: Identifying Intake Plenum Pressure Sensor, Plug Connection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Clear diagnostic fault entries from fault memory.

**13 62 531 REPLACING COOLANT TEMPERATURE SENSOR (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:** Risk of scalding!  
Only perform this repair work on an engine that has cooled down.

**Recycling**

Catch and dispose of escaping coolant.

Fuel escapes when fuel lines are detached.

Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

*Necessary preliminary tasks:*

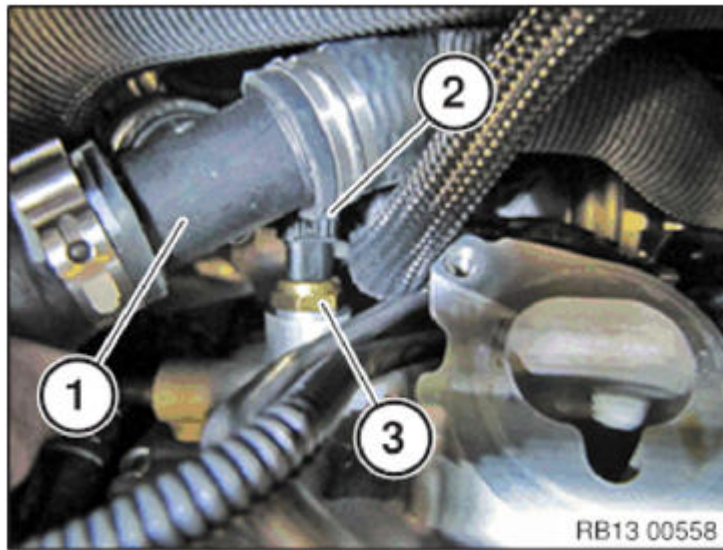
- Remove INTAKE NECK .

Lay coolant hoses (1) to one side.

Unlock connector (2) and remove.

Release and remove coolant temperature sensor (3).

Tightening torque 13 62 5AZ .



**Fig. 13: Identifying Coolant Hose, Connector And Coolant Temperature Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Check stored fault messages.  
Clear diagnostic fault entries from fault memory.  
If necessary, top up coolant.  
Check cooling system for leaks.

## **FUEL INJECTOR**

### **13 64 501 REMOVING AND INSTALLING/REPLACING A FUEL INJECTOR (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- Observe SAFETY INFORMATION for working with electric vehicles.

#### **Recycling**

Fuel escapes when fuel line is detached. Catch and dispose of escaping fuel.

Observe country-specific waste disposal regulations.

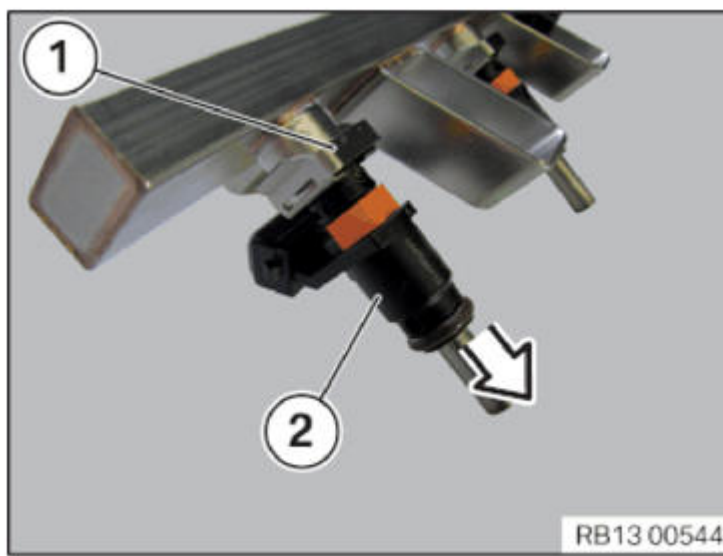
**Necessary preliminary tasks:**

- Remove FUEL INJECTION PIPE

**NOTE:** This procedure is applicable to both fuel injectors.

Lift out retaining clip (1).

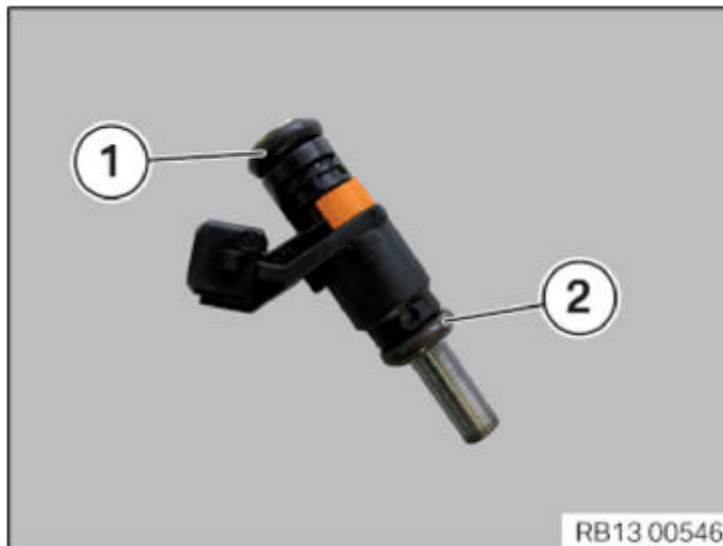
Pull the fuel injector (2) out off the fuel injection pipe.



**Fig. 14: Removing Fuel Injector From Fuel Injection Pipe**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

Replace sealing rings (1) and (2) and coat with rubber care product.

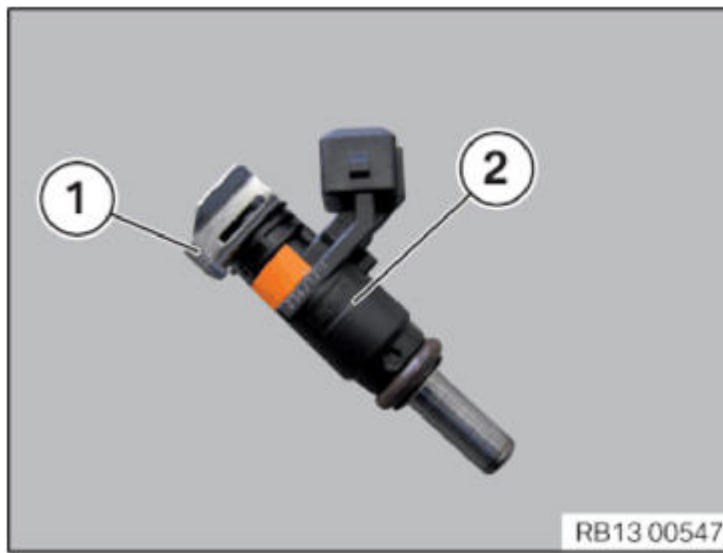


**Fig. 15: Identifying Fuel Injector Sealing Rings**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

Slide retaining clip (1) back onto fuel injector (2).



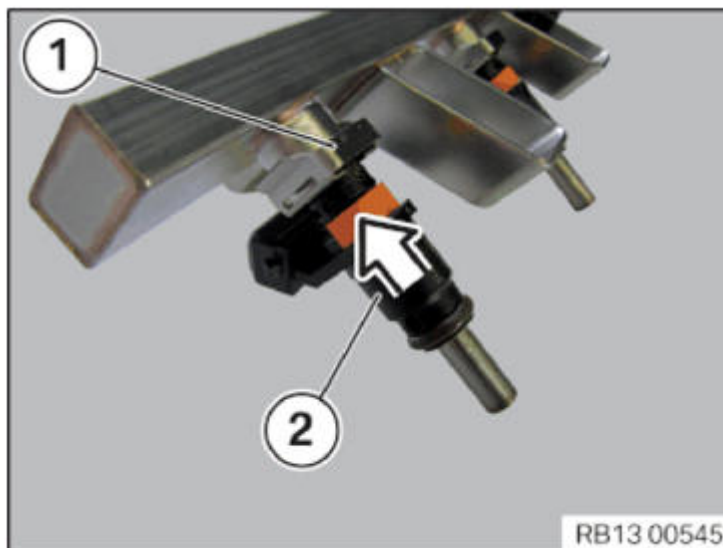


**Fig. 16: Identifying Fuel Injector And Retaining Clip**

Courtesy of BMW OF NORTH AMERICA, INC.

**Installation note:**

Slide fuel injector (2) into fuel injection pipe until retaining clip (1) engages audibly.



**Fig. 17: Installing Fuel Injector Into Fuel Injection Pipe**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Check stored fault message.  
Clear diagnostic fault entries from fault memory.  
Check injection system for leak tightness.

## **INTAKE SILENCER HOUSING**

### **13 71 000 REMOVING AND INSTALLING/REPLACING INTAKE SILENCER HOUSING (I01)**

**WARNING:** High-voltage system - danger to life

Compliance with the following points is mandatory before beginning work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

Necessary preliminary tasks:

- Remove SUPPORT FOR REAR BUMPER PANEL .

Unclip control unit (1) from intake silencer housing and set aside.

Release clamp (2) and pull clean air pipe off of intake silencer housing.

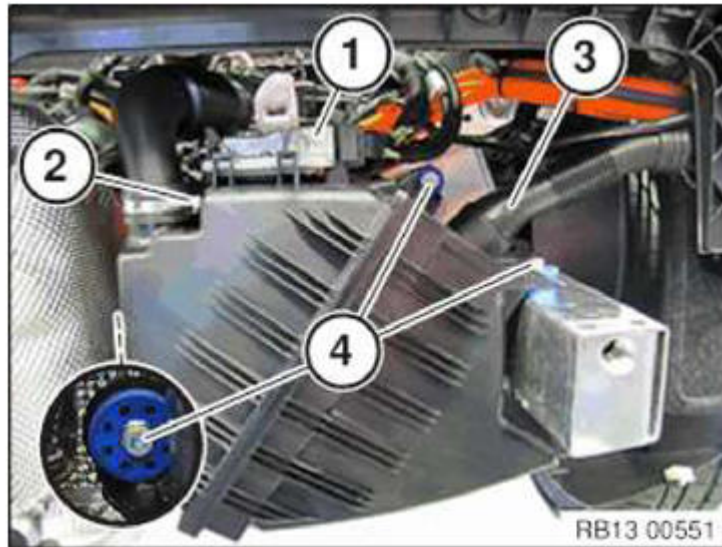
Tightening torque 13 71 4AZ .

Pull raw air pipe (3) off of intake silencer housing.

Release screws (4).

Tightening torque 13 71 1AZ .

Remove intake silencer housing.



**Fig. 18: Identifying Intake Silencer Housing Control Unit, Clamp, Raw Air Pipe And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Reassemble the vehicle.

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## ENGINE

### Fuel System - Special Tools - Only I3 Models With Range Extender

## FUEL SYSTEM

### 2353954 LEAK DETECTOR MP

**NOTE:** "BMW Smoke diagnosis tester" leak detector for the tightness diagnosis of closed systems such as fuel tanks, intake air passages, etc. (1) "BMW Smoke diagnosis tester", (2) "UltraTracer", (3) cylinder with pressure reducer, (4) diverse adapter, (5) coupling kit for compressed air connection, (6) torch with white and UV light including special glasses, (7) power pack note: (2) "UltraTracer".

#### Storage Location

Alternatively

#### SI number

02 11 13 (958)



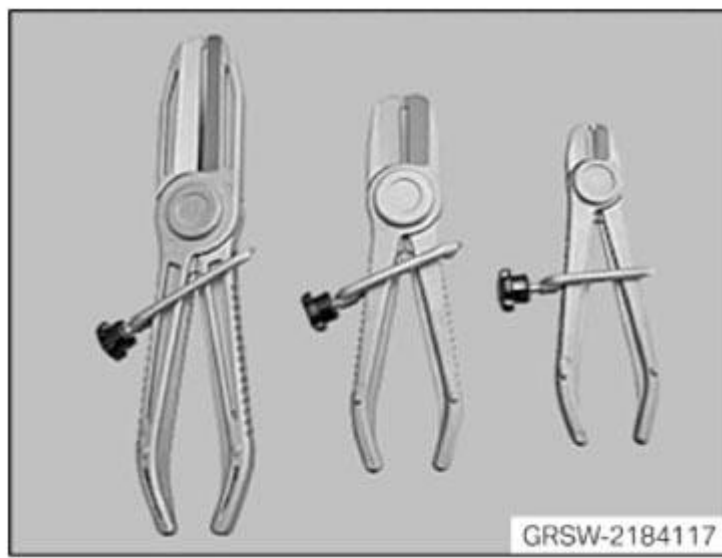
**Fig. 1: Identifying Leak Detector (2353954).**  
Courtesy of BMW OF NORTH AMERICA, INC.

### 2184117 TOOL SET MECHANICAL TOOL

**NOTE:** For disconnecting the coolant or fuel hoses.

#### SI number

08 03 10 (651)



**Fig. 2: Identifying Tool Set (2184117).**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

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**ENGINE****Fuel System - Tightening Torques - Only I3 Models With Range Extender - i3****FUEL INJECTOR NOZZLES AND LINES****13 53 FUEL INJECTOR NOZZLES AND LINES****TIGHTENING TORQUE SPECIFICATION - FUEL INJECTOR NOZZLES AND LINES**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Fuel line to fuel injection pipe	I01 REX	Â	Â	30 Nm
2AZ Fuel line to engine block	I01 REX	M6	Â	10 Nm

**INTAKE SILENCER****13 71 INTAKE SILENCER****TIGHTENING TORQUE SPECIFICATION - INTAKE SILENCER**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Intake silencer to strut brace/deformation element	I01 REX	M6x40	Â	6 Nm
2AZ Screw base to strut brace	I01 REX	M6x70	Â	6 Nm
3AZ Unfiltered-air pipe to side panel	I01 REX	Â	Â	4 Nm
4AZ Clean air pipe to intake silencer and throttle valve	I01 REX	Â	Screw clamp	3 Nm

**SENSORS FOR CONTROL UNIT****13 62 SENSORS FOR CONTROL UNIT****TIGHTENING TORQUE SPECIFICATION - SENSORS FOR CONTROL UNIT**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Pressure sensor on intake plenum	I01	Â	Â	4 Nm
2AZ Camshaft sensor to cylinder head	I01	M6x16	Â	8 Nm
3AZ Crankshaft sensor to crankcase	I01	M6x16	Â	8 Nm
4AZ Knock sensor to crankcase	I01	M8x30	Â	21.4 Nm
5AZ Coolant temperature sensor	I01	Â	Â	13.5 Nm

**THROTTLE VALVE AND OPERATION****13 54 THROTTLE VALVE AND OPERATION****TIGHTENING TORQUE SPECIFICATION - THROTTLE VALVE AND OPERATION**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Throttle body to intake system	I01 REX	Â	Â	6 Nm

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## ENGINE

### Fuel System Operating Fluids

#### 1.0 FUELS FOR GASOLINE ENGINES

Use only unleaded gasoline in vehicles equipped with a catalytic converter.

Fuels containing **up to and including 10%** of ethanol or other oxygenates with up to 2.8% oxygen by weight, that is, 15% MTBE (methyl tertiary butyl ether) or 3% methanol plus an equivalent amount of co-solvent, **will not void** the applicable warranties with respect to defects in materials or workmanship.

Although, usage of such alcohol fuel blends may result in driveability, starting, and stalling problems due to reduced volatility and lower energy content of the fuel. Those driveability problems may be especially evident under certain environmental conditions, such as: high or low ambient temperatures and high altitude.

Only specially adapted vehicles (FFV - Flexible Fuel Vehicles) can run on high alcohol fuel blends. BMW, for the various technical and environmental reasons explained below, does not offer FFV models.

Usage of E85, or any other high alcohol content blend (e. g. E30) in BMW vehicles, will cause various driveability complaints (cold start problems, stalling, reduced performance, poor fuel economy, etc.), may cause excessive emissions, and may cause irreversible damage to engine, emission control and fuel delivery systems due to incompatibility of materials with alcohols.

#### GENERAL NOTES REGARDING E85 FUEL

E85 fuel contains 85% (by volume) of ethanol and 15% of gasoline. Ethanol can be produced chemically from ethylene or biologically from grains, agricultural wastes, or any organic material containing starch or sugar. In the US, ethanol is mainly produced from corn and is classified as a renewable fuel.

Similar to gasoline, ethanol contains hydrogen and carbon; with additional oxygen molecules build into its chemical chain. This chemical structure makes ethanol's burning process slightly cleaner compared to the gasoline (lower tailpipe emissions).

On the other hand, due to lower carbon content, ethanol provides 27% less energy (for identical volume) than gasoline, resulting in the reduced fuel economy of E85 vehicles (approximately 22% higher consumption). Increased fuel consumption requires the appropriately enlarged fuel tank capacities (usually 30% increase), and the specific DME calibrations for the E85 lower Stoichiometric air/fuel ratio (10 compared to 14.7 for gasoline engines).

E85 fuel volatility is typically lower than gasoline (RVP 6-10 psi, compared to 8-15 psi for gasoline). Lower fuel volatility will reduce vehicle evaporative emissions, but it may cause cold starting problems especially with lower ambient temperatures.

Under certain environmental conditions, mainly lower ambient temperatures, ethanol separates from gasoline/alcohol mixture and absorbs water. The ethanol absorbed water molecules are heavier than gasoline or ethanol, they remain at the bottom of fuel tank and when introduced into combustion process they tend to form an extremely lean mixture resulting in misfire, rough idle and cold starting problems.

Certain materials, commonly used with gasoline are totally incompatible with alcohols. When these materials come in contact with ethanol, they may dissolve in the fuel, which may damage engine components and may result in poor vehicle driveability.

Some metals (e. g. zinc, brass, lead, aluminum) become degraded by long exposure to ethanol fuel blends. Also, some nonmetallic materials used in automotive industry such as: natural rubber, polyurethane, cork gasket material, leather, polyvinyl chloride (PVC), polyamides, methyl-methacrylate plastics, and certain thermo & thermoset plastics degrade when in contact with fuel ethanol.

In order to safely and effectively operate a motor vehicle running on E85, the vehicle must be compatible with alcohol use. Some manufacturers have developed vehicles called FFV (Flexible Fuel Vehicle) that can operate on any blend of ethanol and gasoline (from 0% ethanol and 100% gasoline, up to 85% ethanol and 15% gasoline). Ethanol FFVs are similar to gasoline vehicles, with main differences in materials used in fuel management and delivery systems, and DME control module calibrations. In some cases, also E85 vehicles require special lubricating oils.

Aftermarket conversions of gasoline-powered vehicles to ethanol-fueled vehicles, although possible, are not recommended due to internal materials and DME software incompatibility, as well, as the high costs of conversion.

## **TOP TIER DETERGENT GASOLINE**

Deposit-control additives have been required by the EPA in all gasoline from 1995, however, since the introduction of the lowest additive concentration (LAC) most gasoline manufacturers have actually reduced the concentration level of detergent additives by up to 50%.

Low content of cleaning additives results in an excessive accumulation of deposits on fuel injectors, the intake valves, the exhaust manifold or inside the combustion chamber. Due to deposits build-up, customers may experience various driveability problems (e. g. cold start problems, rough idle), increased emissions with Service Engine Soon light illumination, reduced engine performance and poor fuel economy.

In order to increase the level of detergent additives in gasoline, the TOP TIER Detergent Gasoline requirements were approved by four automotive companies (BMW, GM, Honda and Toyota).

Usage of the TOP TIER Gasoline will help keep engines cleaner, and will reduce deposits-related concerns.

A number of gasoline retailers have already met the TOP TIER Detergent Gasoline requirements and are offering this product in all octane grades in all of their respective marketing areas. The current TOP TIER Gasoline retailers are: QuickTrip®; ChevronTexaco®; ConocoPhillips®; 76®; Shell®; Entec Stations®; MFA Oil Company®; Kwik Trip®/Kwik Star®; The Somerset Refinery, Inc.®; Aloha Petroleum®; Jiffy Mart®; Mahalo®; Trip-Par Oil Company®. All gasoline outlets carrying the brand of the approved retailer must conform to TOP TIER requirements on products advertised as such.

**BMW recommends using TOP TIER Detergent Gasoline** of minimum octane rating of AKI 91 and with alcohol content of less than 10% by volume (or any other oxygenates with up to 2.8% of oxygen by weight). Only the exclusive usage of TOP TIER Gasoline provides the full benefit of reducing deposits build-up.

## **ALCOHOL DETECTION PROCEDURE**

Fuel Blends containing a high percentage (10% and above) of alcohol, mainly ethanol, are becoming more commercially available. Usage of E85, or any other high alcohol content blend (e. g. E30) in BMW vehicles, will cause various driveability complaints (cold start problems, stalling, reduced performance, poor fuel economy, etc.), may cause excessive emissions, and may cause irreversible damage to engine, emission control and fuel delivery systems due to incompatibility of materials with alcohols.

In order to correctly diagnose various driveability complaints caused by fuel blends with a high level of ethanol content, BMW is providing you with an alcohol detection test tool.

Distribution of the following tool will be through the Automatic Tool Shipment Program. Additional tools may be purchased through your PDC. All prices on this bulletin are introductory prices and are only valid during the Automatic Tool Shipment.

## **PROCEDURE**

### **Safety Precautions:**

Gasoline is highly flammable; observe normal precautions for working with flammable liquids. Perform all tests away from any source of ignition. A class B fire extinguisher must be available. Wear protective

eye protection with side shields and Nitrile rubber gloves for handling syringe. Please adhere to any applicable OSHA regulations when handling Gasoline.

Dispose of the mixture according to local, state and federal regulations.

Fill a clean container with gasoline drawn from the fuel system of the affected vehicle then fill another container with water. Only a small amount of fuel is needed to perform the test (5 ounces of each fluid).

Slowly draw 3cc of water into the syringe.

**NOTE:** To remove air, draw at least 5cc to 6cc of water, invert the syringe and squirt the water out until the top rim of the rubber plunger is at the 3cc mark.

Slowly draw gasoline into the syringe until the fluid reaches the 12cc mark.

Place your finger over the tip of the syringe, vigorously shake the syringe for one minute. Relieve built-up pressure by occasionally removing your finger.

Place the syringe on a flat surface with the nozzle pointing up, allow the syringe to stand for one minute.

If alcohol is present in the fuel, it will separate from the gasoline and dissolve in the water. This water/alcohol mixture will be in the lower part of the syringe. Record the reading at the boundary of the two liquids, refer to the table below to determine the percentage of alcohol in the fuel.

Empty the syringe and rinse thoroughly with water, allow drying and apply a silicone lubricant to the rubber plunger before storing.

#### SAFETY PRECAUTIONS CHART

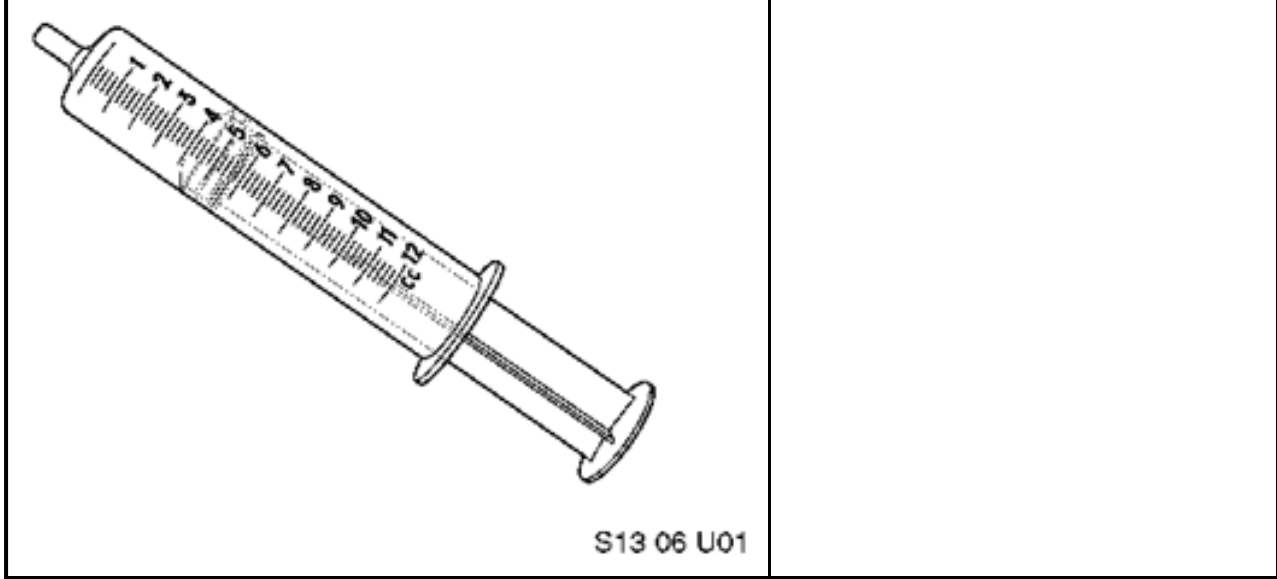
Boundary Line	% Alcohol
9.0cc	0%
8.6cc	5%
8.1cc	10%
7.7cc	15%
7.2cc	20%
6.8cc	25%
6.3cc	30%
5.9cc	35%
5.4cc	40%
5.0cc	45%
4.5cc	55%
4.1cc	60%
3.6cc	65%
3.2cc	70%
2.7cc	75%
2.3cc	80%
1.8cc	85%
1.4cc	90%

#### WARRANTY INFORMATION

Components damage/malfunctions, or any driveability problems caused by use of fuels containing more than 10% ethanol (or other oxygenates with more than 2.8% oxygen by weight) will not be covered under BMW warranties with respect to defects in materials or workmanship. Please document the results found on the vehicle repair order whenever performing this test.

#### WARRANTY INFORMATION CHART

	Alcohol Detection Test Tool Order PN 83 30 0 420 667
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## **ANTI-KNOCK PROPERTIES**

The anti-knock value is the quality rating for gasoline and is a requirement for controlled combustion. Anti-knock value is expressed with an octane number. A higher number indicates better anti-knock properties of a gasoline. Internationally approved methods are used to determine the Research Octane Number (RON) and the Motor Octane Number (MON). In the United States the Anti-Knock Index (AKI) is displayed at the gas pumps.

$$\text{AKI} = \text{RON} + \text{MON}/2$$

## **BOILING RANGE AND VAPOR PRESSURE**

Gasolines must be highly volatile. The boiling range and vapor pressure values are used for evaluation. Gasolines do not have a boiling "point", but rather a boiling "line", since they are produced from a mixture of various hydrocarbon components.

The boiling line (boiling range) and therefore vapor pressure have influence on, for example,

- vapor lock
- starting behavior
- evaporation loss
- transition and driving behavior
- engine oil dilution
- perfect combustion

The boiling range is different for summer and winter gasolines. The vapor pressure test is another means of determining the behavior of a gasoline.

## **SPECIFIC GRAVITY**

The specific gravity is determined by gasoline components. The volume changes with the temperature. Due to the different compositions there are different values for premium grade and regular grade gasolines.

## **CALORIFIC VALUE**

The calorific value expresses the power content of a gasoline. The calorific value of a combustible fuel/air mixture is of prime importance for the power output of engines.

## **PURITY, COMBUSTION DEPOSITS**

Gasolines must be free of contamination. Pumps, jets, injectors, valves and lines must not be clogged or plugged up. Residue and deposits in the intake system and combustion chamber will impair engine operation. The solid residue from evaporation of gasoline provides information on the degree of contamination.

## SULFUR CONTENT

The sulfur content of all gasolines should be as low as possible. In this manner there will be less sulfuric acids or sulfur acids in the combustion residue, which would lead to corrosion and sulfuric emissions on an engine running without reaching operating temperature.

### 1.1 MINIMUM OCTANE AND AKI RATINGS FOR GASOLINE ENGINES

Up to 2005 model year

#### MINIMUM OCTANE AND AKI RATINGS FOR GASOLINE ENGINES REFERENCE CHART

Leaded Gasoline		
	Premium Grade	Regular Grade
RON (Research Octane No.)	≥	at least 91.0
MON (Motor Octane No.)	≥	at least 82.7
AKI*	at least 93.0	at least 87.0

#### MINIMUM OCTANE AND AKI RATINGS FOR GASOLINE ENGINES REFERENCE CHART

Unleaded Gasoline			
	Premium Grade	Mid-Range	Grade Regular Grade
RON	at least 98.0	at least 95.0	at least 91.0
MON	at least 88.0	at least 85.0	at least 82.5
AKI, see (1)	at least 93.0	at least 90.0	at least 87.0

(1) Anti-Knock Index AKI = RON + MON/2

### 1.2 SUMMARY OF FUEL GRADE REQUIREMENTS

#### FUEL GRADE REQUIREMENTS REFERENCE CHART

Engine	Vehicle	Model	Model Year	Unleaded Gasoline	
				Regular (AKI at least 87.0)	Premium (AKI at least 93.0)
<b>M10</b>	E30	318i	'84-'85	X	≥
<b>M20</b>	E30	325e/es	'85-'88	X	≥
≥	E30	325i/iX	thru '91	X	≥
≥	E30	325iC	thru '93	X	≥
≥	E28	528e	thru '88	X	≥
≥	E34	525i	'89-'90	X	≥
<b>M30</b>	E28	535i	'85-'88	X	≥
≥	E34	535i	thru '93	X	≥
≥	E24	635CSi, L6	thru '89	X	≥
≥	E23	735i/iL, L7	thru '87	X	≥
≥	E32	735i/iL	thru '92	X	≥
<b>M42</b>	E30	318i/is/iC	'91-'92	≥	X
≥	E36	318i/is/iC/ti	thru '95	≥	X
<b>M44</b>	E36	318i, Z3	'96-'98	≥	X
≥	E36	318is/iC	'96-'97	≥	X
≥	E36	318ti	'96-'99	≥	X
<b>M50</b>	E36	325i/is	'92	≥	X
≥	E34	525i/iT	'91-'92	≥	X
<b>M50TU</b>	E36	325i/is	'93-'95	≥	X
≥	E36	325iC	'94-'95	≥	X
≥	E34	525i/iT	'93-'95	≥	X

#### FUEL GRADE REQUIREMENTS REFERENCE CHART

				Unleaded Gasoline	
				Regular	Premium
≥	≥	≥	≥		
≥	≥	≥	≥		



Engine	Vehicle	Model	Model Year	(AKI at least 87.0) Regular	(AKI at least 93.0) Premium
<b>Engine</b>	<b>Vehicle</b>	<b>Model</b>	<b>Model Year</b>	<b>(AKI at least 87.0)</b>	<b>(AKI at least 93.0)</b>
<b>M52</b>	E36	323is/iC	'98-'99	^	X
^	E36	328i	'96-'98	^	X
^	E36	328is/iC	'96-'99	^	X
^	E36	Z3	'97-'98	^	X
^	E39	528i	'97-'98	^	X
<b>M52TU</b>	E46	323i, 328i	'99-'00	^	X
^	E46	323Ci, 328Ci	'00	^	X
^	E36	Z3 2.3/2.8	'99-'00	^	X
^	E39	528i/iT	'99-'00	^	X
<b>N52</b>	E60	525i, 530i	'05- present	^	X
^	E61	525xiT, 530xiT	'05- present	^	X
^	E90	325i, 330i	'05-present	^	X
<b>M54</b>	E36	Z3	'01-'03	^	X
^	E46	325i/Ci/CiCiT	'01- present	^	X
^	E46	325xi/xiT	'01- present	^	X
^	E46	330i/Ci/CiC	'01- present	^	X
^	E46	330xi	'01- present	^	X
^	E39	525i/iT	'01- present	^	X
^	E39	530i	'01- present	^	X
^	E53	X5 3.0i	'01- present	^	X
^	E60	525i, 530i	'03- present	^	X
^	E83	X3	'04- present	^	X
^	E85	Z4	'03- present	^	X
<b>M60</b>	E34	530i/iT, 540i	'94-'95	^	X
^	E32	740i/iL	'93-'94	^	X
^	E38	740i/iL	'95	^	X
^	E31	840Ci	'94-'95	^	X
<b>M62</b>	E39	540i	'97-'03	^	X
^	E39	540iT	'99-'03	^	X
^	E38	740i/iL	'96-'01	^	X
^	E31	840Ci	'96-'97	^	X
^	E53	X5	'00-'03	^	X
<b>N62</b>	E53	X5	'04-'05	^	X
^	E60	545i	'03-'05	^	X
^	E63	645Ci	'04-'05	^	X
^	E64	645CiC	'04-'05	^	X
^	E65	745i	'02-'05	^	X
^	E66	745Li	'02-'05	^	X
<b>N62TU</b>	E53	X5	'05- present	^	X
^	E60	550i	'03- present	^	X
^	E63	650Ci	'04- present	^	X
^	E65	750i	'05- present	^	X
^	E66	750Li	'05- present	^	X
<b>M70</b>	E32	750iL	'88-'94	^	X
^	E31	850i/Ci	'91-'94	^	X
<b>M73</b>	E38	750iL	'95-'01	^	X
^	E31	850Ci	'95-'97	^	X
<b>N73</b>	E66	760Li	'04- present	^	X
<b>S14</b>	E30	M3	'88-'91	^	X
<b>S38</b>	E24	M6	'87-'88	^	X
^	E28	M5	'88	^	X

Engine	Vehicle	Model	Model Year	Unleaded Gasoline	
				Regular (AKI at least 87.0)	Premium (AKI at least 93.0)
	E34	M5	'91-'93		X
<b>S50</b>	E36	M3	'95		X
<b>S52</b>	E36	M3	'96-'99		X
	E36	MZ3	'98-'00		X
<b>S54</b>	E36	MZ3	'01-'02		X
	E46	M3	'01-'02		X
<b>S62</b>	E39	M5	'00-'03		X
	E52	Z8	'00- present		X
<b>S70</b>	E31	850CSi	'94-'95		X

## 2.0 FUEL SYSTEM CLEANER PLUS

Recent field experiences have shown a significant increase in various driveability complaints due to excessive carbon deposits in engine's combustion chambers, on the intake valves and fuel injectors.

The overall rise in carbon deposits accumulation is generally attributed to poor gasoline quality, namely, low level of cleaning additives and fuel contamination.

### TECHNICAL BACKGROUND

Combustion chamber deposit formation is a by-product of the gasoline burning process. Fuel injector and intake valve deposits may become less troublesome with the recently introduced Top Tier Detergent Gasoline deposit control standards, which are exceeding the detergent requirements imposed by the EPA since 1995.

However, vehicles that do not exclusively use a Top Tier Detergent Gasoline, or are regularly driven in severe service conditions, such as stop-and-go traffic, high ambient temperatures, and high altitude can experience performance problems caused by intake system and combustion chamber deposits.

The most common customer complaints may include:

### FUEL INJECTORS

Deposits at the injector's tip can impact fuel flow, upsetting the air/fuel mixture ratio.

Symptoms: Hesitation or stumble during acceleration, even loss of power. Poor fuel efficiency. Increased emissions of HC and CO. "Service Engine Soon" light illumination due to intermittent misfire faults, or lean mixture adaptation values

### INTAKE VALVES

Deposits at the valves and on the intake manifold ports can absorb fuel during the warm-up phase, leaning out the air/fuel mixture ratio. Carbon build-up may disturb mixture flow at low throttle conditions/idle speeds.

Symptoms: Poor driveability, loss of power, unstable/rough idle, increased emissions of HC, CO and NOx. "Service Engine Soon" light illumination due to intermittent misfire faults.

### COMBUSTION CHAMBER

Combustion Chamber Deposit Interference, or CCDI, occurs when there is a contact between carbon deposits on the piston crown and cylinder head. The noise can be confused or misdiagnosed as ping, knock or other noises that could indicate a mechanical failure. CCDI occurs first as a cold start noise that can fade as the engine warms to operating temperature. The noise will reoccur at the next cold start. As deposits build, there is an increase in compression temperature that may cause pre-ignition detonations.

Symptoms: Knocking, pinging, run-on, poor acceleration, octane requirement increase, increased emissions of NOx, engine idle speed surges.

Depending on the manufacturer, fuels may contain various additives such as: oxidation and corrosion inhibitors, metal deactivators, emulsifiers, anti-icing agents & dyes, plus they are required to include some form of an intake system deposit control package. Unfortunately, not all fuels are created equal, and some additive packages are not effective enough to maintain integrity of the intake systems in high performance engines, or engines operating in severe environmental conditions. Even worse, the intake system deposit control additives in some fuels may actually contribute to the combustion chamber deposits accumulation, and to the problems associated with those deposits: knock, run-on and increased emissions of oxides of nitrogen.

## **RECOMMENDATION**

BMW recommends using TOP TIER Detergent Gasoline of minimum octane rating of AKI 91 and with alcohol content of less than 10% by volume (or any other oxygenates with up to 2.8% of oxygen by weight). Only the exclusive usage of TOP TIER Detergent Gasoline provides the full benefit of reducing deposits formation.

If the TOP TIER Detergent Gasoline is unavailable, we recommend BMW Group Fuel System Cleaner Plus (PN 82 14 0 413 341) be added to the gas tank. For optimum cleaning and deposits control, add a 20 fl. oz. bottle every 3, 000 miles when refueling.

Regular use of BMW Group Fuel System Cleaner Plus can help address carbon deposits related symptoms listed above. By removing these deposits, an engine may experience restored power, performance and fuel efficiency, a smoother idle running, lower emissions, and reduced octane requirement.

BMW Group Fuel System Cleaner Plus uses polyether amine TECHRONÂ® based technology developed and patented by Chevron. BMW Group Fuel System Cleaner Plus has proven to clean up deposits in fuel injectors, ports & intake valves and reduces the harmful effects of combustion chamber deposits. It helps restore performance lost due to deposit build-up.

Chevron and BMW have run an extensive "no harm" tests with polyether amine technology. When used as directed, it will not harm catalytic converters, oxygen sensors, or any other mechanical components of the engine, or fuel delivery system.

The effectiveness of the additive depends on its presence in the gasoline in large concentrations for short periods of time. One treatment is usually sufficient, but a second treatment (one 20 oz bottle per each, consecutive full tank of gas) may give additional benefits. To keep your fuel intake system clean, we recommend usage at every 3000 miles.

Additionally, vehicle's fuel sending units equipped with silver plated resistor card/contacts are especially vulnerable to attacks by elemental sulfur and/or hydrogen sulfide found in fuels. Adding BMW Group Fuel System Cleaner Plus immediately upon noticing erratic fuel gauge behavior may, in many cases, restore proper performance due to the additive's ability to remove the harmful sulfur compounds from the sending unit's contact surface. Additionally, BMW Group Fuel System Cleaner Plus can help protect the fuel gauge from future malfunctioning by coating all metal surfaces of the fuel system.

BMW Group Fuel System Cleaner Plus.

PN 82 14 0 413 341,

1 bottle, 20 fl. oz.

Ordering in multiples of 6 bottles per case.



**Fig. 1: Identifying BMW Group Fuel System Cleaner Plus Bottle**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** BMW Group Fuel System Cleaner Plus is the only BMW approved in tank additive. Using non approved fluids or tools can lead to premature component failure and will not be covered under Warranty.

#### WARRANTY INFORMATION

Because carbon deposit build-up is related to fuel quality, it cannot be considered as a defect in vehicle's materials or workmanship. Consequently, usage of BMW Group Fuel System Cleaner Plus is not covered under the terms of the BMW New Vehicle Limited Warranty or maintenance plan.

### **3.0 FUEL INJECTION AND INDUCTION SYSTEM CLEANER CONCENTRATE**

The BMW Group has developed a new special tool and cleaner concentrate to clean the fuel injectors, induction system and combustion chamber of harmful deposits.

Fuel Injector and Induction System Cleaner

Concentrate

PN 82 14 0 428 376

1 bottle, 16 fl. oz.



S13 07 U13

**Fig. 2: Identifying Fuel Injector And Induction System Cleaner Bottle**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** BMW Group Fuel Injector and Induction System Cleaner is the only BMW approved fluid that can be used to clean the fuel injection system, induction system and combustion chamber. Using non approved fluids or tools can lead to premature component failure and will not be covered under Warranty.

## 4.0 FUELS FOR DIESEL M21 ENGINES (US MODEL 524TD ONLY)

Diesel fuel is obtained from distilled crude oil. The distilling process is highly complicated, involving precise control of temperatures and pressures. The diesel fuel quality will vary depending on the refining process and the crude oil source.

BMW of North America LLC recommends using automotive diesel Fuel No. 2 with a minimum cetane rating of 45 for use in the BMW 524td. Never use other fuels such as marine fuel or heating oil, since these fuels do not have the appropriate additives or cetane values.

The cetane number is a measure of the fuel's ignition quality, which influences both the ease of starting and combustion stability.

A high cetane number diesel fuel promotes spontaneous burning of the fuel, which is beneficial in a diesel.

Factors which are important qualities of diesel fuel are the Cloud Point (the temperature at which wax forms in diesel fuel) and the Pour Point (the temperature at which fuel stops flowing). These qualities become very important during low temperature operation. As the temperature drops, wax can sometimes form in the fuel tank, fuel lines and/or fuel filter. If this occurs, the fuel supply lines will become clogged and resulting in hard starting and rough running problems.

Temperatures below 20°F (-7°C) are critical to the formation of wax crystals. The following guidelines should solve any cold weather problems which may arise:

**NOTE:** BMW 524td's are equipped with an integral fuel heater, pre-delivery fuel pump, large capacity fuel filter/water separator, and block heater for cold weather operation which should be sufficient for all but the most extreme cold weather.

**If outside temperature is above 20°F (-7°C):**

\*Use Diesel Fuel No. 2

**If outside temperature is below 20°F (-7°C):**

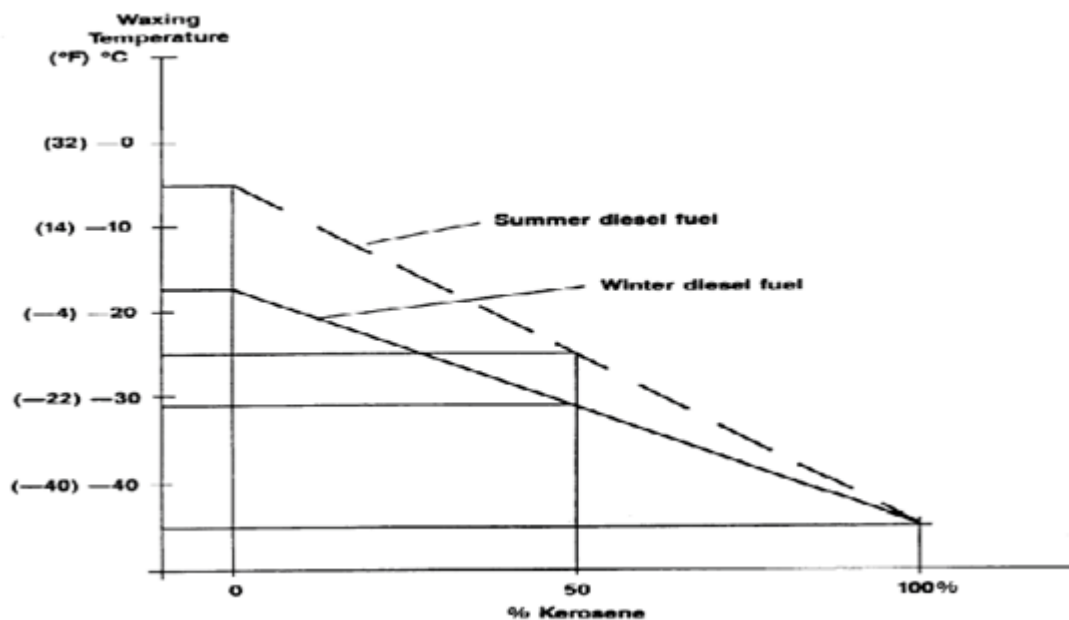
- Diesel Fuel No. 1, if available, should be used.
- Customers should ask if diesel fuel is winterized.
- Diesel Fuel Flow Improver can be added to diesel fuel No. 2 to lower the Cloud Point of the fuel.

**NOTE:** (One) 100 ml can of additive will treat 1 tank full of diesel fuel; additional quantities will not lower the Cloud Point any further.

Diesel Fuel Flow Improver - Wurth Part No. 893532 (former BMW Part No. 81 22 9 407 289)

- Diesel Fuel No. 2 can be mixed with kerosene in the proportions shown on the graph. Engine performance will be reduced with more than a 50% mixture of kerosene.





**Fig. 3: Diesel Fuel Flow Temperature Graph**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Significant improvement in operation can be achieved by using a combination of both kerosene and the diesel fuel flow improver since the kerosene lowers the point at which the wax formation occurs and the additive modifies the structure of the wax crystals for better flow.

## 5.0 FUELS FOR DIESEL M57 D30 T2 US ENGINE

Diesel fuel is obtained from distilled crude oil. The distilling process is highly complicated, involving precise control of temperatures and pressures. The diesel fuel quality will vary depending on the refining process and the crude oil source.

BMW of North America LLC recommends using automotive diesel with a minimum octane rating of 51 in the E90 335D and E70 X5 3.0D. Never use other fuels such as marine fuel or heating oil, since these fuels do not have the appropriate additives or octane values. The octane number is a measure of the fuel's ignition quality, which influences both the ease of starting and combustion stability. A high octane number diesel fuel promotes spontaneous burning of the fuel, which is beneficial in a diesel engine.

The only fuel approved is Ultra-Low Sulfur highway Diesel. ULSD contains a maximum of 15 parts per million (ppm) of sulfur. Low-sulfur diesel (LSD) should never be used, because it contains a much higher concentration of sulfur (up to 500 ppm), which can damage the diesel particulate filter (DPF) as well as increase exhaust emissions.

ULSD dispensing pumps are labeled accordingly:



**Fig. 4: Identifying Ultra-Low Sulfur Highway Diesel Label**  
 Courtesy of BMW OF NORTH AMERICA, INC.

"B5" Biodiesel that consists of a maximum of 5% is approved for use.

The fuel filler neck has been designed with a misfueling feature that only allows the larger diameter diesel fuel filler nozzle to be inserted. The smaller diameter nozzle found on unleaded gasoline pumps cannot be inserted. Nevertheless, if any other fuel (i. e., biodiesel rated at B10 or higher, gasoline, or kerosene) has mistakenly been filled, do not start the engine, not even to move the car away from the fuel pump! Serious damage to the engine can result.

For cold weather operation, filling stations may use "winter diesel", which is an approved blend of ultra-low sulfur kerosene with ULSD. Such a blend will help prevent the diesel fuel from gelling at temperatures below approx. 20Â°F. Factors which are important qualities of diesel fuel are the Cloud Point (the temperature at which wax forms in diesel fuel) and the Pour Point (the temperature at which fuel stops flowing). These qualities become very important during low temperature operation. As the temperature drops, wax can sometimes form in the fuel tank, fuel lines and/or fuel filter. If this occurs, the fuel supply lines will become clogged and resulting hard starting and rough running problems.

### **DIESEL MISFUELING PROTECTION BYPASS ADAPTER**

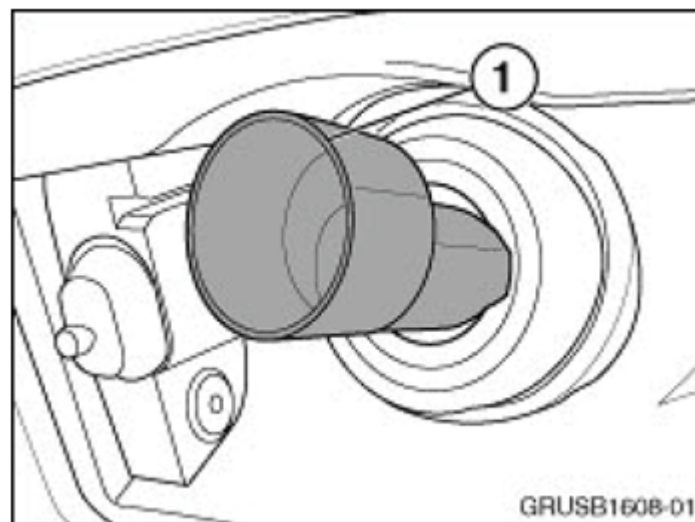
BMW Advanced Diesel vehicles are equipped with a fuel-filler neck that incorporates a misfueling protection system, to prevent gasoline from being mistakenly pumped into the vehicle. If the vehicle is started with gasoline in the fuel tank, internal engine damage will occur.

Only fuel nozzles of the recommended diameter for diesel passenger vehicles can be inserted into the filler neck. Most diesel fuel stations have fuel nozzles with the recommended diameter fitted to their passenger vehicle diesel fuel pumps. Unfortunately in some locations, fuel nozzles of different diameters may have been fitted to passenger vehicle diesel fuel pumps.

The DMBA (1) will enable refueling of the vehicle in emergency circumstances where the fuel station is using the approved Ultra-Low Sulfur Diesel (ULSD), but has a non-standard sized filling nozzle (i. e. gasoline nozzles have a smaller, 21mm diameter), or when using a larger diesel nozzle intended for use on commercial vehicles.

**NOTE:**        **Insert the DMBA into the filler neck so that the offset section is up.**

ULSD has a maximum sulfur content of 15 parts per million (ppm) and is labeled accordingly on the fuel pump.



**Fig. 5: Identifying DMBA**

Courtesy of BMW OF NORTH AMERICA, INC.

## **6.0 OTHER FLUIDS**

The throttle housing studs are to be coated with Loctite 290 on 1991-92 E30 with M42 engine.

The throttle body assembly of M42 engines in E36 vehicles produced from 1/94-6/94 are to be lubricated with Optimoly Paste TA Spray, BMW Part No. 83 23 1 468 932.

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[Back To Article](#)

## EXHAUST SYSTEM

### Exhaust System Operating Fluids

#### 1.0 GENERAL INFORMATION

Detachable joints such as exhaust manifold bolts and exhaust system flange connections can be treated with a grease able to withstand high temperatures and corrosive conditions.

Use Copper Paste (former BMW Part No. 81 22 9 400 794).

3M Part No. 8945

CRC Part No. 3046010

---

## FUEL SYSTEM

### Operating Fluids

## 1.0 DIESEL EXHAUST FLUID OVERVIEW

### E90 335D

Vehicles are factory-filled with DEF (diesel engine additive), also known as AdBlue<sup>®</sup>; DEF is stored in two separate reservoirs within the vehicle. The "active" reservoir from which the DEF is injected into the exhaust system holds approx. 1.6 gallons. It is heated at low exterior temperatures to prevent the DEF from freezing. The second reservoir feeds the active tank via a transfer pump and is large enough to last between scheduled engine oil changes. It is referred to as the "passive" tank, with a capacity of approx 4.5 gallons, and is located in the "spare tire well" of the trunk. At every Engine Oil Service, all remaining DEF must be completely drained from both tanks, and then refilled with new DEF. It is not sufficient to "top up" the reservoir.

The filling location for both tanks is behind an access flap on the surface of the rear bumper's left side. Remove the plugs by inserting the front face of the screwdriver handle (from the vehicle's on-board tool kit) into the plug's recess.

If the supply of DEF runs low, the instrument cluster warning lamp will indicate the estimated remaining distance which the vehicle may be driven, starting at approx. 1000 more miles. At approx. 200 miles, the warning lamp will illuminate again, with the miles counting down to 0. Once the distance reaches 0 miles (shown by "- - -" with the warning lamp symbol), the car will not start up again until DEF is refilled. This is done so that the vehicle meets federal emissions regulations. However, the DEF system does allow one single "emergency" engine start at "0" miles, provided that you start the engine within 3 minutes of last shutting it off.

DEF will soon be available at BMW centers (part number, container size and other details to be provided). One pack of DEF will be sent to each BMW center prior to the first vehicle arrival.

### X5 3.0D

Vehicles are factory-filled with DEF (diesel engine additive), also known as AdBlue<sup>®</sup>; DEF is stored in two separate reservoirs within the vehicle. The "active" reservoir from which the DEF is injected into the exhaust system holds approx. 1.6 gallons. It is heated at low exterior temperatures to prevent the DEF from freezing. The second reservoir, known as the "passive tank", feeds the active tank via a transfer pump and is large enough to last between scheduled engine oil changes. The passive tank's capacity is approx 4.5 gallons, and is located underneath the driver's seat. At every Engine Oil Service, all remaining DEF must be completely drained from both tanks, and then refilled with new DEF. It is not sufficient to "top up" the reservoir.

The active tank can be filled from the passenger side engine compartment.

If the supply of DEF runs low, the instrument cluster warning lamp will indicate the estimated remaining distance which the vehicle may be driven, starting at approx. 1,000 more miles. At approx. 200 miles, the warning lamp will illuminate again, with the miles counting down to 0. Once the distance reaches 0 miles (shown by "- - -" with the warning lamp symbol), the engine will not start up again until DEF is refilled. This is done so that the vehicle meets federal emissions regulations. However, the DEF system does allow one single "emergency" engine start at "0" miles, provided that you start the engine within 3 minutes of the last time that it was shut off.

DEF will soon be available at BMW SAV centers. One pack of DEF will be sent to each BMW center prior to the first vehicle arrival.

## 2.0 DEF EXTRACTION AND REFILL

E70 and E90 with M57Y from start of production.



Scheduled maintenance or warranty repairs which require the evacuation and the refilling of the SCR (Selective Catalyst Reduction) emissions system.

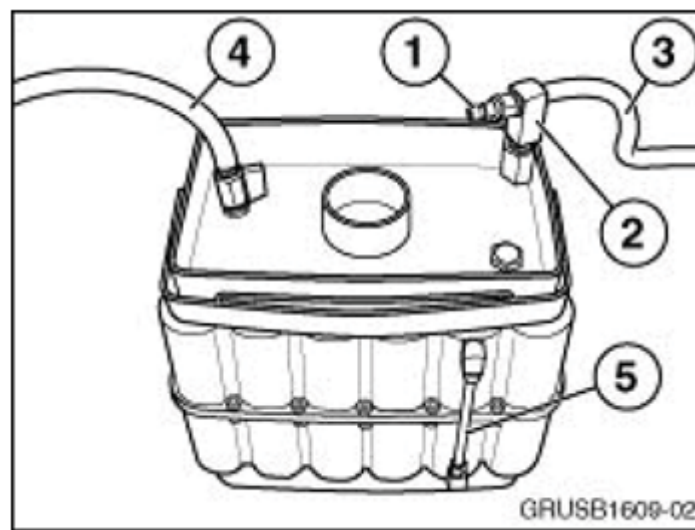
## **OVERVIEW OF DEF (DIESEL EXHAUST FLUID) EXTRACTOR**

Always refer to the latest Repair Instructions: RA16 19 006 (E70 Active), RA16 19 060 (E70 passive), or RA16 19 070 (E90) for important safety considerations when working with DEF.

The DEF Extractor/Filler unit removes DEF from the system, using compressed air to create a vacuum using the Venturi principle. The extractor can hold 11 liters of DEF fluid.

DEF Extractor (P/N 81 39 2 153 908):

1. Shop air connection
2. Venturi valve block
3. Exhaust hose for the valve block
4. Extraction line to service the port on the SCR system
5. DEF level indicator

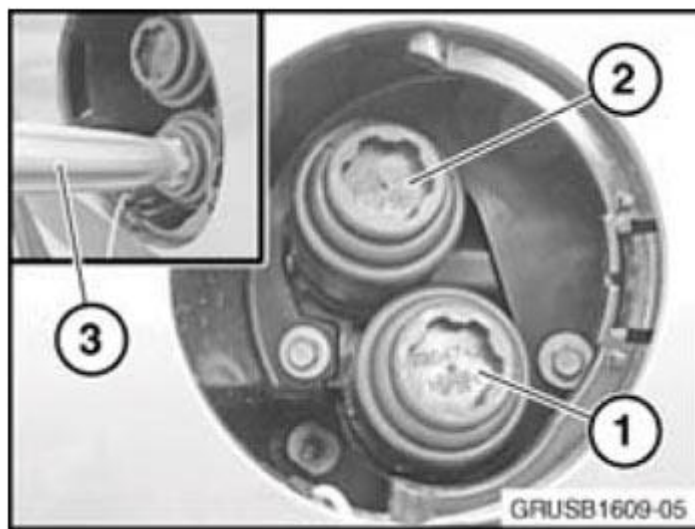


**Fig. 1: Overview Of DEF Extractor**

Courtesy of BMW OF NORTH AMERICA, INC.

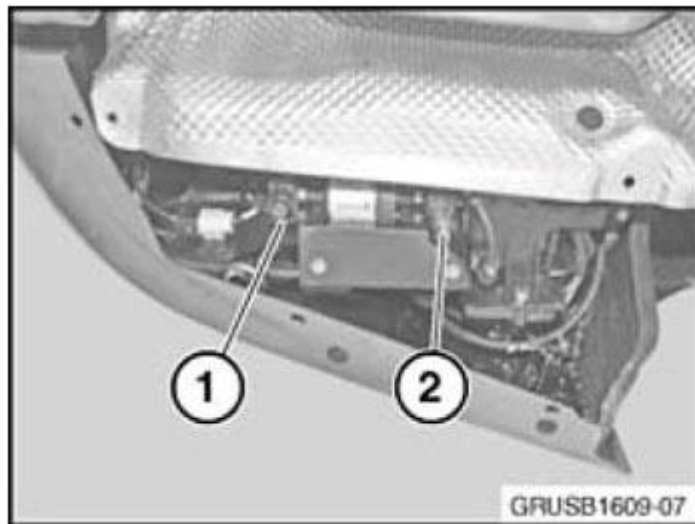
## **DRAINING DEF E90**

1. Remove the filler connection cap on the left rear bumper.
2. When draining the active tank, remove the filler cap (1); for the passive reservoir, remove the filler cap (2).
3. If necessary, use the screwdriver handle (3) from the onboard vehicle tool kit to open the filler caps.



**Fig. 2: Removing Filler Cap Using Screwdriver Handle**  
Courtesy of BMW OF NORTH AMERICA, INC.

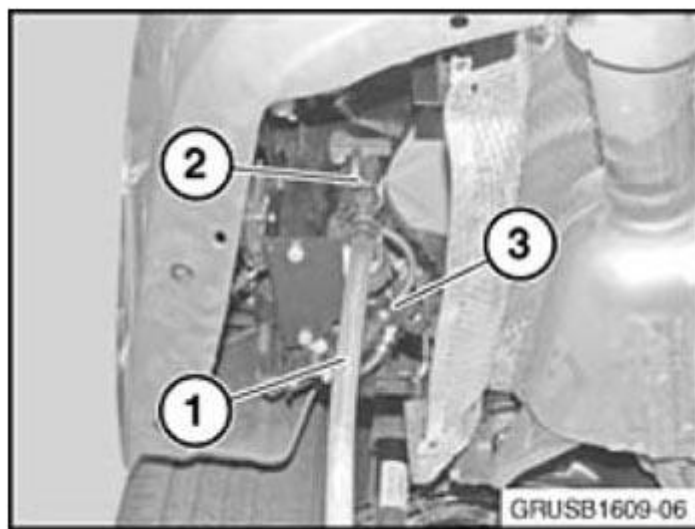
4. Remove the cover under the left rear bumper to access the service ports for the active (1) and passive tanks (2).



**Fig. 3: Identifying Left Rear Bumper Service Ports For Active And Passive Tanks**  
Courtesy of BMW OF NORTH AMERICA, INC.

5. Connect the extraction line (1) from the tool (P/N 81 39 2 153 908) to the active (2) or the passive (3) service ports.

**NOTE:** Clean the caps for the service ports with water before reinstalling. Make sure the caps lock back onto the service ports

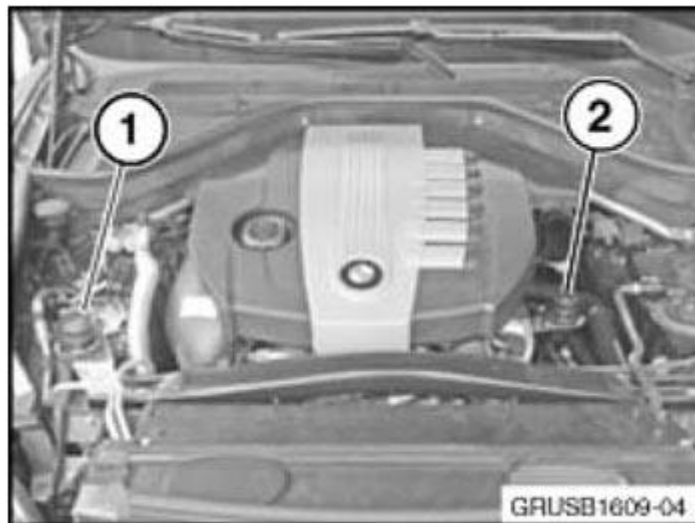


**Fig. 4: Connecting Extraction Line To Active Or Passive Service Ports**  
Courtesy of BMW OF NORTH AMERICA, INC.

6. Connect the shop air to the vacuum block, and open the valve at the vacuum block on the canister for vacuum supply. Slowly open the valve of the suction line at the canister and draw off the DEF. Watch the level through the level tube. Make sure the exhaust hose off the vacuum block is situated so that it will drain into a suitable catch pan, in case the DEF extractor canister gets overfilled.

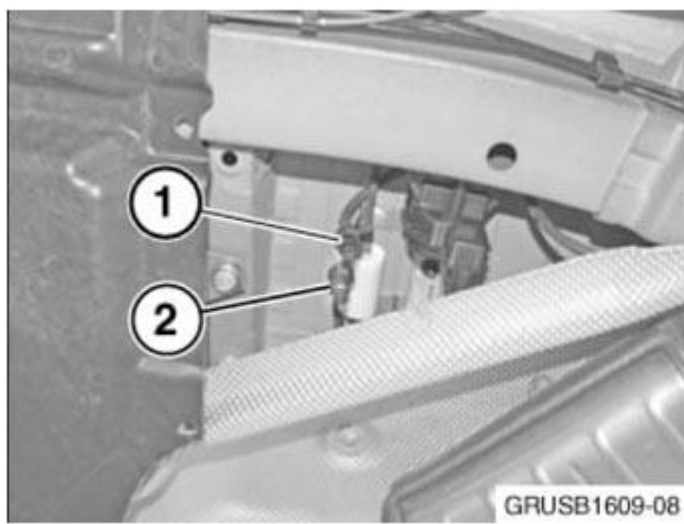
#### **DRAINING DEF E70**

1. Remove the filler cap of the active reservoir (1) or the passive reservoir (2).



**Fig. 5: Identifying Filler Cap Of Active Reservoir And Passive Reservoir**  
Courtesy of BMW OF NORTH AMERICA, INC.

2. Service ports for the active (1) or the passive reservoirs (2) are located under the right side of the vehicle.



**Fig. 6: Identifying Service Ports For Active And Passive Reservoirs**  
Courtesy of BMW OF NORTH AMERICA, INC.

3. Remove the cap from the service port being drained and attach the extractor hose (1) to the port.

**NOTE:**        **Clean the caps for the service ports with water before reinstalling. Make sure the caps lock back onto the service ports.**



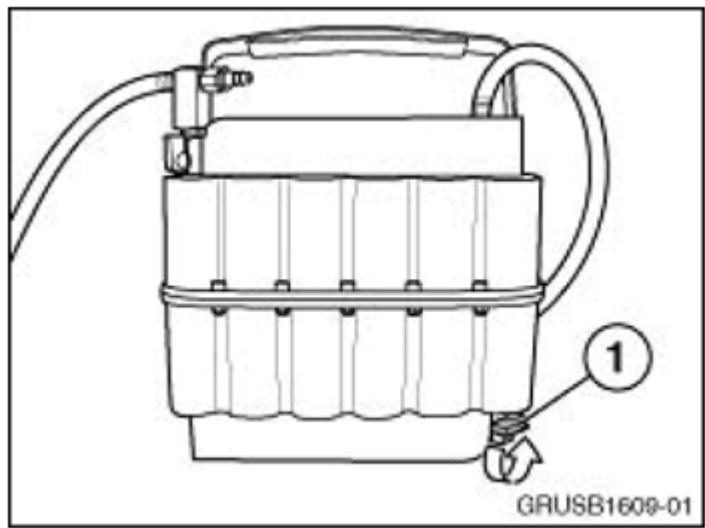
**Fig. 7: Identifying Extractor Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

4. Connect the shop air to the vacuum block, and open the valve at the vacuum block on the canister for vacuum supply. Slowly open the valve of the suction line at the canister and draw off the DEF. Watch the level through the level tube. Make sure the exhaust hose off the vacuum block is situated so that it will drain into a suitable catch pan, in case the DEF extractor canister gets overfilled.

### **EMPTYING THE DEF EXTRACTOR**

1. To empty the canister; open the drain valve (1) on the bottom of the canister.

**NOTE:**        **The extractor will not function properly if the drain is opened while there is vacuum applied to the system.**



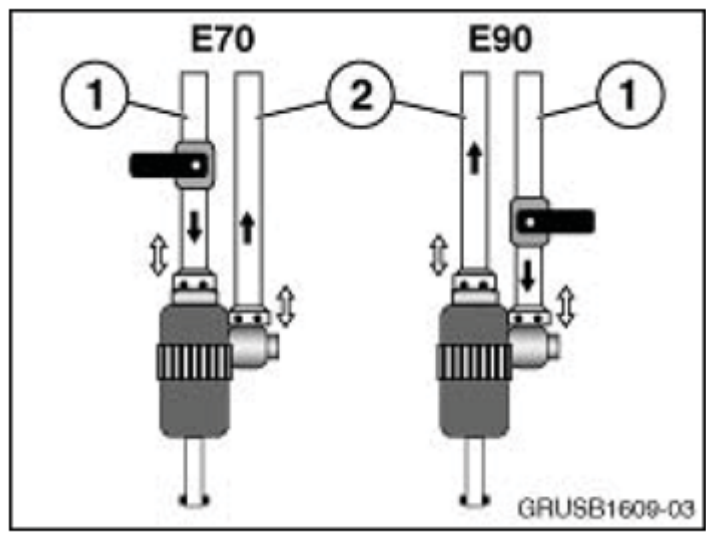
**Fig. 8: Identifying Drain Valve**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Consult with your local municipality on proper disposal of used DEF. Never reuse the DEF that is evacuated from a vehicle. Always refill the SCR system with new DEF (2.5 gallon service bottles, P/N 83 19 0 440 158).

Filling the SCR system

Factory warranty will only reimburse the use of 2.5 gallon service bottles (P/N 83 19 0 440 158) when draining and refilling the SCR system.

**NOTE:** The filling (1) and vent (2) lines at the filler adapter are switched, depending on the application.



**Fig. 9: [Draining And Refilling SCR System]**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Proper maintenance for DEF Extractor/Filler Tools (P/N 81 39 2 153 908/909)

Always rinse the tools, lines and fittings with water after each use.



## GENERAL INFORMATION

### Anti-Lock Brake Safety Precautions

#### \* PLEASE READ THIS FIRST \*

This article is intended for general information purposes only. This information may not apply to all makes and models. If vehicle is equipped with Anti-Lock Brake System (ABS), refer to appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section for description, operation, depressurizing, testing, system bleeding, trouble shooting and servicing of specific system.

### ANTI-LOCK BRAKE SAFETY PRECAUTIONS

**WARNING:** Failure to depressurize ABS could lead to physical injury.

- NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized.
  - NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
  - **DO NOT** attempt to bleed hydraulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section.
  - Only use specially designed brake hoses/lines on ABS equipped vehicles.
  - **DO NOT** tap on speed sensor components (sensor, sensor rings). Sensor rings must be pressed into hubs, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
  - **DO NOT** mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
  - **DO NOT** contaminate speed sensor components with grease. Only use recommended coating, when system calls for an anti-corrosion coating.
  - When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
  - ONLY use recommended brake fluids. **DO NOT** use silicone brake fluids in an ABS equipped vehicle.
  - When installing transmission devices (CB's, telephones, etc.) on ABS equipped vehicles, **DO NOT** locate the antenna near the ABS control unit (or any control unit).
  - Disconnect all on-board computers, when using electric welding equipment.
  - **DO NOT** expose the ABS control unit to prolonged periods of high heat (185 Â°F/85Â°C for 2 hours is generally considered a maximum limit).
-

## GENERAL INFORMATION

### Clutch Trouble Shooting

#### \* PLEASE READ THIS FIRST \*

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

#### ALL MODELS

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

#### CLUTCH TROUBLE SHOOTING

Problem & Possible Cause	Action
<b>Clutch Chatters/Grabs</b>	
Incorrect Pedal Adjustment	Adjust Free Play
Worn Input Shaft Spline	Replace Input Shaft
Binding Pressure Plate	Replace Pressure Plate
Binding Throw-Out Lever	Check Throw-Out Lever, Check Throw-Out Bearing, Check Bearing Retainer
Uneven Pressure Plate Contact With Flywheel	Align/Replace Worn Parts
Transmission Misaligned	Align Transmission
Worn Pressure Plate	Replace Clutch Assembly
Oil-Saturated Disc	Replace Clutch Assembly, Repair Oil Leak
Loose Engine Mounts	Replace Engine Mounts
<b>Clutch Pedal Sticks Down</b>	
Clutch Cable Binding	Replace Clutch Cable
Weak Pressure Plate Springs	Replace Clutch Assembly
Binding Clutch Linkage	Lubricate Linkage
Broken Clutch Pedal Return Spring	Replace Return Spring
<b>Clutch Will Not Release</b>	
Oil-Saturated Disc	Replace Clutch Assembly, Repair Oil Leak
Defective Disc Face	Replace Clutch Assembly
Disc Sticking on Input Shaft Splines	Replace Disc/Input Shaft
Binding Pilot Bearing	Replace Pilot Bearing
Faulty Clutch Master Cylinder	Replace Master Cylinder

<b>Problem &amp; Possible Cause</b>	<b>Action</b>
Faulty Clutch Slave Cylinder	Replace Slave Cylinder
Blown Clutch Hose	Replace Hose
Sticky Throw-Out Bearing Sleeve	Clean/Lube Sleeve
Clutch Cable Binding	Replace Clutch Cable
Broken/Loose Bellhousing	Check Bellhousing
<b>Rattling/Squeaking</b>	
Broken Throw-Out Lever Return Spring	Replace Return Spring
Faulty Throw-Out Bearing	Replace Throw-Out Bearing
Faulty Clutch Disc	Replace Clutch Disc
Faulty Pilot Bearing	Replace Pilot Bearing
Worn Throw-Out Bearing	Replace Throw-Out Bearing
Dry Bearing Retainer Slide For Throw-Out Bearing Sleeve	Lubricate Slide
<b>Slipping</b>	
Faulty Pressure Plate	Replace Clutch Assembly
Worn Clutch Disc	Replace Clutch Assembly
Incorrect Alignment	Realign Clutch Assembly
Faulty Clutch Slave Cylinder	Replace Slave Cylinder
<b>No Pedal Pressure</b>	
Leaky Hydraulic System	Check Clutch Master Cylinder, Check Clutch Slave Cylinder
	Check Clutch Hose
Broken Clutch Cable	Replace Clutch Cable
Faulty Throw-Out Lever	Replace Throw-Out Lever
Broken Clutch Linkage	Repair Clutch Linkage
<b>Noisy Clutch Pedal</b>	
Faulty Safety Switch	Check/Replace Switch
Noisy Self-Adj. Ratchet	Replace Ratchet
Dry Throw-Out Bearing	Replace Throw-Out Bearing
Dry Pilot Bearing	Replace Pilot Bearing
Worn Input Shaft	Replace Input Shaft

## GENERAL INFORMATION

### Commonly Used Abbreviations

#### **\* PLEASE READ THIS FIRST \***

**NOTE:** This article is intended for general information purposes only. This information may not apply to all makes and models. Not all abbreviations are covered as manufacturers add new ones every day.

#### **"A"**

##### **A**

Amperes

##### **ABS**

Anti-Lock Brakes

##### **ABRS**

Air Bag Restraint System

##### **AC**

Alternating Current

##### **A/C**

Air Conditioning

##### **ACCS**

A/C Cycling Switch

##### **ACCUM**

Accumulator

##### **ACCY**

Accessory

##### **ACT**

Air Charge Temperature Sensor

##### **ADJ**

Adjust or Adjustable

##### **ADV**

Advance

##### **AFS**

Airflow Sensor

**AI**

Air Injection

**AIR or A.I.R.**

Air Injection Reactor

**AIS**

Air Injection System

**Alt.**

Alternator or Altitude

**Amp./amp/amperes**

Ampere

**ASCS**

Air Suction Control Solenoid

**ASD**

Auto Shutdown

**ASDM**

Air Bag System Diagnostic Module

**ASV**

Air Suction Valve

**A/T**

Automatic Transmission/Transaxle

**ATC**

Automatic Temperature Control

**ATDC**

After Top Dead Center

**ATF**

Automatic Transmission Fluid

**ATS**

Air Temperature Sensor

**Aux.**

Auxiliary

**Avg.**

Average

**AXOD**



**"B"**

**BAC**

By-Pass Air Control

**BAP**

Barometric Absolute Pressure Sensor

**BARO**

Barometric

**Batt.**

Battery

**Bbl.**

Barrel (Example: 4-Bbl.)

**BCM**

Body Control Module

**BHP**

Brake Horsepower

**BMAP**

Barometric and Manifold Absolute Pressure Sensor

**BOO**

Brake On-Off Switch

**B/P**

Backpressure

**BPS**

Barometric Pressure Sensor

**BPT**

Backpressure Transducer

**BTDC**

Before Top Dead Center

**BTSI**

Brake Transmission Shift Interlock

**BTU**

British Thermal Unit

**BVSV**

**"C"**

**Â° C**

Celsius (Degrees)

**Calif.**

California

**CANP**

Canister Purge

**CARB**

California Air Resources Board

**CAT**

Catalytic Converter

**CB**

Circuit Breaker

**CBD**

Closed Bowl Distributor

**cc**

cubic centimeter

**CCC**

Close Coupled Catalyst

**CCC**

Computer Command Control

**CCD**

Computer Controlled Dwell

**CCOT**

Cycling Clutch Orifice Tube

**CCW**

Counterclockwise

**CDI**

Capacitor Discharge Ignition

**CEC**

Computerized Engine Control

**CID**

Cubic Inch Displacement

**cm**

Centimeter

**CMP**

Camshaft Position Sensor

**CO**

Carbon Monoxide

**CO<sub>2</sub>**

Carbon Dioxide

**Cont.**

Continued

**CONV**

Convertible

**CP**

Canister Purge

**CKP**

Crankshaft Position Sensor

**CTS**

Coolant Temperature Sensor

**Cu. In.**

Cubic Inch

**CVC**

Constant Vacuum Control

**CV**

Check Valve or Constant Velocity

**CW**

Clockwise

**CYL or Cyl.**

Cylinder

**C<sup>3</sup>I**

Computer Controlled Coil Ignition

**C<sup>4</sup>**

Computer Controlled Catalytic Converter

**"D"**

**"D"**

Drive

**DC**

Direct Current Or Discharge

**DDD**

Dual Diaphragm Distributor

**Def.**

Defrost

**Defog.**

Defogger

**DERM**

Diagnostic Energy Reserve Module

**DFI**

Digital Fuel Injection

**Diag.**

Diagnostic

**DTC**

Diagnostic Trouble Code

**DIC**

Driver Information Center

**DIS**

Distributorless Ignition System

**DIST**

Distribution

**DLC**

Data Link Connector

**DOC**

Diesel Oxidation Catalyst

**DOHC**

Double Overhead Cam

**DOT**

Department of Transportation

**DPF**

Diesel Particulate Filter

**DRB-II**

Diagnostic Readout Box

**DVOM**

Digital Volt-Ohmmeter

**"E"****EACV**

Electric Air Control Valve

**EATX**

Electronic Automatic Transaxle

**EBCM**

Electronic Brake Control Module

**EBL**

Electronic Back Light

**ECM**

Engine Control Module

**ECT**

Engine Coolant Temperature Sensor

**EDIS**

Electronic Distributorless Ignition System

**EEC**

Electronic Engine Control

**EECS**

Evaporative Emission Control System

**EEPROM**

Electronically Erasable PROM

**EFE**

Early Fuel Evaporation

**EGO**

Exhaust Gas Oxygen Sensor

**EGR**

Exhaust Gas Recirculation



**EOT**

Engine Oil Temperature

**ESA**

Electronic Spark Advance

**ESC**

Electronic Spark Control

**EST**

Electronic Spark Timing

**EVAP**

Fuel Evaporative System

**EVIC**

Electronic Vehicle Information Center

**EVP**

EGR Valve Position Sensor

**EWMA**

Exponentially Weighted Moving Average (MODE 6)

**Exc.**

Except

**"F"****Â° F**

Fahrenheit (Degrees)

**F/B**

Fuse Block

**Fed.**

Federal

**FI**

Fuel Injection

**FICU**

Fuel Injection Control Unit

**FIPL**

Fuel Injector Pump Lever

**FLI**

Fuel Level Indicator

**FPR-VSV**

Fuel Pressure Regulator Vacuum Switching Valve

**Ft. Lbs.**

Foot Pounds

**FWD**

Front Wheel Drive

**"G"****g**

grams

**Gals.**

gallons

**GND or GRND**

Ground

**"H"****HAC**

High Altitude Compensation

**HC**

Hydrocarbons

**H/D**

Heavy Duty

**HO2S**

Heated Exhaust Gas Oxygen Sensor

**Hg**

Mercury

**Hgt.**

Height

**HLDT**

Headlight

**HO**

High Output

**HO2S**

Heated Oxygen Sensor

**HP**

High Performance

**HSC**

High Swirl Combustion

**HSO**

High Specific Output

**HTR**

Heater

**Hz**

Hertz (Cycles Per Second)

**"I"**

**IAC**

Idle Air Control

**IACV**

Idle Air Control Valve

**IAT**

Intake Air Temperature

**IC**

Integrated Circuit

**ID**

Identification

**I.D.**

Inside Diameter

**IFS**

Independant Front Suspension

**IFS**

Inertia Fuel Shutoff (Ford)

**Ign.**

Ignition

**IMRC**

Intake Manifold Runner Control

**In.**

Inches

**INCH Lbs.**

Inch Pounds

**in. Hg**

Inches of Mercury

**Inj.**

Injector

**IP**

Instrument Panel

**IRS**

Independent Rear Suspension

**ISC**

Idle Speed Control

**IVD**

Interactive Vehicle Dynamics (Ford)

**IVSV**

Idle Vacuum Switching Valve

**"J"**

**J/B**

Junction Block

**"K"**

**KAPWR**

Keep Alive Power

**k/ohms**

kilo-ohms (1000 ohms)

**kg**

Kilograms (weight)

**kg/cm<sup>2</sup>**

Kilograms Per Square Centimeter

**KM/H**

Kilometers Per Hour

**KOEO**

Key On, Engine Off

**KOER**

Key On, Engine Running

**KS**

Knock Sensor

**kW**

Kilowatt

**kV**

Kilovolt

**"L"**

**L**

Liter

**lbs. (Lbs. when used in table)**

Pounds

**LCD**

Liquid Crystal Display

**L/D**

Light Duty

**LDP**

Leak Detection Pump (Part of EVAP system.)

**LED**

Light Emitting Diode

**LH**

Left Hand

**"M"**

**mA**

Milliamps

**MA or MAF**

Mass Airflow

**MAFS**

Mass Airflow Sensor

**MAP**

Manifold Absolute Pressure

**MAT**

Manifold Air Temperature



**Mem.**

Memory

**MEM-CAL**

Memory Calibration Chip

**mfd.**

Microfarads

**MFI**

Multiport Fuel Injection

**MICU**

Multiplex Integrated Control Unit (Acura/Honda)

**MIL**

Malfunction Indicator Light

**MPI**

Multi-Point (Fuel) Injection

**mm**

Millimeters

**MPH**

Miles Per Hour

**mV**

Millivolts

**"N"****NA**

Not Available

**NAC**

NOx Adsorber Catalyst

**NCA**

No Color Available (Wiring Diagrams)

**NGS**

New Generation Star

**N.m**

Newton Meter

**No.**

Number

**Nos.**

Numbers

**NO<sub>x</sub>**

Oxides of Nitrogen

**"O"**

**O<sub>2</sub>**

Oxygen

**OBD**

On-Board Diagnostics

**OC**

Oxidation Catalyst

**OD**

Overdrive

**O.D.**

Outside Diameter

**OHC**

Overhead Camshaft

**OSS**

Output Speed Sensor

**O/S**

Oversize

**oz.**

Ounce

**ozs.**

Ounces

**"P"**

**"P"**

Park

**P/C**

Printed Circuit

**PCM**

Powertrain Control Module

**PCS**

Purge Control Solenoid

**PC-SOL**

Purge Control Solenoid

**PCV**

Positive Crankcase Ventilation

**PFI**

Port Fuel Injection

**PGM-FI**

Programmed Fuel Injection

**PID**

Parameter Identification

**PIP**

Profile Ignition Pick-up

**PNP**

Park Neutral Position Switch

**P/N**

Park/Neutral

**PRNDL**

Park Reverse Neutral Drive Low

**PROM**

Programmable Read-Only Memory

**psi**

Pounds Per Square Inch

**P/S**

Power Steering

**PSPS**

Power Steering Pressure Switch

**PTC**

Positive Temperature Coefficient

**PTO**

Power Take-Off

**Pts.**

Pints

**Pwr.**

Power

**"Q"**

**Qts.**

Quarts

**"R"**

**RABS**

Rear Anti-Lock Brake System

**RECIRC**

Recirculation

**RH**

Right Hand

**RPM**

Revolutions Per Minute

**RWAL**

Rear Wheel Anti-Lock Brake

**RWD**

Rear Wheel Drive

**"S"**

**SAS**

Steering Angle Sensor

**SBC**

Single Bed Converter

**SBEC**

Single Board Engine Controller

**SDARS**

Satellite Digital Audio Radio Service

**SES**

Service Engine Soon

**SFI**

Sequential (Port) Fuel Injection

**SIL**

Shift Indicator Light

**SIR**

Supplemental Inflatable Restraint

**SOHC**

Single Overhead Cam

**SOL or Sol.**

Solenoid

**SPFI**

Sequential Port Fuel Injection

**SPK**

Spark Control

**SPOUT**

Spark Output

**SRI**

Service Reminder Indicator

**SRS**

Supplemental Restraint System (Air Bag)

**STAR**

Self-Test Automatic Readout

**STO**

Self-Test Output

**SUB-O<sub>2</sub>**

Sub Oxygen Sensor

**Sw.**

Switch

**Sys.**

System

**"T"****TAB**

Thermactor Air By-Pass

**TAC**

Throttle Actuator Module



**TAD**

Thermactor Air Diverter

**TBC**

Body Control Module (General Motors)

**TBI**

Throttle Body Injection

**TCC**

Torque Converter Clutch

**TDC**

Top Dead Center

**Temp.**

Temperature

**TFI**

Thick Film Ignition

**THERMAC**

Thermostatic Air Cleaner

**TPM**

Tire Pressure Monitor

**TPMS**

Tire Pressure Monitor System

**TPS**

Throttle Position Sensor/Switch

**TS**

Temperature Sensor

**TV**

Therموالve

**TWC**

Three-Way Catalyst

**"V"****V**

Valve

**Vac.**

Vacuum

**VAF**

Vane Airflow

**VAPS**

Variable Assist Power Steering

**VCC**

Viscous Converter Clutch

**VCRM**

Variable Control Relay Module

**VIN**

Vehicle Identification Number

**VM**

Vacuum Modulator

**Volt.**

Voltage

**VOM**

Volt-Ohmmeter (Analog)

**VRV**

Vacuum Regulator Valve

**VSS**

Vehicle Speed Sensor

**VSV**

Vacuum Switching Valve

**"W"****W/**

With

**W/O**

Without

**WAC**

Wide Open Throttle A/C Switch

**WOT**

Wide Open Throttle

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## GENERAL INFORMATION

### Drive Axle Noise Diagnosis

#### \* PLEASE READ THIS FIRST \*

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

#### UNRELATED NOISES

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires and other parts of the vehicle. Make sure that cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any parts.

#### NON-DRIVE AXLE NOISES

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A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and trim moldings.

In certain conditions, the pitch of exhaust gases may sound like gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow tires, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings can also cause a whistling or whining noise. Ensure that none of these components are causing the noise before disassembling the drive axle.

#### GEAR NOISE

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear noise, make sure that tires, exhaust, and vehicle trim have been checked as possible causes.

#### CHUCKLE

**NOTE:** This is **GENERAL** information. This article is not intended to be specific

**to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused by excessive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough to cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

## **KNOCK**

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This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

## **CLUNK**

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Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, clunk will not be eliminated by overhauling drive axle.

## **BEARING WHINE**

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Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at driveshaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

## **BEARING RUMBLE**

**NOTE: This is GENERAL information. This article is not intended to be specific**



**to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of driveshaft speed.

## **CHATTER ON TURNS**

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This is a condition where the whole front or rear vibrates when vehicle is moving. The vibration is easily felt and heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates the chatter.

## **AXLE SHAFT NOISE**

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Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes. Noise will persist with transmission in neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect axle shafts and replace axle bearings. Re-evaluate vehicle for noise before removing any internal components.

## **VIBRATION**

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
  - Resonance vibrations of the body and frame structures caused by rotating of unbalance parts.
  - Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.
-

## GENERAL INFORMATION

### Electrostatic Discharge (ESD) Warning - Basic Information

#### **\* PLEASE READ THIS FIRST \***

**NOTE:** This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.

#### **INTRODUCTION**

**NOTE:** This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.

All Electrostatic Discharge (ESD) sensitive components contain solid state circuits (transistors, diodes, semiconductors) that may become damaged when contacted with an electrostatic charge. The following information applies to all ESD sensitive devices. The ESD symbol shown in Fig. [Fig.1](#) may be used on schematics to indicate which components are ESD sensitive. See [Fig.1](#). Although different manufactures may display different symbols to represent ESD sensitive devices, the handling and measuring precautions and procedures are the same.



**Fig. 1: Sample ESD Symbol**

## **HANDLING STATIC-SENSITIVE CIRCUITS/DEVICES**

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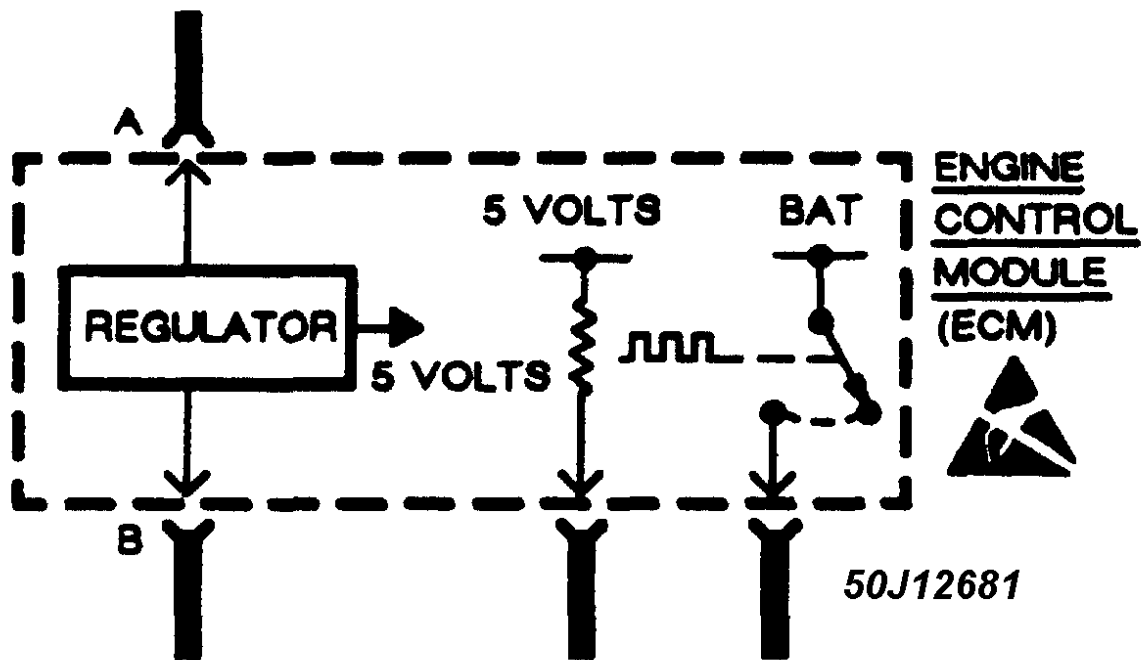
When handling an electronic part that is ESD sensitive, the technician should follow these guidelines to reduce any possible electrostatic charge build-up on the technician's body and the electronic part.

1. Always touch a known good ground source before handling the part. This should be repeated while handling the part and more frequently after sitting down from a standing position, sliding across the seat or walking a distance.
2. Avoid touching electrical terminals of the part, unless instructed by a diagnostic procedure.
3. DO NOT open the package of a new part until it is time to install the part.
4. Before removing the part from its package, ground the package to a known good ground source.

## **CHECKING STATIC-SENSITIVE CIRCUITS/DEVICES**

**NOTE:** This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.

1. Solid State circuits in electronic devices are shown greatly simplified in schematics. See [Fig.2](#). Due to the simplification of the electronic devices on the schematic, resistance measurements could be misleading or could lead to an electrostatic discharge. Always follow the recommended diagnostic procedure.



**Fig. 2: Sample Schematic Showing Typical ESD Sensitive Device**

2. Only measure resistance at the terminals of the devices when instructed by the recommended diagnostic procedure.
3. When using a voltmeter, be sure to connect the ground lead first.

**GENERAL INFORMATION**  
**Engine Displacement Conversion Table**

**CONVERSION TABLE**

**LITER/CID CONVERSION**

<b>Liter</b>	<b>CID</b>
1.0	59
1.0	60
1.0	61
1.1	66
1.1	68
1.1	70
1.2	71
1.2	72
1.2	73
1.2	76
1.3	77
1.3	78
1.3	79
1.3	80
1.3	81
1.3	82
1.4	85
1.4	85
1.4	86
1.5	89
1.5	90
1.5	91
1.6	94
1.6	95
1.6	96
1.6	97
1.6	98
1.6	99
1.7	102
1.7	103
1.7	105
1.8	107
1.8	109
1.8	110
1.8	111
1.8	112
1.9	113
1.9	114
1.9	116
1.9	119
2.0	119
2.0	120
2.0	121



<b>Liter</b>	<b>CID</b>
2.0	122
2.1	125
2.1	126
2.1	128
2.1	129
2.1	130
2.1	131
2.2	132
2.2	133
2.2	134
2.2	135
2.2	136
2.2	137
2.3	138
2.3	140
2.3	141
2.3	143
2.4	143
2.4	144
2.4	145
2.4	146
2.4	147
2.4	149
2.5	150
2.5	151
2.5	152
2.5	153
2.6	155
2.6	156
2.6	157
2.6	158
2.6	159
2.7	162
2.7	163
2.7	164
2.7	167
2.8	168
2.8	170
2.8	171
2.8	173
2.9	174
2.9	179
3.0	180
3.0	181
3.0	182
3.0	183
3.0	184
3.1	191
3.1	192
3.2	193
3.2	194
3.2	195

<b>Liter</b>	<b>CID</b>
3.2	196
3.2	197
3.2	198
3.3	199
3.3	200
3.3	201
3.3	204
3.4	206
3.4	207
3.4	209
3.5	210
3.5	211
3.5	212
3.5	213
3.5	214
3.5	215
3.6	219
3.6	220
3.7	225
3.7	226
3.7	229
3.8	229
3.8	230
3.8	231
3.8	232
3.8	234
3.8	238
3.9	239
3.9	240
3.9	241
4.0	241
4.0	242
4.0	243
4.0	244
4.1	250
4.1	252
4.2	255
4.2	258
4.3	259
4.3	260
4.3	262
4.3	263
4.3	266
4.4	266
4.4	267
4.4	268
4.5	273
4.5	274
4.5	276
4.6	278
4.6	279
4.6	281

<b>Liter</b>	<b>CID</b>
4.6	283
4.7	284
4.7	285
4.7	287
4.7	289
4.8	290
4.8	292
4.9	300
4.9	301
4.9	302
5.0	302
5.0	304
5.0	305
5.0	307
5.1	310
5.2	315
5.2	318
5.3	326
5.4	327
5.4	328
5.4	330
5.5	334
5.5	335
5.6	340
5.6	343
5.7	345
5.7	348
5.7	350
5.8	351
5.8	352
5.9	359
5.9	360
5.9	361
5.9	362
6.0	366
6.0	368
6.1	370
6.1	372
6.2	379
6.2	381
6.3	383
6.4	389
6.4	390
6.4	392
6.5	396
6.6	400
6.6	401
6.6	402
6.6	403
6.7	410
6.8	412
6.8	413

<b>Liter</b>	<b>CID</b>
6.8	414
6.8	415
6.9	420
6.9	421
7.0	425
7.0	426
7.0	427
7.0	428
7.0	429
7.0	430
7.1	432
7.2	440
7.4	454
7.5	455
7.5	460
7.6	462
8.0	488
8.2	500
8.8	534
8.8	537
8.8	538
8.9	540
9.0	549
9.1	555
9.3	568
9.3	570
9.6	588
9.8	600
9.9	605
10.0	611

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## GENERAL INFORMATION

### Engine Overhaul Procedures

#### **\* PLEASE READ THIS FIRST \***

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Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

#### **DESCRIPTION**

Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of cleaning, inspection, and assembly processes are included.

#### **ENGINE IDENTIFICATION**

Engine may be identified from Vehicle Identification Number (VIN) stamped on a metal tab. Metal tab may be located in different locations depending on manufacturer. Engine identification number or serial number is located on cylinder block. Location varies with each manufacturer.

#### **INSPECTION PROCEDURES**

#### **\* PLEASE READ THIS FIRST \***

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#### **GENERAL**

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Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Engine components must be inspected to meet manufacturer's specifications and tolerances during overhaul. Proper dimensions and tolerances must be met to obtain proper performance and maximum engine life.



Micrometers, depth gauges and dial indicator are used for checking tolerances during engine overhaul. Magnaflux, Magnaglo, dye-check, ultrasonic and x-ray inspection procedures are used for parts inspection.

## **MAGNETIC PARTICLE INSPECTION**

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### **Magnaflux & Magnaglo**

Magnaflux is an inspection technique used to locate material flaws and stress cracks. Component is subjected to a strong magnetic field. Entire component or a localized area can be magnetized. Component is coated with either a wet or dry material that contains fine magnetic particles.

Cracks which are outlined by the particles cause an interruption of magnetic field. Dry powder method of Magnaflux can be used in normal lighting and crack appears as a bright line.

Fluorescent liquid is used along with a Black light in the Magnaglo Magnaflux system. Darkened room is required for this procedure. The crack will appear as a glowing line. Complete demagnetizing of component upon completion is required on both procedures. Magnetic particle inspection applies to ferrous materials only.

## **PENETRANT INSPECTION**

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### **Zyglo**

The Zyglo process coats material with a fluorescent dye penetrant. Component is often warmed to expand cracks that will be penetrated by the dye. Using darkened room and Black light, component is inspected for cracks. Crack will glow brightly.

Developing solution is often used to enhance results. Parts made of any material, such as aluminum cylinder heads or plastics, may be tested using this process.

### **Dye Check**

Penetrating dye is sprayed on the previously cleaned component. Dye is left on component for 5-45 minutes, depending upon material density. Component is then wiped clean and sprayed with a developing solution. Surface cracks will show up as a bright line.

## **ULTRASONIC INSPECTION**

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If an expensive part is suspected of internal cracking, ultrasonic testing is used. Sound waves are used for component inspection.

## **X-RAY INSPECTION**

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This form of inspection is used on highly stressed components. X-ray inspection may be used to detect internal and external flaws in any material.

## **PRESSURE TESTING**

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Cylinder heads can be tested for cracks using a pressure tester. Pressure testing is performed by plugging all but one of the holes of cylinder head and injecting air or water into the open passage.

Leaks are indicated by the appearance of wet or damp areas when using water. When air is used, it is necessary to spray the head surface with a soap solution. Bubbles will indicate a leak. Cylinder head may also be submerged in water heated to specified temperature to check for cracks created during heat expansion.

## **CLEANING PROCEDURES**

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## **GENERAL**

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All components of an engine do not have the same cleaning requirements. Physical methods include bead blasting and manual removal. Chemical methods include solvent blast, solvent tank, hot tank, cold tank and steam cleaning of components.

## **BEAD BLASTING**

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Manual removal of deposits may be required prior to bead blasting, followed by some other cleaning method. Carbon, paint and rust may be removed using bead blasting method. Components must be free of oil and grease prior to bead blasting. Beads will stick to grease or oil soaked areas causing area not to be cleaned.

Use air pressure to remove all trapped residual beads from component after cleaning. After cleaning internal engine parts made of aluminum, wash thoroughly with hot soapy water. Component must be thoroughly cleaned as glass beads will enter engine oil resulting in bearing damage.

## **CHEMICAL CLEANING**

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Solvent tank is used for cleaning oily residue from components. Solvent blasting sprays solvent through a siphon gun using compressed air.

The hot tank, using heated caustic solvents, is used for cleaning ferrous materials only. DO NOT clean aluminum parts such as cylinder heads, bearings or other soft metals using the hot tank. After cleaning, flush parts with hot water.

A non-ferrous part will be ruined and caustic solution will be diluted if placed in the hot tank. Always use eye protection and gloves when using the hot tank.

Use of a cold tank is for cleaning aluminum cylinder heads, carburetors and other soft metals. A less caustic and unheated solution is used. Parts may be left in the tank for several hours without damage. After cleaning, flush parts with hot water.

Steam cleaning, with boiling hot water sprayed at high pressure, is recommended as the final cleaning process when using either hot or cold tank cleaning.

# COMPONENT CLEANING

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## SHEET METAL PARTS

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Examples of sheet metal parts are rocker covers, front and side covers, oil pan and bellhousing dust cover. Glass bead blasting or hot tank may be used for cleaning.

Ensure all mating surfaces are flat. Deformed surfaces should be straightened. Check all sheet metal parts for cracks and dents.

## INTAKE & EXHAUST MANIFOLDS

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Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Using solvent cleaning or bead blasting, clean manifolds for inspection. If intake manifold has an exhaust crossover, all carbon deposits must be removed. Inspect manifolds for cracks, burned or eroded areas, corrosion and damage to fasteners.

Exhaust heat and products of combustion cause threads of fasteners to corrode. Replace studs and bolts as necessary. On "V" type intake manifolds, sheet metal oil shield must be removed for proper cleaning and inspection. Ensure all manifold parting surfaces are flat and free of burrs.

## CYLINDER HEAD REPLACEMENT

**\* PLEASE READ THIS FIRST \***

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**Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.**

## REMOVAL

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**Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.**

Remove intake and exhaust manifolds and valve cover. Cylinder head and camshaft carrier bolts (if equipped) should be removed only when engine is cold. On many aluminum cylinder heads, removal while hot will cause cylinder head warpage. Mark rocker arm or overhead cam components for location.

Remove rocker arm components or overhead cam components. Components must be installed in original location. Individual design rocker arms may utilize shafts, ball-type pedestal mounts or no rocker arms. For all design types, wire components together and identify according to corresponding valve. Remove cylinder head bolts. Note length and location. Some applications require cylinder head bolts be removed in proper sequence to prevent cylinder head damage. See [Fig. 1](#). Remove cylinder head.

## INSTALLATION

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

**Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.**

Ensure all surfaces and head bolts are clean. Check that head bolt holes of cylinder block are clean and dry to prevent block damage when bolts are tightened. Clean threads with tap to ensure accurate bolt torque.

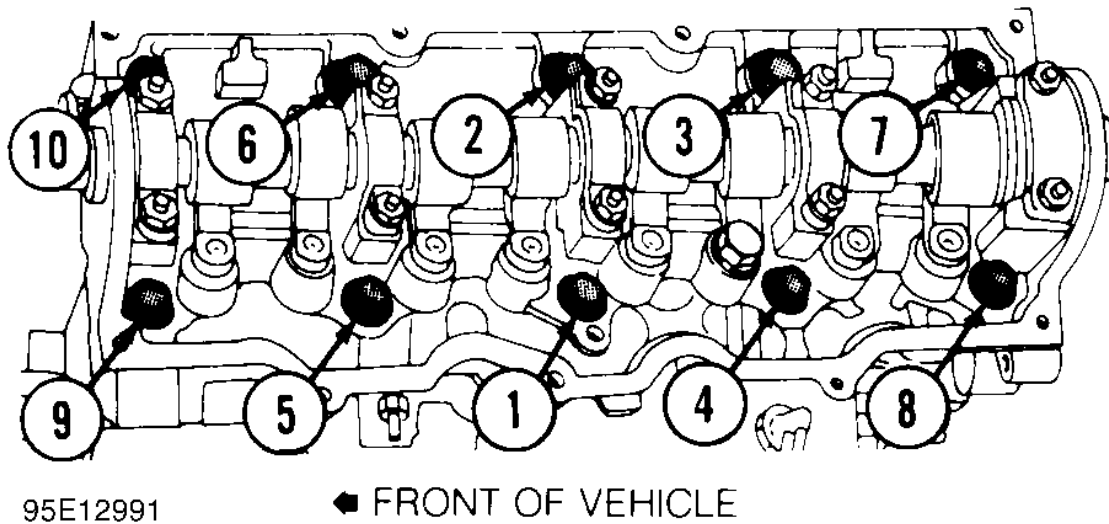
Install head gasket on cylinder block. Some manufacturers may recommend sealant be applied to head gasket prior to installation. Note that all holes are aligned. Some gasket applications may be marked so that certain area faces upward. Install cylinder head using care not to damage head gasket. Ensure cylinder head is fully seated on cylinder block.

Some applications require head bolts be coated with sealant prior to installation. This is done if head bolts are exposed to coolant passages. Some applications require head bolts be coated with light coat of engine oil.

Install head bolts. Head bolts should be tightened in proper steps and sequence to specification. See [Fig. 1](#). Install remaining components. Tighten all bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT.

**NOTE:** Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.





**Fig. 1: Typical Cylinder Head Tightening or Loosening Sequence**

### **VALVE ADJUSTMENT**

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Engine specifications will indicate valve train clearance and temperature at which adjustment is to be made on most models. In most cases, adjustment will be made with a cold engine. In some cases, both a cold and a hot clearance will be given for maintenance convenience.

On some models, adjustment is not required. Rocker arms are tightened to specification and valve lash is automatically set. On some models with push rod actuated valve train, adjustment is made at push rod end of rocker arm while other models do not require adjustment.

Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

Some models require hydraulic lifter to be bled down and clearance measured. Push rods of different length can be used to obtain proper clearance. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge.

Overhead cam engines designed without rocker arms actuate valves directly on a cam follower. A hardened, removable disc is installed between the cam lobe and lifter. Clearance will be checked between cam heel and adjusting disc in proper sequence using a feeler gauge. Engine will be rotated to obtain all valve adjustments.

On overhead cam engines designed with rocker arms, adjustment is made at valve end of rocker arm. Ensure valve to be adjusted is riding on heel of cam on all engines. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

# CYLINDER HEAD OVERHAUL

**\* PLEASE READ THIS FIRST \***

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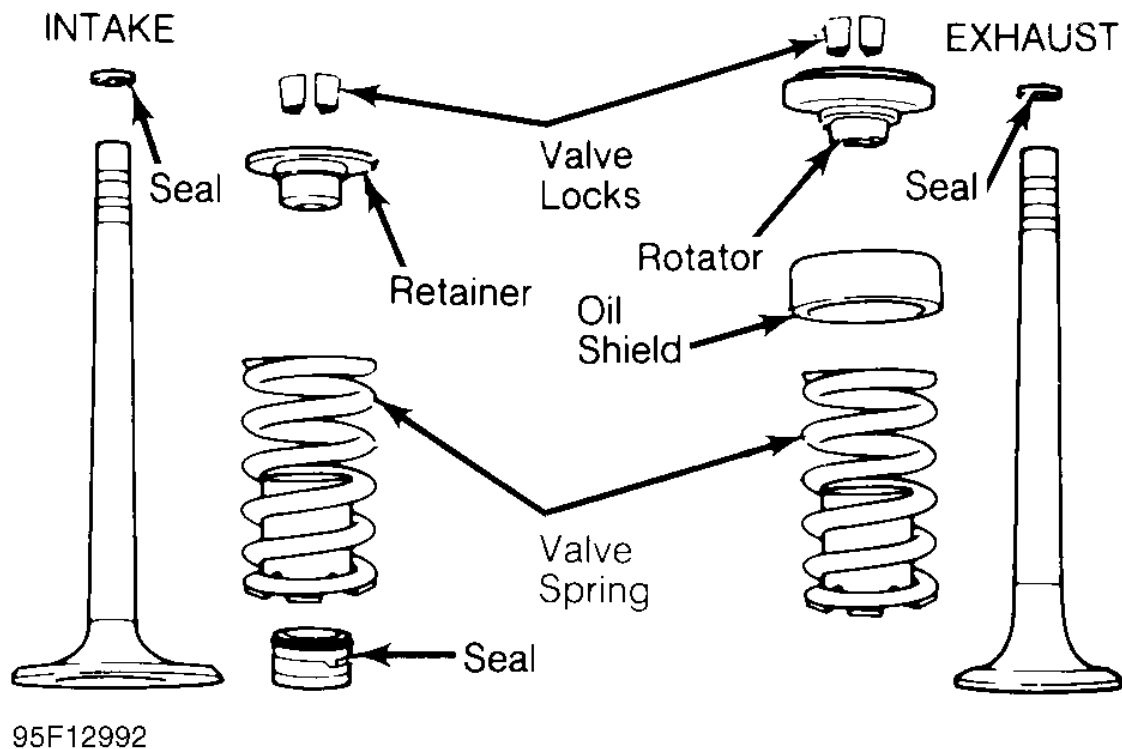
Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

## CYLINDER HEAD DISASSEMBLY

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Mark valves for location. Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator, valve spring, spring seat and valve. See [Fig. 2](#).



**Fig. 2: Exploded View of Valve Assemblies**

## CYLINDER HEAD CLEANING & INSPECTION

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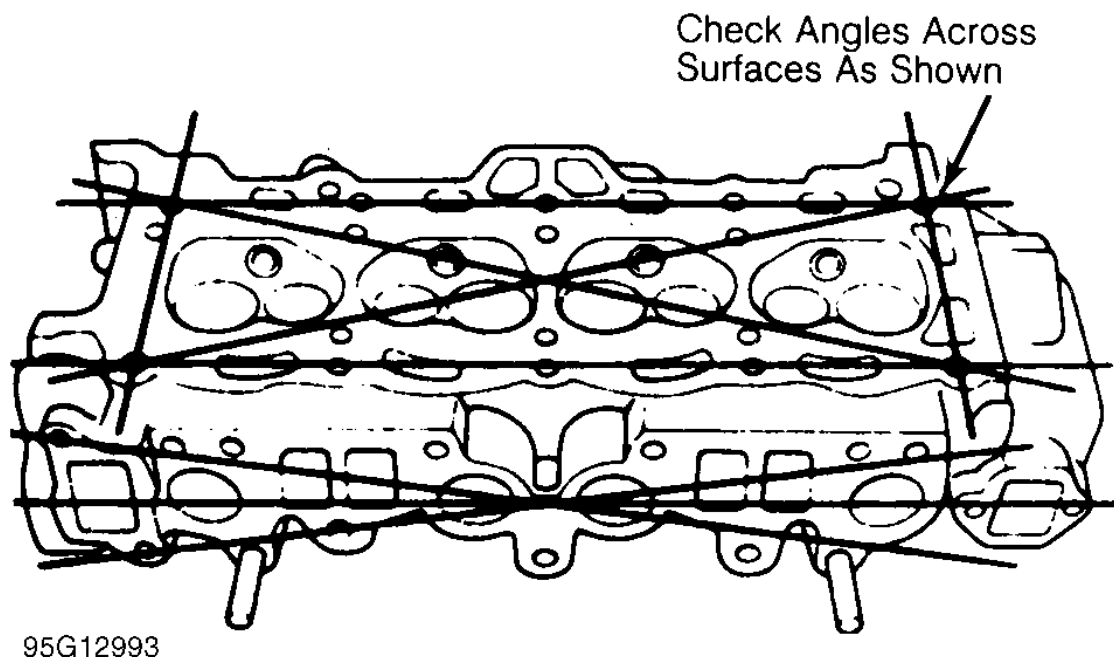
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Clean cylinder head and valve components using approved cleaning methods. Inspect cylinder head for cracks, damage or warped gasket surface. Place straightedge across gasket surface. Determine clearance at center of straightedge. Measure across both diagonals, longitudinal center line and across cylinder head at several points. See [Fig. 3](#).

On cast iron cylinder heads, if warpage exceeds .003" (.08 mm) in a 6" span, or .006" (.15 mm) over total length, cylinder head must be resurfaced. On most aluminum cylinder heads, if warpage exceeds .002" (.05 mm) in any area, cylinder head must be resurfaced. Warpage specification may vary by manufacturer. If warpage exceeds specification on some cylinder heads, cylinder head must be replaced.

Cylinder head thickness should be measured to determine amount of material which can be removed before replacement is required. Cylinder head thickness must not be less than the manufacturer's specification.

If cylinder head required resurfacing, it may not align properly with intake manifold. On "V" type engines, misalignment is corrected by machining intake manifold surface that contacts cylinder head. Cylinder head may be machined on surface that contacts intake manifold. Using oil stone, remove burrs or scratches from all sealing surfaces.



**Fig. 3: Checking Cylinder Head for Warpage**

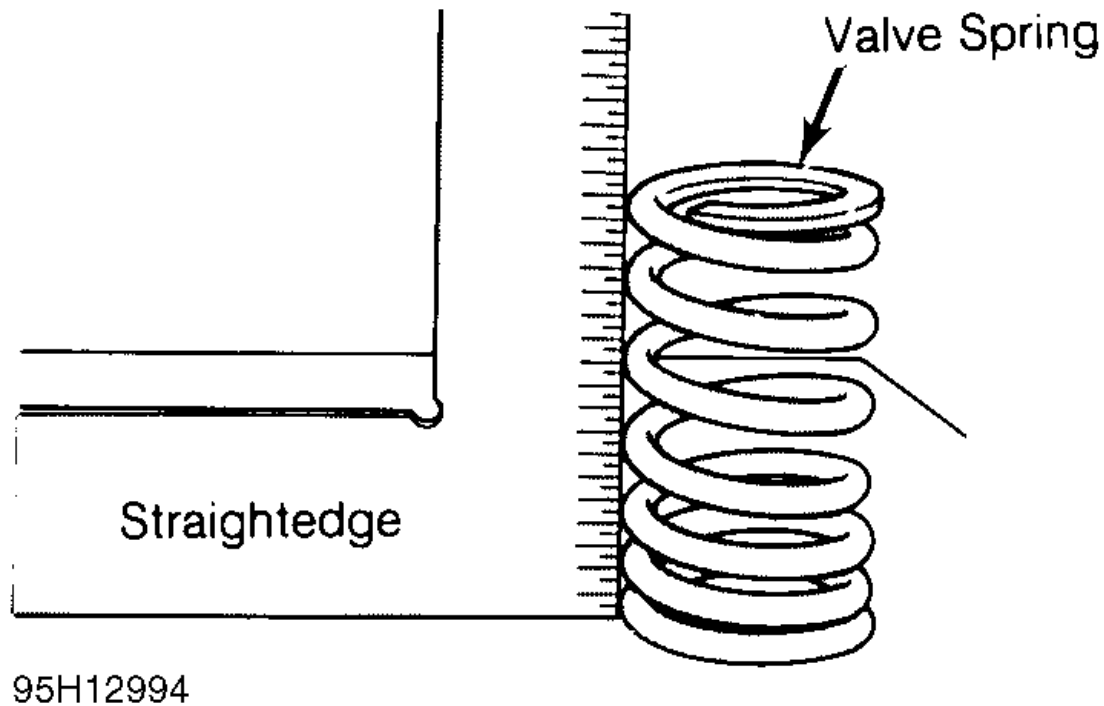
## **VALVE SPRINGS**

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Inspect valve springs for corroded or pitted valve spring surfaces which may lead to breakage. Polished spring ends caused by a rotating spring indicate that spring surge has occurred. Replace springs showing evidence of these conditions.

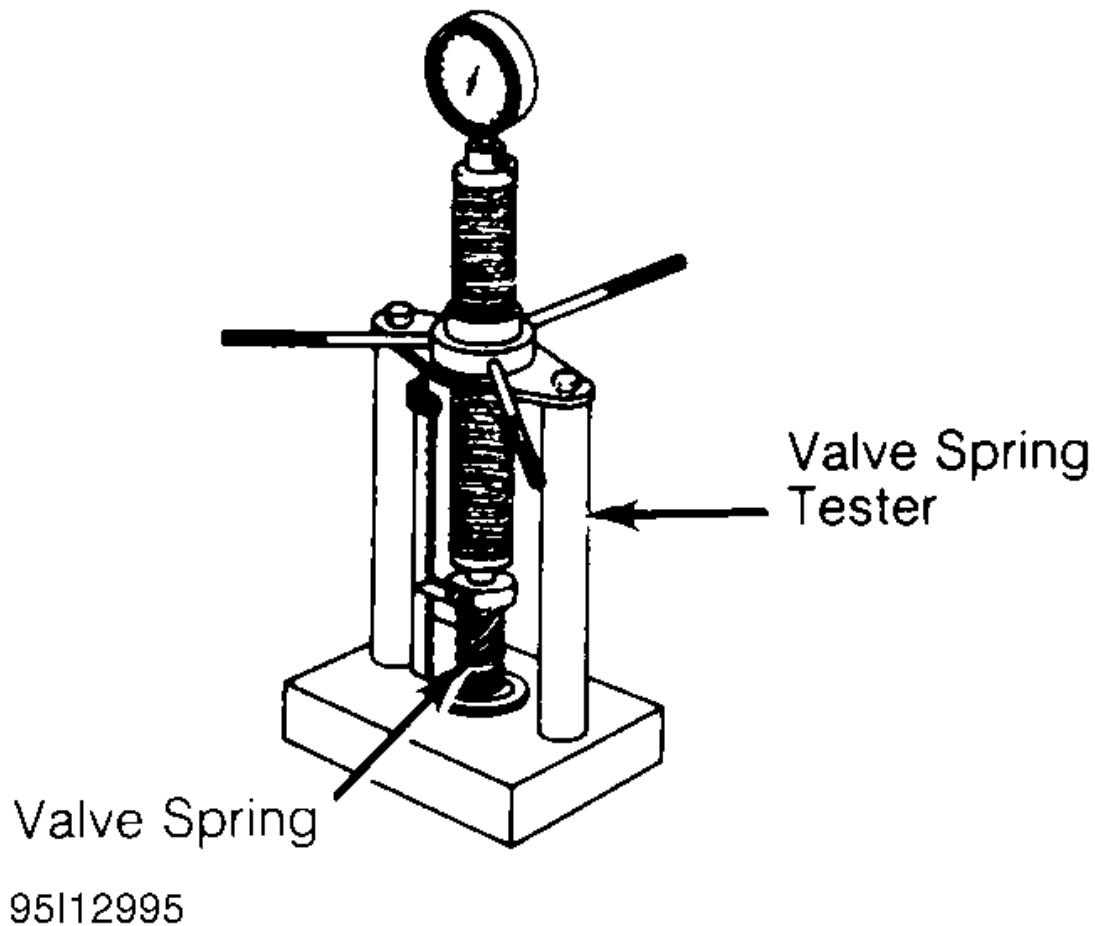
Inspect valve springs for squareness using a 90-degree straightedge. See [Fig. 4](#). Replace valve spring if out-of-square exceeds manufacturer's specification.



**[Fig. 4: Checking Valve Spring Squareness](#)**

Using vernier caliper, measure free length of all valve springs. Replace springs if not within specification. Using valve spring tester, test valve spring pressure at installed and compressed heights. See [Fig. 5](#).

Usually compressed height is installed height minus valve lift. Replace valve spring if not within specification. It is recommended to replace all valve springs when overhauling cylinder head. Valve springs may need to be installed with color coded end or small coils at specified area according to manufacturer.



**Fig. 5: Checking Valve Spring Pressure**

### **VALVE GUIDE**

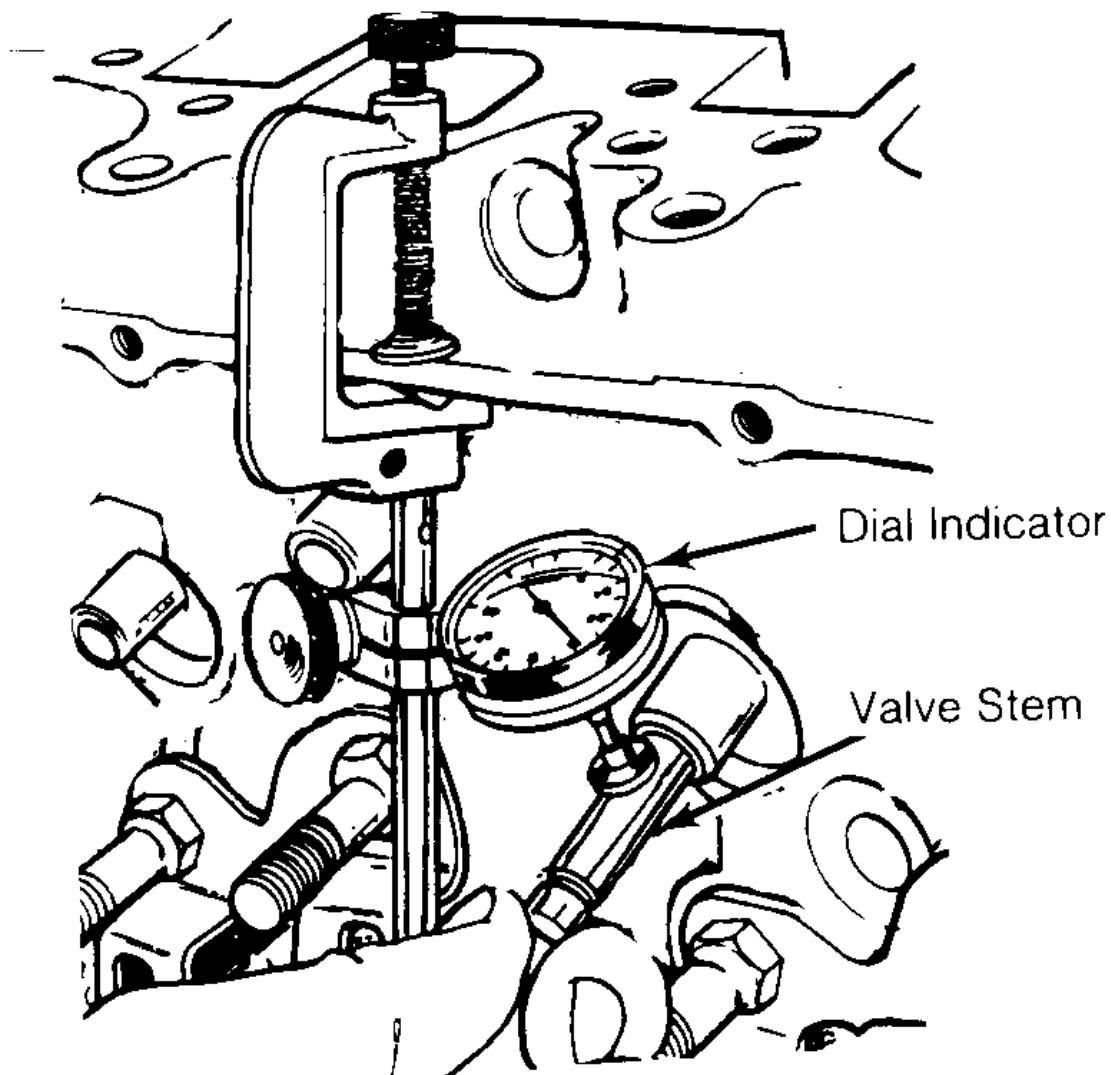
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### **Measuring Valve Guide Clearance**

Check valve stem-to-guide clearance. Ensure valve stem diameter is within specification. Install valve in valve guide. Install dial indicator assembly on cylinder head with tip resting against valve stem just above valve guide. See [Fig. 6](#).





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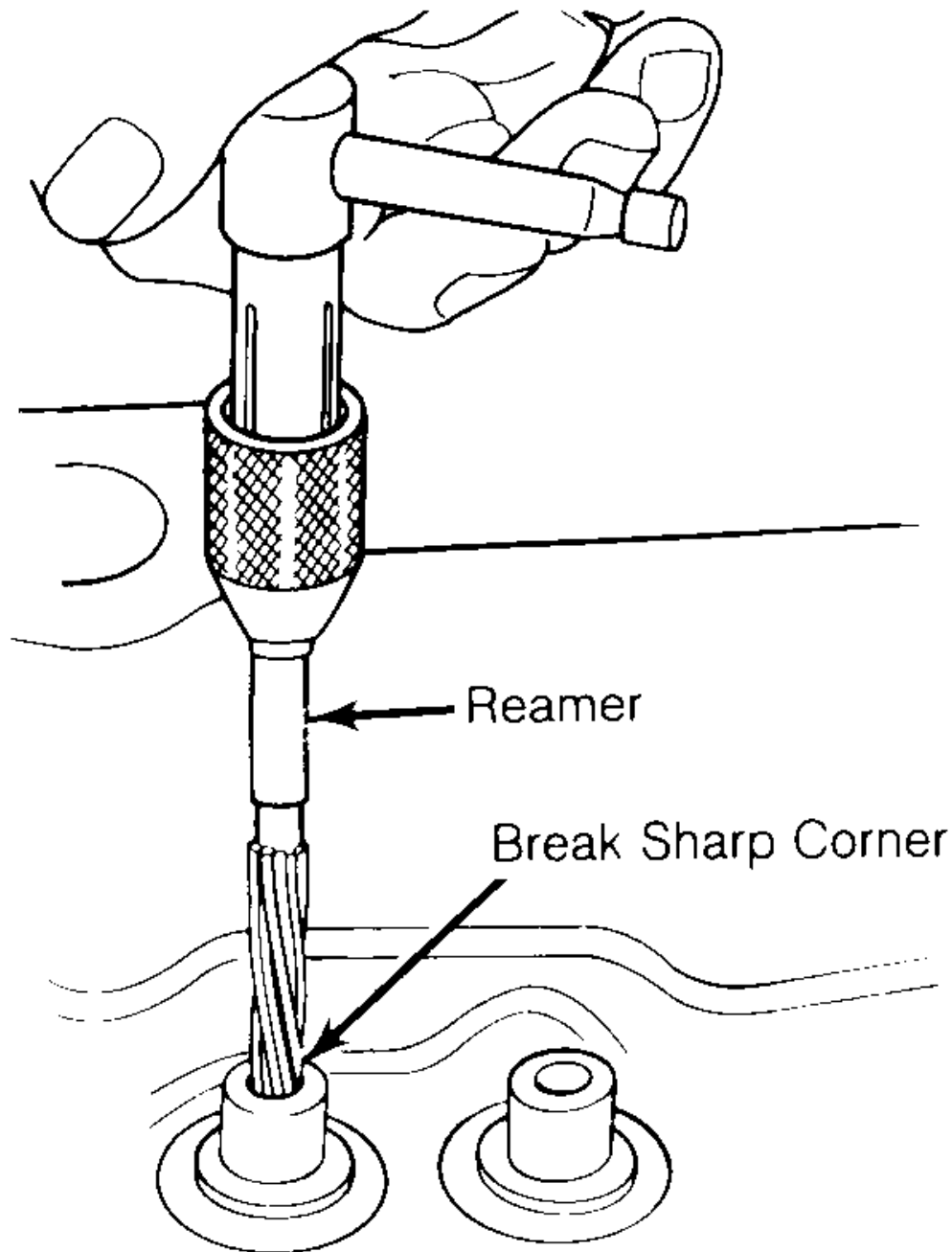
### **Fig. 6: Measuring Valve Stem-to-Guide Clearance**

Lower valve approximately 1/16" below valve seat. Push valve stem against valve guide as far as possible. Adjust dial indicator to zero. Push valve stem in opposite direction and note reading. Clearance must be within specification.

If valve guide clearance exceeds specification, valves with oversize stems may be used and valve guides are reamed to larger size or valve guide must be replaced. On some applications, a false guide is installed, then reamed to proper specification. Valve guide reamer set is used to ream valve guide to obtain proper clearance for new valve.

### **Reaming Valve Guide**

Select proper reamer for size of valve stem. Reamer must be of proper length to provide clean cut through entire length of valve guide. Install reamer in valve guide and rotate to cut valve guide. See [Fig. 7](#).



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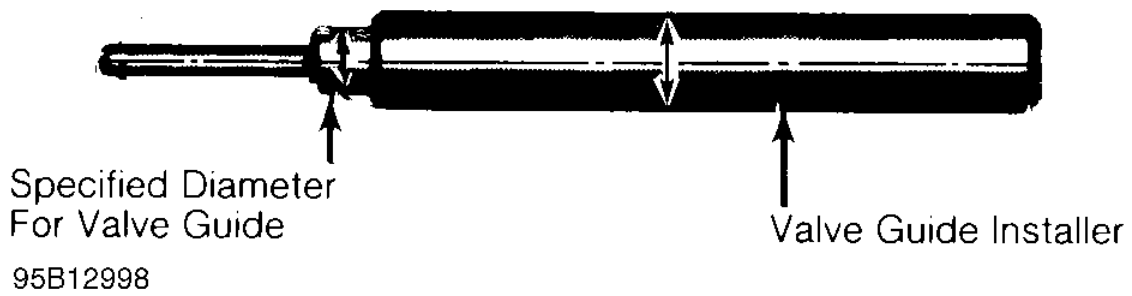
### Fig. 7: Reaming Valve Guides

#### Replacing Valve Guide

Replace valve guide if clearance exceeds specification. Valve guides are either pressed, hammered or shrunk in place, depending upon cylinder head design and type of metal used.

Remove valve guide from cylinder head by pressing or tapping on a stepped drift. See [Fig. 8](#). Once valve guide is installed, distance from cylinder head to top of valve guide must be checked. This distance must be within specification.

Aluminum heads are often heated before installing valve guide. Valve guide is sometimes cooled in dry ice prior to installation. Combination of a heated cylinder head and cooled valve guide ensures a tight guide fit upon assembly. The new guide must be reamed to specification.



**Fig. 8: Typical Valve Guide Remover & Installer**

## VALVES & VALVE SEATS

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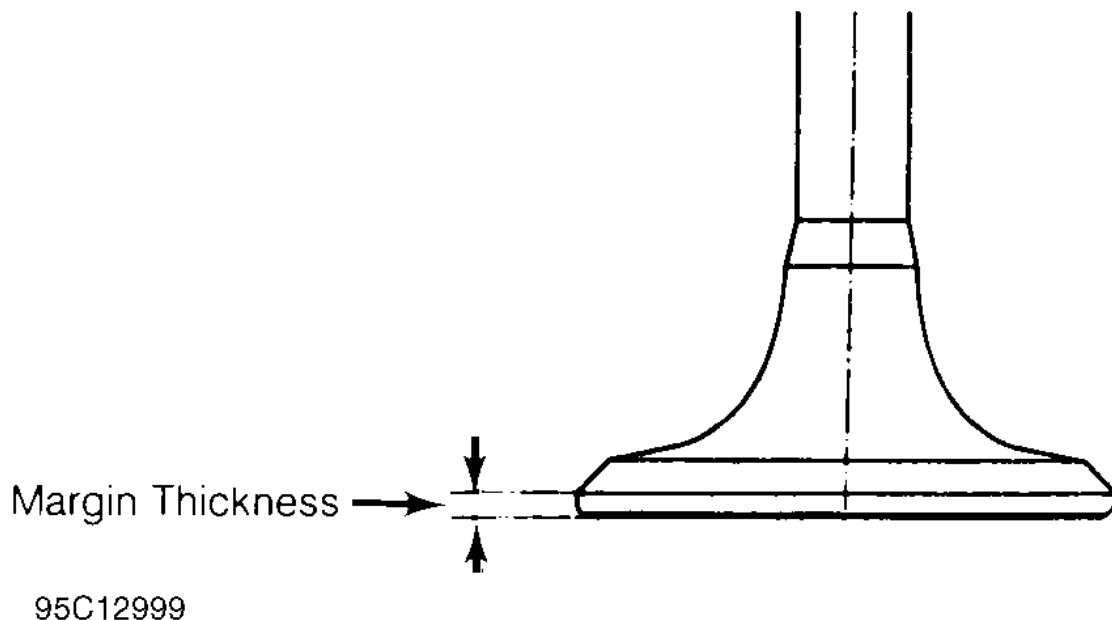
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### Valve Grinding

Valve stem O.D. should be measured in several areas to indicate amount of wear. Replace valve if not within specification. Valve margin area should be measured to ensure that valve can be ground. See [Fig. 2](#).

If valve margin is less than specification, the valves will be burned. Valve must be replaced. Due to minimum margin dimensions during manufacture, some new type valves cannot be reground. Some manufacturers use stellite coated valves that must NOT be machined. Valves can only be lapped into valve seat.

**CAUTION:** Some valves are sodium filled. Extreme care must be used when disposing of damaged or worn sodium-filled valves.



**Fig. 9: Measuring Valve Head Margin**

Resurface valve to proper angle specification using valve grinding machine. Follow manufacturer's instructions for valve grinding machine. Specifications may indicate a different valve face angle than seat angle. Measure valve margin after grinding. Replace valve if not within specification. Valve stem tip can be refinished using valve grinding machine.

### **Valve Lapping**

During valve lapping of recently designed valves, be sure to follow manufacturer's recommendations. Surface hardening and materials used with some valves do not permit lapping. Lapping process will remove excessive amounts of the hardened surface.

Valve lapping is done to ensure adequate sealing between valve face and seat. Use either a hand drill or lapping stick with suction cup attached.

Moisten and attach suction cup to valve. Lubricate valve stem and guide. Apply a thin coat of fine valve grinding compound between valve and seat. Rotate lapping tool between the palms or with hand drill.

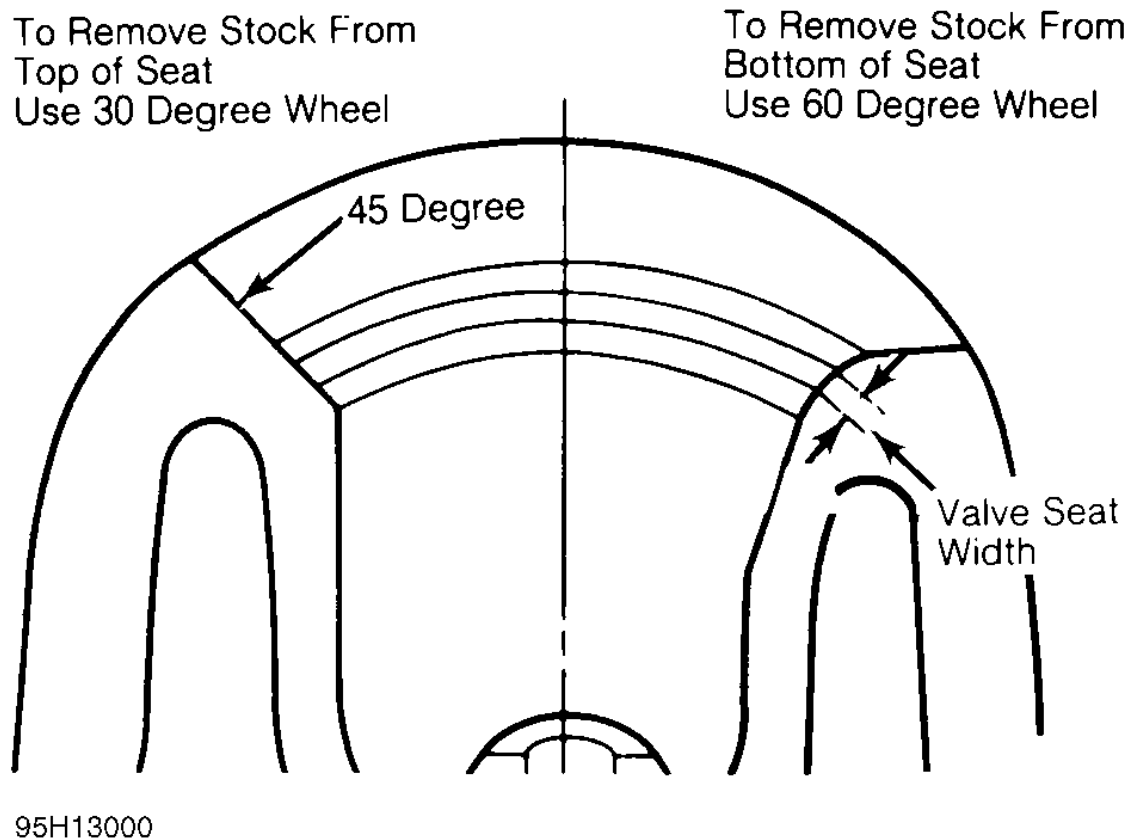
Lift valve upward off the seat and change position often. This is done to prevent grooving of valve seat. Lap valve until a smooth polished seat is obtained. Thoroughly clean grinding compound from components. Valve-to-valve seat concentricity should be checked. See **VALVE SEAT CONCENTRICITY**.

**CAUTION:** Valve guides must be in good condition and free of carbon deposits prior to valve seat grinding. Some engines contain an induction hardened valve seat. Excessive material removal will damage valve seats.

### **Valve Seat Grinding**

Select coarse stone of correct size and angle for seat to be ground. Ensure stone is true and has a smooth surface. Select correct size pilot for valve guide dimension. Install pilot in valve guide. Lightly lubricate pilot shaft. Install stone on pilot. Move stone off and on the seat approximately 2 times per second during grinding operation.

Select a fine stone to finish grinding operation. Various angle grinding stones are used to center and narrow the valve seat as required. See **Fig. 10**.



**Fig. 10: Adjusting Valve Seat Width**

### Valve Seat Replacement

Replacement of valve seat inserts is done by cutting out the old insert and machining an oversize insert bore. Replacement oversize insert is usually cooled and the cylinder head is sometimes warmed. Valve seat is pressed into the head. This operation requires specialized machine shop equipment.

### Valve Seat Concentricity

Using dial gauge, install gauge pilot in valve guide. Position gauge arm on the valve seat. Adjust dial indicator to zero. Rotate arm 360 degrees and note reading. Runout should not exceed specification.

To check valve-to-valve seat concentricity, coat valve face lightly with Prussian Blue dye. Install valve and rotate it on valve seat. If pattern is even and entire seat is coated at valve contact point, valve is concentric with the valve seat.

## CYLINDER HEAD REASSEMBLY

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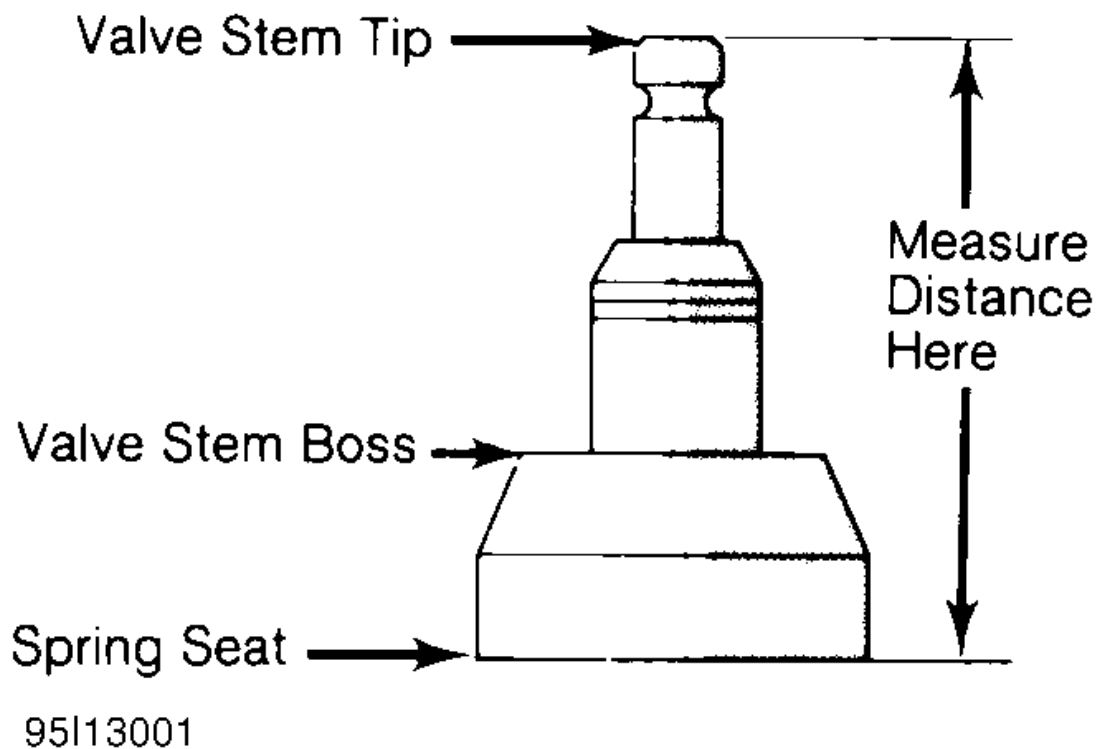
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### Valve Stem Installed Height

Valve stem installed height must be checked when new valves are installed or when valves or valve seats have been ground. Install valve in valve guide. Measure distance from tip of valve stem to spring seat. See [Fig. 11](#). Distance must be within specification to allow sufficient clearance for valve operation.



Remove valve and grind valve stem tip if height exceeds specification. Valve tips are surface hardened. DO NOT remove more than .010" (.25 mm) from tip. Chamfer sharp edge of reground valve tip. Recheck valve stem installed height.



**Fig. 11: Measuring Valve Stem Installed Height**

### **VALVE STEM OIL SEALS**

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Valve stem oil seals must be installed on valve stem. See [Fig. 2](#). Seals are needed due to pressure differential at the ends of valve guides. Atmospheric pressure above intake guide, combined with manifold vacuum below guide, causes oil to be drawn into the cylinder.

Exhaust guides also have pressure differential created by exhaust gas flowing past the guide, creating a low pressure area. This low pressure area draws oil into the exhaust system.

Some manufacturers require that special color code or specified height valve stem oil seal be installed in designated area.

### **Replacement (On-Vehicle)**

Mark rocker arm or overhead cam components for location. Remove rocker arm components or overhead cam components. Components must be installed in original location. Remove spark plugs. Valve stem oil seals may be replaced by holding valves against seats using air pressure.

Air pressure must be installed in cylinder using an adapter for spark plug hole. An adapter can be constructed by welding air hose connection to spark plug body with porcelain removed.

Rotate engine until piston is at top of stroke. Install adapter in spark plug hole. Apply a minimum of 140 psi (9.8 kg/cm<sup>2</sup>) line pressure to adapter. Air pressure should hold valve closed. If air pressure does not hold valve closed, check for damaged or bent valve. Cylinder head must be removed for service.

Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator and valve spring. Remove valve stem oil seal.

If oversize valves have been installed, oversize oil seals must be used. Coat valve stem with engine oil. Install protective sleeve over end of valve stem. Install new oil seal over valve stem and seat on valve guide. Remove protective sleeve. Install spring seat, valve spring and retainer or rotator. Compress spring and install valve locks. Remove spring compressor. Ensure valve locks are fully seated.

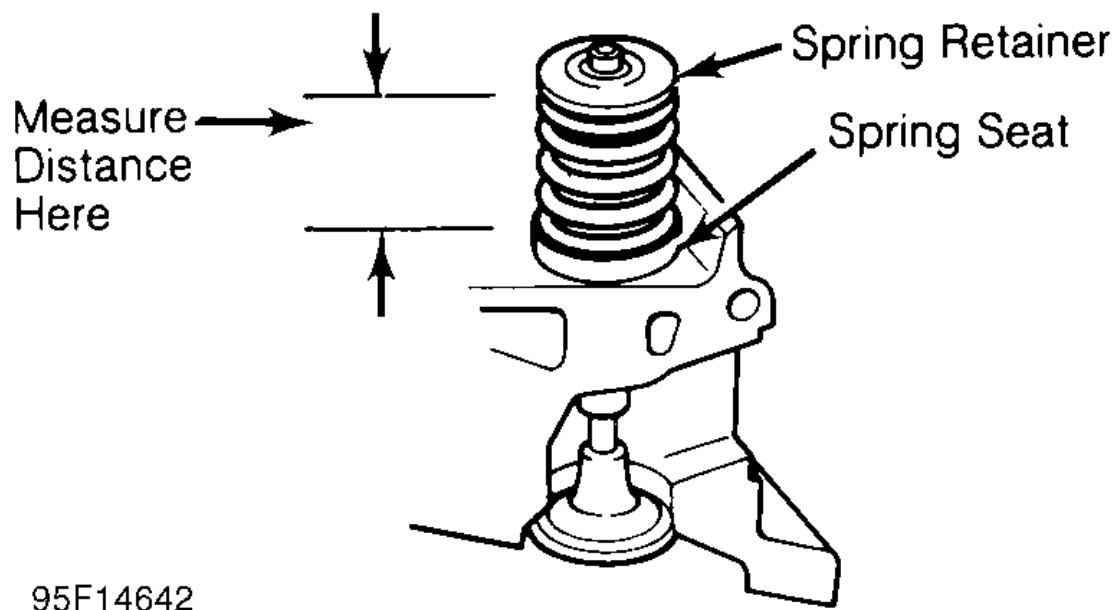
Install rocker arms or overhead cam components. Tighten all bolts to specification. Adjust valves if required. Remove adapter. Install spark plugs, valve cover and gasket.

## VALVE SPRING INSTALLED HEIGHT

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Valve spring installed height should be checked during reassembly. Measure height from lower edge of valve spring to the upper edge. DO NOT include valve spring seat or retainer. Distance must be within specification. If valves and/or seats have been ground, a valve spring shim may be required to correct spring height. See [Fig. 12](#).



**Fig. 12: Measuring Valve Spring Installed Height**

## ROCKER ARMS & ASSEMBLIES

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### Rocker Studs

Rocker studs are either threaded or pressed in place. Threaded studs are removed by locking 2 nuts on the stud. Unscrew the stud by turning the jam nut. Coat new stud threads with Loctite and install. Tighten to specification.

Pressed-in stud can be removed using a stud puller. Ream stud bore to proper specification and press in a new oversize stud. Pressed-in studs are often replaced by cutting threads in the stud bore to accept a threaded stud.

### Rocker Arms & Shafts

Mark rocker arms for location. Remove rocker arm retaining bolts. Remove rocker arms. Inspect rocker arms, shafts, bushings and pivot balls (if equipped) for excessive wear. Inspect rocker arms for wear in valve stem contact area. Measure rocker arm bushing I.D. Replace bushings if excessively worn.

The rocker arm valve stem contact point may be reground, using special fixture for valve grinding machine. Remove minimum amount of material as possible. Ensure all oil passages are clear. Install rocker arm components in original location. Ensure rocker arm is properly seated in push rod. Tighten bolts to specification. Adjust valves if required. See [VALVE ADJUSTMENT](#).

## PUSH RODS

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Remove rocker arms. Mark push rods for location. Remove push rods. Push rods can be steel or aluminum, solid or hollow. Hollow push rods must be internally cleaned to ensure oil passage to rocker arms is cleaned. Check push rods for damage, such as loose ends on steel tipped aluminum types.

Check push rod for straightness. Roll push rod on a flat surface. Using feeler gauge, check clearance at center. Replace push rod if bent. The push rod can also be supported at each end and rotated. A dial indicator is used to detect a bent area in the push rod.

Lubricate ends of push rod and install push rod in original location. Ensure push rod is properly seated in lifter. Install rocker arm. Tighten bolts to specification. Adjust valves if required. See [VALVE ADJUSTMENT](#).

## LIFTERS

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### Hydraulic Lifters

Before replacing a hydraulic lifter for noisy operation, ensure noise is not caused by worn rocker arms or valve tips. Also ensure sufficient oil pressure exists. Hydraulic lifters must be installed in original location. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold, cylinder head or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use a hydraulic lifter remover or magnet. Different type lifters are used. See [Fig. 13](#).

On sticking lifters, disassemble and clean lifter. DO NOT mix lifter components or positions. Parts are select-fitted and are not interchangeable. Inspect all components for wear. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. On roller type lifters, inspect roller for flaking, pitting, loss of needle bearings and roughness during rotation.

Measure lifter body O.D. in several areas. Measure lifter bore I.D. Ensure components or oil clearance is within specification. Some models offer oversize lifters. Replace lifter if damaged.

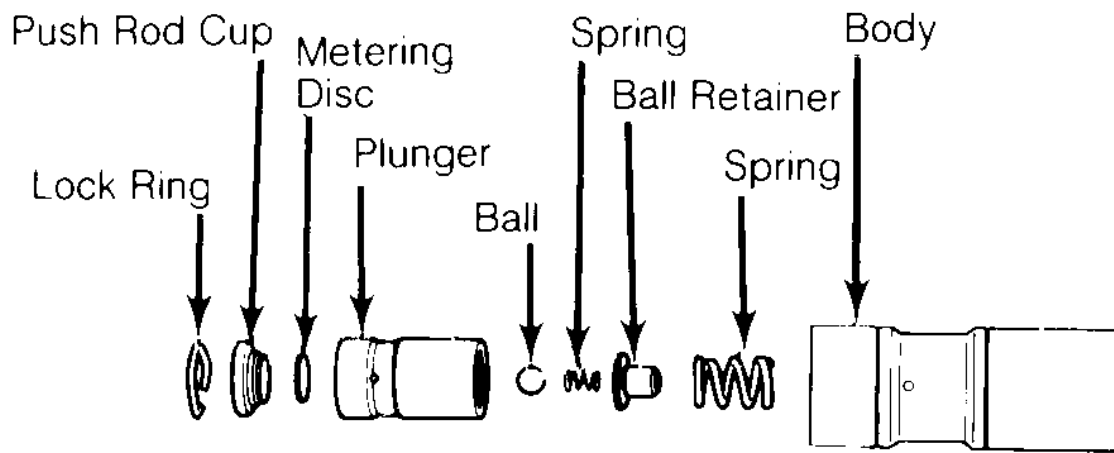
If lifter check valve is not operating, obstructions may be preventing it from closing or valve spring may be broken. Clean or replace components as necessary.

Check plunger operation. Plunger should drop to bottom of the body by its own weight when assembled dry. If plunger is not free, soak lifter in solvent to dissolve deposits.

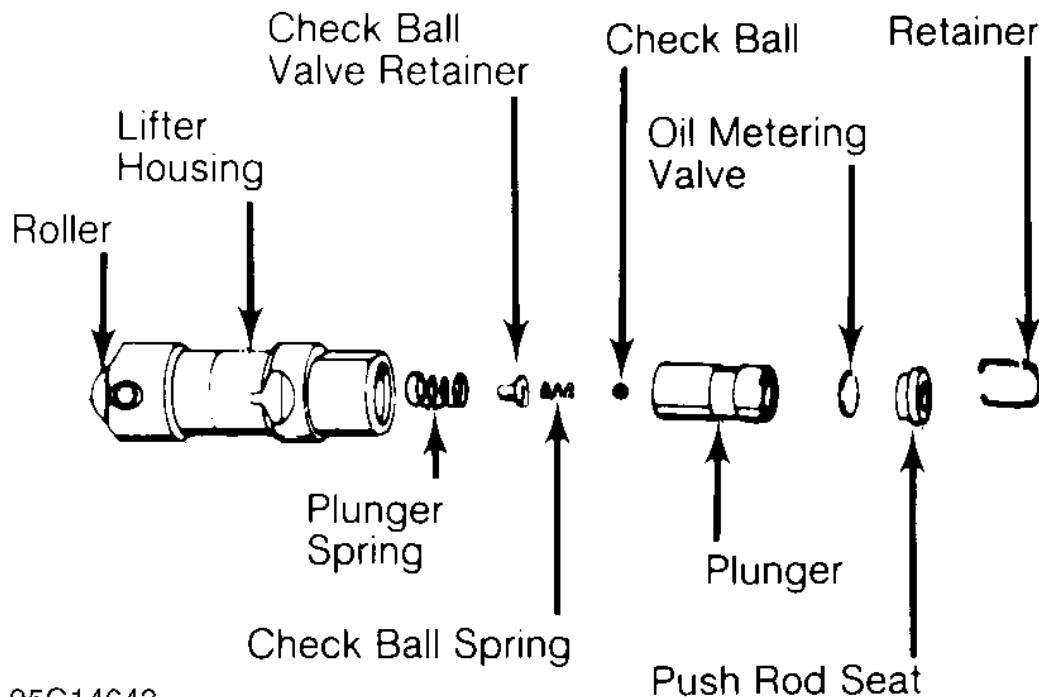
Lifter leak-down test can be performed on lifter. Lifter must be filled with special test oil. New lifters contain special test oil. Using lifter leak-down tester, perform leak-down test following manufacturer's instructions. If leak-down time is not within specifications, replace lifter assembly.

Lifters should be soaked in clean engine oil several hours prior to installation. Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. See [Fig. 13](#). Install lifter in original location. Install remaining components. Valve lash adjustment is not required on most hydraulic lifters. Preload of hydraulic lifter is automatic. Some models may require adjustment.

**NOTE:** **Some manufacturers require that a crankcase conditioner be added to engine oil and engine operated for specified amount of time to aid in lifter break-in procedure if new lifters or camshaft are installed.**



FLAT LIFTER



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ROLLER LIFTER

**Fig. 13: Typical Hydraulic Valve Lifter Assemblies**

**Mechanical Lifters**

Lifter assemblies must be installed in original locations. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use lifter remover or magnet.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. Install lifter in original location. Install remaining components. Tighten bolts to specification. Adjust valves. See **VALVE ADJUSTMENT**.

**PISTONS, CONNECTING RODS & BEARINGS**

**\* PLEASE READ THIS FIRST \***



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## **RIDGE REMOVAL**

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Ridge in cylinder wall must be removed prior to piston removal. Failure to remove ridge prior to removing pistons will cause piston damage in piston ring lands or grooves.

With piston at bottom dead center, place rag in bore to trap metal chips. Install ridge reamer in cylinder bore. Adjust ridge reamer using manufacturer's instructions. Remove ridge using ridge reamer. DO NOT remove an excessive amount of material. Ensure ridge is completely removed.

## **PISTON & CONNECTING ROD REMOVAL**

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Note top of piston. Some pistons may contain a notch, arrow or be marked FRONT. Piston must be installed in proper direction to prevent damage with valve operation.

Check that connecting rod and cap are numbered for cylinder location and which side of cylinder block the number faces. Proper cap and connecting rod must be installed together. Connecting rod cap must be installed on connecting rod in proper direction to ensure bearing lock procedure. Mark connecting rod and cap if necessary. Pistons must be installed in original location.

Remove cap retaining nuts or bolts. Remove bearing cap. Install tubing protectors on connecting rod bolts. This protects cylinder walls from scoring during removal. Ensure proper removal of ridge. Push piston and connecting rod from cylinder. Connecting rod boss can be tapped with a wooden dowel or hammer handle to aid in removal.

## **PISTON & CONNECTING ROD**

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### Disassembly

Using ring expander, remove piston rings. Remove piston pin retaining rings (if equipped). Note direction of piston installation on connecting rod. On pressed type piston pins, special fixtures and procedures according to manufacturer must be used to remove piston pins. Follow manufacturer's recommendations to avoid piston distortion or breakage.

### Cleaning

Remove all carbon and varnish from piston. Pistons and connecting rods may be cleaned in cold type chemical tank. Using ring groove cleaner, clean all deposits from ring grooves. Ensure all deposits are cleaned from ring grooves to prevent ring breakage or sticking. DO NOT attempt to clean pistons with wire brush.

### Inspection

Inspect pistons for nicks, scoring, cracks or damage in ring areas. Connecting rod should be checked for cracks using Magnaflux procedure. Piston diameter must be measured in manufacturer's specified area.

Using telescopic gauge and micrometer, measure piston pin bore of piston in 2 areas, 90 degrees apart. This is done to check diameter and out-of-round.

Install proper bearing cap on connecting rod. Ensure bearing cap is installed in proper location. Tighten bolts or nuts to specification. Using inside micrometer, measure inside diameter in 2 areas, 90 degrees apart.

Connecting rod I.D. and out-of-round must be within specification. Measure piston pin bore I.D. and piston pin O.D. All components must be within specification. Subtract piston pin diameter from piston pin bore in piston and connecting rod to determine proper fit.

Connecting rod length must be measured from center of crankshaft journal inside diameter to center of piston pin bushing using proper caliper. Connecting rods must be the same length. Connecting rods should be checked on an alignment fixture for bent or twisted condition. Replace all components which are damaged or not within specification.

## PISTON & CYLINDER BORE FIT

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Ensure cylinder is checked for taper, out-of-round and properly honed prior to checking piston and cylinder bore fit. See **CYLINDER BLOCK**. Using dial bore gauge, measure cylinder bore.

Measure piston skirt diameter at 90 degree angle to piston pin at specified area by manufacturer. Subtract piston diameter from cylinder bore diameter to determine piston-to-cylinder clearance. Clearance must be within specification. Mark piston for proper cylinder location.

## ASSEMBLING PISTON & CONNECTING ROD

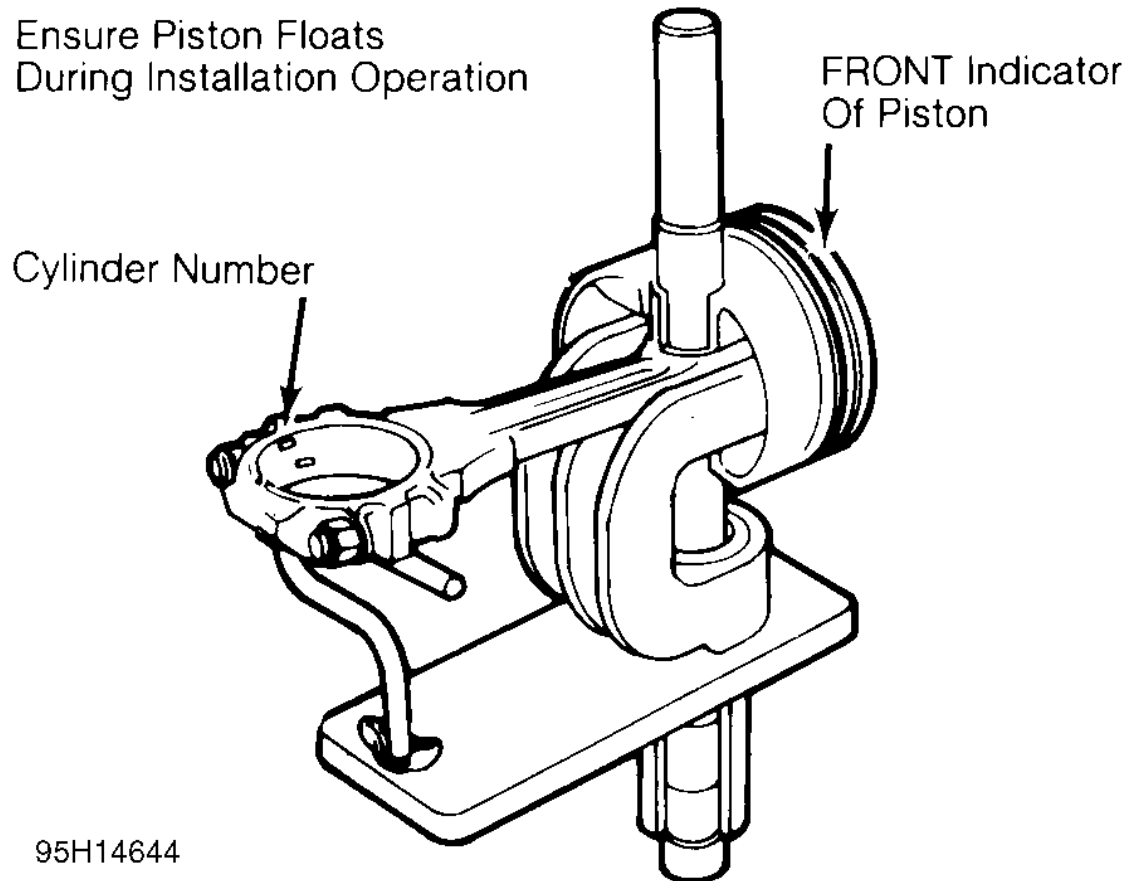
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Install piston on connecting rod for corresponding cylinder. Ensure reference marking on top of piston corresponds with connecting rod and cap number. See [Fig. 14](#).

Lubricate piston pin and install in connecting rod. Ensure piston pin retainers are fully seated (if equipped). On pressed type piston pins, follow manufacturer's recommended procedure to avoid distortion or breakage.



**Fig. 14: Installing Typical Piston Pin**

### **CHECKING PISTON RING CLEARANCES**

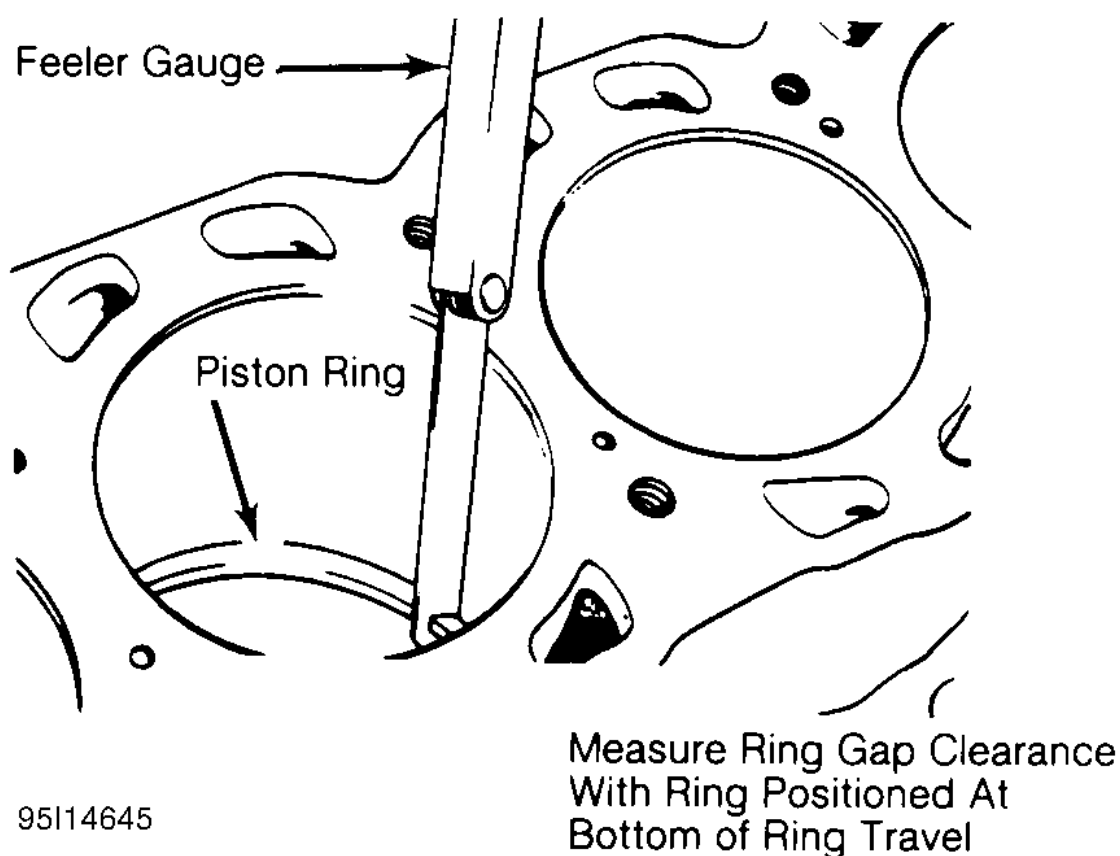
**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

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Piston rings must be checked for side clearance and end gap. To check end gap, install piston ring in cylinder in which it is to be installed. Using an inverted piston, push ring to bottom of cylinder in smallest cylinder diameter.

Using feeler gauge, check ring end gap. See [Fig. 15](#). Piston ring end gap must be within specification. Ring breakage will occur if insufficient ring end gap exists.

Some manufacturers permit correcting insufficient ring end gap by using a fine file while other manufacturers recommend using another ring set. Mark rings for proper cylinder installation after checking end gap.



### **Fig. 15: Checking Piston Ring End Gap**

For checking side clearance, install rings on piston. Using feeler gauge, measure clearance between piston ring and piston ring land. Check side clearance in several areas around piston. Side clearance must be within specification.

If side clearance is excessive, piston ring grooves can be machined to accept oversize piston rings (if available). Normal practice is to replace piston.

## **PISTON & CONNECTING ROD INSTALLATION**

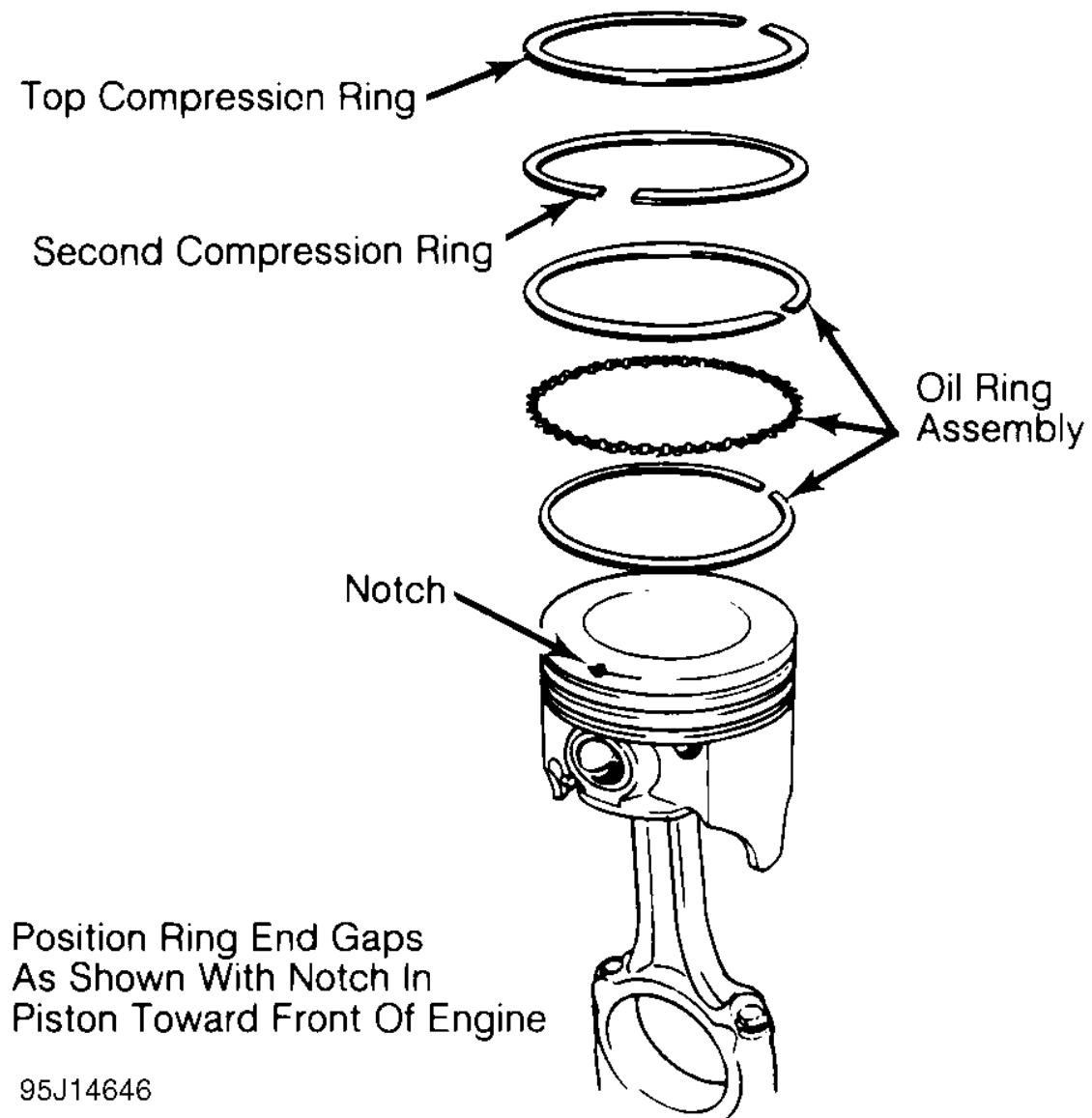
**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

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Cylinders must be honed prior to piston installation. See [CYLINDER HONING](#) under CYLINDER BLOCK.

Install upper connecting rod bearings. Lubricate upper bearings with engine oil. Install lower bearings in rod caps. Ensure bearing tabs are properly seated. Position piston ring gaps according to manufacturer's

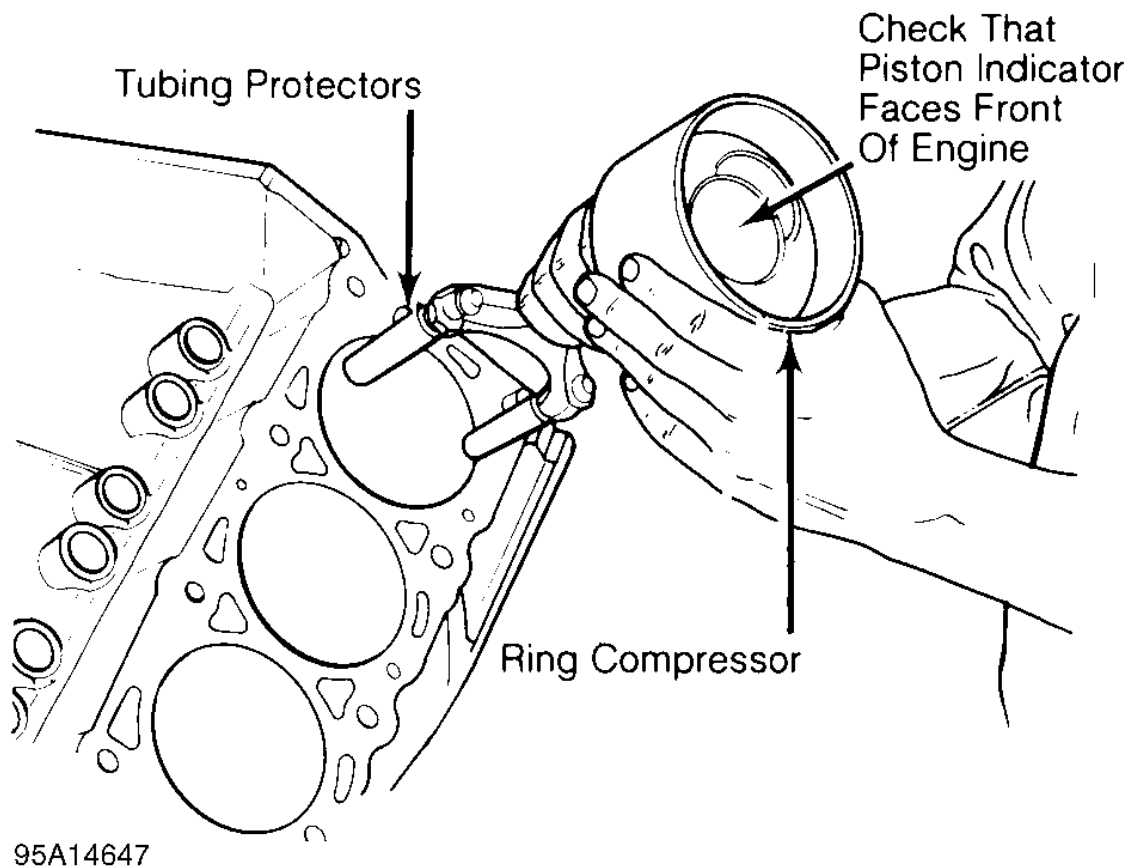
recommendations. See [Fig. 16](#). Lubricate pistons, rings and cylinder walls.



**[Fig. 16: Positioning Typical Piston Ring End Gap](#)**

Install ring compressor. Use care not to rotate piston rings. Compress rings with ring compressor. Install plastic tubing protectors over connecting rod bolts. Install piston and connecting rod assembly. Ensure piston notch, arrow or FRONT mark is toward front of engine. See [Fig. 17](#).





**Fig. 17: Installing Piston & Connecting Rod Assembly.**

Carefully tap piston into cylinder until rod bearing is seated on crankshaft journal. Remove protectors. Install rod cap and bearing. Lightly tighten connecting rod bolts. Repeat procedure for remaining cylinders. Check bearing clearance. See [MAIN & CONNECTING ROD BEARING CLEARANCE](#).

Once clearance is checked, lubricate journals and bearings. Install bearing caps. Ensure marks are aligned on connecting rod and cap. Tighten rod nuts or bolts to specification. Ensure rod moves freely on crankshaft. Check connecting rod side clearance. See [CONNECTING ROD SIDE CLEARANCE](#).

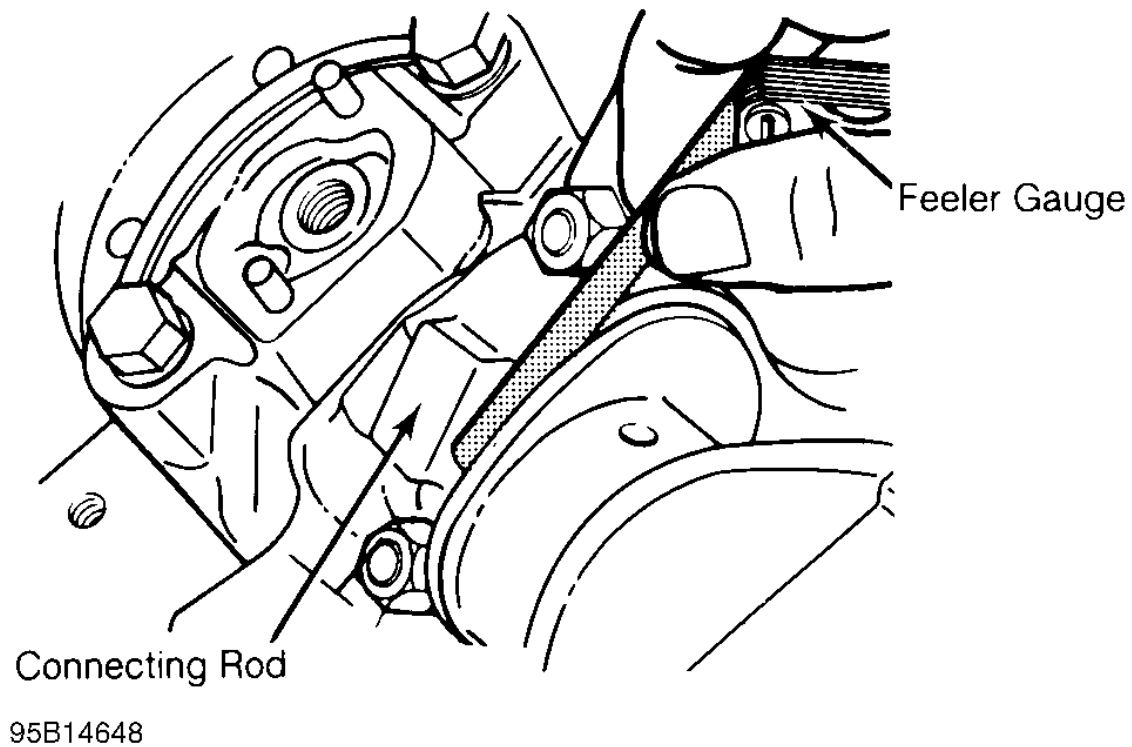
### **CONNECTING ROD SIDE CLEARANCE**

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Position connecting rod toward one side of crankshaft as far as possible. Using feeler gauge, measure clearance between side of connecting rod and crankshaft. See [Fig. 18](#). Clearance must be within specification.

Check for improper bearing installation, wrong bearing cap or insufficient bearing clearance if side clearance is insufficient. Connecting rod may require machining to obtain proper clearance. Excessive clearance usually indicates excessive wear at crankshaft. Crankshaft must be repaired or replaced.



**Fig. 18: Measuring Connecting Rod Side Clearance**

## **MAIN & CONNECTING ROD BEARING CLEARANCE**

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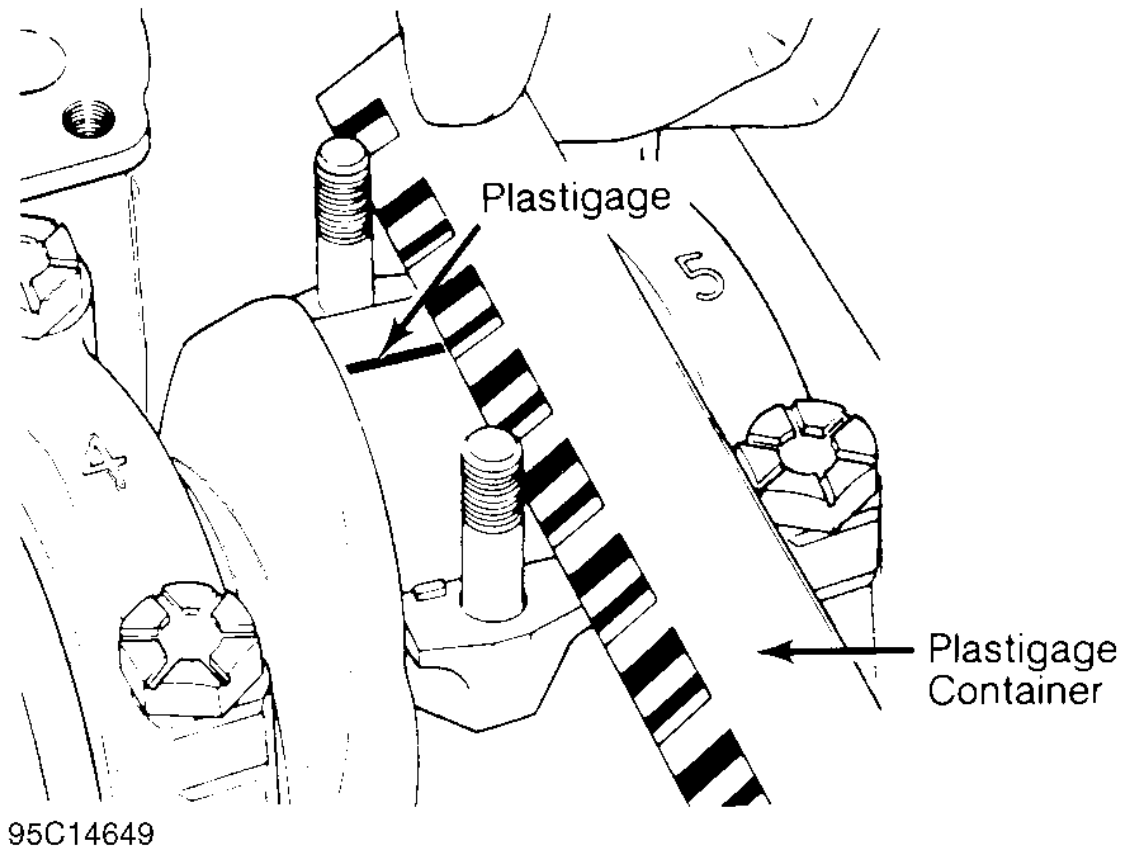
### **Plastigage Method**

Plastigage method may be used to determine bearing clearance. Plastigage can be used with an engine in service or during reassembly. Plastigage material is oil soluble.

Ensure journals and bearings are free of oil or solvent. Oil or solvent will dissolve material and false reading will be obtained. Install small piece of Plastigage along full length of bearing journal. Install bearing cap in original location. Tighten bolts to specification.

**CAUTION:** **DO NOT rotate crankshaft while Plastigage is installed. Bearing clearance will not be obtained if crankshaft is rotated.**

Remove bearing cap. Compare Plastigage width with scale on Plastigage container to determine bearing clearance. See [Fig. 19](#). Rotate crankshaft 90 degrees. Repeat procedure. This is done to check journal eccentricity. This procedure can be used to check oil clearance on both connecting rod and main bearings.



**Fig. 19: Measuring Bearing Clearance**

#### **Micrometer & Telescopic Gauge Method**

A micrometer is used to determine journal diameter, taper and out-of-round dimensions of the crankshaft. See **CLEANING & INSPECTION** under CRANKSHAFT & MAIN BEARINGS in this article.

With crankshaft removed, install bearings and caps in original location on cylinder block. Tighten bolts to specification. On connecting rods, install bearings and caps on connecting rods. Install proper connecting rod cap on corresponding rod. Ensure bearing cap is installed in original location. Tighten bolts to specification.

Using a telescopic gauge and micrometer or inside micrometer, measure inside diameter of connecting rod and main bearings bores. Subtract each crankshaft journal diameter from the corresponding inside bearing bore diameter. This is the bearing clearance.

## **CRANKSHAFT & MAIN BEARINGS**

**\* PLEASE READ THIS FIRST \***

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### **REMOVAL**

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Ensure all main bearing caps are marked for location on cylinder block. Some main bearing caps have an arrow stamped on them. The arrow must face timing belt or timing chain end of engine. Remove main bearing cap bolts. Remove main bearing caps. Carefully remove crankshaft. Use care not to bind crankshaft in cylinder block during removal.

## **CLEANING & INSPECTION**

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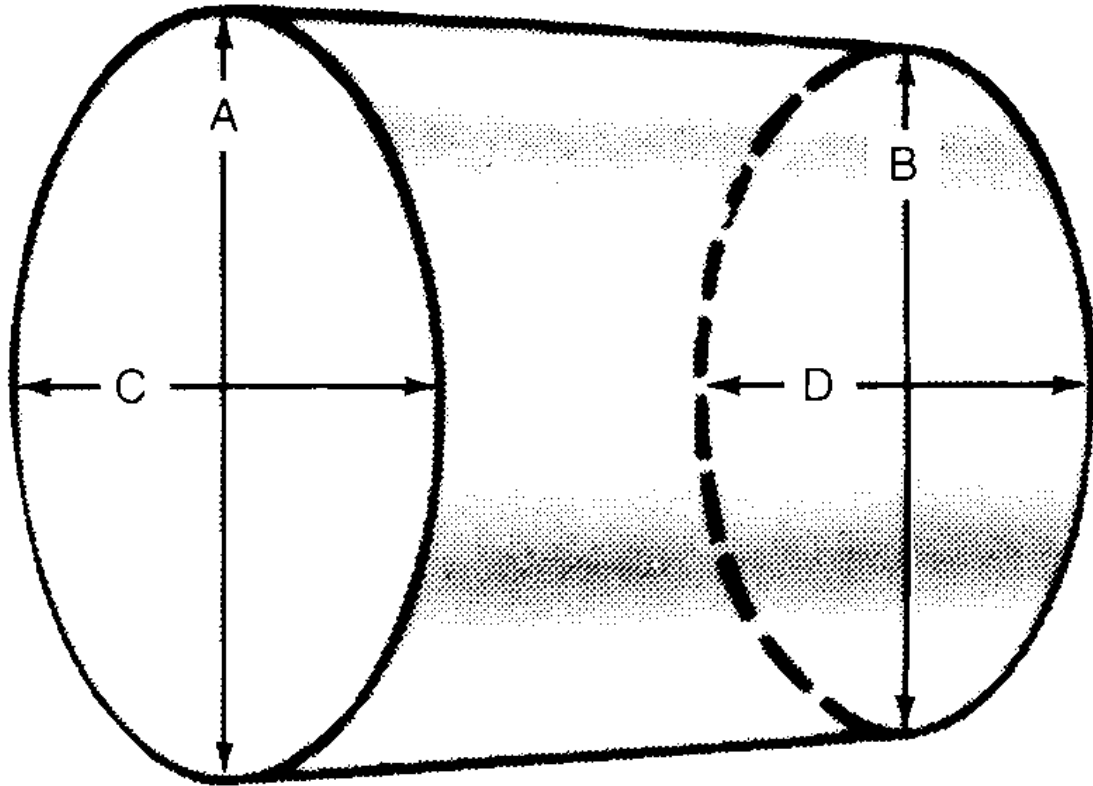
Thoroughly clean crankshaft using solvent. Dry with compressed air. Ensure all oil passages are clear and free of sludge, rust, dirt and metal chips.

Inspect crankshaft for scoring and nicks. Inspect crankshaft for cracks using Magnaflux procedure. Inspect rear seal area for grooving or damage. Inspect bolt hole threads for damage. If pilot bearing or bushing is used, check pilot bearing or bushing fit in crankshaft. Inspect crankshaft gear for damaged or cracked teeth. Replace gear if damaged. Ensure oil passage plugs are tight (if equipped).

Using micrometer, measure all journals in 4 areas to determine journal taper, out-of-round and undersize. See [Fig. 20](#). Some crankshafts can be reground to the next largest undersize, depending on the amount of wear or damage. Crankshafts with rolled fillet cannot be reground and must be replaced.

- A - B = Vertical Taper
- C - D = Horizontal Taper
- A - C & B - D = Out-Of-Round

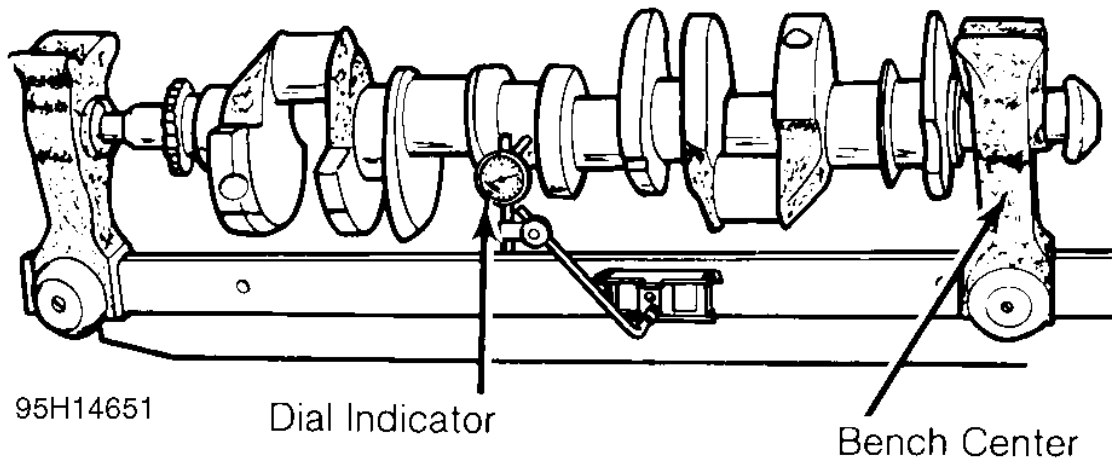
Check For Out-Of-Round At Each End Of Journal



95G14650

**Fig. 20: Measuring Crankshaft Journals**

Crankshaft journal runout should be checked. Install crankshaft in "V" blocks or bench center. Position dial indicator with tip resting on the main bearing journal area. See [Fig. 21](#). Rotate crankshaft and note reading. Journal runout must not exceed specification. Repeat procedure on all main bearing journals. Crankshaft must be replaced if runout exceeds specification.



95H14651

Dial Indicator

Bench Center



## INSTALLATION

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Install upper main bearing in cylinder block. Ensure lock tab is properly located in cylinder block. Install bearings in main bearing caps. Ensure all oil passages are aligned. Install rear seal (if removed).

Ensure crankshaft journals are clean. Lubricate upper main bearings with clean engine oil. Carefully install crankshaft. Check each main bearing clearance using Plastigage method. See [MAIN & CONNECTING ROD BEARING CLEARANCE](#).

Once clearance is checked, lubricate lower main bearing and journals. Install main bearing caps in original location. Install rear seal in rear main bearing cap (if removed). Some rear main bearing caps require sealant to be applied in corners to prevent oil leakage.

Install and tighten all bolts except thrust bearing cap to specification. Tighten thrust bearing cap bolts finger tight only. Some models require that thrust bearing be aligned. On most applications, crankshaft must be moved rearward then forward. Procedure may vary with manufacturer. Thrust bearing cap is then tightened to specification. Ensure crankshaft rotates freely. Crankshaft end play should be checked. See [CRANKSHAFT END PLAY](#).

## CRANKSHAFT END PLAY

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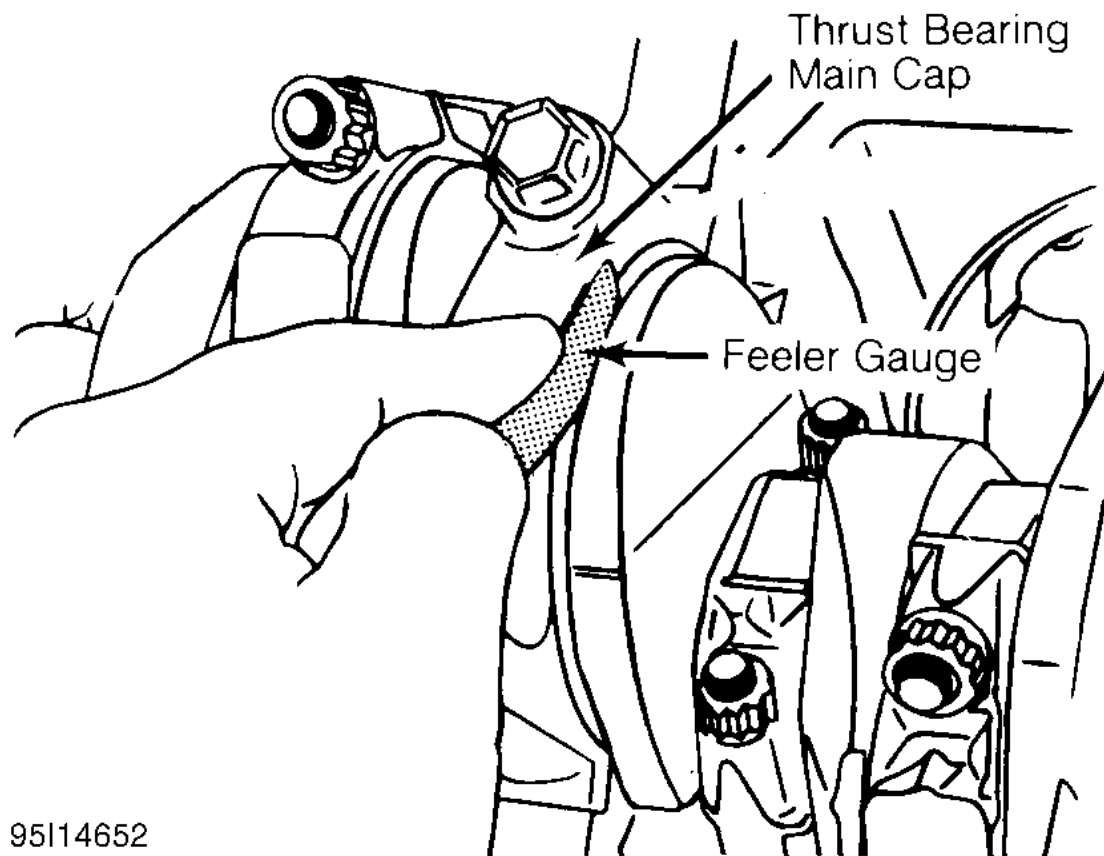
### Dial Indicator Method

Crankshaft end play can be checked using dial indicator. Mount dial indicator on rear of cylinder block. Position dial indicator tip against rear of crankshaft. Ensure tip is resting against flat surface.

Pry crankshaft rearward. Adjust dial indicator to zero. Pry crankshaft forward and note reading. Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversize thrust bearings.

### Feeler Gauge Method

Crankshaft end play can be checked using feeler gauge. Pry crankshaft rearward. Pry crankshaft forward. Using feeler gauge, measure clearance between crankshaft and thrust bearing surface. See [Fig. 22](#).



**Fig. 22: Checking Crankshaft End Play**

Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversize thrust bearings.

## **CYLINDER BLOCK**

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### **Block Cleaning**

Only cast cylinder blocks should be hot tank cleaned. Aluminum cylinder blocks should be cleaned using cold tank method. Cylinder block is cleaned in order to remove carbon deposits, gasket residue and water jacket scale. Remove oil gallery plugs, freeze plugs and cam bearings before cleaning block.

### **Block Inspection**

Visually inspect the block. Check suspected areas for cracks using the Dye Penetrant inspection method. Block may be checked for cracks using the Magnaflux method.

Cracks are most commonly found at the bottom of cylinders, main bearing saddles, near expansion plugs and between cylinders and water jackets. Inspect lifter bores for damage. Inspect all head bolt holes for damaged threads. Threads should be cleaned using tap to ensure proper head bolt torque. Consult machine shop concerning possible welding and machining (if required).

## Cylinder Bore Inspection

Inspect bore for scoring or roughness. Cylinder bore is dimensionally checked for out-of-round and taper using dial bore gauge. For determining out-of-round, measure cylinder parallel and perpendicular to the block center line. Difference in the 2 readings is the bore out-of-round. Cylinder bore must be checked at top, middle and bottom of piston travel area.

Bore taper is obtained by measuring bore at the top and bottom. If wear has exceeded allowable limits, block must be honed or bored to next available oversize piston dimension.

## Cylinder Honing

Cylinder must be properly honed to allow new piston rings to properly seat. Cross-hatching at correct angle and depth is critical to lubrication of cylinder walls and pistons.

A flexible drive hone and power drill are commonly used. Drive hone must be lubricated during operation. Mix equal parts of kerosene and SAE 20W engine oil for lubrication.

Apply lubrication to cylinder wall. Operate cylinder hone from top to bottom of cylinder using even strokes to produce 45 degree cross-hatch pattern on the cylinder wall. DO NOT allow cylinder hone to extend below cylinder during operation.

Recheck bore dimension after final honing. Wash cylinder wall with hot soapy water to remove abrasive particles. Blow dry with compressed air. Coat cleaned cylinder walls with lubricating oil.

## Deck Warpage

Check deck for damage or warped gasket surface. Place a straightedge across gasket surface of the deck. Using feeler gauge, measure clearance at center of straightedge. Measure across width and length of cylinder block at several points.

If warpage exceeds specifications, deck must be resurfaced. If warpage exceeds manufacturer's maximum tolerance for material removal, replace block.

**NOTE:** Some manufacturers recommend that a total amount of material (cylinder head and cylinder block) can only be removed before components must be replaced.

## Deck Height

Distance from crankshaft center line to block deck is called the deck height. Measure and record front and rear main journals of crankshaft. To compute this distance, install crankshaft and retain with center main bearing and cap only. Measure distance from crankshaft journal to block deck, parallel to cylinder center line.

Add one half of main bearing journal diameter to distance from crankshaft journal to block deck. This dimension should be checked at front and rear of cylinder block. Both readings should be the same.

If difference exceeds specification, cylinder block must be repaired or replaced. Deck height and warpage should be corrected at the same time.

## Main Bearing Bore & Alignment

For checking main bearing bore, remove all bearings from cylinder block and main bearing caps. Install main bearing caps in original location. Tighten bolts to specification. Using inside micrometer, measure main bearing bore in 2 areas 90 degrees apart. Determine bore size and out-of-round. If diameter is not within specification, block must be align-bored.

For checking alignment, place a straightedge along center line of main bearing saddles. Check for clearance between straightedge and main bearing saddles. Block must be align-bored if clearance exists.

## Expansion Plug Removal

Drill hole in center of expansion plug. Remove with screwdriver or punch. Use care not to damage sealing surface.

### Expansion Plug Installation

Ensure sealing surface is free of burrs. Coat expansion plug with sealer. Using wooden dowel or pipe of slightly smaller diameter, install expansion plug. Ensure expansion plug is evenly located.

### Oil Gallery Plug Removal

Remove threaded oil gallery plugs using appropriate wrench. Soft press-in plugs are removed by drilling into plug and installing a sheet metal screw. Remove plug with slide hammer or pliers.

### Oil Gallery Plug Installation

Ensure threads or sealing surface is clean. Coat threaded oil gallery plugs with sealer and install. Replacement soft press-in plugs are installed with a hammer and drift.

## CAMSHAFT

### \* PLEASE READ THIS FIRST \*

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### CLEANING & INSPECTION

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Clean camshaft with solvent. Ensure all oil passages are clear. Inspect cam lobes and bearing journals for pitting, flaking or scoring. Using micrometer, measure bearing journal O.D.

Support camshaft at each end with "V" blocks. Position dial indicator with tip resting on center bearing journal. Rotate camshaft and note camshaft runout reading. If reading exceeds specification, replace camshaft.

Check cam lobe lift by measuring base circle of camshaft using micrometer. Measure again at 90-degree angle to tip of cam lobe. Cam lift can be determined by subtracting base circle diameter from tip of cam lobe measurement.

Different lift dimensions are given for intake and exhaust cam lobes. Reading must be within specification. Replace camshaft if cam lobes or bearing journals are not within specification.

Inspect camshaft gear for chipped, eroded or damaged teeth. Replace gear if damaged. On camshafts using thrust plate, measure distance between thrust plate and camshaft shoulder. Replace thrust plate if not within specification.

### CAMSHAFT BEARINGS

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### Removal & Installation

Remove camshaft rear plug. Camshaft bearing remover is assembled with shoulder resting against bearing to be removed according to manufacturer's instructions. Tighten puller nut until bearing is removed. Remove remaining bearings, leaving front and rear bearings until last. These bearings act as a guide for camshaft bearing remover.

To install new bearings, puller is rearranged to pull bearings toward the center of block. Ensure all lubrication passages of bearing are aligned with cylinder block. Coat new camshaft rear plug with sealant. Install camshaft rear plug. Ensure plug is even in cylinder block.

### CAMSHAFT INSTALLATION

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Lubricate bearing surfaces and cam lobes with ample amount of Molykote or camshaft lubricant. Carefully install camshaft. Use care not to damage bearing journals during installation. Install thrust plate retaining bolts (if equipped). Tighten bolts to specification. On overhead camshafts, install bearing caps in original location. Tighten bolts to specification. On all applications, check camshaft end play.

### CAMSHAFT END PLAY

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Using dial indicator, check camshaft end play. Position dial indicator on front of engine block or cylinder head. Position indicator tip against camshaft. Push camshaft toward rear of cylinder head or engine and adjust indicator to zero.

Move camshaft forward and note reading. Camshaft end play must be within specification. End play may be adjusted by relocating gear, shimming thrust plate or replacing thrust plate depending on each manufacturer.

### TIMING CHAINS & BELTS

**\* PLEASE READ THIS FIRST \***



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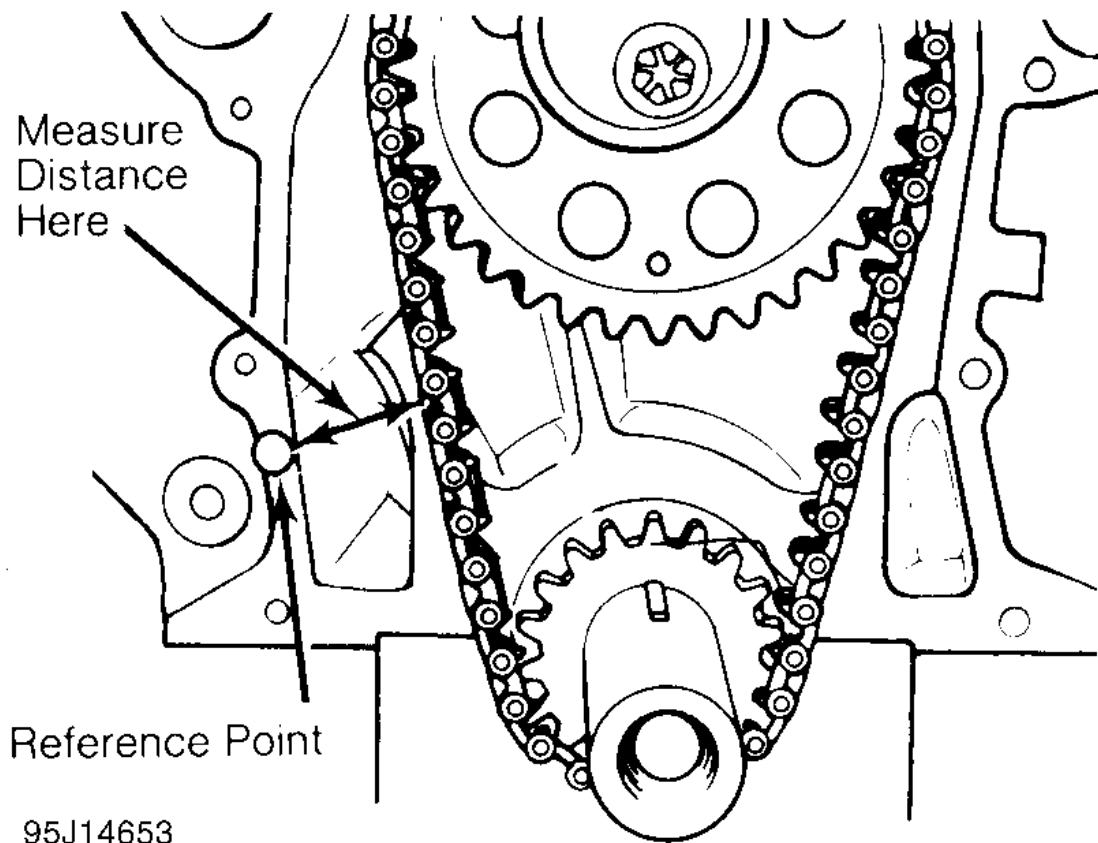
**TIMING CHAINS****NOTE:**

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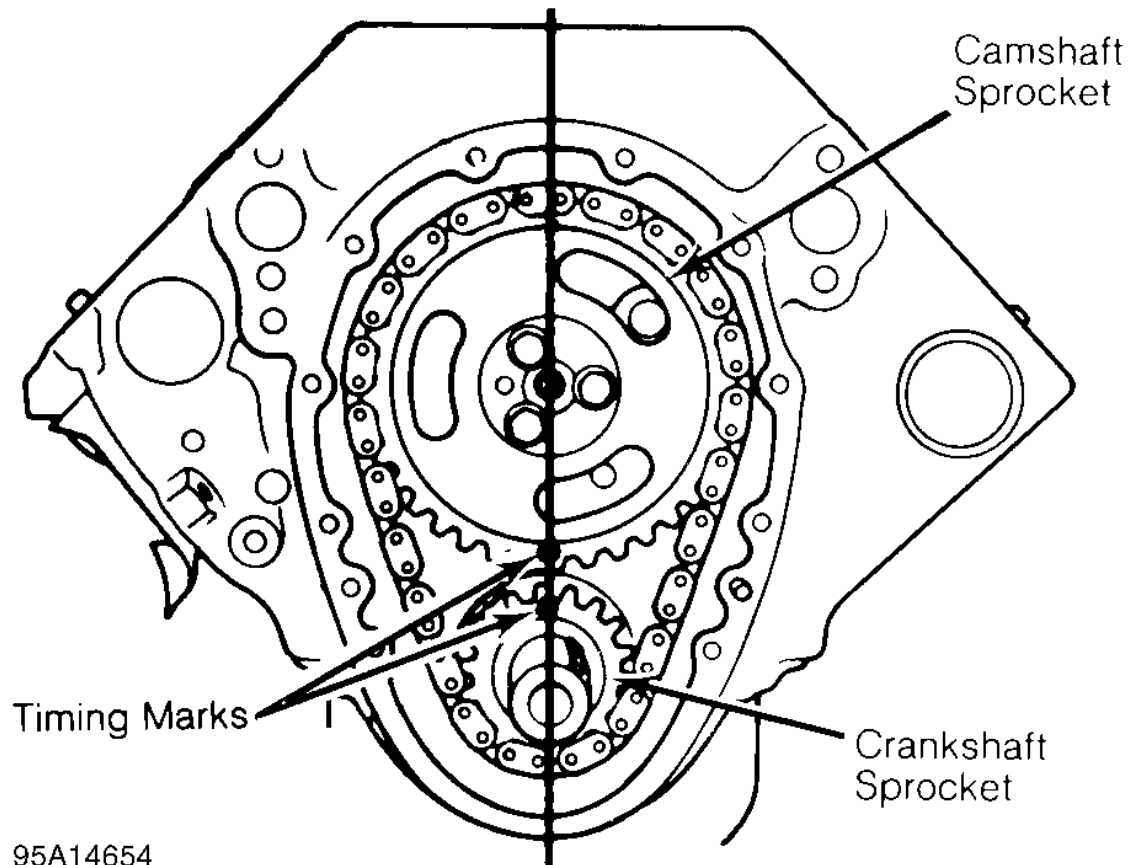
Timing chains will stretch during operation. Limits are placed upon amount of stretch before replacement is required. Timing chain stretch will alter ignition timing and valve timing.

To check timing chain stretch, rotate crankshaft to eliminate slack from one side of timing chain. Mark reference point on cylinder block. Rotate crankshaft in opposite direction to eliminate slack from remaining side of timing chain. Force other side of chain outward and measure distance between reference point and timing chain. See [Fig. 23](#). Replace timing chain and gears if not within specification.



**Fig. 23: Measuring Timing Chain Stretch**

Timing chains must be installed so timing marks on camshaft gear and crankshaft gear are aligned according to manufacturer. See [Fig. 24](#).



**Fig. 24: Typical Gear Timing Mark Alignment**

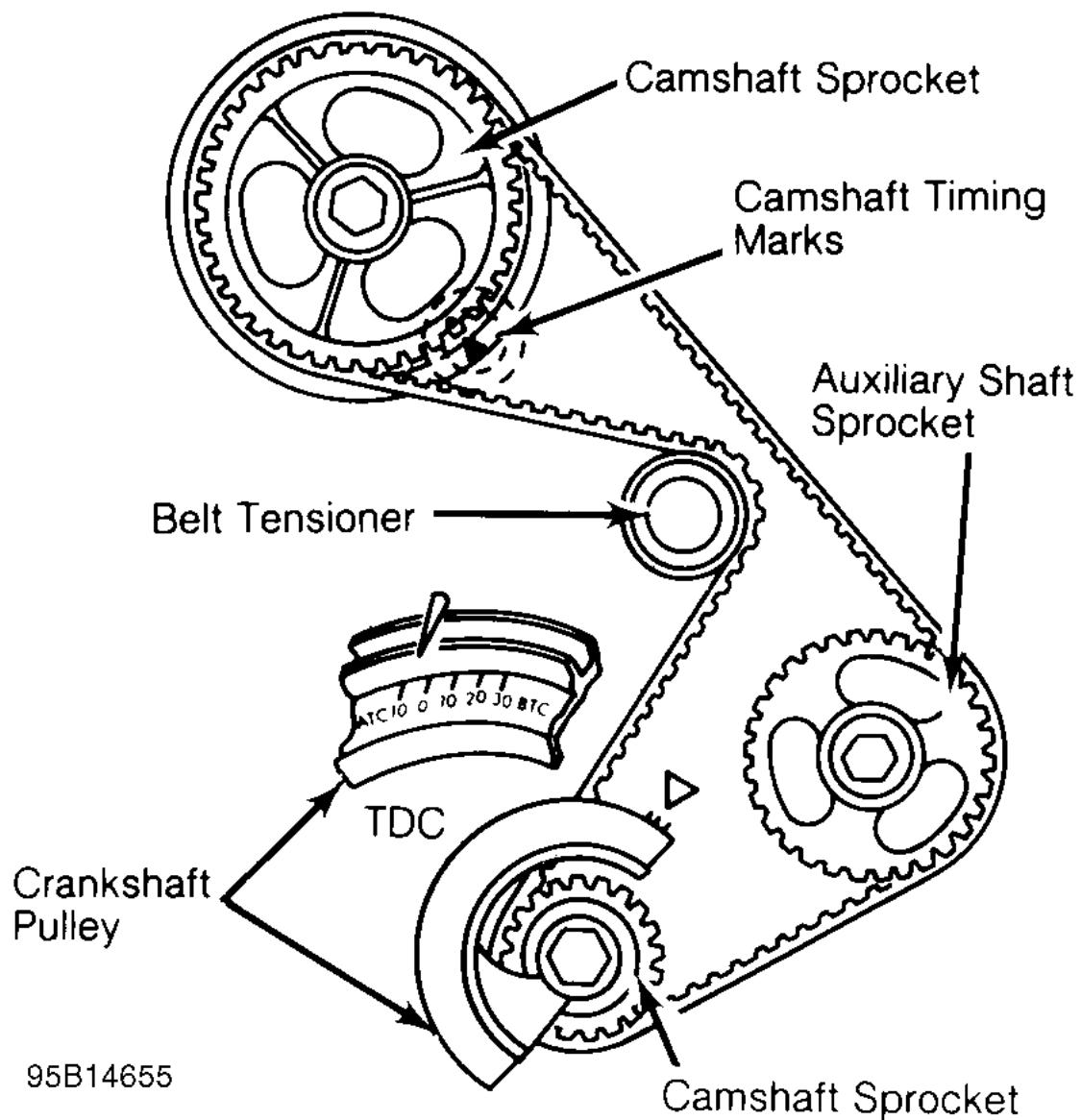
## **TIMING BELTS**

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Cogged tooth belts are commonly used on overhead cam engines. Inspect belt teeth for rounded corners or cracking. Replace belt if it is cracked, damaged, missing teeth or oil soaked.

Used timing belt must be installed in original direction of rotation. Inspect all sprocket teeth for wear. Replace all worn sprockets. Sprockets are marked for timing purposes. Engine is positioned so that crankshaft sprocket mark will be upward. Camshaft sprocket is aligned with reference mark on cylinder head or timing belt cover and then timing belt can be installed. See [Fig. 25](#).



**Fig. 25: Typical Camshaft Belt Sprocket Alignment**

### **TENSION ADJUSTMENT**

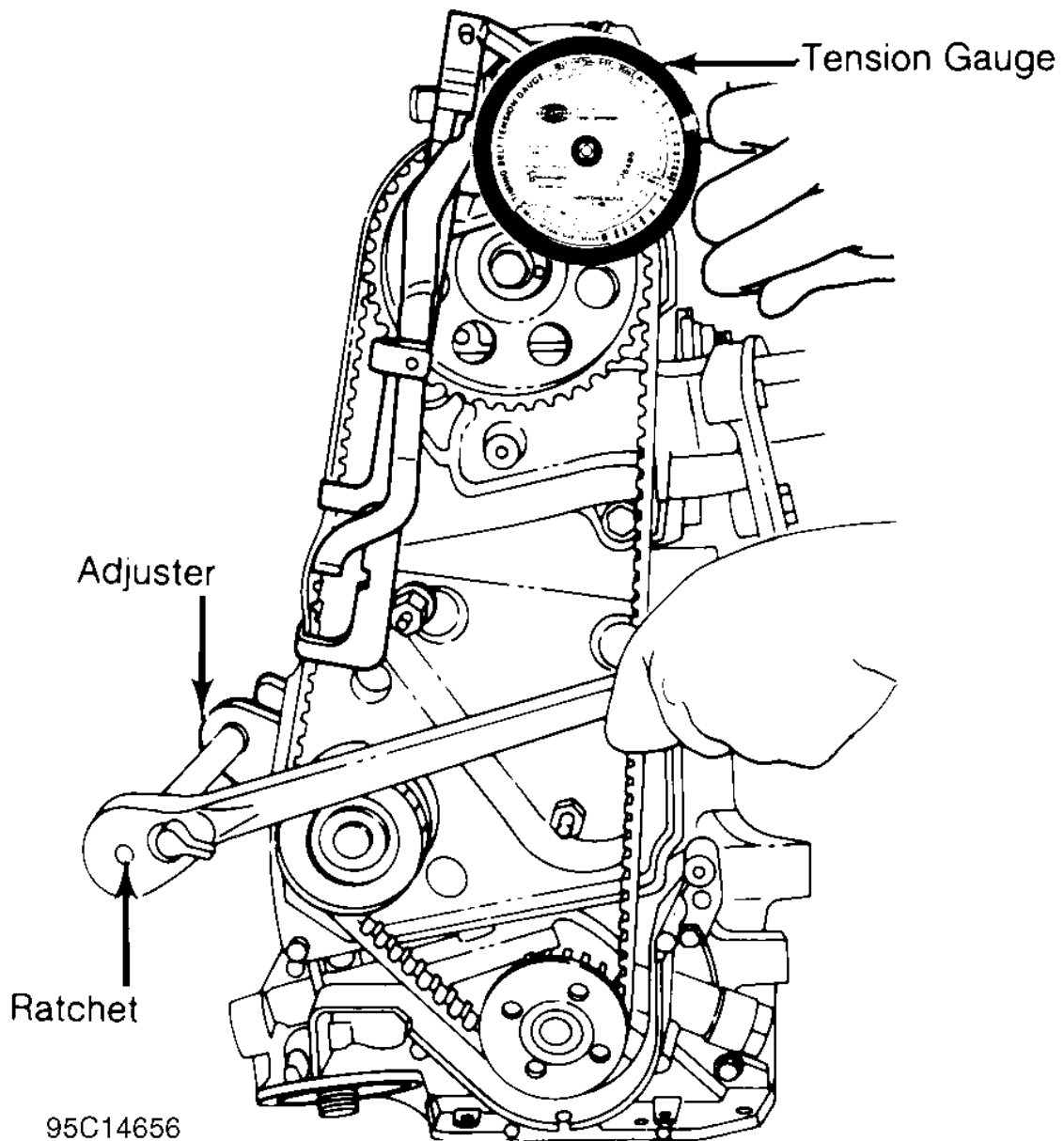
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If guide rails are used with spring loaded tensioners, ensure at least half of original rail thickness remains. Spring loaded tensioner should be inspected for damage.

Ensure all timing marks are aligned. Adjust belt tension using manufacturer's recommendations. Belt tension may require checking using tension gauge. See [Fig. 26](#).



**Fig. 26: Adjusting Typical Timing Belt Tension**

## **TIMING GEARS**

**\* PLEASE READ THIS FIRST \***

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## **TIMING GEAR BACKLASH & RUNOUT**

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On engines where camshaft gear operates directly on crankshaft gear, gear backlash and runout must be checked. To check backlash, install dial indicator with tip resting on tooth of camshaft gear. Rotate camshaft gear as far as possible. Adjust indicator to zero. Rotate camshaft gear in opposite direction as far as possible and note reading.

To determine timing gear runout, mount dial indicator with tip resting on face edge of camshaft gear. Adjust indicator to zero. Rotate camshaft gear 360 degrees and note reading. If backlash or runout exceeds specification, replace camshaft and/or crankshaft gear.

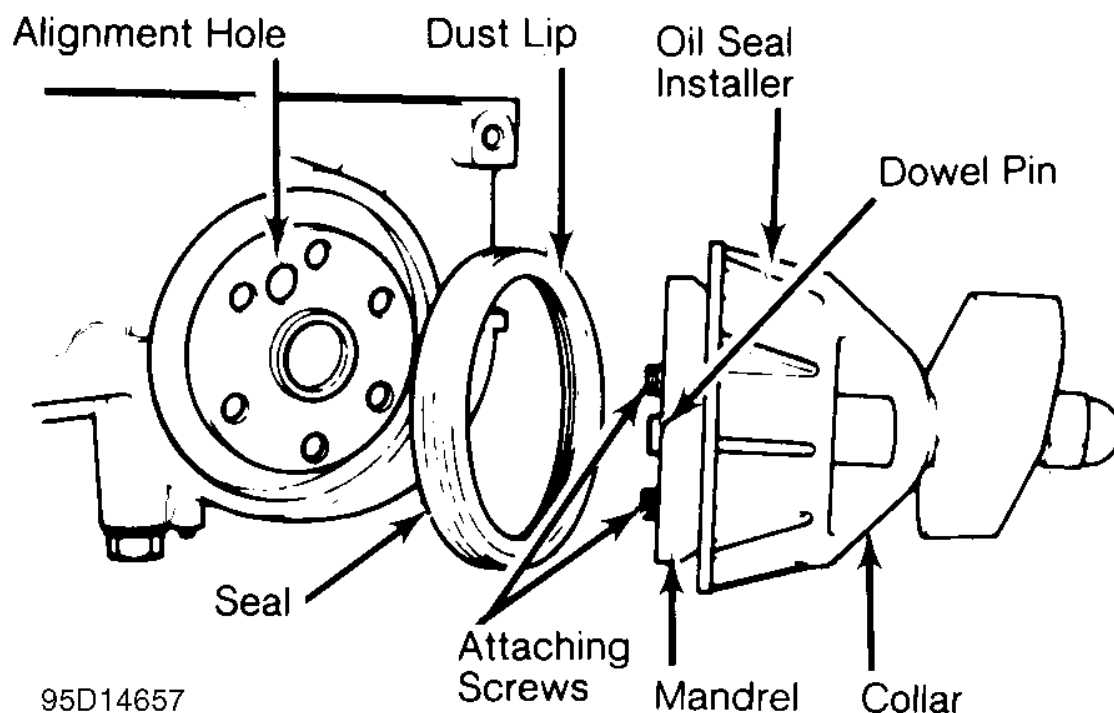
## REAR MAIN OIL SEAL INSTALLATION

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### One-Piece Type Seal

For one-piece type oil seal installation, coat block contact surface of seal with sealer if seal is not factory coated. Ensure seal surface is free of burrs. Lubricate seal lip with engine oil and press seal into place using proper oil seal installer. See [Fig. 27](#).



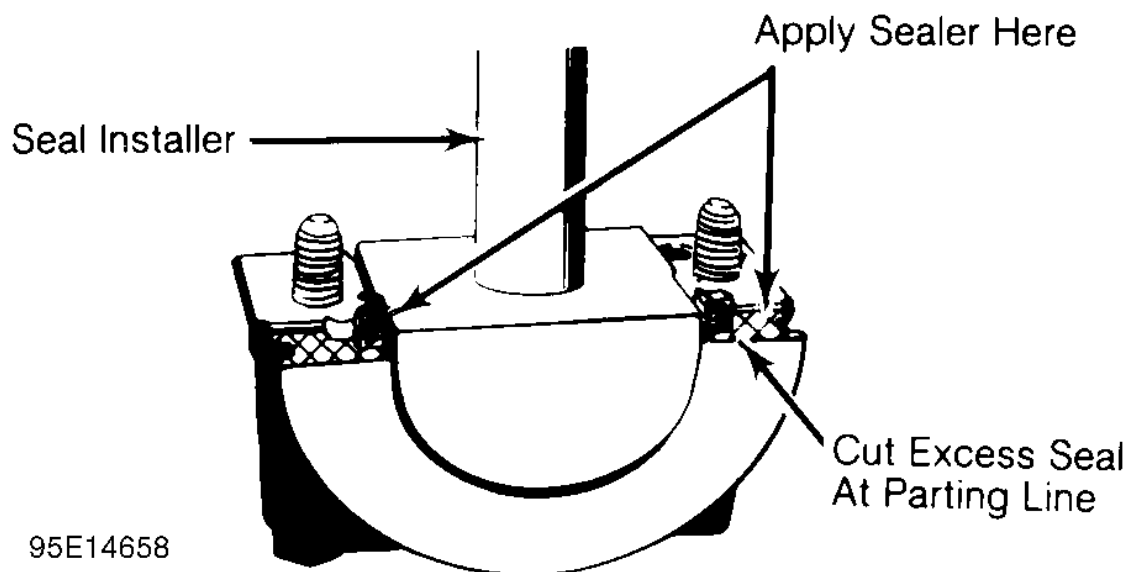
**Fig. 27: Installing Typical One-Piece Oil Seal**

### Rope Type Seal



For rope type rear main oil seal installation, press seal lightly into seat area. Using seal installer, fully seat seal in bearing cap or cylinder block.

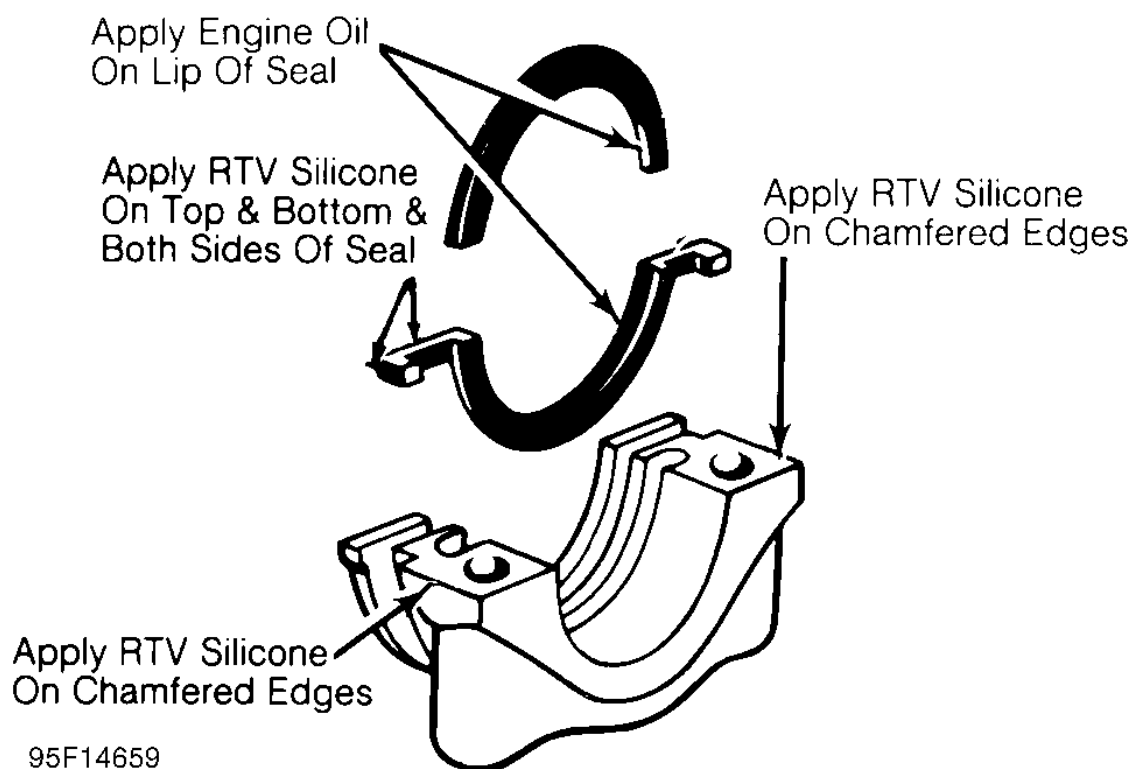
Trim seal ends even with cylinder block parting surface. Some applications require sealer to be applied on main bearing cap before installing. See [Fig. 28](#).



**Fig. 28: Installing Typical Rope Seal**

### Split-Rubber Type Seal

Follow manufacturer's procedures when installing split-rubber type rear main oil seals. Installation procedures vary with manufacturer and engine type. See [Fig. 29](#).



**Fig. 29: Installing Typical Split-Rubber Seal**

# OIL PUMP

**\* PLEASE READ THIS FIRST \***

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

## ROTOR TYPE

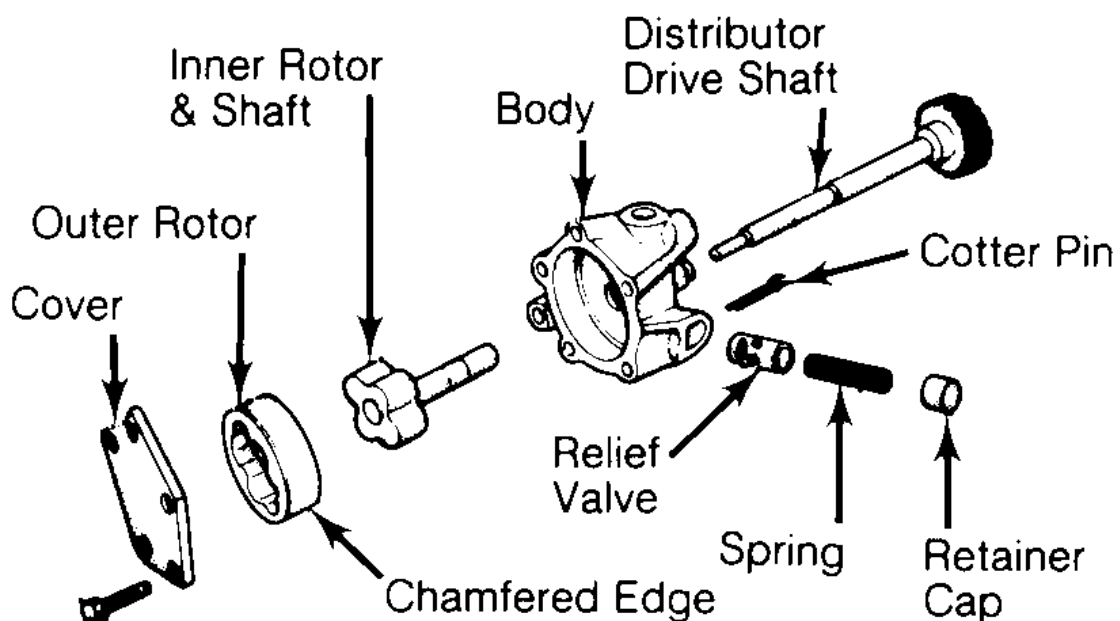
**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Mark oil pump rotor locations before removing. See [Fig. 30](#). Remove outer rotor and measure thickness and diameter. Measure inner rotor thickness. Inspect shaft for scoring or wear. Inspect rotors for pitting or damage. Inspect cover for grooving or wear. Replace worn or damaged components.

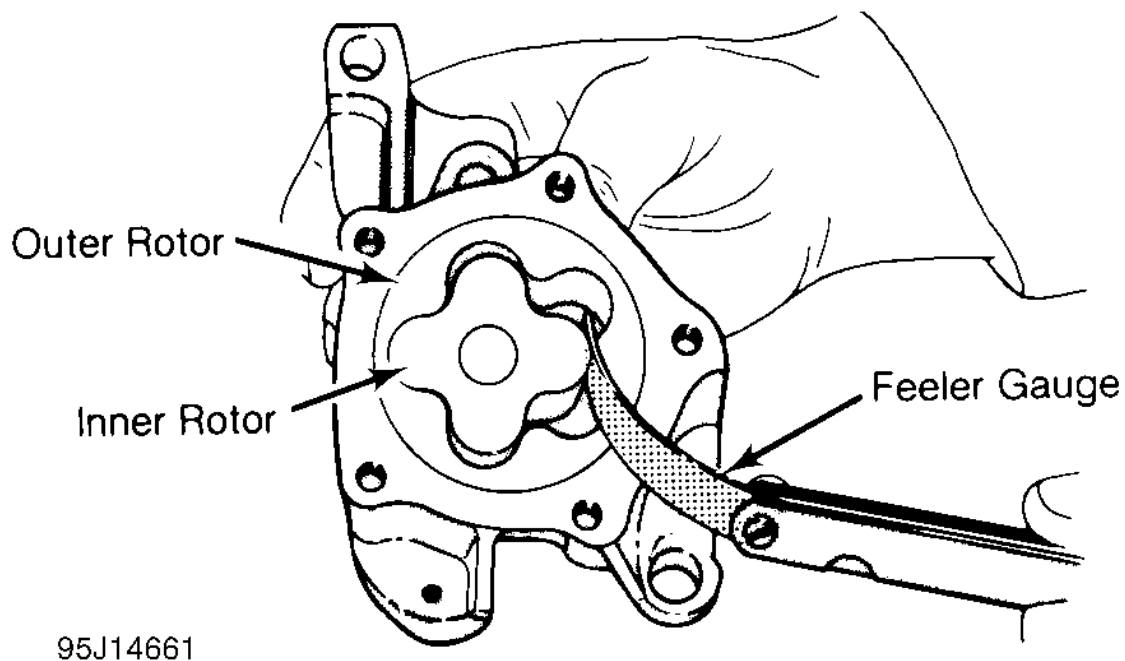
Measure outer rotor-to-body clearance. Replace pump assembly if clearance exceeds specification. Measure clearance between rotors. See [Fig. 31](#). Replace shaft and both rotors if clearance exceeds specification.

Install rotors in pump body. Position straightedge across pump body. Using feeler gauge, measure clearance between rotors and straightedge. Pump cover wear is measured using a straightedge and feeler gauge. Replace pump if clearance exceeds specification.



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**Fig. 30: Typical Rotor Type Oil Pump**



**Fig. 31: Measuring Rotor Clearance**

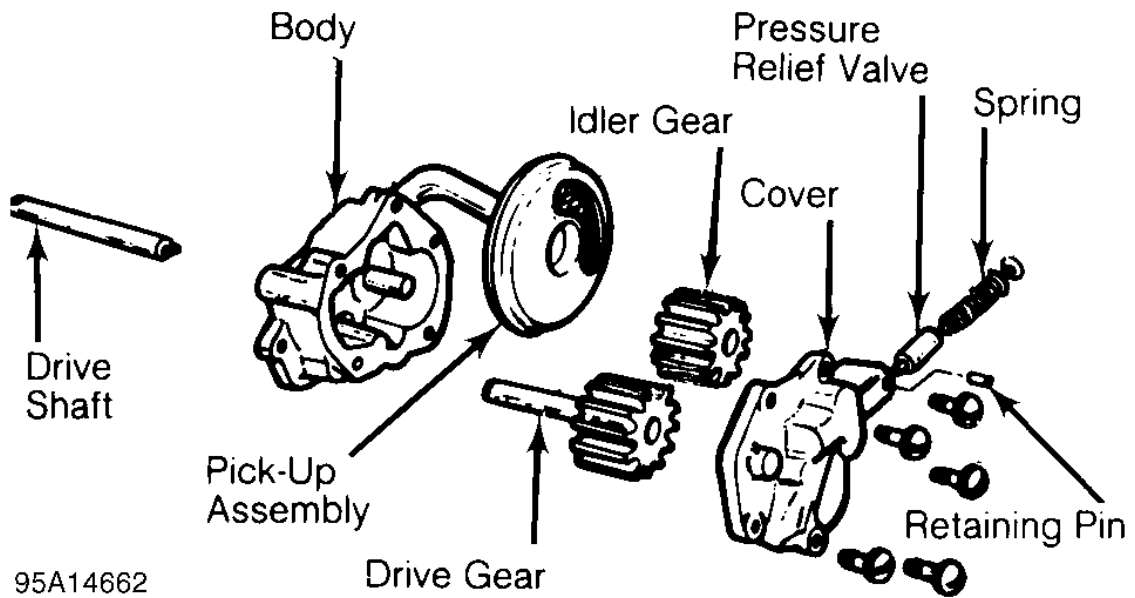
**GEAR TYPE**

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

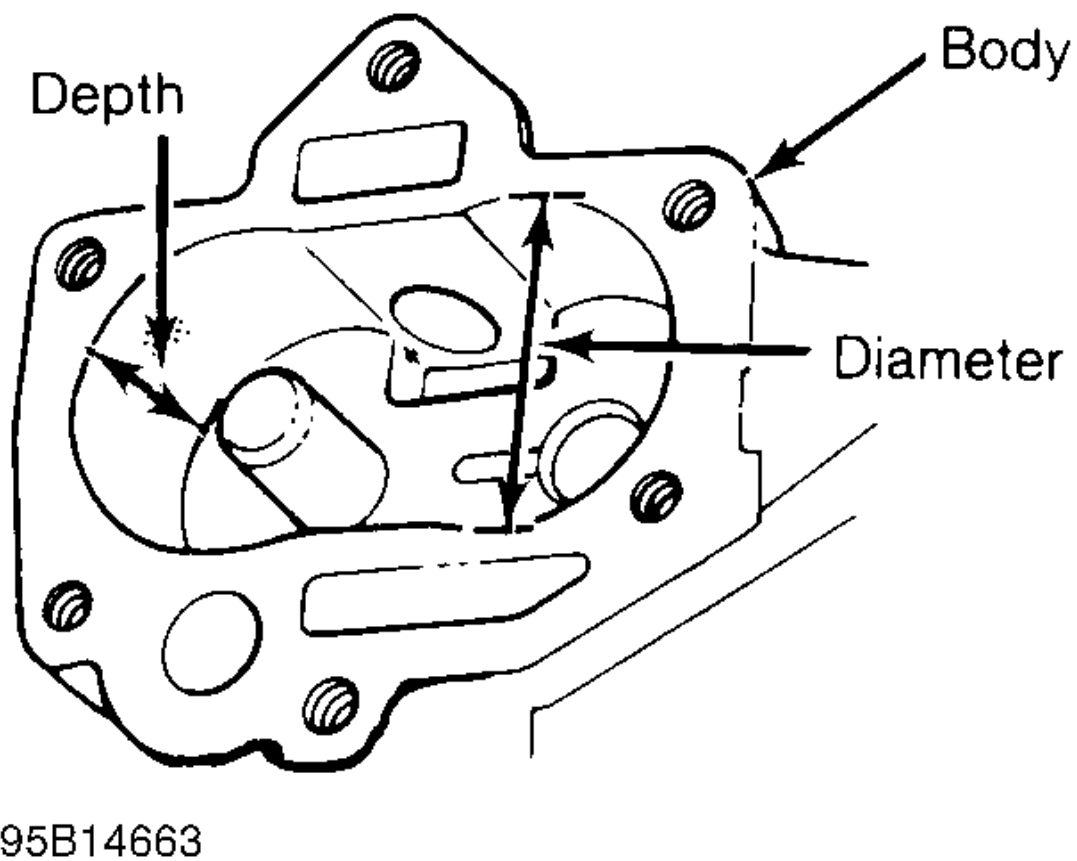
**Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.**

Mark oil pump gear location before removing. See [Fig. 32](#). Remove gears from pump body. Inspect gears for pitting or damage. Inspect cover for grooving or wear. Measure gear diameter and length. Measure gear housing cavity depth and diameter. See [Fig. 33](#). Replace worn or damaged components.

Pump cover wear is measured using a straightedge and feeler gauge. Replace pump or components if warpage or wear exceeds specification, or mating surface of pump cover is scratched or grooved.



**Fig. 32: Typical Gear Type Oil Pump**



**Fig. 33: Measuring Oil Pump Gear Cavity**

**BREAK-IN PROCEDURE**

**\* PLEASE READ THIS FIRST \***

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

## **ENGINE PRE-OILING**

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Pre-oil engine prior to operation to prevent engine damage. Lightly oiled oil pump will cavitate unless oil pump cavities are filled with engine oil or petroleum jelly.

Engine pre-oiling can be done using pressure oiler (if available). Connect pressure oiler to cylinder block oil passage such as oil pressure sending unit. Operate pressure oiler long enough to ensure correct amount of oil has filled crankcase. Check oil level while pre-oiling.

If pressure oiler is not available, disconnect ignition system. Remove oil pressure sending unit and replace with oil pressure test gauge. Using starter motor, rotate engine starter until gauge shows normal oil pressure for several seconds. **DO NOT** crank engine for more than 30 seconds to avoid starter motor damage. Ensure oil pressure has reached the most distant point from the oil pump.

**NOTE:** If new lifters or camshaft are installed, some manufacturers require that a crankcase conditioner be added to engine oil. The engine should be operated for specified amount of time to aid in lifter break-in procedure.

## **INITIAL START-UP**

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Start engine and operate engine at low speed while checking for coolant, fuel and oil leaks. Stop engine. Recheck coolant and oil level. Adjust if necessary.

## **CAMSHAFT**

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.



**Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.**

Break-in procedure is required when new or reground camshaft has been installed. Operate and maintain engine speed between 1500-2500 RPM for approximately 30 minutes. Procedure may vary due to manufacturer's recommendations.

## **PISTON RINGS**

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

**Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.**

Piston rings require a break-in procedure to ensure seating of rings to cylinder walls. Serious damage may occur to rings if correct procedures are not followed.

Extremely high piston ring temperatures are obtained during break-in process. If rings are exposed to excessively high RPM or high cylinder pressures, ring damage can occur. Follow piston ring manufacturer's recommended break-in procedure.

## **FINAL ADJUSTMENTS**

**NOTE:** Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

**Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.**

Check or adjust ignition timing and dwell (if applicable). Adjust valves (if necessary). Adjust idle speed and mixture. Retighten cylinder heads (if required). If cylinder head or block is aluminum, retighten bolts when engine is cold. Follow the engine manufacturer's recommended break-in procedure and maintenance schedule for new engines.

**NOTE:** Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.

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## GENERAL INFORMATION

### Engine Performance Diagnostic Routine Outline

#### **\* PLEASE READ THIS FIRST \***

**NOTE:** This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

#### **WHERE DOES DRIVEABILITY DIAGNOSIS START?**

##### **PERFORM BASIC INSPECTION**

**NOTE:** This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

1. Verify Customer Complaint
2. Check for Relevant Technical Service Bulletins (TSBs)
3. Perform Visual Inspection (See **Basic Diagnostic Procedures**)
4. Test Engine Sub-Systems (See **Basic Diagnostic Procedures**)
  - Mechanical Condition (Compression)
  - Ignition Output
  - Fuel Delivery
5. Check Air Induction System For Leaks
6. Check & Adjust Basic Engine Settings(See **On-Vehicle Adjustments**)
  - Ignition Timing
  - Idle Speed

##### **CHECK FOR TROUBLE CODES**

**NOTE:** This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

1. Check for Diagnostic Trouble Codes (DTCs).(See **Self-Diagnostics**)
2. Repair cause of DTCs.
3. Clear PCM memory and repeat self-test.

##### **DIAGNOSE SYMPTOM**

**NOTE:** This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

1. If no self-diagnostics available, or no trouble codes present, identify symptom.
2. See trouble shooting procedure to identify problem. (See **Trouble Shooting - No Codes**)

##### **TEST SYSTEM**

**NOTE:** This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

1. Perform required tests. **(See Systems & Component Testing)**

2. Verify complaint is repaired.

---

## GENERAL INFORMATION

### Engine Performance Safety Precautions

- Always refer to Emission Decal in engine compartment before servicing vehicle. If manual and decal differ, always use decal specifications.
  - Do not allow or create a condition of misfire in more than one cylinder for an extended period of time. Damage to converter may occur due to loading converter with unburned air/fuel mixture.
  - Always turn ignition off and disconnect negative battery cable BEFORE disconnecting or connecting computer or other electrical components.
  - DO NOT drop or shock electrical components such as computer, airflow meter, etc.
  - DO NOT use fuel system cleaning compounds that are not recommended by the manufacturer. Damage to gaskets, diaphragm materials and catalytic converter may result.
  - Before performing a compression test or cranking engine using a remote starter switch, disconnect coil wire from distributor and secure it to a good engine ground, or disable ignition.
  - Before disconnecting any fuel system component, ensure fuel system pressure is released.
  - Use a shop towel to absorb any spilled fuel to prevent fire.
  - DO NOT create sparks or have an open flame near battery.
  - If any fuel system components such as hoses or clamps are replaced, ensure they are replaced with components designed for fuel system use.
  - Always reassemble throttle body components with new gaskets, "O" rings and seals.
  - If equipped with an inertia switch, DO NOT reset switch until fuel system has been inspected for leaks.
  - Wear safety goggles when drilling or grinding.
  - Wear proper clothing which protects against chemicals and other hazards.
-

## GENERAL INFORMATION

### English-Metric Conversion Chart

## METRIC CONVERSIONS

Metric conversions are making life more difficult for the mechanic. In addition to increasing the number of tools required, metric-dimensioned nuts and bolts are used alongside English components in many new vehicles. The mechanic has to decide which tool to use, slowing down the job. The tool problem can be solved by trial and error, but some metric conversions aren't so simple.

Converting temperature, lengths or volumes requires a calculator and conversion charts, or else a very nimble mind. Conversion charts are only part of the answer though, because they don't help you "think" metric, or "visualize" what you are converting. The following examples are intended to help you "see" metric sizes:

### LENGTH

Meters are the standard unit of length in the metric system. The smaller units are 10ths (decimeter), 100ths (centimeter), and 1000ths (millimeter) of a meter. These common examples might help you to visualize the metric units:

- A meter is slightly longer than a yard (about 40 inches).
- An aspirin tablet is about one centimeter across (.4 inches).
- A millimeter is about the thickness of a dime.

### VOLUME

The metric weight system is based on the gram, with the most common unit being the kilogram (1000 grams). Our comparable units are ounces and pounds:

- A kilogram is about 2.2 pounds.
- A kilogram is about 2.2 pounds.

### TORQUE

Torque is somewhat complicated. The term describes the amount of effort exerted to turn something. A chosen unit of weight or force is applied to a lever of standard length. The resulting leverage is called torque. In our standard system, we use the weight of one pound applied to a lever a foot long, resulting in the unit called a foot-pound. A smaller unit is the inch-pound (the lever is one inch long). Metric units include the meter kilogram (lever one meter long with a kilogram of weight applied) and the Newton-meter (lever one meter long with force of one Newton applied). Some conversions are:

- A meter kilogram is about 7.2 foot pounds.
- A foot pound is about 1.4 Newton-meters.
- A centimeter kilogram (cmkg) is equal to .9 inch pounds.

### PRESSURE

Pressure is another complicated measurement. Pressure is described as a force or weight applied to a given area. Our common unit is pounds per square inch. Metric units can be expressed in several ways. One is the kilogram per square centimeter ( $\text{kg}/\text{cm}^2$ ). Another unit of pressure is the Pascal (force of one Newton on an area of one square meter), which equals about 4 ounces on a square yard. Since this is a very small amount of pressure, we usually see the kiloPascal, or kPa (1000 Pascals). Another common automotive term for pressure is the bar (used by German manufacturers), which equals 10 Pascals. Thoroughly confused? Try the examples below:

- Atmospheric pressure at sea level is about 14.7 psi.



- Atmospheric pressure at sea level is about 1 bar.
- Atmospheric pressure at sea level is about 1 kg/cm<sup>2</sup> .
- One pound per square inch is about 7 kPa.

## CONVERSION FACTORS

### CONVERSION FORMULA

To Convert	To	Multiply By
<b>LENGTH</b>		
Millimeters (mm)	Inches	.03937
Inches	Millimeters	25.4
Meters (M)	Inches	39.37
Meters (M)	Feet	3.28084
Feet	Meters	.3048
Kilometers (Km)	Miles	.62137
<b>AREA</b>		
Square Centimeters (cm <sup>2</sup> )	Square Inches	.155
Square Inches	Square Centimeters	6.45159
<b>VOLUME</b>		
Cubic Centimeters	Cubic Inches	.06103
Cubic Inches	Cubic Centimeters	16.38703
Liters	Cubic Inches	61.025
Cubic Inches	Liters	.01639
Liters	Quarts	1.05672
Quarts	Liters	.94633
Liters	Pints	2.11344
Pints	Liters	.47317
Liters	Ounces	33.81497
Ounces	Liters	.02957
<b>WEIGHT</b>		
Grams	Ounces	.03527
Ounces	Grams	28.34953
Kilograms	Pounds	2.20462
Pounds	Kilograms	.45359
<b>WORK</b>		
Centimeter Kilograms	Inch Pounds	.8676
Pounds/Sq. Inch	Kilograms/Sq. Centimeter	.07031
Bar	Pounds/Sq. Inch	14.504
Pounds/Sq. Inch	Bar	.06895
Atmosphere	Pounds/Sq. Inch	14.696
Pounds/Sq. Inch	Atmosphere	.06805
<b>TEMPERATURE</b>		
Centigrade Degrees	Fahrenheit Degrees	$(C \times \frac{9}{5}) + 32$
Fahrenheit Degrees	Centigrade Degrees	$(F - 32) \times \frac{5}{9}$

### EQUIVALENCIES

Inches	Decimals	mm
1/64	.016	.397
1/32	.031	.794
3/64	.047	1.191
1/16	.063	1.588
5/64	.078	1.984

<b>Inches</b>	<b>Decimals</b>	<b>mm</b>
3/32	.094	2.381
7/64	.109	2.778
1/8	.125	3.175
9/64	.141	3.572
5/32	.156	3.969
11/64	.172	4.366
3/16	.188	4.763
13/64	.203	5.159
7/32	.219	5.556
15/64	.234	5.953
1/4	.250	6.350
17/64	.266	6.747
9/32	.281	7.144
19/64	.297	7.541
5/16	.313	7.938
21/64	.328	8.334
11/32	.344	8.731
23/64	.359	9.128
3/8	.375	9.525
25/64	.391	9.922
13/32	.406	10.319
27/64	.422	10.716
7/16	.438	11.113
29/64	.453	11.509
15/32	.469	11.906
31/64	.484	12.303
1/2	.500	12.700
33/64	.516	13.097
17/32	.531	13.494
35/64	.547	13.891
9/16	.563	14.288
37/64	.578	14.684
19/32	.594	15.081
39/64	.609	15.478
5/8	.625	15.875
41/64	.641	16.272
21/32	.656	16.669
43/64	.672	17.066
11/16	.687	17.463
45/64	.703	17.859
23/32	.719	18.256
47/64	.734	18.653
3/4	.750	19.050
49/64	.766	19.447
25/32	.781	19.844
51/64	.797	20.241
13/16	.813	20.638
53/64	.828	21.034
27/32	.844	21.431
55/64	.859	21.828
7/8	.875	22.225
57/64	.891	22.622

<b>Inches</b>	<b>Decimals</b>	<b>mm</b>
29/32	.906	23.019
59/64	.922	23.416
15/16	.938	23.813
61/64	.953	24.209
31/32	.969	24.606
63/64	.984	25.003
1	1.000	25.400

Release December 2019

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## GENERAL INFORMATION

### Gear Tooth Contact Patterns

#### \* PLEASE READ THIS FIRST \*

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

#### INSPECTION

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Wipe lubricant from internal parts. Rotate gears and inspect for wear or damage. Mount dial indicator to housing and check backlash at several points around ring gear. Backlash must be within specification at all points. If no defects are found, check gear tooth pattern contact.

**NOTE:** Drive pattern should be well centered on ring gear teeth. Coast pattern should be centered, but may be slightly toward toe of ring gear teeth.

#### GEAR TOOTH CONTACT PATTERN

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

1. Paint ring gear teeth with marking compound. Wrap cloth or rope around drive pinion flange to act as brake. Rotate gear until clear contact pattern is obtained.
2. Contact pattern will indicate whether correct pinion bearing mounting shim has been installed and if drive gear backlash has been set properly. Backlash between drive gear pinion must be maintained within specified limits until correct tooth pattern is obtained.

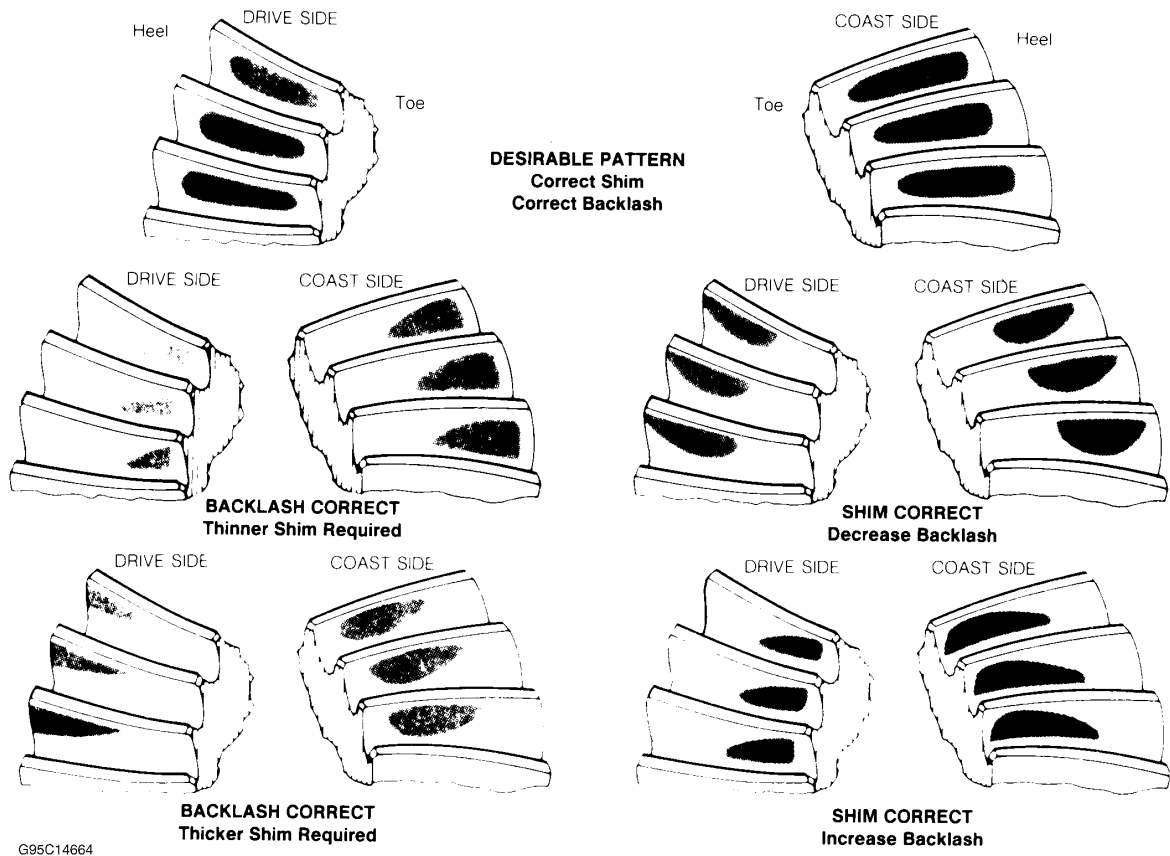
#### ADJUSTMENTS

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#### GEAR BACKLASH & PINION SHIM CHANGES

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

1. With no change in backlash, moving pinion further from ring gear moves drive pattern toward heel and top of tooth, and moves coast pattern toward toe and top of tooth.
2. With no change in backlash, moving pinion closer to ring gear moves drive pattern toward toe and bottom of tooth, and moves coast pattern toward heel and bottom of tooth.
3. With no change in pinion shim thickness, an increase in backlash moves ring gear further from pinion. Both drive and coast patterns move toward heel and top of tooth.
4. With no change in pinion shim thickness, a decrease in backlash moves ring gear closer to pinion gear. Both drive and coast patterns move toward toe and bottom of tooth.



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**Fig. 1: Drive Axle Gear Tooth Patterns**



## GENERAL INFORMATION

### General Cooling System Service

#### \* PLEASE READ THIS FIRST \*

This article is generic in nature and all information does not apply to all vehicles including those without a liquid cooling system. For vehicle specific information, see the appropriate articles in the ENGINE category.

## DESCRIPTION

The liquid cooling system consists of a radiator, water pump, thermostat, electric or belt-driven cooling fan, pressure cap, heater, and various connecting hoses and cooling passages in the engine block and cylinder head.

## MAINTENANCE

### DRAINING

Remove radiator cap and open heater control valve to maximum heat position. Open drain cocks or remove plugs in bottom of radiator and engine block. In-line engines usually have one plug or drain cock, while "V" type engines have 2, one in each bank of cylinders.

### FLUSHING

**CAUTION:** Some manufacturers use an aluminum and plastic radiator. Flushing solution must be compatible with aluminum.

#### Radiator

Connect flushing gun to water outlet of radiator. Disconnect water inlet hose. To prevent flooding engine, use a hose connected to radiator inlet. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

#### Engine Block

To flush engine, remove thermostat. Connect flushing gun to water outlet of radiator. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

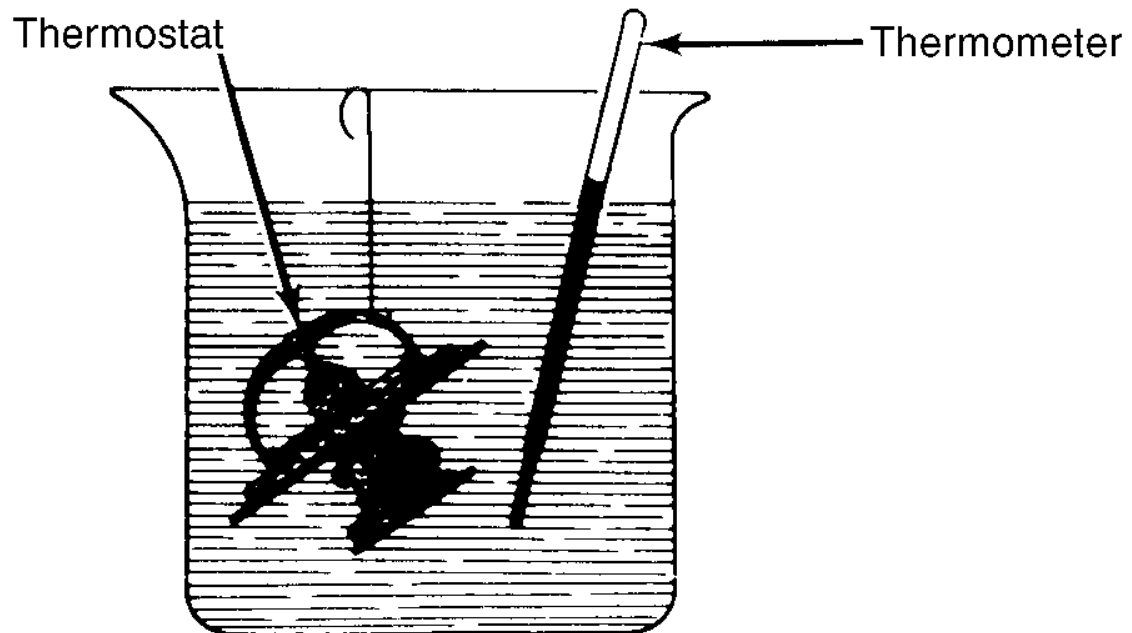
### REFILLING

To prevent air from being trapped in engine block, engine should be running when refilling cooling system. After system is full, continue running engine until thermostat is open, then recheck fill level. Do not overfill system.

## TESTING

### THERMOSTAT

1. Remove and inspect thermostat for corrosion and proper seating of valve. If okay, suspend thermostat and thermometer in a 50/50 mixture of coolant and water. See [Fig.1](#). DO NOT allow thermostat or thermometer to touch bottom or container. Heat water until thermostat begins to open.
2. Read temperature on thermometer. This is the initial opening temperature and should be within specification. Continue heating water until thermostat is fully open and note temperature. This is the fully open temperature. If either reading is not to specification, replace thermostat.



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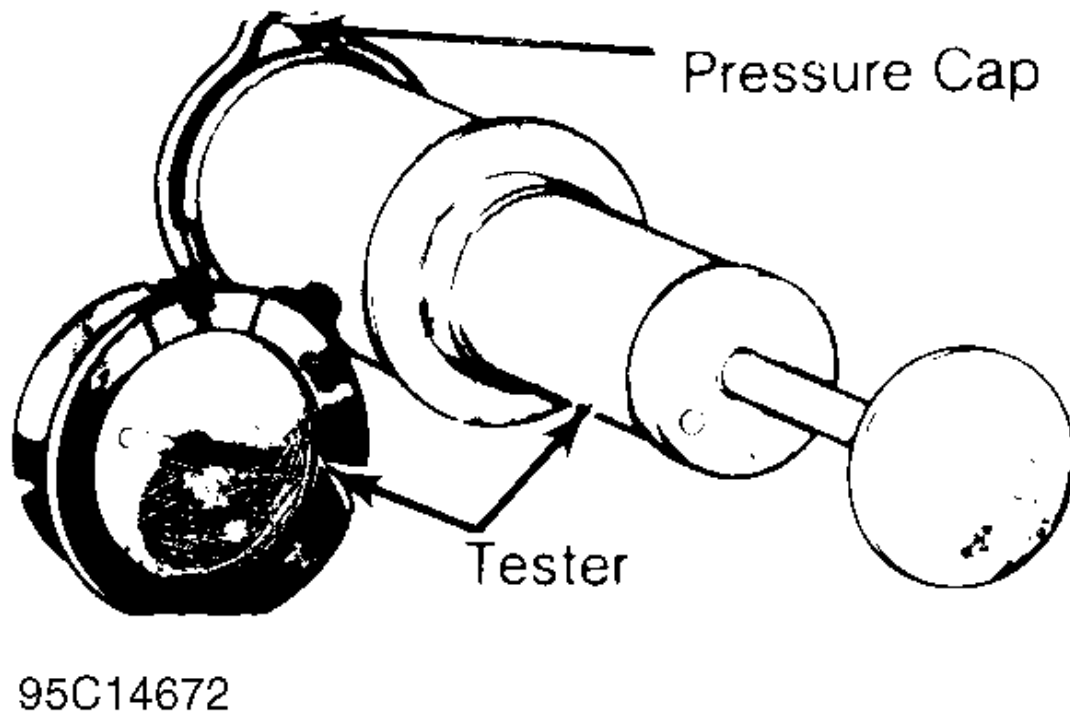
**Fig. 1: Testing Thermostat in Coolant/Water Solution**

### **PRESSURE TESTING**

A pressure tester is used to check both radiator cap and complete cooling system. Follow pressure tester manufacturer instructions and test components as follows:

#### **Radiator Cap**

Visually inspect radiator cap. If cap looks okay, connect pressure tester to cap. See [Fig. 2](#). Pressurize tester to full radiator cap specification. Replace cap if it fails to hold pressure.



**Fig. 2: Pressure Testing Radiator Cap**

### Cooling System

1. Turn ignition off and allow engine to cool. Ensure radiator is filled to correct level. Remove cap and attach pressure tester to radiator. Pressurize tester to full radiator rating specification.
2. If pressure drops, check for external leaks. If no leaks are found, start engine and allow to idle. If pressure builds up immediately, check cylinder head and block for cracks. If pressure does not build up immediately, go to next step.

**CAUTION:** DO NOT allow excess pressure to build in cooling system or damage may result.

3. Using pressure tester, pump cooling system up to pressure specified on radiator cap. If pump gauge pointer vibrates, compression or combustion leak into cooling system is indicated. Isolate leak by shorting each spark plug wire to cylinder block. Gauge pointer vibration will stop or decrease when leaking cylinder is shorted.

## GENERAL INFORMATION

### Maintenance And General Information - Repair - All I3 Models - i3

## SAFETY INFORMATION

### (00 SAFETY INSTRUCTIONS FOR HANDLING OIL)

**WARNING:** **DANGER OF POISONING** if oil is ingested/absorbed through the skin!  
**RISK OF INJURY** if oil comes into contact with eyes and skin!

#### Recycling:

Observe country-specific waste-disposal regulations.

#### Measures if oil is unintentionally released:

- **Personal precautionary measures:** Danger of slipping! Keep non-involved persons away from the work area. Wear personal protective clothing/equipment.
- **Environmental protection measures:** Prevent oil from draining into drain channels, sewerage systems, pits, cellars, water and the ground.
- **Limiting spread:** Use oil blocks to prevent the surface spread of oil.
- **Cleaning procedure:** Bind and dispose of escaped oil with nonflammable absorbents.

**NOTE:** Do not flush oil away with water or aqueous cleaning agents.

### 00 Danger of poisoning if oil is ingested/absorbed through the skin Danger of poisoning!

Ingesting oil or absorbing through the skin may cause poisoning!

#### Possible symptoms are:

- Headaches
- Dizziness
- Stomach aches
- Vomiting
- Diarrhoea
- Cramps/fits
- Unconsciousness

#### Protective measures/rules of conduct:

- Pour oil only into appropriately marked containers
- Do **not** pour oil into drinking vessels (drinks bottles, glasses, cups or mugs)
- Observe country-specific safety regulations

#### First aid measures:

- Do not induce vomiting.

If the person affected is still conscious, he/she must rinse out their mouth with water, drink plenty of water and consult a doctor immediately.

If the person affected is unconscious, do not administer anything by mouth, place the person in the recovery position and seek immediate medical attention.

## **Danger of injury!**

Contact with eyes or skin may result in injury!

### **Possible symptoms are:**

- Impaired sight
- Irritation of the eyes
- Reddening of the skin
- Rough and cracked skin

### **Protective measures/rules of conduct:**

- Wear protective goggles
- Wear oil-resistant protective gloves
- Observe country-specific safety regulations

### **First aid measures:**

- **Eye contact:** Rinse eyes immediately with plenty of water for at least 15 minutes; if available, use an eye-rinsing bottle. If irritation of the eyes persists, consult a doctor.
- **Skin contact:** Wash off with soap and water immediately. If irritation persists, consult a doctor.

**NOTE:** Do not use solvents/thinners.

## **(64 00... INFORMATION ON USING CLEANING AGENT/PAINTS (PERSONAL PROTECTION EQUIPMENT))**

**WARNING:** Use of cleaning agents/paints not compliant with instructions can cause serious injuries or burns!  
Handling cleaning agents/paints can trigger allergic skin and respiratory reactions!

### **Observe following instructions:**

- IMPORTANT:
- Store cleaning agents/paints only in a secure cabinet.
  - Keep cleaning agents/paints away from naked flames and other sources of ignition.
  - Protect cleaning agents/paints from high temperatures and direct sunlight.
  - Always keep an eye douche on hand, change the water regularly (once a month).

### **Observe following instructions before use:**

- IMPORTANT:
- Manufacturer's instructions (on container/packaging)
  - Hazard warnings (on container/packaging)
  - Manufacturer's instructions on package insert
  - Material safety data sheet of manufacturer
  - National market regulations

### **IMPORTANT: Observe following instructions during use:**

- Do not eat, drink or smoke while working with these products.
- Avoid direct contact with skin and eyes.
- Wear personal protective clothing/equipment.

- Ensure that all enclosed areas are well ventilated or extract fumes directly.
- Immediately change working clothes soiled with cleaning agent/paint.
- After finishing work, wash your hands and apply protective skin cream.

**IMPORTANT:** Follow hazard warnings and wear personal protection equipment!

### **First Aid:**

- If product comes in contact with eyes, immediately flush with running water for about 10 - 15 minutes. Seek the advice of eye specialist.
- In the event of skin contact and where applicable an allergic skin reaction, clean the affected areas immediately with soap and water and then apply silicone-free skin cream. Seek advice of physician.
- If an adhesive product is swallowed, rinse mouth/parts of mouth thoroughly with running water. Drink 1-2 glasses of water. Do not induce vomiting. Consult a doctor.
- After inhaling vapors ensure ample supply of fresh air. Keep calm, keep respiratory tracks clear and call doctor.

### **Recycling:**

Dispose of cleaning agents/paints in a professional manner!

Observe national/country-specific disposal regulations.

### **(61 00... NOTES ON HANDLING THE HIGH PRESSURE CLEANER)**

**WARNING:** Only used a high pressure cleaner approved by BMW!  
 Only instructed persons aged over 16 years may work using a high pressure cleaner.  
 Check the high pressure cleaner and electrical wiring for visible damage.  
 Only use at a suitable location.

#### **Pay attention to following hazard warnings:**

- Danger of injury due to water jet
- Contact with hazardous substances in spray
- Risk of skidding on wet floor
- Risk of stumbling due to hoses and cables
- Comply with **NOTES AND INSTRUCTIONS ON HANDLING CLEANING AGENTS!**
- Risk of scalding when cleaning with hot water.
- On electric or hybrid cars, the safety instructions for handling with hybrid cars are to be complied with.

**IMPORTANT:**

**WARNING:** The following personal protective equipment is to be used:

- **Safety goggles/face guard**
- **Suitable gloves**
- **Apron**
- **Rubber boots**
- **Ear protectors**
- **Safety shoes**

**IMPORTANT:** Notes on washing a vehicle with a high pressure cleaner:



- Do not wash directly on gaskets and control units during engine washes.
- A minimum distance of 30 cm must be adhered to for tires and tire valves.
- A minimum distance of 30 cm must be adhered to for the soft top and painted parts.
- Do not use if engine is still hot.
- Do not exceed maximum water temperature of 60 degrees.
- Do not spray directly onto cameras/sensors.
- On electric or hybrid cars do not wash on high-voltage components.

## GENERAL SERVICE AND MAINTENANCE

### 00 00... CBS RESET

**NOTE:**        **The CBS maintenance jobs can be reset in the car. It is always recommended to reset the CBS jobs via the diagnosis system.**

It is only possible to code the country-specific statutory intervals with the diagnosis system.

#### **Service of front/rear brake (as of version 07/2014 only):**

A CBS reset in the vehicle is only possible if the brake pad wear sensor is partially ground (CBS display in CID active).

If the brake pad wear sensor is not partially ground (no CBS display in CID), a CBS reset can only be carried out with the diagnosis system.

#### **CBS reset with diagnosis system**

**NOTE:**        **To be able to check or correct the vehicle's on-board date properly, the diagnosis system requires the correctly set tester system date!**

The jobs may only be reset after the service measure has been completed.

The CBS jobs can be reset via the diagnosis system on the following path:

- Service functions
- Maintenance
- CBS reset

#### **CBS reset in the car**

On the vehicle, service operations can be reset at the instrument panel.

**NOTE:**        **On-board date must be correctly set.**

A reset is only possible in the car if:

- No CC message is present
- Availability of the service job is under 90 %

Resetting of a service job must always be carried out **after** a maintenance measure has been completed.

The resetting process is interrupted if the time is exceeded or if a terminal is changed.

1. Switch the ignition on.
2. Press the trip distance recorder reset button (1) (referred to as button in the following) for approx. 10 seconds until the 1st service job is displayed in the display (2).

Bring up the next item by briefly pressing the button again. Select the desired service job.

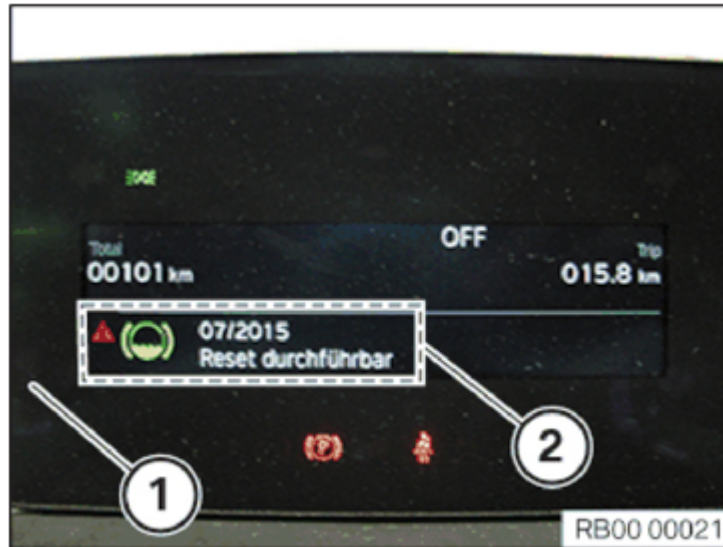
3. If a reset is possible, this is displayed in the instrument cluster as "Reset possible".

Press the button for 3 s to start the reset.

4. Confirm text message "Perform reset?" by pressing the button for 3 seconds again.

The status of the reset is indicated in the display by a progress bar and in text as "Reset in progress".

5. The reset is confirmed as "Reset successful" after completion.



**Fig. 1: Screen Display CBS Reset - 1st Service Job**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **CBS reset of inspections/tests required by law**

Input the target date for the statutory vehicle inspection by clicking on the scope of maintenance work with the controller in the CBS main menu of the Central Information Display under:

- **Vehicle information**
- **Vehicle status**
- **Service requirements**
- **Vehicle inspection**
- **Enter service appointment**

The target month or the target year can be set and acknowledged by turning and pressing



## 00 00... CHECKING HORN, HEADLIGHT FLASHERS AND HAZARD WARNING FLASHERS

### Horn

Check function.

**NOTE:** In the case of twin-tone fanfares, make sure that both fanfares are working properly.

### Headlight flasher

Activate headlight flashers, check high-beam headlights and blue indicator light in instrument panel for correct operation.

### Hazard warning lights

Check function.

**NOTE:** After consultation with the customer, rectify faults and issue a separate invoice.

## 00 00... CHECKING COOLANT LEVEL AND CONCENTRATION, CORRECTING IF NECESSARY

- Check connections, hose clamps and hoses for coolant residues and damage such as e.g. cracks.
- Check coolant composition in expansion tank: Should be  $-35\text{ }^{\circ}\text{C}$  to  $-40\text{ }^{\circ}\text{C}$ .
- Check coolant levels of both expansion tanks (drive unit and heating) in front of luggage compartment. The coolant levels must be between the marks "min" and "max". If necessary, top up coolant to max. fill level. If there is no coolant, also identify the cause and notify the customer.

**NOTE:** Special i3 coolant is used for heater circuit!

- During refill (for special allocation):
  - If needed, drain coolant volume difference. See [DRAINING COOLING CIRCUIT \(HIGH-TEMPERATURE COOLING SYSTEM\) OF RANGE EXTENDER \(I01\)](#), [DRAINING COOLING CIRCUIT \(LOW TEMPERATURE COOLING SYSTEM\) FOR DRIVE](#), and [DRAINING COOLANT, HEATER CIRCUIT](#).
  - Top up prescribed coolant

## 00 00... CHECKING WINDSCREEN WASH/WIPE SYSTEM

- Check wiper range for streaks; if necessary, replace wiper blades after consulting with customer
- The spray jet must emerge uniformly from the washer jet, adjust nozzle or replace if necessary and issue a separate invoice

## 00 00... CHECKING INSTRUMENT/INSCRIPTION LIGHTING, INTERIOR/LUGGAGE COMPARTMENT/GLOVE BOX LIGHTS AND BLOWER

### Instrument lighting

Check function of instrument and indicator/warning lights.

### Inscription lighting

Check function of light switches; dimmer; controls; heater/air conditioning; rear window demister; radio; (depending on equipment) on-board computer; power windows; electric slide/tilt sunroof; fog lamp.

### Interior lighting, glove box light and luggage compartment lights

Check function of footwell lighting, front and rear reading lights, make-up mirror light, mood lighting (door handles, exit, etc.), glove box light, luggage compartment lights, etc..

**NOTE:** Lighting may vary, depending on the equipment specification.

## Heating

Check function of all blower stages, air distribution and air outlet.

**NOTE:** After consultation with the customer, rectify faults and issue a separate invoice.

## 00 00... CHECKING LIGHTING SYSTEM

- Check lighting system for correct operation:
  - Check headlights, rear lights and associated indicator lights
  - Check headlight adjustment
  - Check side lights, parking lights, low-beam headlight and high-beam headlight for correct operation
  - Check headlight flasher for correct operation
  - Check left/right turn indicators and hazard warning flashers for correct operation
  - Check brake lights for correct operation
  - Check reversing lights and number plate lights for correct operation
  - Check front and rear fog lights for correct operation
  - If necessary ground lights of outside door handles

## 00 00... CHECKING OF ROAD SAFETY (TEST DRIVE)

- **Checking of road safety**
  - Carry out a test drive in order to check the service and Automatic Hold brakes
  - Check steering for play, ease of movement and directional stability
  - Visually inspect shock absorbers for leaks
  - Check indicator/warning lamps and Check Control system for correct operation
  - Check due date for statutory roadworthiness and exhaust emission tests and advise customer of test dates

## 00 00 009 PRE-DELIVERY CHECK (BMW DEALER)

### Quality assurance by BMW i Service

Model:

Vehicle identification number:

(Please tick where appropriate)

Included with the vehicle:

- Maintenance record booklet (with national-market version Korea only)
- Local documents:
- Vehicle keys (number):

I hereby confirm that I have received the vehicle in perfect condition.

...

Place and date

...

Signature of vehicle owner

**Pre-delivery check by BMW i Service**

**Scopes of inspection:** To be kept with the workshop documents

The following work must be carried out on the vehicle by BMW i Service prior to delivery.

Model:

Vehicle identification number:

**\* Denotes optional extra or national-market version. Observe possible changes in this regard.**

<b>Scopes of inspection: To be kept with the workshop documents</b>			
	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
<b>Accessory items</b>			
Include charging cable in front luggage compartment, where appropriate	Â	Â	Â
Install other accessory items	Â	Â	Â
<b>Using diagnosis system</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Carry out "CBS pre-delivery check" in the Service Function path under Maintenance	Â	Â	Â
Deactivate transportation mode	Â	Â	Â
Reset average mileage/kilometers driven	Â	Â	Â
Enter first registration	Â	Â	Â
Set on-board date	Â	Â	Â
Set statutory inspection dates*	Â	Â	Â
Enter service telephone numbers	Â	Â	Â
BMW TeleServices*: Activation	Â	Â	Â
Navigation system*: Activate the roadmap. Check the up-to-dateness of the roadmap and update if necessary.	Â	Â	Â
Check battery, observe notes in the diagnosis system, if applicable, charge battery	Â	Â	Â
Delete fault memory	Â	Â	Â
Carry out vehicle test, eliminate faults if necessary	Â	Â	Â
<b>Fluid tank for washer fluid</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Check fluid level and top up if necessary, where required with antifreeze additive	Â	Â	Â
<b>Labels*</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Attach the label for BMW i breakdown assistance	Â	Â	Â
<b>Body, interior equipment, vehicle underbody</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Check for transportation damage	Â	Â	Â
<b>Spring blocker*</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Remove spring blocker	Â	Â	Â
<b>Tires</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Checking tire pressure	Â	Â	Â
Observe note on tolerance compensation for tire pressure control!			
Initialize Run Flat Indicator (RPA) or tire pressure control (RDC)	Â	Â	Â
For winter tires* attach the label V-max.	Â	Â	Â
<b>Maintenance record booklet* (with national-market version Korea only)</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>

<b>Scopes of inspection: To be kept with the workshop documents</b>			
Stamp pre-delivery check/enter vehicle identification number	Â	Â	Â
<b>Documents (place in glove box)</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
If applicable, attach local documents* ...	Â	Â	Â
Maintenance record booklet* (with national-market version Korea only)	Â	Â	Â
Attach keys (note the amount)	Â	Â	Â
<b>Indicator/warning lights and Check Control</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Check and remove fault if applicable	Â	Â	Â
<b>Service and parking brake</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Transport and immobilization periods of 3-6 weeks: Check for correct operation	Â	Â	Â
In event of transportation and immobilization periods of more than 6 weeks: Brake in	Â	Â	Â
<b>Transportation lock* and vehicle cleaning</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Remove the <b>TRANSPORTATION PROTECTIVE FILM</b>	Â	Â	Â
Clean inside and outside of vehicle	Â	Â	Â
Check front and rear luggage compartment for cleanliness, and clean if necessary	Â	Â	Â
<b>High-voltage battery unit</b>	<b>O.K.</b>	<b>Not OK</b>	<b>not present</b>
Fully load high-voltage battery unit	Â	Â	Â
Set the charge current in the central information display to "low".	Â	Â	Â
<b>Notes:</b>	Â	Â	Â

...

Date

...

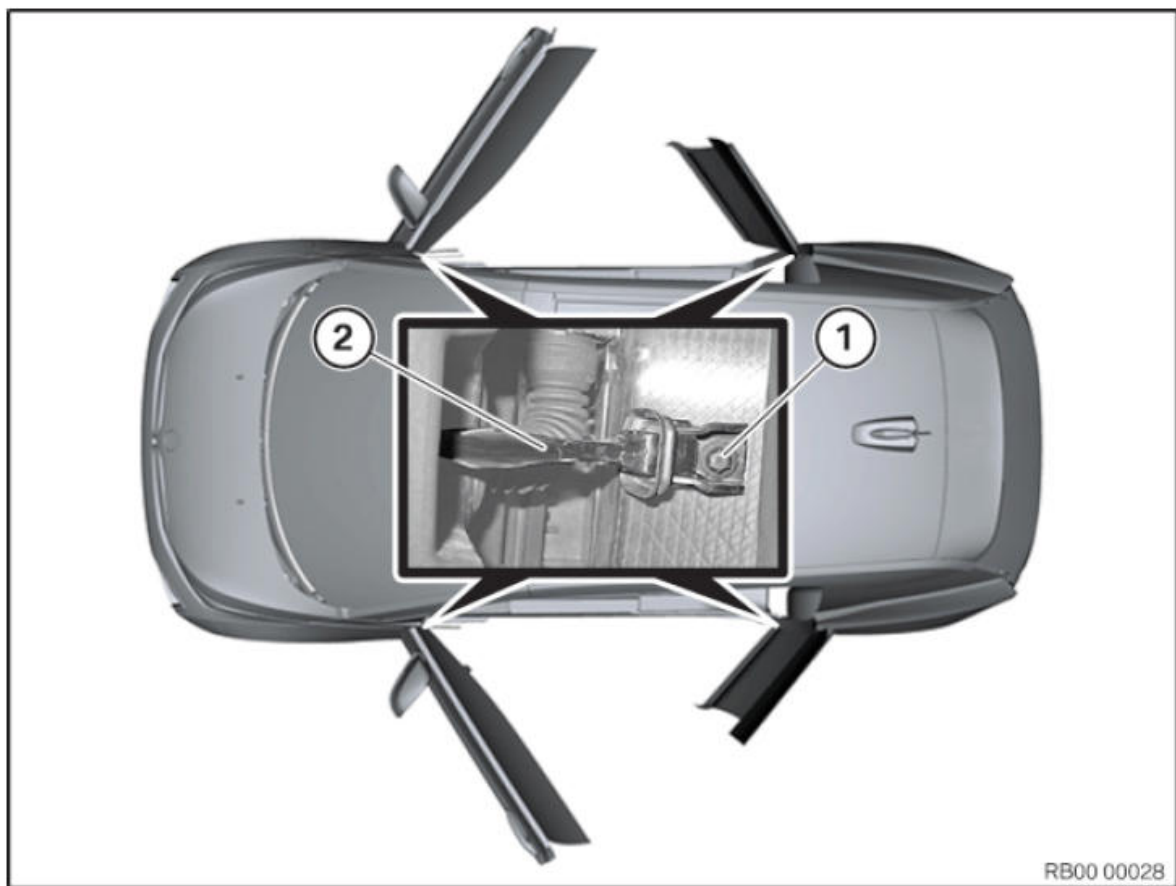
Mechanic

...

Workshop Supervisor

**00 00... RETIGHTENING SCREW CONNECTIONS OF ALL DOOR STOPS (FRONT AND REAR DOORS)**





**Fig. 3: Identifying Door Stop And Screw Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

Retighten screw connection (1) of the door stop (2) on the front and rear doors (left and right).

**Front door (left and right):**

Tightening torque **51 21 3AZ** .

**Rear door (left and right):**

Tightening torque **51 22 6AZ** .

**00 00... SEAT BELTS: CHECK CONDITION OF SEAT BELT STRAP, CHECK FUNCTION OF AUTOMATIC REEL, SEAT BELT LOCKING REEL, SEAT BELT BUCKLE, SEAT BELT CLIP AND, IF NECESSARY, SEAT BELT CLASP**

**Seat belt strap, automatic reel, seat belt locking reel**

Pull out seat belt strap and make sure it emerges without jerking.

Check seat belt strap for damage:

- folding
- unraveling
- pinches
- cracks and tears
- traces of melting

Check the seat belt clip (retaining button) and, if necessary, seat belt clasp of belt tongue on seat belt strap for damage and installation.

Retract seat belt strap; here the automatic reel must retract the seat belt strap automatically and without squeaking noises; the last section of the strap may have to be fed in.

Pull out seat belt strap in short tugs - seat belt locking reel must lock.

## Seat belt buckle

The belt tongue on the seat belt strap must easily snap into place with an audible click.

When the "Press" button is pressed, the belt tongue must be ejected from the buckle under spring pressure.

**NOTE:** If the seat belt is damaged, you must replace the seat belt completely after consulting the customer; issue a separate invoice for this work.

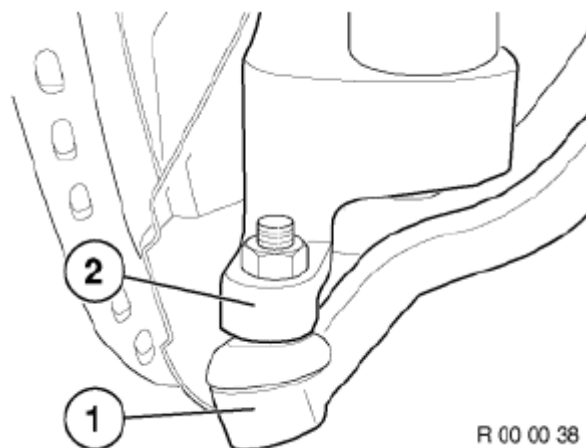
Instructions on how to proceed, refer to [CHECKING AUTOMATIC SEAT BELT](#) .

## 00 00... STEERING COMPONENTS: CHECK FOR PLAY AND DAMAGE

### Checking play:

**NOTE:** Observe notes on checking the steering backlash!

1. Check the tie rod backlash only in loaded condition or in the design position.
2. Checking with front axle raised:
  - To evaluate the play of the steering gear, it is necessary to pressurize the steering gear via its servo system!
  - The combustion engine must be running during hydraulically or electrically assisted steering for this purpose



**Fig. 4: Checking Tie Rod Backlash**

Courtesy of BMW OF NORTH AMERICA, INC.

### Steering wheel:

Move steering wheel back and forth and check for play.

### Track rod joint:

There must be no play between the track rod joint (1) and track-rod arm (2).

### Check for damage:

Check gaiter, axle and gaiter for damage (e.g. cracks, holes) and leaks.

Check gaiter for missing tensioning straps.

## 00 00... TIRES: CHECKING AND IF NECESSARY CORRECTING INFLATION PRESSURE, CHECKING CONDITION, TREAD DEPTH AND PATTERN

- **Checking tire pressure:**
  - Check tire pressure in accordance with label on B-pillar

• **Check tire condition:**

- Check tread depth of all tires with tire tread gauge
- Check tire tread surfaces and side walls for incisions and foreign particles such as nails or screws
- Check tread wear pattern for localized flattening and wear on one side; if necessary, carry out wheel/chassis alignment after consulting with customer and issue a separate invoice for this work

**NOTE:**

- **For reasons of driving safety, only use tires of the same design and tire tread on a single vehicle**
- **Inform customer of any incorrect or worn tires**

**00 00... UNDERBODY INCL. ALL VISIBLE COMPONENTS: CHECK FOR DAMAGE, CORRECT POSITION, TIGHTNESS, CORROSION**

- Visually inspect underbody:
  - For leaks (transmission, fuel system, brake components, steering)
  - For correct routing of electrical line (e.g. brake pad wear sensor, pulse sensor)
  - Check visible high-voltage cables for damage, correct routing and fixation
  - Check tightness of shock absorbers and check installation and corrosion of springs in rebound state
  - Damage to underbody
  - Corrosion on underbody
  - Damage on high-voltage battery unit
  - Complete mounting of add-on parts (e.g. underbody panelling)

IMPORTANT: If damage to the underbody is identified:

- If damage to high-voltage system identified, observe **SAFETY INFORMATION FOR HANDLING ELECTRIC VEHICLES**
- If necessary, remove trim panels from underbody.
- Check brackets as well as brake- and fuel lines for damage and correct installation position.

Rectify identified faults after consulting with customer and issue a separate invoice.

**00 00... WINDSCREEN WASHER SYSTEM: CHECKING FLUID LEVEL, TOPPING UP IF NECESSARY**

- Top up washer fluid reservoir up to edge or mark.

IMPORTANT: A pH-neutral BMW window cleaning fluid (antifreeze in winter) must always be added to the water.

**00 00... WORK INSTRUCTION FOR REMOVING THE PROTECTIVE FILM**

**NOTE:** The protective film is applied to new vehicles at the works. The dealer must guarantee only expert removal of the protective film.

The protective film should be removed 48 hours before vehicle handover to the customer.

The protective film can be easily removed from the affected surfaces. Polishing is necessary only in exceptional cases.

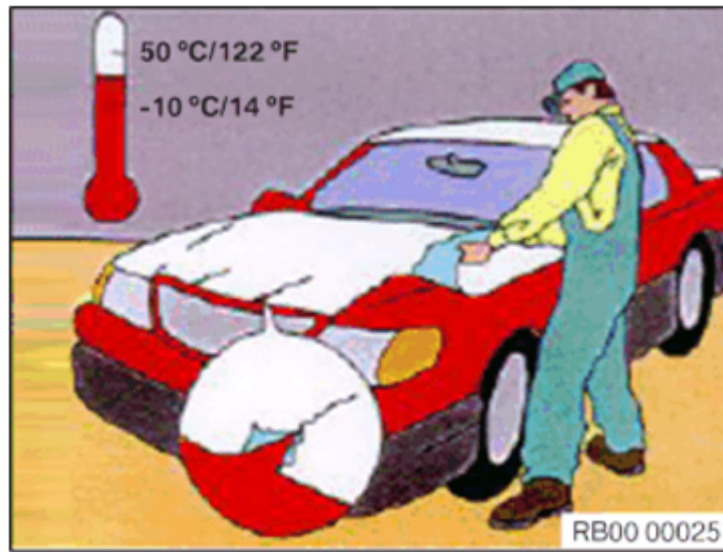
**Instructions for removing the protective film:**

- In order to reduce the amount of force required, the film can be torn at the edge and pulled off in narrower strips.

- Remove the film in a surface 87 of 186 temperature range of -10 Å°C to +50 Å° C.

Excessively high temperatures can lead to adhesive residue being left on the surface.

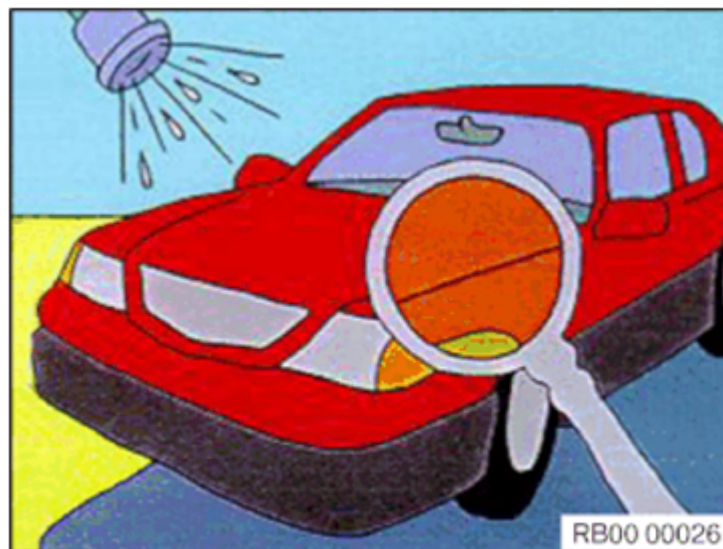
In order to achieve the recommended temperature for pulling off the adhesive film from the vehicle after direct exposure to the sun, it is possible to carry out a car wash with applied protective film in order to cool the vehicle down.



**Fig. 5: Pulling Off Adhesive Film From Car**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Car wash and surface inspection:**

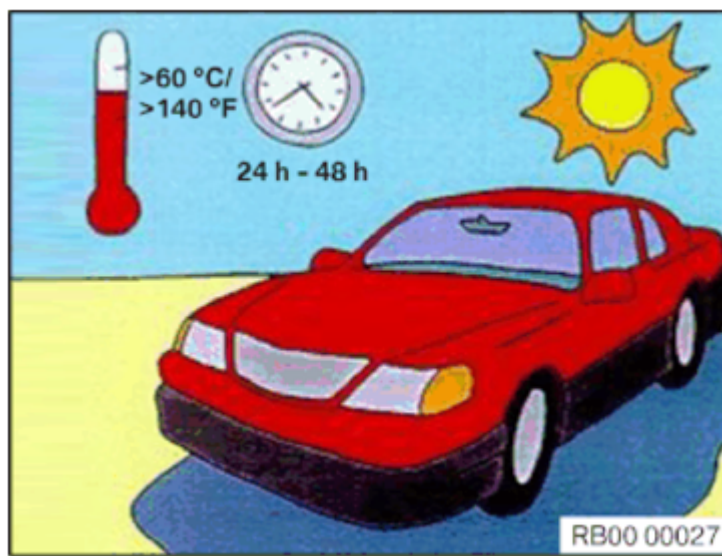
- Check vehicle surface after the car wash.
- Any adhesive residue left on the vehicle surface can be removed by rubbing by hand or using a cleaning agent R2 (part number 83 19 0 417 324) or stain remover (part number 83 11 9 407 816) and a lint-free cloth.



**Fig. 6: Checking Vehicle Surface After Car Wash**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Procedure in the event of paint swelling:**

- Any paint swelling normally disappears within 48 hours.
- Higher temperatures (infrared lamp) accelerate this process.
- Polishing of the surfaces is necessary only in rare cases if the heat treatment does not result in success.



**Fig. 7: Identifying Paint Swelling Procedure**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **JACKING/LIFTING VEHICLE**

### **(LIFTING THE VEHICLE USING A VEHICLE HOIST)**

**WARNING:** **Danger to life!**  
Read and follow operating instructions for vehicle hoist.  
Do not exceed approved load-carrying capacity and load distribution of vehicle hoist.  
Weight compensation may be necessary due to the loading situation of the vehicle.  
This also applies in the event of considerable removal of parts or conversions on the vehicle.

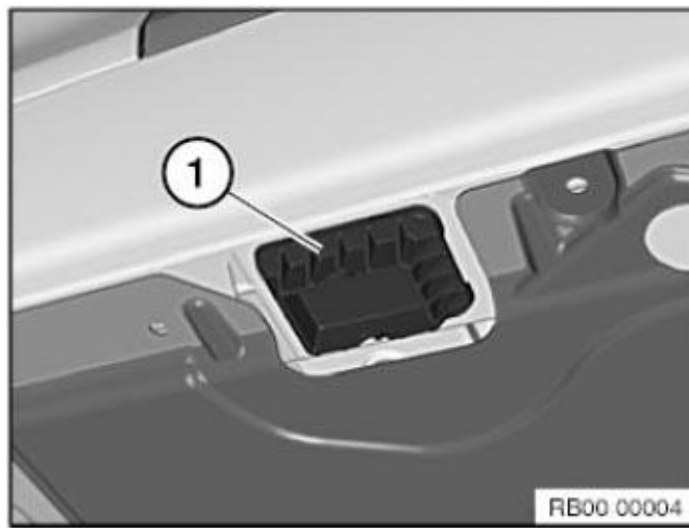
**NOTE:** The vehicle hoist must comply with the relevant statutory/country-specific accident prevention regulations and be serviced according to the regulations.

**IMPORTANT:** Risk of damage!  
Before driving onto a vehicle hoist, make sure there is sufficient ground clearance between the vehicle hoist and the vehicle.  
The vehicle may only be raised with the vehicle hoist at the four jacking points.

#### **Necessary preliminary tasks:**

- If necessary, remove jacking points from equipment pack (with new vehicles) and insert from below into openings in front and rear sill areas

**IMPORTANT:** All four jacking points (1) must be available!  
Never raise the vehicle without the jacking points (1)!



**Fig. 8: Identifying Jacking Points**

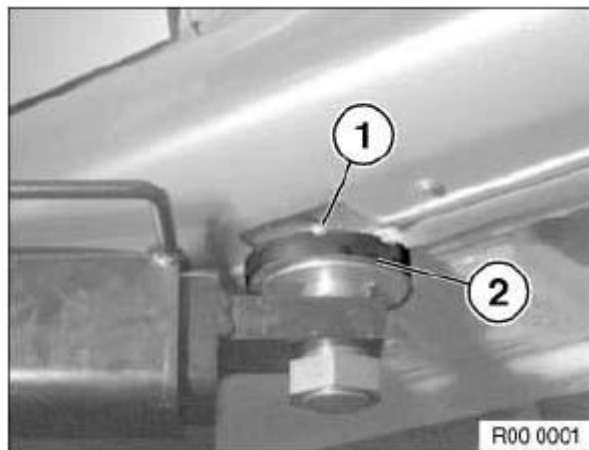
Courtesy of BMW OF NORTH AMERICA, INC.

Risk of damage!

Align support plates (2) of lifting platform arms to jacking points (1) in such a way that

IMPORTANT: no adjoining components are touched and thereby damaged.

**In electric vehicles, there is a risk of damage to the high-voltage component behind the underbody panelling!**



**Fig. 9: Identifying Support Plates And Jacking Points**

Courtesy of BMW OF NORTH AMERICA, INC.

Risk of damage!

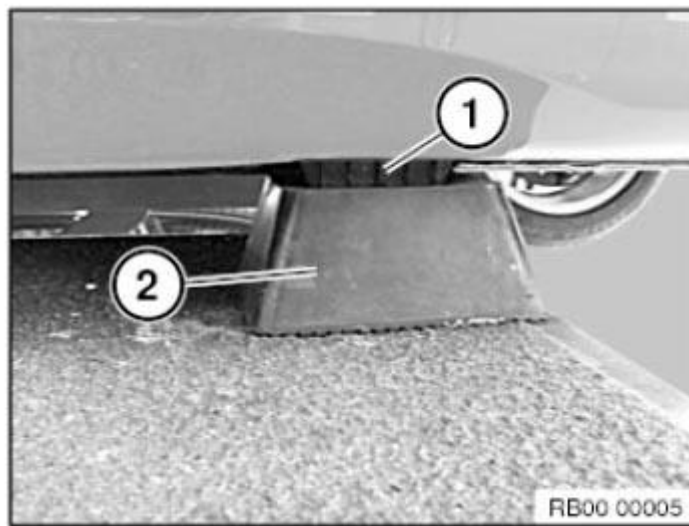
Align the rubber block (2) with the jacking points (1) in such a way that no adjoining components are touched and thereby damaged.

IMPORTANT: **Never raise the vehicle without rubber blocks (or rigid foam blocks)!**

There is a major risk of damage to the vehicle underbody!

**In electric vehicles, there is a risk of damage to the high-voltage component behind the underbody panelling!**





**Fig. 10: Identifying Rubber Block And Jacking Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **12V VEHICLE ELECTRICAL SYSTEM**

**(61 20... INFORMATION ON AGM BATTERY)**



T6104916

**Fig. 11: Identifying AGM Battery**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **Introduction**

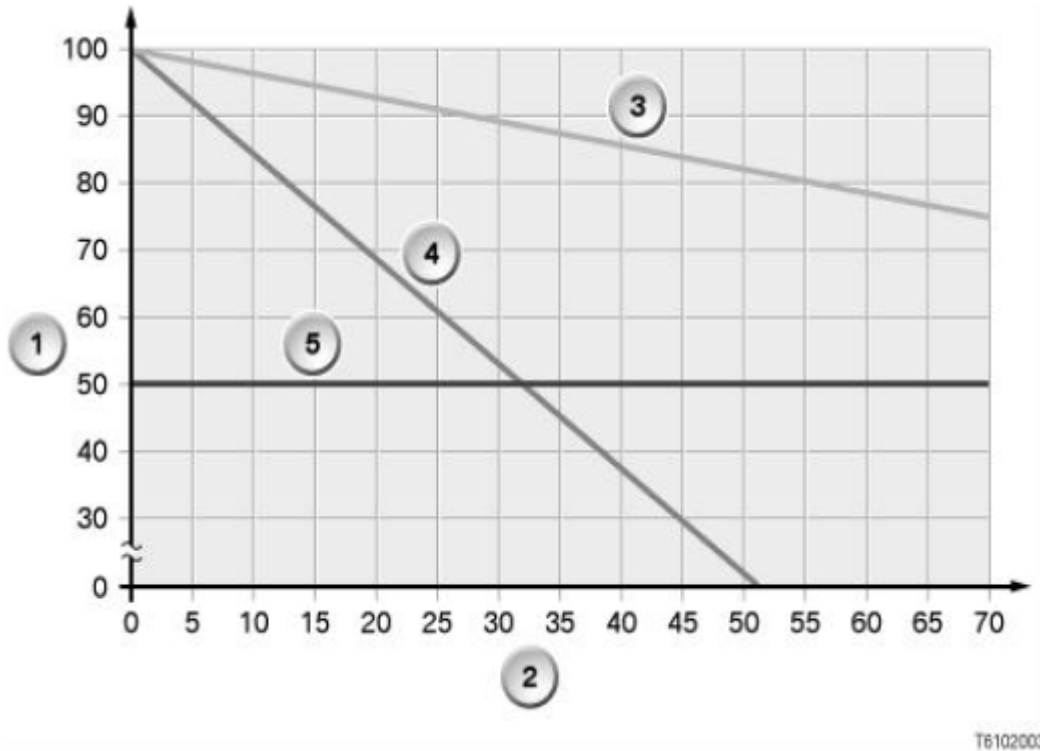
In September 2002, the first so-called VRLA batteries, better known as **AGM batteries** came into use. (VRLA stands for **V**alve **R**egulated **L**ead **A**cid, i.e. lead-acid battery with pressure relief valve; **AGM** stands for **A**bsorbent **G**lass **M**at, i.e. absorbent glass-fibre fleece).

The constantly increasing energy demand of modern vehicle electrical systems calls for ever more powerful battery solutions. A modern luxury-class vehicle has some 100 actuator motors that have to be fed with electrical current. Added to these are safety, environmental and comfort elements which are increasingly becoming standard features, such as e.g. Antilock Brake System (ABS), Dynamic Stability Control (DSC), steering assistance (EPS), electronic chassis and suspension control, air conditioning and navigation system. Current consumption is considerable even when the vehicle is not in use.

The somewhat higher price compared with a battery of similar size is fully balanced by the following benefits:

- greatly longer service life
- improved starting reliability at low temperatures
- reliable starting of engines with high starting current requirements, e.g. high-performance diesel engines
- 100 % freedom from maintenance
- low risk in the event of an accident (reduced environmental risk)

### Service life of AGM batteries



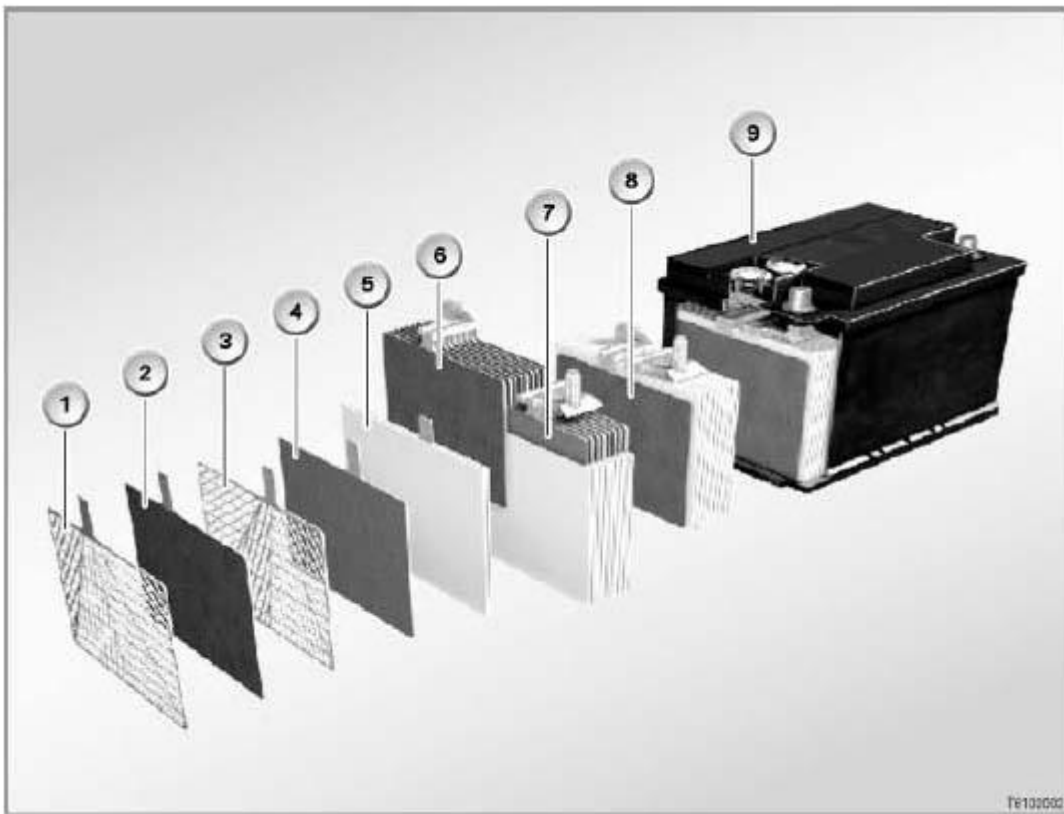
**Fig. 12: AGM Batteries Service Life Graph**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Item	Explanation
1	Available capacity [%]
2	Mileage [thousand km]
3	AGM battery
4	Lead-calcium battery
5	50 % capacity limit
Â	Â

In contrast to conventional lead-calcium batteries, the sulfuric acid in a battery with fleece technology is not held freely in the battery housing. Rather, 100% of the sulfuric acid is bound into the mats of the glass-fibre fleece (separators). For this reason, no battery acid can escape if the battery housing is damaged. In addition, the AGM battery is sealed to be airtight. This is possible because the gases are converted back into water by the permeability of the separators.

### Brief component description

The AGM battery has a black housing and the so-called "Magic Eye" is missing.



**Fig. 13: Identifying AGM Battery Components**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Item	Explanation
1	Positive grille with silver alloy
2	Positive plate
3	Negative grille
4	Negative plate
5	Separator made of glass-fibre fleece
6	Set of positive plates
7	Set of negative plates
8	Block of plates
9	Block box with base strips
Â	Â

### Construction

The AGM battery differs from the conventional lead calcium battery as follows:

- larger plates: Larger plates allow a 25% larger power density.
- Separators made of glass-fibre fleece: These can cause an up to 3-times higher cycle stability to be reached. This improves the cold starting capability, the power consumption and service life.
- Airtight housing with pressure relief valve:

The inspection plugs are sealed and can not be opened.

- Battery acid bound in glass-fibre fleece: Battery acid is not found free in the housing as before, but is rather bound 100% in the glass-fibre fleece. This gives increased security against the acid escaping and thus reduces the environmental risk.

### How it works

The AGM battery differs from conventional batteries in its non-polluting and substance-retaining behavior during charging.

When a battery is charged, the electrolysis process emits the gases oxygen and hydrogen.

- In a conventional wet lead calcium battery, the two gases hydrogen and oxygen are dissipated into the atmosphere.
- In an AGM battery, the two gases are converted back into water: The oxygen which is created at the positive electrode during charging passes through the permeable glass fibre fleece to the negative electrode. At the negative electrode the oxygen reacts with the arriving hydrogen ions in the electrolyte to form water (oxygen cycle).

In this manner, the gas and thus also the electrolyte are not lost.

Only in the event of an excessively heavy build-up of gas, i.e. excessively high pressure build-up (20 to 200 mbar), does the pressure relief valve discharge the gas. In this process, the pressure relief valve does not allow any oxygen in the air to enter. Because the pressure in the battery is regulated by a valve, the AGM battery is also known as the VRLA battery (valve-regulated lead acid).

### Notes for service technicians:

It is necessary when handling an AGM battery to observe some particular points pertaining to battery changing and installation location.

#### *Charging*

**WARNING:** Do not charge the AGM battery with  $\geq 14.8$  V. Do not use rapid-charging programs!

When charging removed batteries (so-called stand-alone batteries), do not exceed the maximum charging voltage of 14.8 V at room temperature. Also, for charging via the external start connection point, the maximum charging voltage of 14.8 V at room temperature must not be exceeded. The battery can be damaged even if the AGM battery is only briefly charged with a charging voltage higher than 14.8 V. A charging voltage of more than 14.8 V is usually used in quick-charging routines.

#### *Installation location*

**WARNING:** Do not install the AGM battery in the engine compartment. The AGM battery must not be installed in the engine compartment on account of the high spatial temperature differences, otherwise its service life will be significantly shortened.

#### *Housing*

**WARNING:** Do not open AGM batteries. On no account may AGM batteries be opened, as the ingress of oxygen from the atmosphere would cause the battery to lose its chemical balance, rendering it unserviceable.

### **(61 12... INFORMATION ON INTELLIGENT BATTERY SENSOR (IBS))**

**NOTE:** Do not connect the charger to the 12 V charging socket

The 12 V charging socket is supplied with voltage by the rear power distribution box via relay. This relay drops out after terminal 15 OFF. This means that a trickle charger connected at the 12 V charging socket will be disconnected from the battery. Only charge the battery via the jump start terminal point. Only then can the voltage supply be registered by the vehicle.

**WARNING:** Danger of destruction in event of mechanical strain

- Do not introduce any additional connections at the battery negative terminal.
- Do not modify the grounding cable. The ground cable also serves heat dissipation.
- Do not establish any connection between the IBS and the sensor screw.
- Do not use force when disconnecting the pole shoe from the battery terminal:
  - Do not pull on the ground cable.

- Do not place any tools under the IBS to lever off the pole shoe.
- Do not use IBS connections as levers.
- Use a torque wrench and set tightening torque in accordance with repair instructions.
- Do not release or tighten down sensor screw (Torx screw).
- Avoid contact between IBS and ground.

**WARNING:** **Danger of destruction to IBS and wiring upon battery replacement**

- The IBS and wiring can be destroyed by mechanical strain upon battery replacement. Therefore avoid mechanical strain.
- The size (capacity) of the battery required for the car is coded in the Car Access System (CAS).
- Use the battery size (capacity) installed as standard upon battery replacement.
- Recode the Car Access System (CAS) when installing a battery with a different capacity.
- Register battery replacement via Service functions in diagnosis system.
- Delete fault code entries in the Digital Engine Electronics (DME) associated with battery replacement.
- Always proceed in accordance with the repair instructions.

**NOTE:** **Battery draining possible in spite of the intelligent battery sensor IBS being fault-free.**

- A battery can be drained (e.g. with lights or radio switched on) even when the IBS functions perfectly in conjunction with power management.
- **For this reason, only exchange the IBS when there is a corresponding fault code entry!**

**(61 00... NOTES ON ELECTRICAL PROPERTIES OF CARBON BODY)**

**NOTE:** **The body of BMW i vehicles consists of several carbon body components linked together by means of adhesive. (carbon: carbon fibre reinforced plastic)**

Carbon body components are electroconductive!  
Nonetheless, the electrical conductivity of carbon is lower than the one of steel or aluminum.

**IMPORTANT:** Therefore, the carbon body cannot be used as the ground of the vehicle electrical system!  
The adhesive partially prevents the electrical current flow between the carbon body components.

**IMPORTANT:** In the case of a short circuit between vehicle electrical system and carbon body, the current may be below the triggering threshold of electrical fuses!  
If the electrical fuse was not triggered in such case of a short circuit, the carbon body components may be damaged due to high heat load!

**To prevent damages on the carbon body, it is crucial to adhere to the following notes:**

- Carbon body may not be used as ground.
- Measurements may only be carried out to ground/ground support point, not to the carbon body.
- Ensure a correct ground contact according to the wiring diagram is set before carrying out checks relating to electrical components.

**In case of damages of electrical components, proceed as follows:**

1. Disconnect high-voltage system from power.
2. Disconnect battery ground cable.
3. Repair damaged electrical components.

4. Check carbon body for eventually visible surface damage caused by heat load in the area of damage of electrical components.
5. Contact Technical Support in cases of doubt.

### **(61 00... NOTES ON HANDLING OPTICAL FIBRES)**

To avoid damage when handling optical fibres, comply with the following points:

- IMPORTANT:**
- The minimum permitted bending radius is 25 mm
  - Do not subject optical fibres to compressive and tensile load
  - Protect optical fibres against the effects of heat  $\geq 85 \text{ }^{\circ}\text{C}$  (e.g. during welding work, drying work with infrared beams or hot air blower)
  - Fibre-optic cables are permitted to show only one junction point (bridge), replace fibre-optic cables if necessary

**NOTE:** The optical fibres are colored differently as follows:

- **Green = MOST (Media Oriented Systems Transport) optical fibre**
- **Yellow = ISIS (Intelligent Safety and Integration System) optical fibre**
- **Orange=repair fibre-optic cables**

Follow notes for processing cables and optical fibres. See [CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH](#) and [CRIMPING OPTICAL FIBRES](#) .

### **(61 00... NOTES ON HANDLING WIRING HARNESSES AND CABLES)**

**The following applies in general:**

To avoid damage, observe the following instructions:

- Avoid compressive and tensile loads
- To ensure professional repairs, perform repair work only with BMW-approved or recommended special tools and spare parts
- Make sure cables are laid without kinks or abrasions
- Ensure non-contacting routing at sharp-edged body parts; use edge protection if necessary
- Secure additionally laid cables/leads with cable ties

**The following additionally applies**

#### **Shielded cables**

Contact points in the shielding can cause problems with regard to noise radiation and interference immunity. Consequently, distinctions have to be drawn between the following types:

#### **Coaxial cable**

- Shielded coaxial cables RTK031 may only be repaired with a special crimping tool.
- For aerial lines only the bushing contact may be repaired.
- RG174 Lines and the bushing contact may not be repaired.

#### **CVBS cables**

- CVBS cables may not be repaired.
- CVBS cables must be replaced in their entirety.

#### **HSD cables**



- HSD cables may not be repaired.
- HSD cables must be replaced in their entirety.

### Fibre-optic cables:

**NOTE:** Fibre-optic cables are colored differently as follows:

- Green = MOST (Media Oriented Systems Transport) optical fibre
- Yellow = ISIS (Intelligent Safety Integration System) optical fibres
- Orange=repair fibre-optic cables

### Attention!

- Optical fibres are permitted to show only **one** junction point (bridge). Replace optical fibres if necessary
- Smallest permissible bending radius is 25 mm
- Avoid effects of heat  $\geq 85 \text{ }^{\circ}\text{C}$

Treating cables and fibre-optic cables. See [CUTTING/STRIPPING INSULATION AND CUTTING TO LENGTH](#) and [CRIMPING OPTICAL FIBRES](#).

### FlexRay (twisted cables):

It is possible to repair the FlexRay. In the event of damage, the cables can be joined with conventional [BUTT CONNECTORS AND HEAT-SHRINK TUBING](#).

**NOTE:**

- FlexRay lines may only reveal one separation point (bride); renew complete line if necessary.
- If possible, maintain twisted cable after repair.
- After repairs, twist cables as close as possible to the connector/separation point.
- Twisting must be as symmetrical as possible.

### Airbag lines:

#### [REPAIRING AIRBAG CABLES](#)

### Replacement of wiring harnesses:

If after replacing wiring harnesses connectors remain, they should be sealed outside the vehicle interior, for example, with butyl tape so that moisture ingress can be eliminated permanently.

## HIGH-VOLTAGE ELECTRICAL SYSTEM

### (61 25... NOTES ON CHARGING THE 12 V BATTERY/HIGH-VOLTAGE BATTERY IN BOOTH VEHICLES)

Experience has shown that failure to comply with the following points will damage  
**IMPORTANT:** batteries in the vehicle and they must be replaced consequently.  
 This bears significant costs!

#### 1st charging interval

**IMPORTANT:** With stationary vehicles, the 12 V battery/high-voltage battery must be recharged at least every 6 weeks.

#### 2. Charging the 12 V battery/high-voltage battery on booth vehicles:

**NOTE:** When charging the high-voltage battery by means of the charging cable, the 12 V battery will be automatically charged as well.

Â	12 V battery must be charged	High-voltage battery must be charged	Charging by means of charging cable	12 V battery is also charged
after 6 weeks	x	x	x	x

## ENGINE OIL AND FILTER

### (11 00 ENGINE OIL CHANGE FOR GASOLINE RANGE EXTENDER)

See [11 00 ENGINE OIL CHANGE \(W20\)](#) .

## BRAKES

### 00 00... BRAKE LINES AND CONNECTIONS: VISUAL INSPECTION FOR LEAKS, DAMAGE, ATTACHMENT AND CORRECT POSITION

#### Check brake lines and connections

- Visual inspection in visible area for:
  - Check brake fluid level in expansion tank
  - Leaks
  - Traces of fluid
  - Damage
  - Pinched areas
  - Correct routing of brake lines
  - Correct seating of brake lines in holders

**NOTE:** Detected faults must urgently be repaired after consultation with the customer!

### (00 00 618 SERVICE - BRAKE FLUID)

- Change [BRAKE FLUID](#)
- Replace battery of the remote key(s) as necessary
- Reset [CBS DISPLAY](#) according to factory specification
- Carry over maintenance works in electronic service booklet, if applicable.

### (00 00 614 SERVICE - FRONT AND REAR BRAKES)

Refer to [FRONT BRAKES](#) and [REAR BRAKES](#) .

- After performing complete brake service, reset [CBS DISPLAY](#) as per factory specification
- For vehicles with electronic service booklet:

Carry over maintenance works in electronic service booklet.

## HVAC

### (64 50... SAFETY INFORMATION FOR HANDLING REFRIGERANT R1234YF)

**WARNING:** Danger of injury!  
Refrigerant circuit is under high pressure! Work on the refrigerant circuit may only be carried out by experts!  
Draw off refrigerant without fail BEFORE all repair work on the refrigerant

**circuit.**

**The refrigerant circuit is depressurized AFTER drawing off.**

- **The pressure gauge on the A/C service unit must be checked for the actual pressure drop prior to repair work.**

**It is absolutely essential to read and observe the relevant operating instructions for the A/C service unit used!**

**At high temperatures, R1234yf is inflammable!**

**Protective measures/rules of conduct:**

- Wear safety goggles
- Wear oil-resistant protective gloves
- Do not smoke!
- Observe country-specific safety regulations.

**First aid measures:**

- **Eye contact:** In the event of contact with the eyes, rinse immediately with plenty of running water and consult an ophthalmologist.
- **Skin contact:** In the event of contact with skin, remove affected clothing immediately and rinse with plenty of water.
- **After inhalation:** If refrigerant vapors are inhaled in greater concentrations, remove the person affected to an area of fresh air and keep them under supervision. Call for a doctor. If breathing problems are experienced, breathe additional oxygen. If the person affected is breathing with difficulty or has stopped breathing, incline the person's head at the neck and administer the kiss of life.

**(64 50... SAFETY INFORMATIONS FOR HANDLING REFRIGERANT OIL)**

**WARNING:** Danger of injury!

**Refrigerant circuit is under high pressure! Work on the refrigerant circuit may only be carried out by experts!**

**Draw off refrigerant without fail BEFORE all repair work on the refrigerant circuit.**

**The refrigerant circuit is depressurized AFTER drawing off!**

- **Before conducting repairs, check the actual pressure drop on the pressure gauge of the A/C service station**

**Read and comply with the relevant operating instructions for the A/C service station used!**

**Protective measures/rules of conduct:**

- Wear safety goggles
- Wear oil-resistant protective gloves
- Do not smoke!
- Observe country-specific safety regulations.

**First aid measures:**

- **If swallowed:** Do NOT induce vomiting, unless expressly instructed to do so by medical personnel. Do not administer anything to an unconscious person through their mouth. Consult a

doctor immediately if larger quantities of this substance are swallowed. Loosen tight-fitting items of clothing (e.g. collar, tie, belt or similar).

- **Eye contact:** Remove contact lenses if worn. In the event of eye contact, rinse eyes for at least 15 minutes with plenty of water. **It is essential to use WARM WATER. Consult a doctor.**
- **Skin contact:** In the event of skin contact, rinse immediately with plenty of water. Remove contaminated clothes and shoes. Wash affected clothes before wearing again. Clean shoes thoroughly before reusing. **Call for a doctor**.
- **After inhalation:** If inhaled, take the person affected outside into fresh air immediately and keep them under supervision. Call for a doctor. If breathing difficulties are experienced, administer additional oxygen. If the person affected stops breathing, administer the kiss of life.

Refrigerant is hygroscopic and must therefore be stored in suitable containers that are sealed airtight!

refrigerant oil is non-combustible and non-explosive at normal temperatures.

IMPORTANT: Nevertheless, the following points must be observed:

- Do not store in the vicinity of flames, heat sources or strongly oxidizing materials
- Suitable extinguishants are carbon dioxide (CO<sub>2</sub>) dry extinguishant and foam

## Recycling

Catch and dispose of emerging refrigerant oil.

Observe country-specific waste disposal regulations.

Absorb escaping refrigerant oil with fluid-binding material.

Notify the relevant authorities if larger amounts of refrigerant are discharged into aboveground water supplies, drainage systems or subsoil.

## (64 50... INSTRUCTIONS FOR HANDLING R1234YF REFRIGERANT)

**Work on the refrigerant circuit may only be carried out by experts!**

Avoid all contact with liquid or gaseous R1234yf. Wear safety goggles and gloves when working on the refrigerant circuit.

- **FOLLOW SAFETY INFORMATION FOR HANDLING REFRIGERANT R1234YF!**

**WARNING:** Although R1234yf at normal temperature is non-toxic, non-flammable and not explosive in air in any mixture ratio, it is still essential to follow various safety precautions. At higher temperatures, R1234yf is inflammable.

As a gas, R1234yf is colorless, odorless and heavier than air. If it enters the atmosphere, this may result in an imperceptible danger of asphyxiation or in cardiac palpitations, especially in workshop pits. Ventilate rooms adequately; if necessary, turn on installed extractor systems.

Store charged refrigerant pressure flasks in a place where they are not exposed to direct sunlight or any other heat source (max. 45 °C). Also avoid exposing them to mechanical stress (e.g. by dropping).

Do not weld or solder on to filled air conditioning systems or in rooms into which R1234yf may have leaked. Exposure to flames or high temperatures ( $\geq 50$  °C) may give rise to toxic products of decomposition (hydrofluoric acid). For this reason, do not smoke either.

In the event of fire, carbon dioxide (CO<sub>2</sub>), extinguishing powder and a sprayed water jet are deemed to be suitable extinguishant. Cool reservoirs at risk with a sprayed water jet (risk of bursting!).

If the protective caps on the filling valves are difficult to open, there is a risk of injury from leaking valve inserts (high pressure).

The filled refrigerant circuit of the A/C system is subject to excess pressure. Before carrying out repairs on the A/C system, it is absolutely essential to draw off the refrigerant.

- Before conducting repairs, check the actual pressure drop on the pressure gauge of the A/C service station.

R1234yf must be drawn off, cleaned and returned to the A/C system using an A/C service station following the relevant operating instructions.

For a properly functioning A/C system, it is essential to have the greatest possible levels of cleanliness when working on the A/C system and the longest possible evacuation (at least 30 minutes dehumidification from refrigerant circuit) before each filling of the A/C system.

R1234yf easily absorbs moisture. Therefore, seal off opened pipes, condenser, evaporator, compressor and dryer flask immediately with plugs.

- If an A/C system has been completely drained by leakage, accident or repair, the desiccant insert must be replaced as excessive moisture may have entered the system. See **REPLACE CAPACITOR (WITH DESICCANT INSERT FOR VERSION WITHOUT HEAT PUMP) FOR HEATING AND AIR CONDITIONING SYSTEM** or **REPLACING DRYER FLASK FOR AIR CONDITIONING (EQUIPMENT SPECIFICATION WITH HEAT PUMP)**.

With exchange parts, the plugs may only be removed immediately before the lines are connected. In the event of warranty claims, the used parts must be provided with plugs to be able to determine the cause of the damage.

**Installation note:**

After each refill of an A/C system, check that the protective caps of the filler valves are hand-tight. They serve as additional seals.

**(64 50... NOTES REGARDING REFRIGERANT (R134A, R1234YF) AND REFRIGERANT OIL (SANDEN SP-A2))**

Two different refrigerants and the refrigerant oil Sanden SP A2 are used.

**IMPORTANT:** Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!

This information can be found on the **type plate** on the bonnet.

Observe notes on **HANDLING R1234YF REFRIGERANT**.

**R1234yf refrigerant is used in the following countries:**

Europe				Asia	America
Belgium	Great Britain	Malta	Sweden	Israel	USA
Bosnia and Herzegovina	Ireland	Macedonia	Switzerland	Â	Canada
Bulgaria	Iceland	The Netherlands	Slovakia	Â	Â
Denmark	Italy	Norway	Slovenia	Â	Â
Germany	Croatia	Austria	Spain	Â	Â
Estonia	Latvia	Poland	Czech Republic	Â	Â
Finland	Liechtenstein	Portugal	Hungary	Â	Â
France	Lithuania	Romania	Cyprus	Â	Â
Greece	Luxembourg	Serbia	Â	Â	Â

**Introduction of R1234yf refrigerant:**

European countries listed in the table and Israel:

- BMW i as of 09/2013

- All other vehicles as of 07/2016

USA and Canada:

- All vehicles as of 07/2016

The introduction date may vary slightly according to the specific country and model.

**The refrigerant R134a will continue to be used in all other countries.**

Observe notes on **HANDLING R1234YF REFRIGERANT**.

**Refrigerant oil Sanden SP-A2 is used for both, R1234yf and R134a .**

Observe notes on **HANDLING REFRIGERANT OIL**.

**Attention!**

**I01, I12 with production date up to 08/2014:**

**In the national-market version with R134a a wrong refrigerant oil is present on the type plate**

**Always use Sanden SP-A2**

(Part number Sanden SP-A2: 2 339 920)

**Attention!**

Only vehicles with a production date from 09/2013 and **R1234yf** refrigerant/Sanden **SP-A2** refrigerant oil can be filled using the A/C service station for **R1234yf** .

In addition to vehicles with a production date from 09/2013, also all previous vehicles **without the electric A/C compressor** with **R134a** refrigerant and both ND-8 and Sanden **SP-A2** refrigerant oil can be filled using the A/C service station for **R134a**.

**Exception:**

BMW i and hybrid vehicles (with an electric A/C compressor) that are filled with **R134a** refrigerant/Sanden **SP-A2** refrigerant oil. These vehicles must be **INJECTED** with Sanden **SP-A2** refrigerant oil.

**When filling the refrigerant circuit with R134a, always ensure you use the correct, vehicle-specific refrigerant oil type!**

**The previous ND-8 refrigerant oil must not be mixed with Sanden SPA2 refrigerant oil!**

**Sanden SP-A2 refrigerant oil may be mixed with ND-8 refrigerant oil in vehicles without an electric A/C compressor.**

**To prevent inadmissibly mixing the different refrigerant oil types, rinse the A/C service station hoses after each drawing off/filling procedure!**

**(64 53... INSTRUCTIONS FOR DESICCANT INSERT REPLACEMENT)**

**Special tools required:**

- **32 1 270**

A desiccant insert that is in a correctly functioning, sealed heating and air conditioning system does not have to be changed at regular service-inspection intervals.

**However, the dryer flask or desiccant insert must absolutely be replaced in the event of:**

- contamination of the refrigerant with debris (e.g. when the compressor is clamped).
- With depressurized and/or completely drained refrigerant circuit.



- With a refrigerant circuit, which was closed using special tool [32 1 270](#) but remains open for more than 24 hours.

### The desiccant insert cannot be replaced in the following vehicles:

- *1-Series E8x, 3-Series E9x from 12/2008*
- *E84, E89*
- *1-Series F2x, 3-Series F3x*
- *BMW i 01 without heat pump*

In these vehicles, the condenser for the heating and air conditioning system must be replaced.

- *BMW i 01 with heat pump*

On this vehicle the low pressure battery must be replaced.

### **(64 52... INSTRUCTIONS FOR OPENING AND PART REPLACEMENT IN REFRIGERANT CIRCUIT)**

#### Special tools required:

- [00 9 030](#)
- [32 1 270](#)

#### **WARNING:**

- **Avoid contact with refrigerant and refrigerant oil**
- **Follow all information for refrigerant. See [SAFETY INFORMATION FOR HANDLING REFRIGERANT R1234YF](#) and [INSTRUCTIONS FOR HANDLING R1234YF REFRIGERANT](#).**
- **Follow safety information for [HANDLING REFRIGERANT OIL](#)**

#### Attention!

- Always use new O-rings each time A/C connections are opened

They must not be coated.

Use special tool [00 9 030](#) to install sealing rings without damaging them.

- Open the refrigerant circuit for as short of a period as possible.
- Close all components and lines in the refrigerant circuit and return parts **immediately** following the removals at openings with special tool [32 1 270](#) to prevent penetration of moisture or foreign objects.
- If the refrigerant circuit was closed at the openings with special tool [32 1 270](#) but it remains open for more than 24 h, the dryer insert for the air conditioning must be replaced.

#### **I. Part replacement as preliminary work for further repair work and part replacement based on gradual leakage.**

(minor leak, e.g. hairline crack)

#### *Procedure:*

- Draw off [HEATING AND AIR CONDITIONING SYSTEM](#) , then determine drawn-off amount of refrigerant oil
- Carry out part replacement
- Replace removed refrigerant oil and additionally top up with new refrigerant oil according to components replaced:
  - Compressor: refer to [NOTES ON COMPRESSOR REPLACEMENT](#)

- Evaporator: 10 ml
- Capacitor: 20 ml
- Desiccant insert/dryer flask: 20 ml
- Each replaced refrigerant line: 10 ml
- Condenser with integrated dryer flask: 40 ml
- Safety pressure switch and gasket: no additional refrigerant oil
- Only I01: Radiator, high-voltage battery unit: 20 ml
- **EVACUATE AND FILL AIR CONDITIONING SYSTEM**

## II. Part replacement due to sudden leakage

(major leak, e.g. pipe break due to accident)

*Procedure:*

- Draw off **HEATING AND AIR CONDITIONING SYSTEM** , then determine drawn-off amount of refrigerant oil
- Carry out part replacement
- Replace removed refrigerant oil and additionally top up with new refrigerant oil according to components replaced:
  - Compressor: refer to **NOTES ON COMPRESSOR REPLACEMENT**
  - Evaporator: 35 ml
  - Capacitor: 35 ml
  - Desiccant insert/dryer flask: 55 ml
  - Each replaced refrigerant line: 35 ml
  - Condenser with integrated dryer flask: 55 ml
  - Safety pressure switch and gasket: no additional refrigerant oil
  - Only I01: Radiator, high-voltage battery unit: 35 ml
- **EVACUATE AND FILL A/C SYSTEM**

### **(64 53... INSTRUCTIONS FOR REPLACEMENT OF AIR CONDITIONING CAPACITORS AND RADIATOR/COOLERS)**

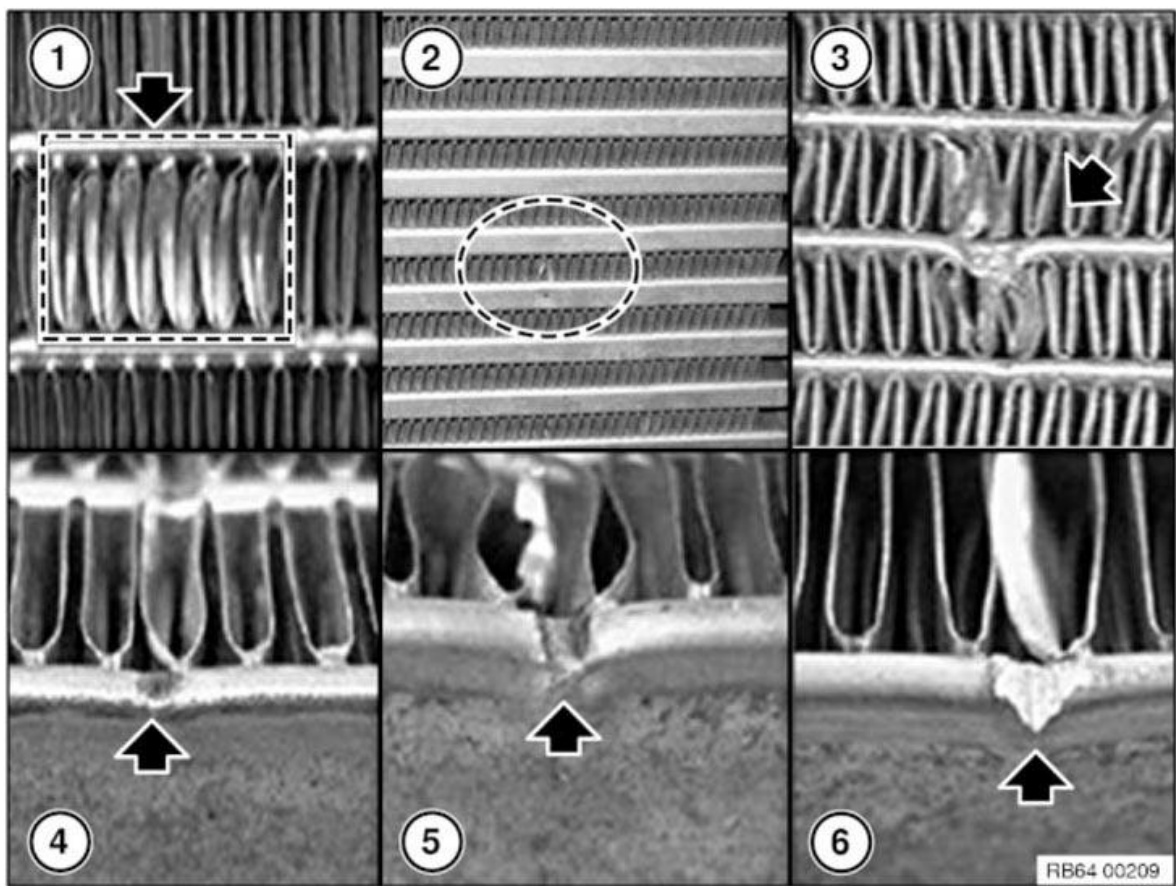
Even when they are correctly installed or due to normal driving, radiators (oil cooler, radiator, charge air cooler) or air conditioning condensers may show slight impressions or deformations on their discs (1).

**IMPORTANT:** A slight sag with a large radius for the air conditioning condenser is also permissible. As long as tightness/function are not degraded and an adequate distance of a few mm between the radiator and air conditioning condenser remains in place, **this is not damage in either case.**

**Radiators or air conditioning condensers are not to be replaced in these cases!**

**NOTE:** The deformations shown in Fig. (1) can be bent back with a standard fin comb.

Damage to lines carrying media or on the flat pipe require exchange of the radiator or air conditioning condenser (2-6).



**Fig. 14: Identifying Radiator/Air Conditioning Condenser Deformations**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Dryer flask** (integrated in the air conditioning condenser):

Round dents/depressions are permitted.

**The air conditioning condenser is not to be replaced in this case.**

**(64 31 010 REPLACING MICROFILTER FOR INTERIOR VENTILATION)**

See [64 31 010 REPLACING MICROFILTER FOR INTERIOR VENTILATION](#) .

**(64 50 AIR CONDITIONING, LEAK DETECTION)**

See [AIR CONDITIONING, LEAK DETECTION](#) .

## **E-TRANSMISSION, E-GEAR**

**(00 11 240 CHECK/ADD TRANSMISSION OIL IN E-GEAR I01 (WITH OIL FILLER PLUG))**

**IMPORTANT:** Deletion of oil filler plug:

For motor vehicles with range extender from 04.2015

For motor vehicles without range extender from 05.2015.

Transmission oil is filled via input of output shaft into E-gear.

**Necessary preliminary tasks:**

- Remove STRUT ON HORIZONTAL RIGHT .
- Remove output shaft on left or right. See [REPLACING LEFT OUTPUT SHAFT](#) or [REPLACING RIGHT OUTPUT SHAFT](#) .

**NOTE:** Transmission must be at operating temperature.

Transmission oil:

- refer to [OPERATING FLUIDS](#) .

Filling capacities:

- Refer to [TECHNICAL DATA](#) .

Pry off clamps (1) of sound insulation (2).

Remove soundproofing (2).

*Installation note:*

Replace clamps (1).



**Fig. 15: Identifying Sound Insulation And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Draining transmission oil:

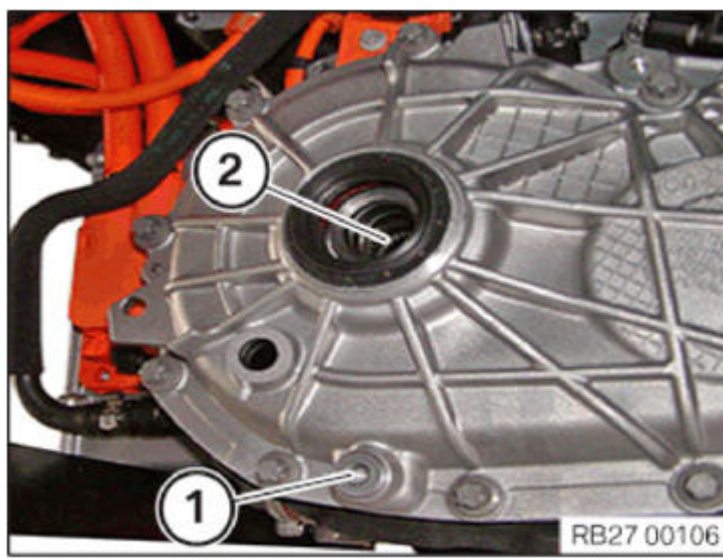
**Parts:** Replace gasket.

- Remove oil drain plug (1).
- Clean oil drain plug (1) and screw in.

Tightening torque [27 00 13AZ](#) .

Fill transmission with transmission oil.

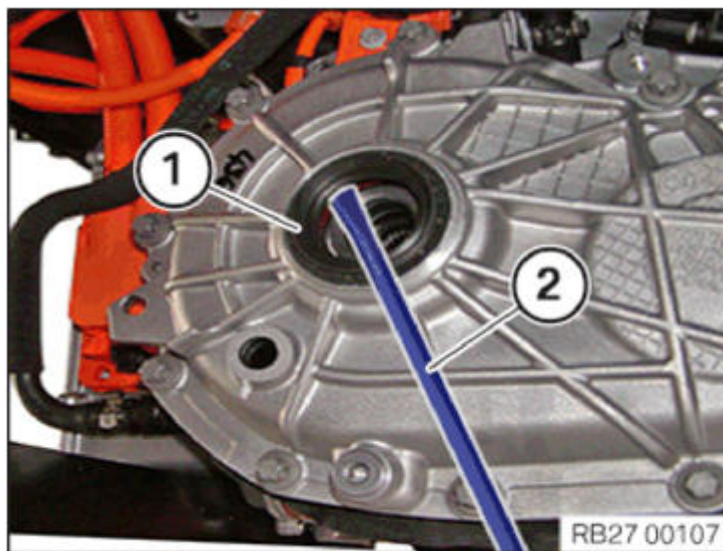
- Fill in 0.5 l transmission oil via input of output shaft (2) into E-transmission.



**Fig. 16: Identifying Oil Drain Plug And Output Shaft**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Parts:** The radial shaft seal (1) must be renewed.

Lift out radial shaft seal (1) using a screwdriver (2) from E-transmission.



**Fig. 17: Lifting Out Radial Shaft Seal Using Screwdriver**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**(00 11 240 CHECK/ADD TRANSMISSION OIL IN E-TRANSMISSION I01 (WITH OIL FILLER PLUG))**

IMPORTANT: Deletion of oil filler plug:

For motor vehicles with range extender from 04.2015

For motor vehicles without range extender from 05.2015.

Transmission oil is filled via input of output shaft into E-transmission.

**Necessary preliminary tasks:**

- Remove RIGHT HORIZONTAL STRUT

**NOTE:** Transmission must be at operating temperature.

Transmission oil:



- refer to [OPERATING FLUIDS](#) .

Filling capacities:

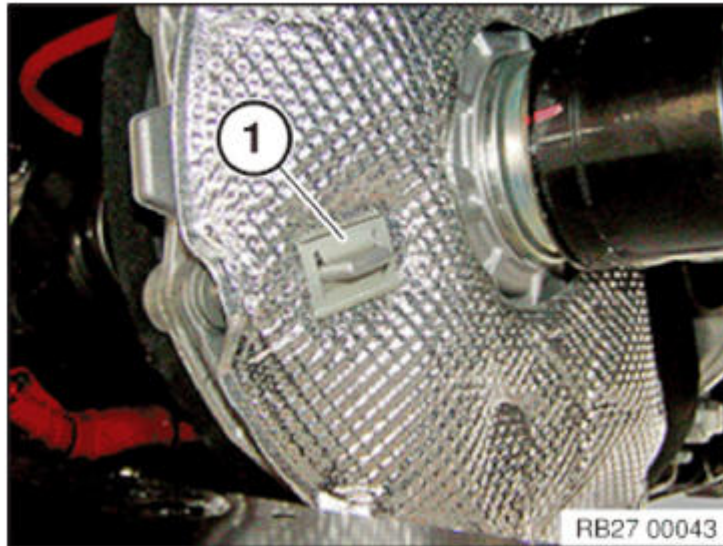
- Refer to [TECHNICAL DATA](#) .

Pry off clamps (1) of sound insulation (2).

List sound insulation (2).

*Installation note:*

Replace clamps (1).



**Fig. 18: Identifying Sound Insulation Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Draining transmission oil:

**Parts:** Replace gaskets.

- Release oil drain plug (1) and oil filler plug (2).
- Clean oil drain plug (1) and screw in.

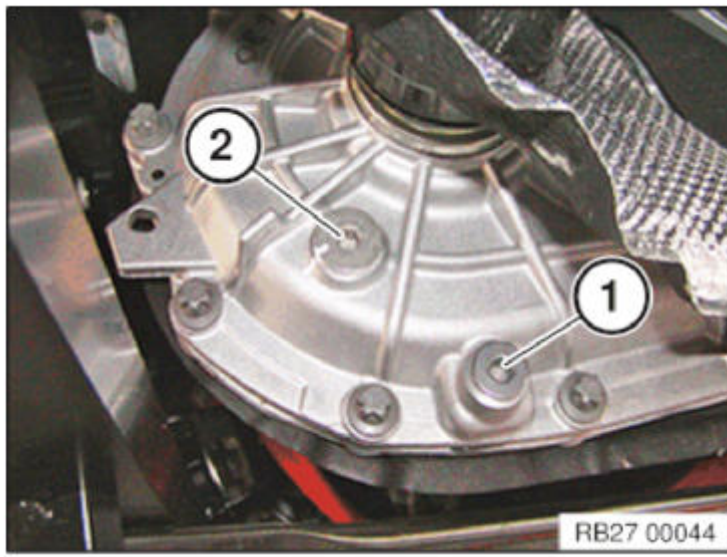
Tightening torque [27 00 13AZ](#) .

Fill transmission with transmission oil.

- Pour in gear oil until overflowing.
- Screw in oil filler plug (2).

Tightening torque: [27 00 13AZ](#) .





**Fig. 19: Identifying Oil Drain Plug And Oil Filler Plug**  
Courtesy of BMW OF NORTH AMERICA, INC.

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[Back To Article](#)

## GENERAL INFORMATION

Maintenance And General Information - Special Tools - All I3 Models - i3

## MAINTENANCE AND GENERAL DATA

### 2305379 ACCESSORIES AM

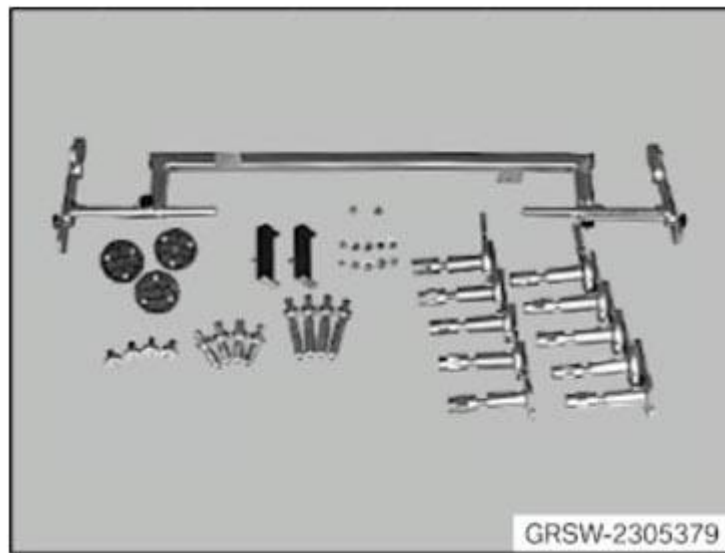
In conjunction with:

### MOBILE MAJOR ASSEMBLY TABLE LIFT MHT 1200

**NOTE:** Bracket set for equipment table lift MHT 1200.

#### SI number

06 01 10 (649)



**Fig. 1: Identifying Accessories (2305379).**

Courtesy of BMW OF NORTH AMERICA, INC.

### 2350280 ACCESSORIES MP

**NOTE:** Cable cabinet storage for adapter cable

#### Storage Location

Individual

#### SI number

83 11 14 (002)

### 2407220 ADAPTER AM



**Fig. 2: Identifying Adapter (2407220).**  
Courtesy of BMW OF NORTH AMERICA, INC.

In conjunction with: [81312353954](#)

**NOTE:** Country-specific connection adapter (China) for CO2 bottles for connecting to the leak detector "BMW Smoke Tester" (81 31 2 353 954).

**Storage Location**

Individual

**2356843 BOX AM**

**NOTE:** Storage box 50 mm, set (15)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 3: Identifying Box (2356843).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356845 BOX AM**

**NOTE:** Storage box 150 mm, set (10)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 4: Identifying Box (2356845)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356844 BOX AM**

**NOTE:** Storage box 108 mm, set (10)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 5: Identifying Box (2356844)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2361696 CABINET AM**

**NOTE:** Replaced cable cabinet (0 490 069)

**Storage Location**

Individual

**SI number**

02 08 14 (115)



**Fig. 6: Identifying Cabinet (2361696)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2361678 CABINET MP**

**NOTE:** Replaced cable cabinet (0490070)

**Storage Location**

Individual

**SI number**

02 08 14 (115)



**Fig. 7: Identifying Cabinet (2361678)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2405036 CABLE MP**

**NOTE:** Applies to: BMW i Aftersales High Voltage - replaces 83 30 2 353 364

SI number

08 10 15 (270)



**Fig. 8: Identifying Cable (2405036)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2413317 CABLE STRAP MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** The "Cable ties" parts set consists of 3 items as follows: ABV232 Length: 320 mm color: Red ABV250 Length: 500 mm color: Red ABVS270 Length: 665 mm color: Red

SI number

01 47 15 (332)



**Fig. 9: Identifying Cable Strap (2413317)**

Courtesy of BMW OF NORTH AMERICA, INC.

**009329 CASE AM**

**NOTE:** (Case) with insert not incl. panel wedges

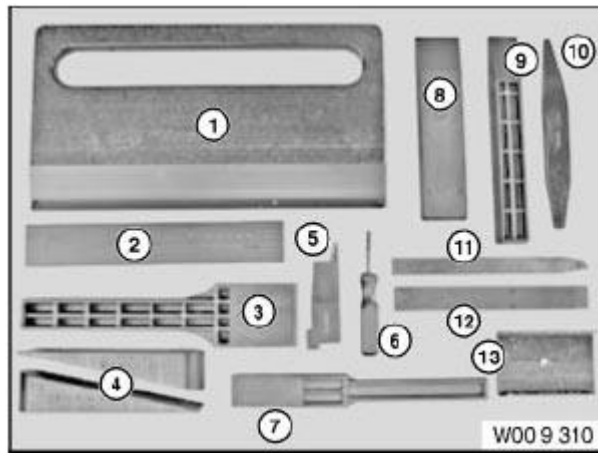
Storage Location



Individual

SI number

01 07 09 (530)



**Fig. 10: Identifying Case (009329).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2359907 CHARGER MP**

**NOTE:** State of charge adjustment of new HV battery modules before installation in the HV battery Replaces: 83 30 2 353 363 valid for: BMW i Aftersales High Voltage and BMW Plug-in Hybrid Electric Vehicle

Storage Location

Individual

SI number

08 11 14 (142)



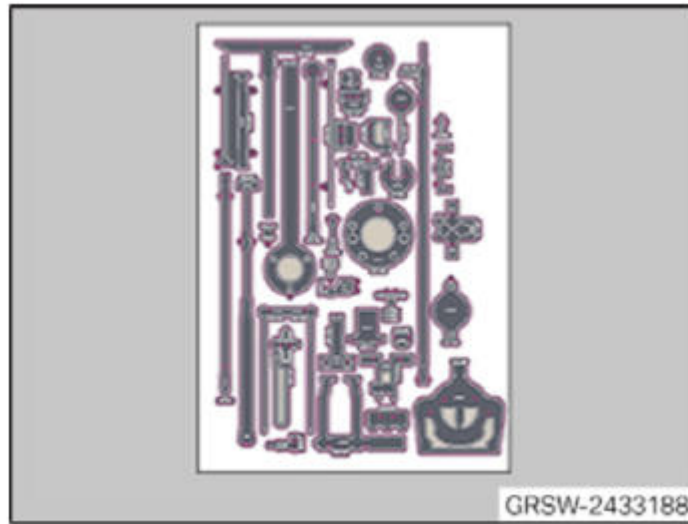
**Fig. 11: Identifying Charger (2359907).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2433188 CONTOUR-GRAPHIC SILHOUETTE FOIL AM**

**NOTE:** KGS Set 2 for cabinet 1

SI number



**Fig. 12: Identifying Contour-Graphic Silhouette Foil (2433188).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2348324 FITTING AID AM**

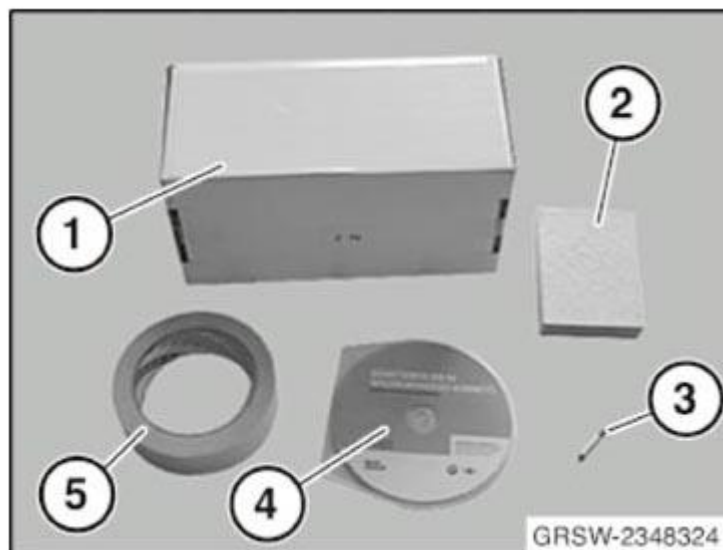
**NOTE:** Fitting aid for film bonding and attaching the tool board in the special tool cabinet

**Storage Location**

Individual

**SI number**

00 01 13 (912)



**Fig. 13: Identifying Fitting Aid (2348324).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2360335 FOIL MP**

**NOTE:** Foil set alphabets (A-L) for tool cabinet 550

**Storage Location**

Individual

**SI number**



**Fig. 14: Identifying Foil (2360335)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2360332 FOIL MP**

**NOTE:** Basic film (12 pieces) for gluing the perforated metal sheets of the tool cabinet 550

**Storage Location**

Individual

**SI number**

02 09 14 (116)



**Fig. 15: Identifying Foil (2360332)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2337732 FOIL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Foil set alphabets (A - G) for cable cabinet 1

**Storage Location**

Individual

SI number

02 08 14 (115)



**Fig. 16: Identifying Foil (2337732)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2288689 FOIL MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** New basis film

Storage Location

Individual

SI number

00 22 13 (969)

**2355961 FOIL AM**

Storage Location

Individual

SI number

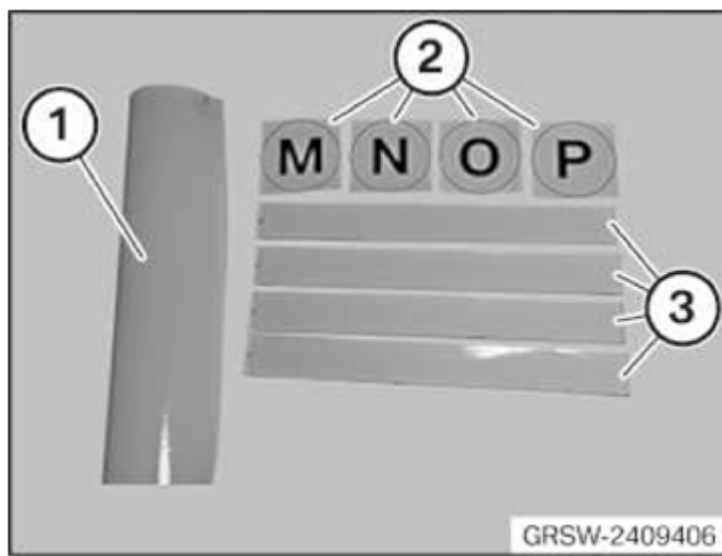
00 22 13 (969)

**2409406 FOIL MP**

**NOTE:** Foil set for the tool cabinet 350 for the adapter cable

SI number

02 09 15 (240)



**Fig. 17: Identifying Foil (2409406)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2337730 FOIL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Basic films (2 piece) for cable cabinet rear wall and cable cabinet doors.

**Storage Location**

Individual

**SI number**

02 08 14 (115)



**Fig. 18: Identifying Foil (2337730)**

Courtesy of BMW OF NORTH AMERICA, INC.

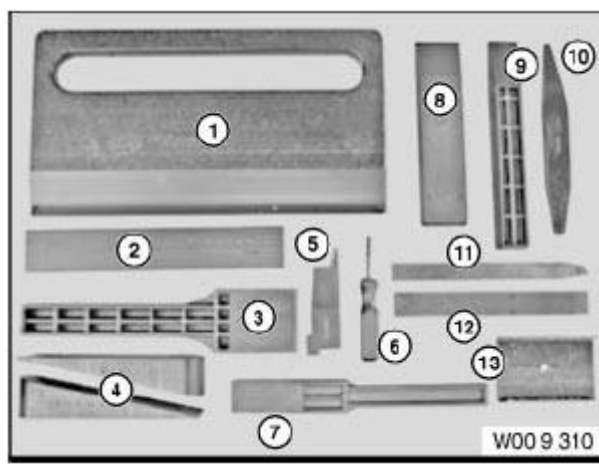
**009321 FOLDING STICK AM**

**Storage Location**

Individual

**SI number**

01 07 09 (530)



**Fig. 19: Identifying Folding Stick (009321)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**009470 GAUGE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** (Gap gauge) From 1 to 5 mm (1; 1.5; 2; 2.5...). For checking body gap dimensions.

**Storage Location**

A23

**SI number**

01 03 07 (337)



**Fig. 20: Identifying Gauge (009470)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2413037 HANDLE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Universal drift handle.

**Storage Location**

C77

**SI number**

01 53 14 (211)





**Fig. 21: Identifying Handle (2413037).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2364840 HEAD-UP FOIL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

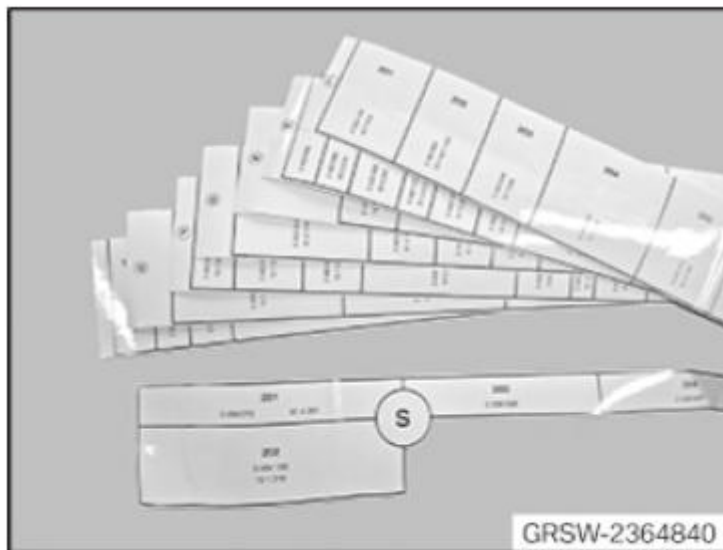
**NOTE:** Head-up film set for cable cabinet 2

**Storage Location**

Individual

**SI number**

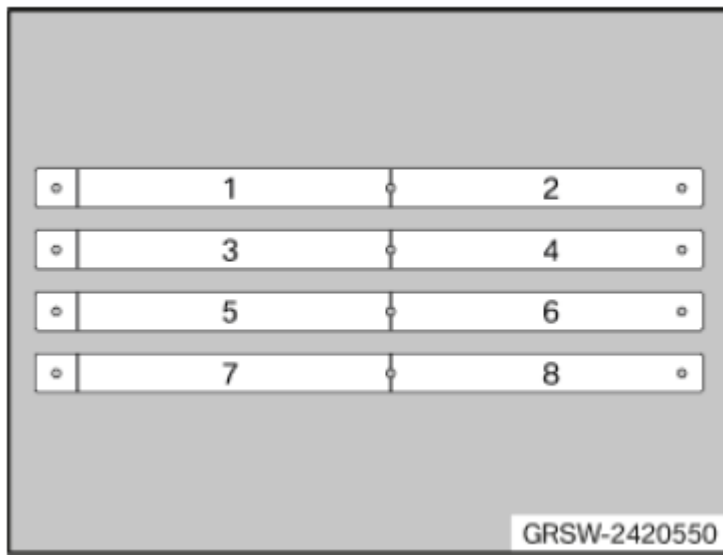
02 08 14 (115)



**Fig. 22: Identifying Head-Up Foil (2364840).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2420550 HEAD-UP FOIL AM**

**NOTE:** Head-Up-sheets set for cabinet 1 (Sheet 1-8)



**Fig. 23: Identifying Head-Up Foil (2420550)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2364839 HEAD-UP FOIL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

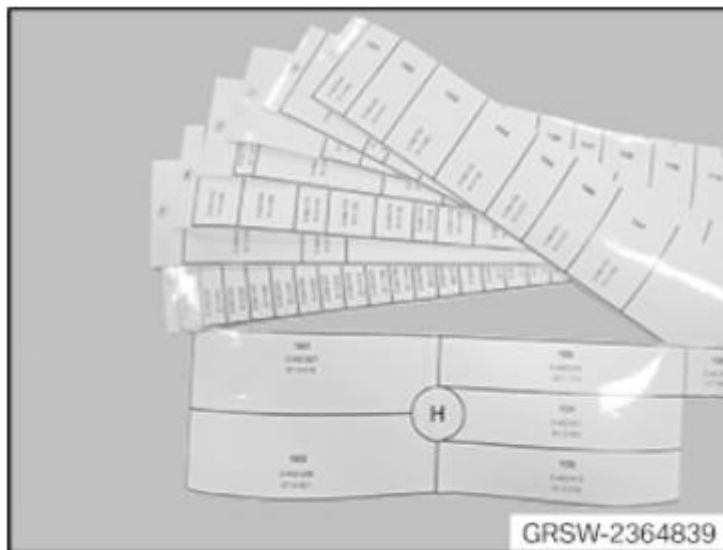
**NOTE:** Head-up films (A-H) for cable cabinet 1

**Storage Location**

Individual

**SI number**

02 08 14 (115)



**Fig. 24: Identifying Head-Up Foil (2364839)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2405554 HEAD-UP FOIL MINIMUM SET: MECHANICAL TOOLS AM**

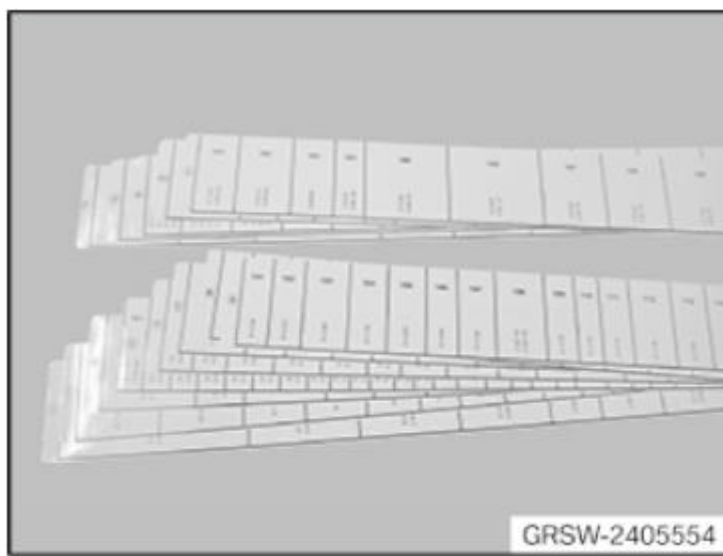
**NOTE:** Head-up film set (A-L) for tool cabinet 550

**Storage Location**

Individual

**SI number**

02 09 14 (116)



**Fig. 25: Identifying Head-Up Foil (2405554)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2350281 HOLDER MINIMUM SET: MECHANICAL TOOLS AM**

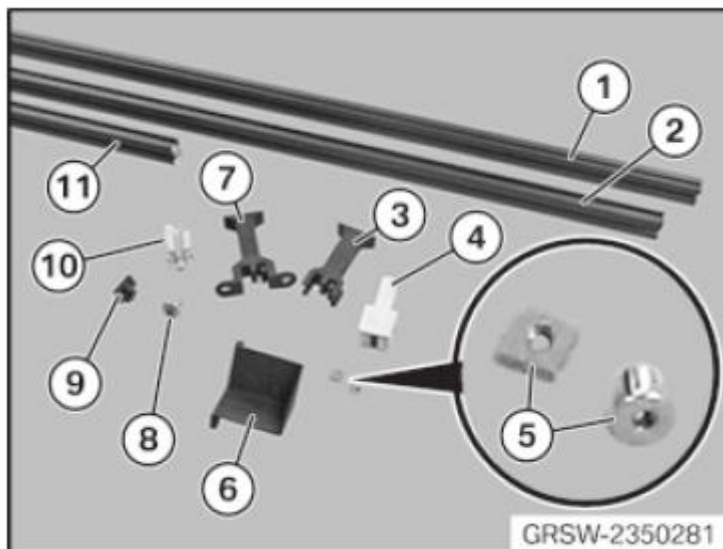
**NOTE:** Set of holders for cable cabinet 2

**Storage Location**

Individual

**SI number**

02 08 14 (115)



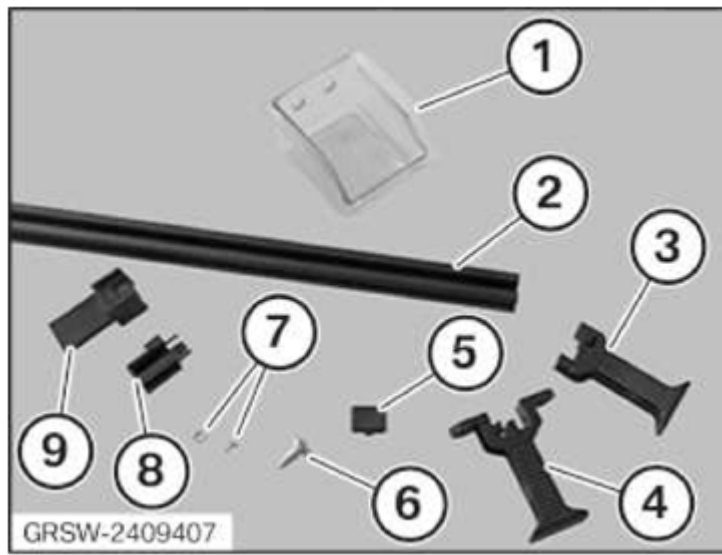
**Fig. 26: Identifying Holder (2350281)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2409407 HOLDER MP**

**NOTE:** For tool cabinet 350 (for diagnostic cable) consisting of: 1. Retaining bowls, 2. Profile strip, 3. Clamping element without strap, 4. Clamping element with strap, 5. End caps, 6. Sheet metal screws, 7. Square nuts and hexagon socket screws, 8. Fitting aid for clamping elements, 9. Fitting aid for square nuts

**SI number**

02 09 15 (240)



**Fig. 27: Identifying Holder (2409407)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2350282 HOLDER MINIMUM SET: MECHANICAL TOOLS AM**

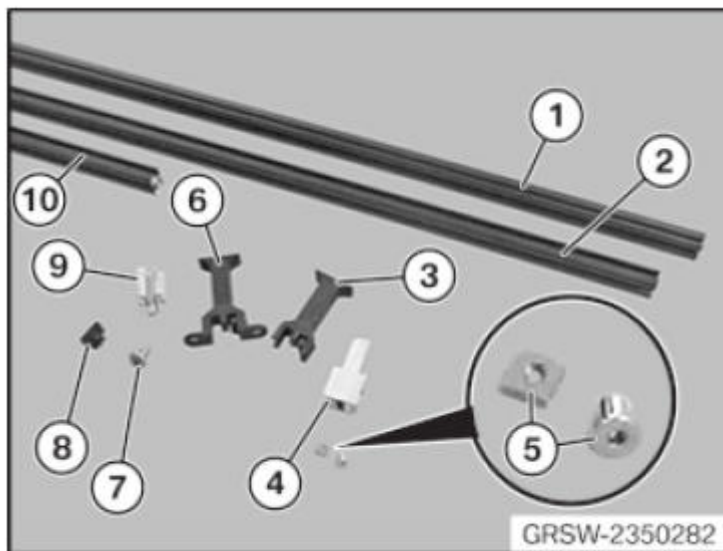
**NOTE:** Set of holders for cable cabinet 1

**Storage Location**

Individual

**SI number**

02 08 14 (115)



**Fig. 28: Identifying Holder (2350282)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2356827 HOOK AM**

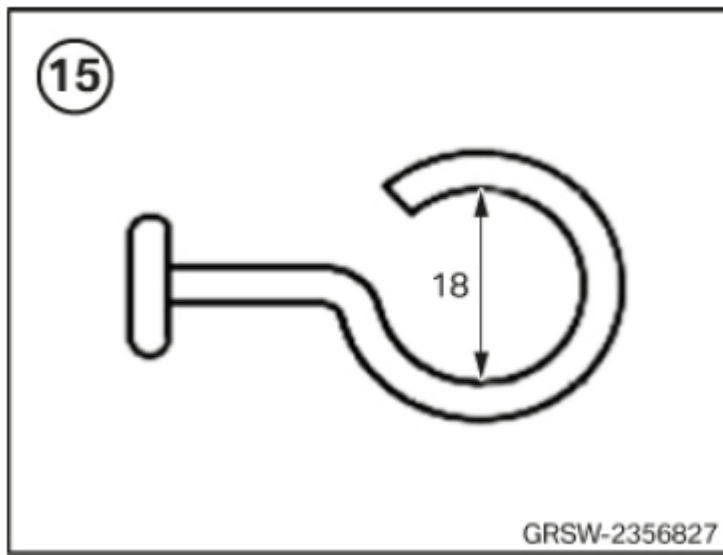
**NOTE:** Hook no. 15, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 29: Identifying Hook (2356827).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356836 HOOK AM**

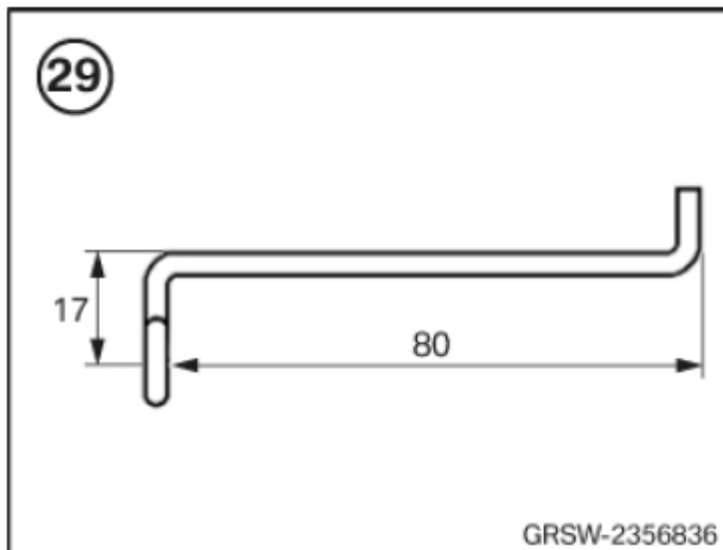
**NOTE:** Hook no. 29, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 30: Identifying Hook (2356836).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356837 HOOK AM**

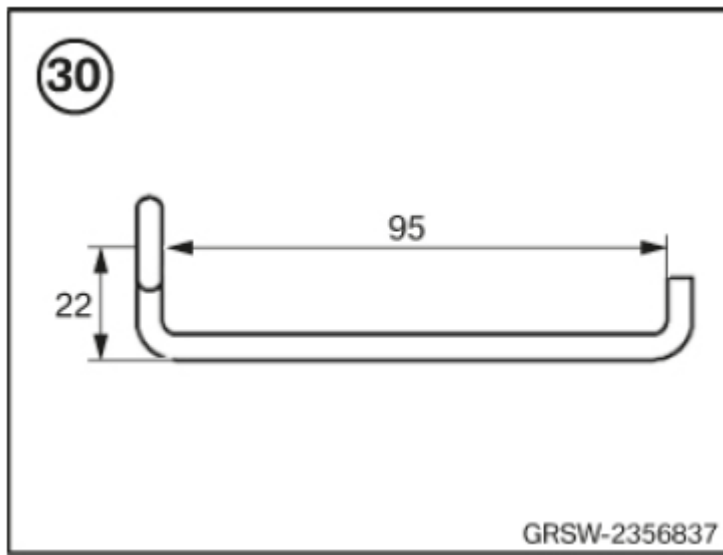
**NOTE:** Hook no. 30, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 31: Identifying Hook (2356837)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356826 HOOK AM**

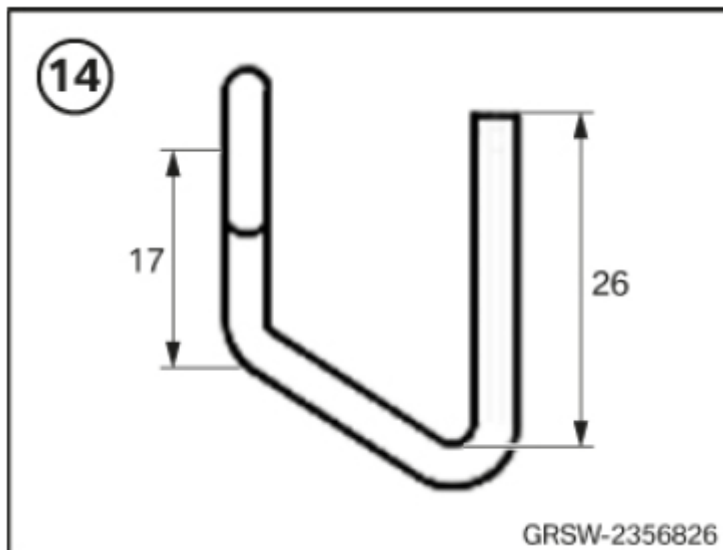
**NOTE:** Hook no. 14, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 32: Identifying Hook (2356826)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356829 HOOK AM**

**NOTE:** Hook no. 17, set (25)

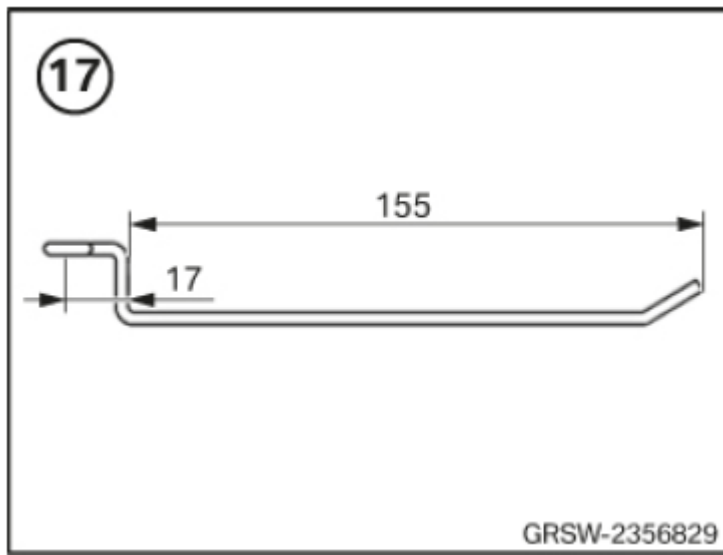
**Storage Location**

Individual

**SI number**

00 22 13 (969)





**Fig. 33: Identifying Hook (2356829)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356841 HOOK AM**

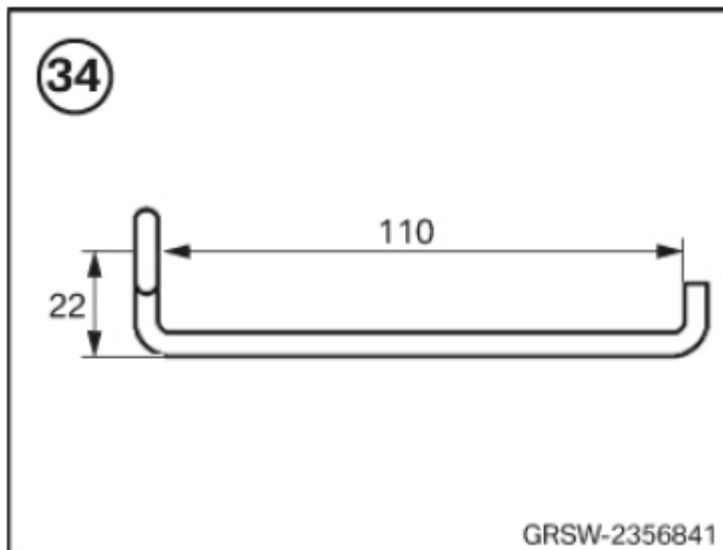
**NOTE:** Hook no. 34, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 34: Identifying Hook (2356841)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356828 HOOK AM**

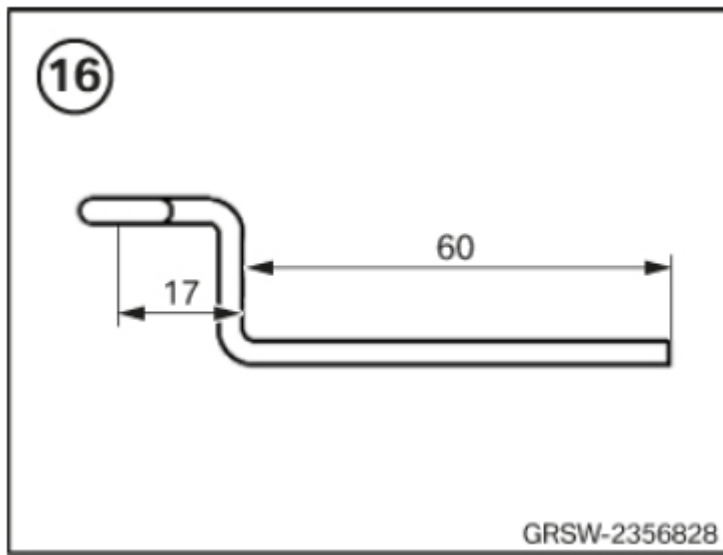
**NOTE:** Hook no. 16, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 35: Identifying Hook (2356828)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356838 HOOK AM**

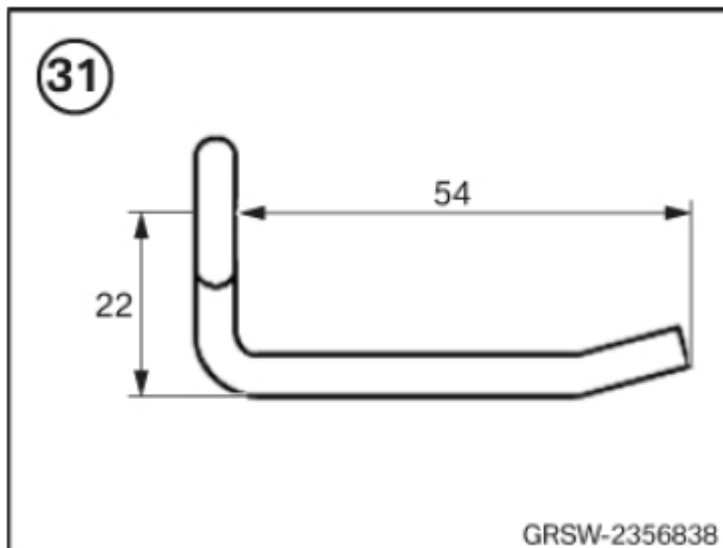
**NOTE:** Hook no. 31, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 36: Identifying Hook (2356838)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356834 HOOK AM**

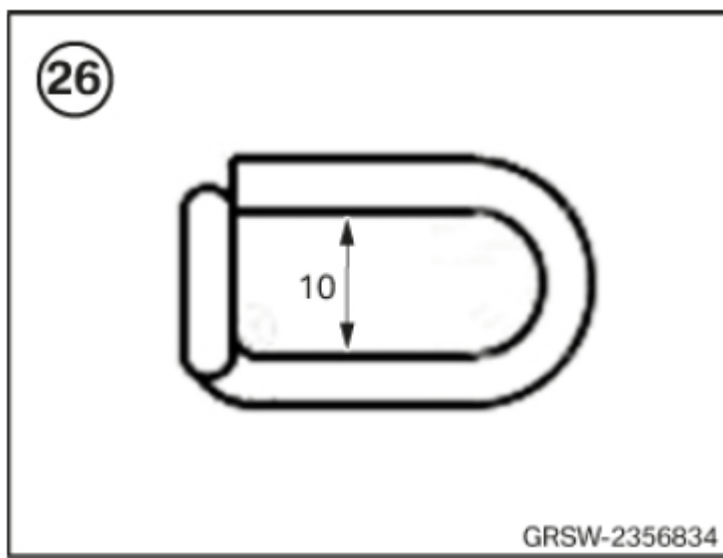
**NOTE:** Hook no. 26, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 37: Identifying Hook (2356834)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356816 HOOK AM**

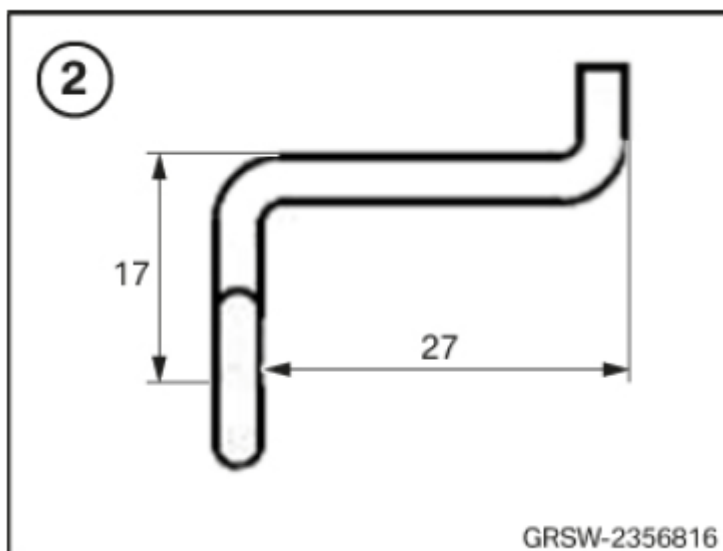
**NOTE:** Hook no. 2, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 38: Identifying Hook (2356816)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356833 HOOK AM**

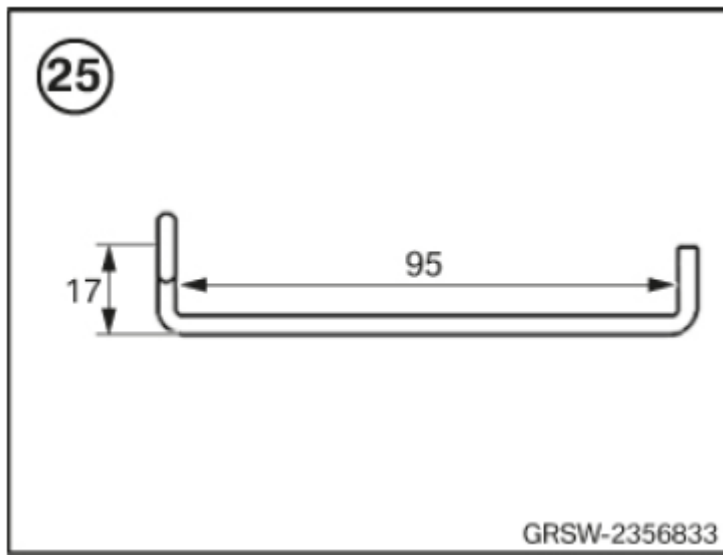
**NOTE:** Hook no. 25, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 39: Identifying Hook (2356833)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356820 HOOK AM**

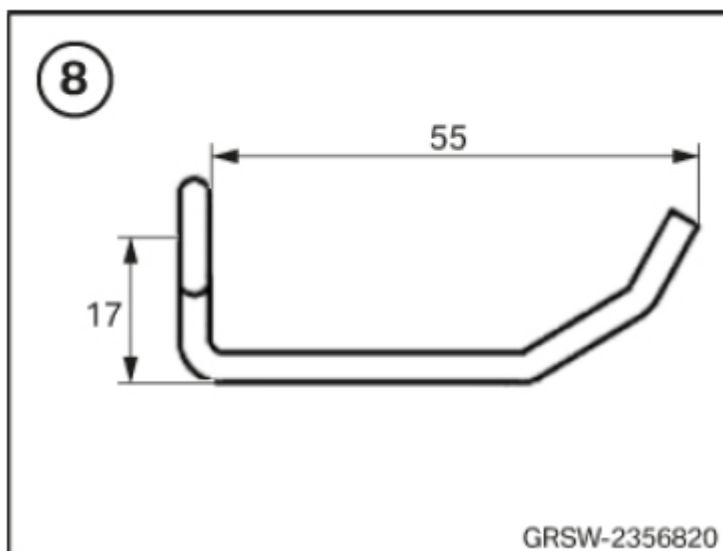
**NOTE:** Hook no. 8, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 40: Identifying Hook (2356820)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356839 HOOK AM**

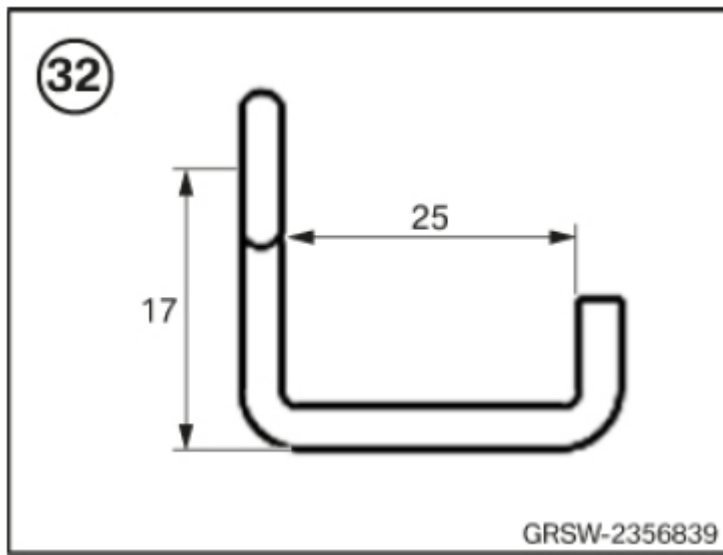
**NOTE:** Hook no. 32, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 41: Identifying Hook (2356839)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356835 HOOK AM**

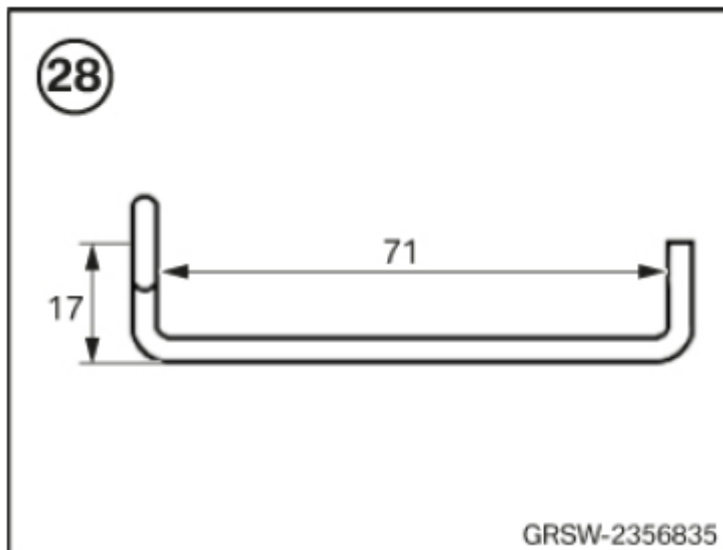
**NOTE:** Hook no. 28, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 42: Identifying Hook (2356835)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356821 HOOK AM**

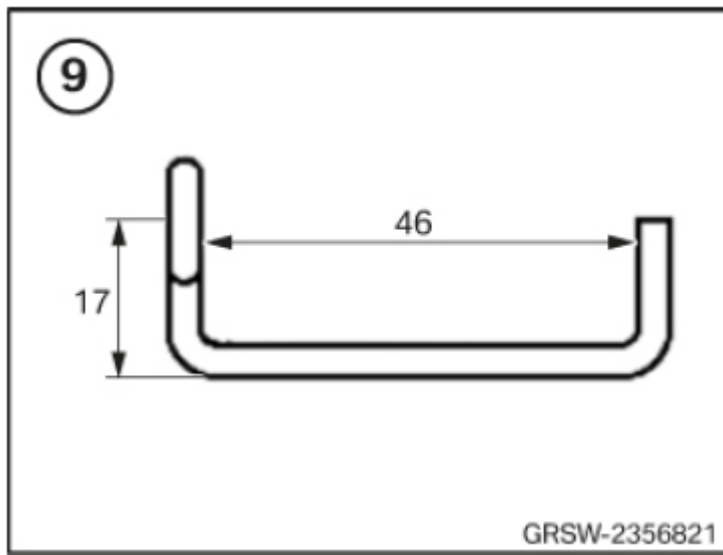
**NOTE:** Hook no. 9, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 43: Identifying Hook (2356821)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356831 HOOK AM**

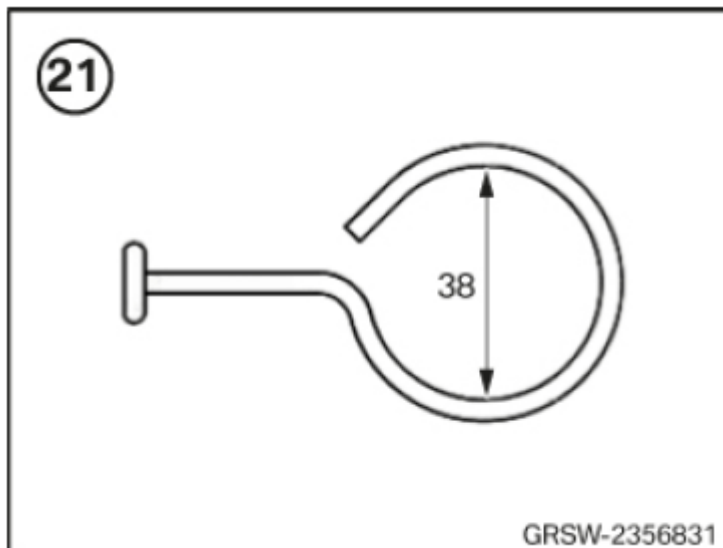
**NOTE:** Hook no. 21, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 44: Identifying Hook (2356831)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356840 HOOK AM**

**NOTE:** Hook no. 33, set (25)

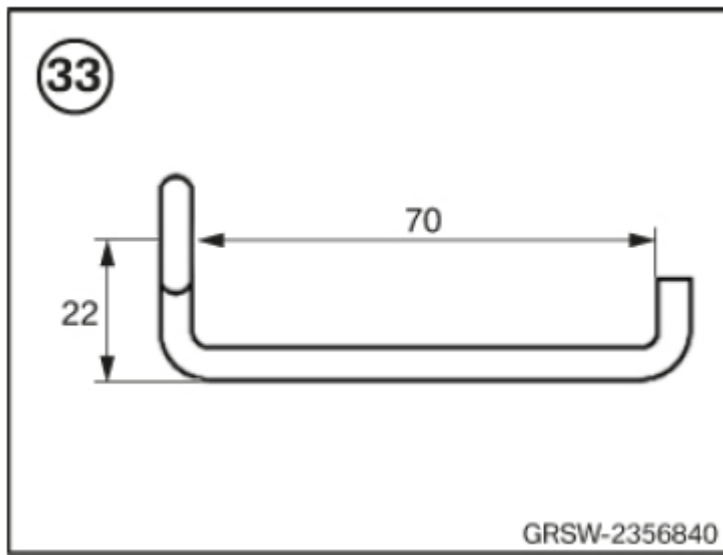
**Storage Location**

Individual

**SI number**

00 22 13 (969)





**Fig. 45: Identifying Hook (2356840)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356817 HOOK AM**

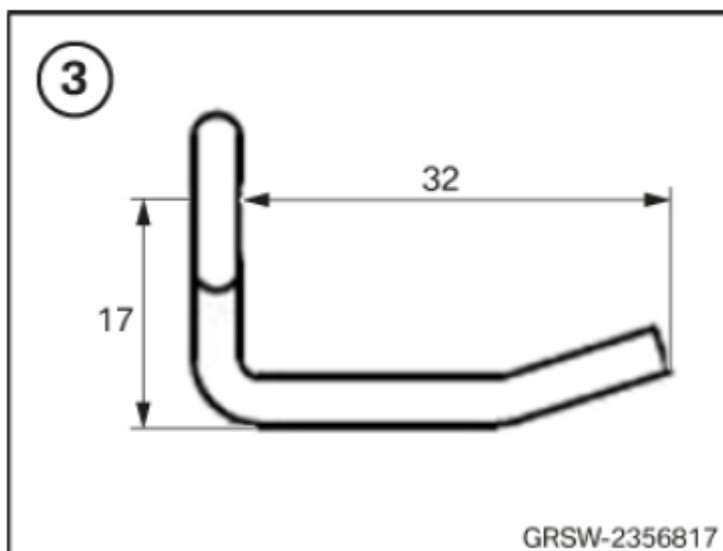
**NOTE:** Hook no. 3, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 46: Identifying Hook (2356817)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356824 HOOK AM**

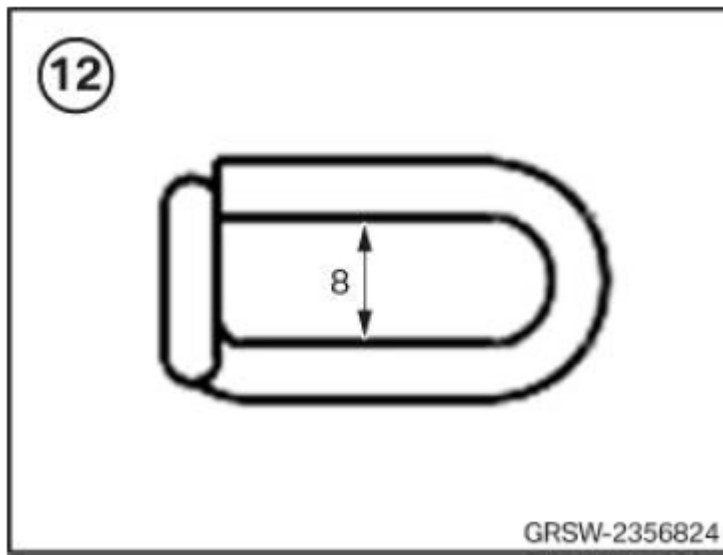
**NOTE:** Hook no. 12, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 47: Identifying Hook (2356824)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356815 HOOK AM**

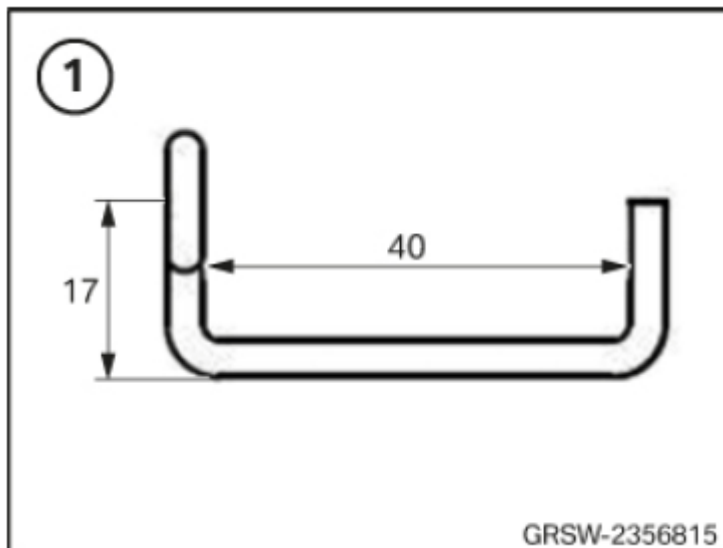
**NOTE:** Hook no. 1, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 48: Identifying Hook (2356815)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356823 HOOK AM**

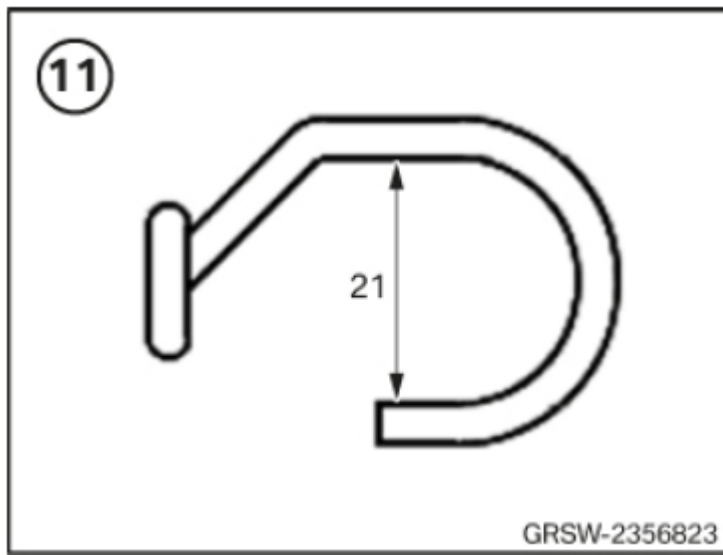
**NOTE:** Hook no. 11, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 49: Identifying Hook (2356823)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356819 HOOK AM**

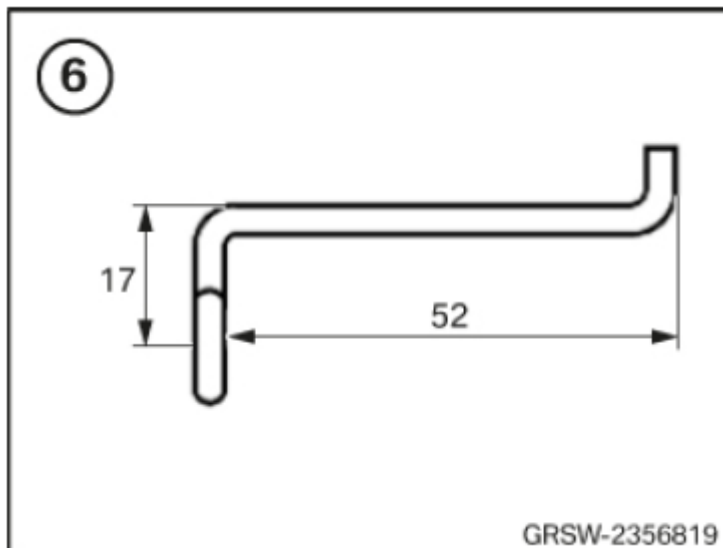
**NOTE:** Hook no. 6, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 50: Identifying Hook (2356819)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356830 HOOK AM**

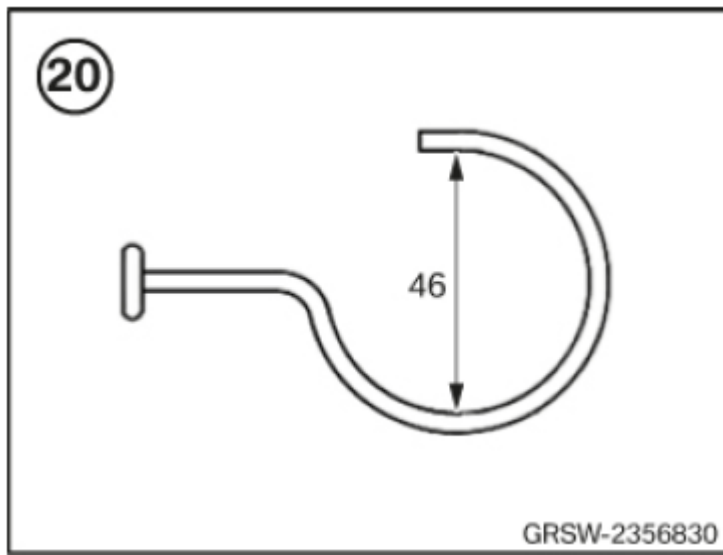
**NOTE:** Hook no. 20, set (25)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 51: Identifying Hook (2356830)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356832 HOOK AM**

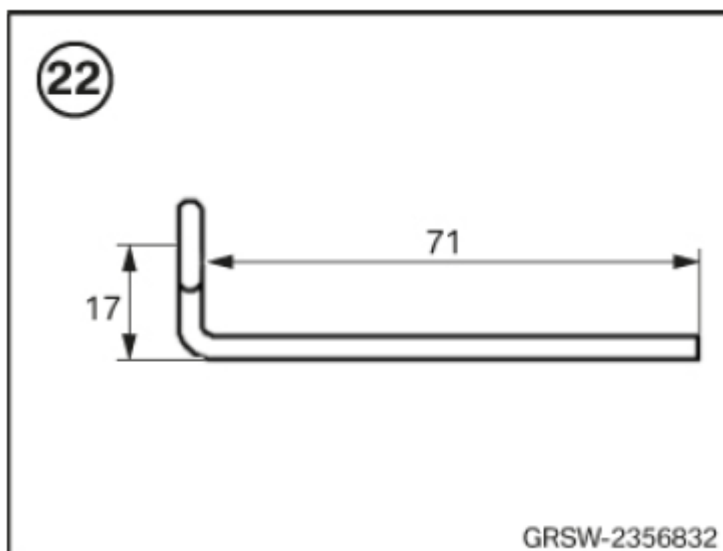
**NOTE:** Hook no. 22, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 52: Identifying Hook (2356832)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356822 HOOK AM**

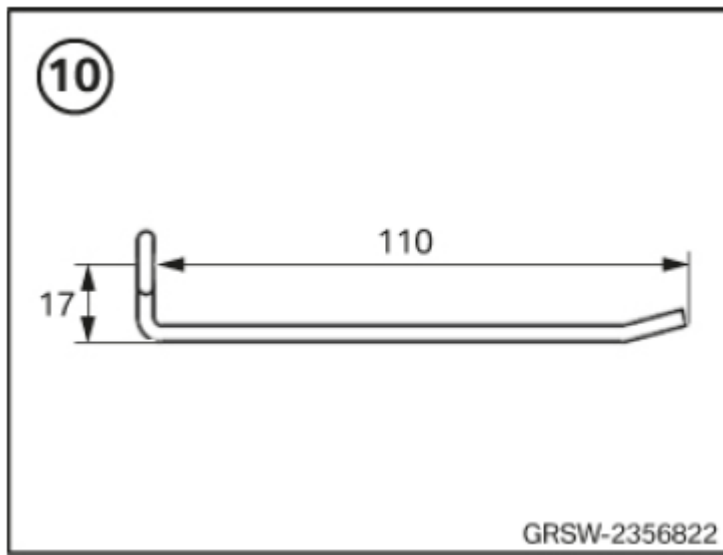
**NOTE:** Hook no. 10, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 53: Identifying Hook (2356822)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356818 HOOK AM**

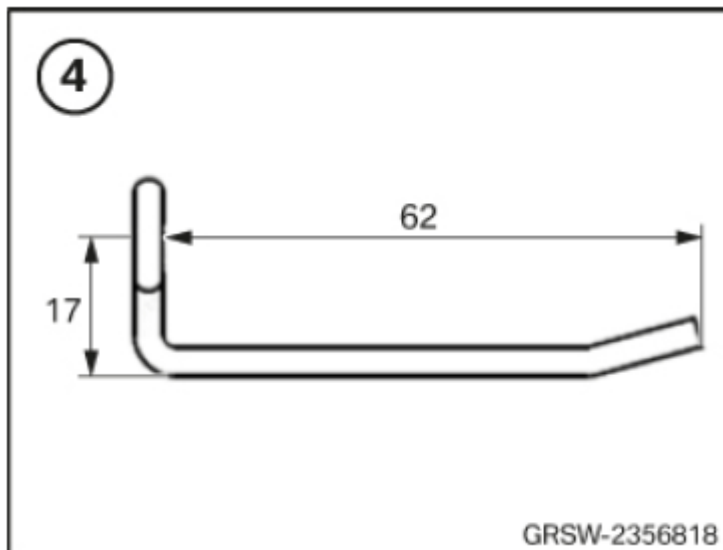
**NOTE:** Hook no. 4, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 54: Identifying Hook (2356818)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2356825 HOOK AM**

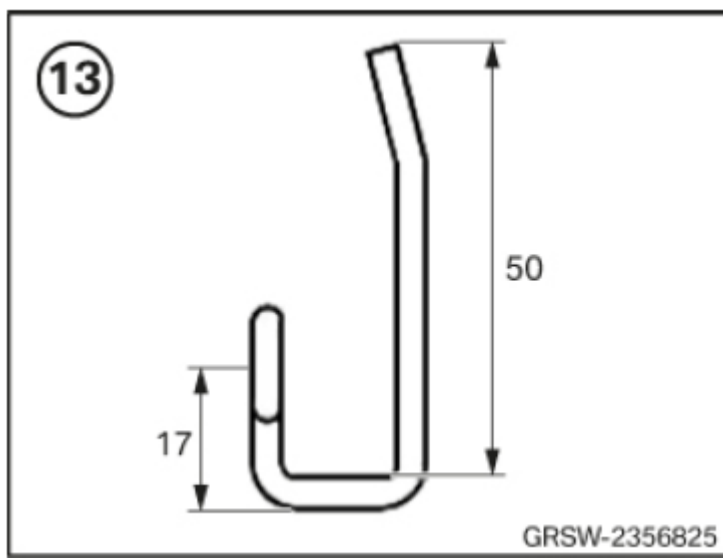
**NOTE:** Hook no. 13, set (50)

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 55: Identifying Hook (2356825)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2219012 HYDRAULIC LIFTER AM**

**NOTE:** For raising and lowering various vehicle components.

**SI number**

01 05 90 (207)



**Fig. 56: Identifying Hydraulic Lifter (2219012)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2444437 INSERT MP**

**NOTE:** For the top pull-out (system location "S") cable cabinet 2, to store testers.

**SI number**

02 16 16 (378)





**Fig. 57: Identifying Insert (2444437).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2444436 INSERT MP**

**NOTE:** For the top pull-out (storage location "H") cable cabinet 1 - to store testers.

**SI number**

02 16 16 (378)



**Fig. 58: Identifying Insert (2444436).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2353954 LEAK DETECTOR MP**

**NOTE:** "BMW Smoke diagnosis tester" leak detector for the tightness diagnosis of closed systems such as fuel tanks, intake air passages, etc.. (1) "BMW Smoke diagnosis tester", (2) "UltraTracer", (3) cylinder with pressure reducer, (4) diverse adapter, (5) coupling kit for compressed air connection, (6) torch with white and UV light including special glasses, (7) power pack note: (2) "UltraTracer".

**Storage Location**

Alternatively

**SI number**



**Fig. 59: Identifying Leak Detector (2353954)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356842 MAGNET AM**

**NOTE:** Magnet set of 25

**Storage Location**

Individual

**SI number**

00 22 13 (969)



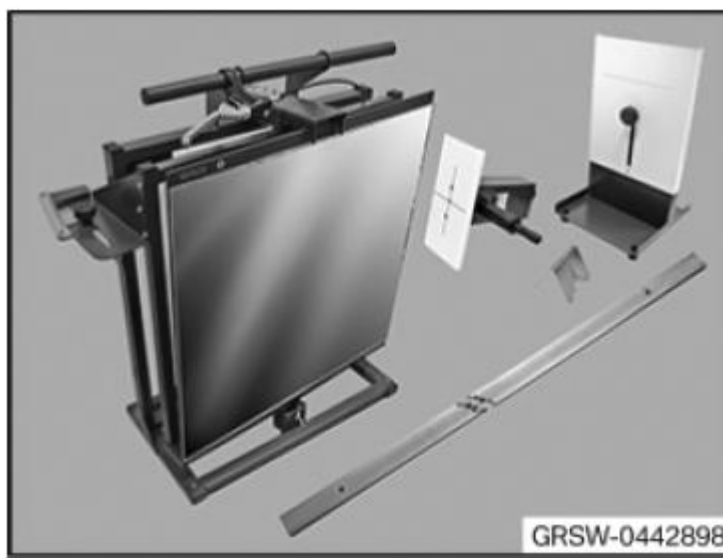
**Fig. 60: Identifying Magnet (2356842)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**0442898 MEASURING DEVICE MP**

**NOTE:** ACC adjusting device. Using this adjusting device, an ACC sensor built into the vehicle can be adjusted in the workshop. Prerequisite is a suitable measuring station.

**SI number**

02 04 05 (208)



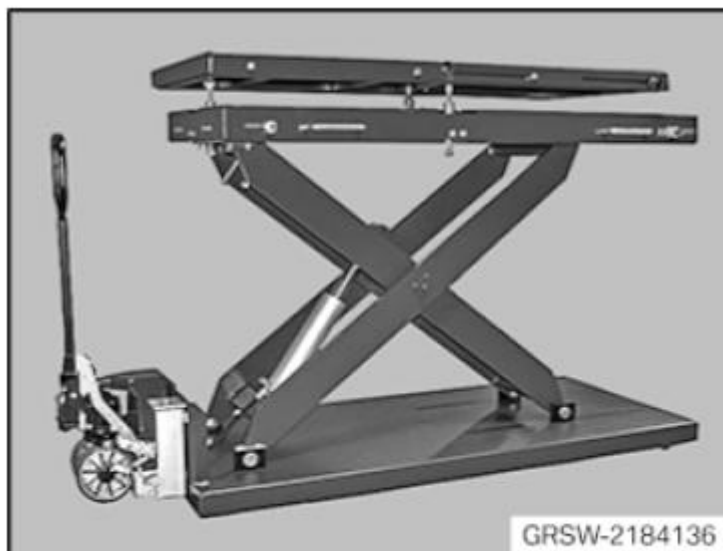
**Fig. 61: Identifying Measuring Device (0442898)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2184136 MOBILE EQUIPMENT TABLE LIFT AM**

**NOTE:** Table lift MHT 1200

**SI number**

06 01 10 (649)



**Fig. 62: Identifying Mobile Equipment Table Lift (2184136)**  
Courtesy of BMW OF NORTH AMERICA, INC.

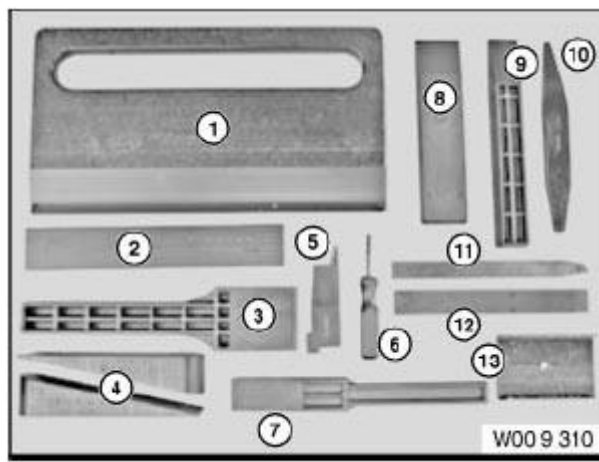
**009311 PANEL WEDGE AM**

**Storage Location**

Individual

**SI number**

01 07 09 (530)



**Fig. 63: Identifying Panel Wedge (009311)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**009324 PANEL WEDGE AM**

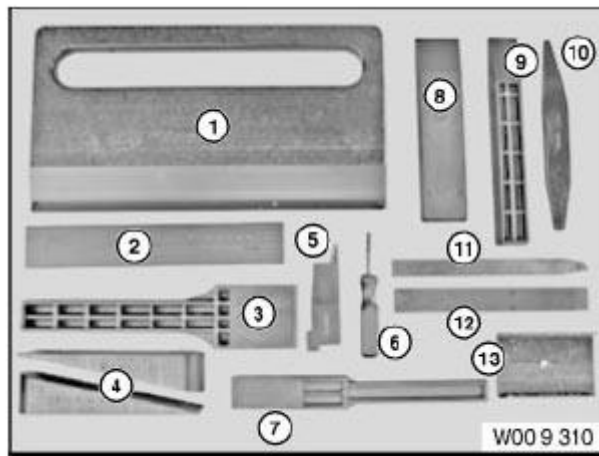
**NOTE:** (Panel wedge (panel)) For removing cavity strips on the doors from E60

**Storage Location**

Individual

**SI number**

01 25 05 (230)



**Fig. 64: Identifying Panel Wedge (009324)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2357071 PLATE MINIMUM SET: MECHANICAL TOOLS AM**

In conjunction with:

**TABLE LIFT MHT 1200**

**NOTE:** Additional support plates for table lift MHT 1200.

**SI number**

01 21 13 (987)

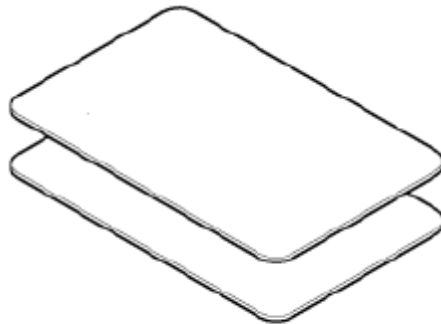


**Fig. 65: Identifying Plate (2357071)**

Courtesy of BMW OF NORTH AMERICA, INC.

**009341 REMOVAL AID MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Only available as a set (2 tools) under 00 9 340 (= 83 30 0 493 687).



W00 9 340

**Fig. 66: Identifying Removal Aid (009341)**

Courtesy of BMW OF NORTH AMERICA, INC.

**009340 REMOVAL AID MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** (Removal aid (2 x)) For levering out switch block on driver's door.

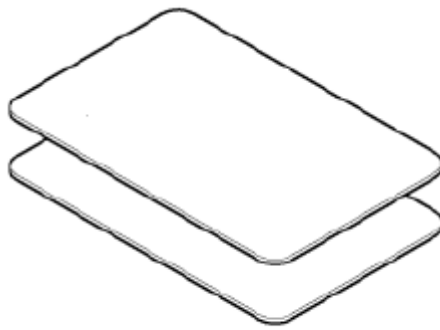
**SI number**

01 15 99 (483)

Consisting of:

1 = **0496289** Removal aid

**NOTE:** Only available as a set (2 tools) under 00 9 340 (= 83 30 0 493 687).



W009 340

**Fig. 67: Identifying Removal Aid (009340)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356846 SCREW AM**

**NOTE:** Screw set of 100



**Fig. 68: Identifying Screw (2356846)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**009312 STRIKING ELEMENT AM**

**NOTE:** (Striking wedge, square)

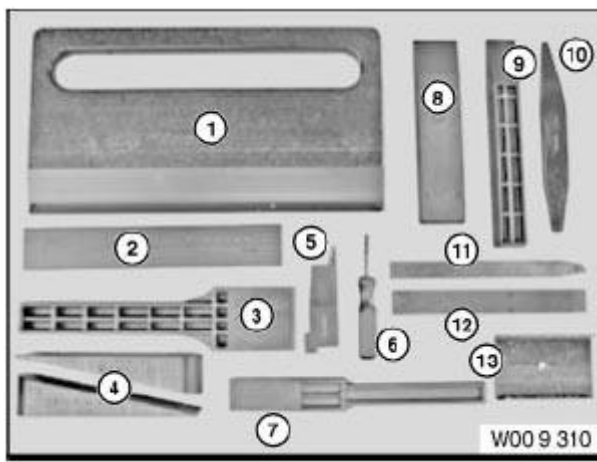
**Storage Location**

Individual

**SI number**

01 07 09 (530)





**Fig. 69: Identifying Striking Element (009312)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**009319 STRIKING ELEMENT AM**

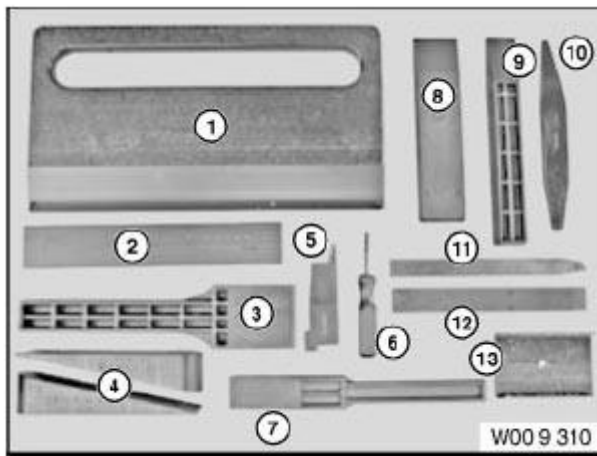
**NOTE:** (Striking wedge, small)

**Storage Location**

Individual

**SI number**

01 07 09 (530)



**Fig. 70: Identifying Striking Element (009319)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**009313 STRIKING ELEMENT AM**

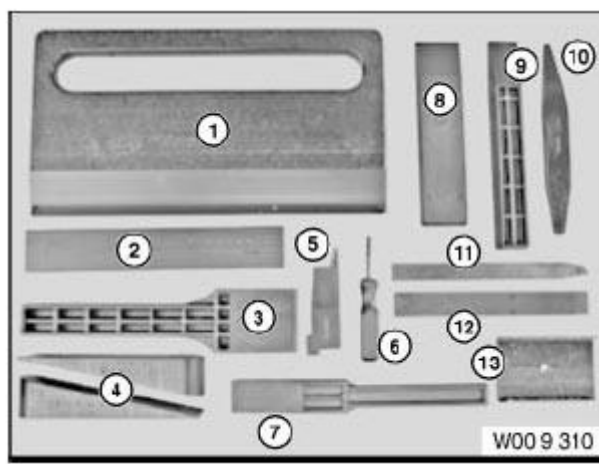
**NOTE:** (Striking wedge, large)

**Storage Location**

Individual

**SI number**

01 07 09 (530)



**Fig. 71: Identifying Striking Element (009313)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**2334974 TESTER MP**

**NOTE:** Tester for trailer socket. For the diagnosis of the trailer module an electrical consumer is required on the trailer socket.

**Storage Location**

universal

**SI number**

02 04 13 (981)



**Fig. 72: Identifying Tester (2334974)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**005040 TOOL AM**

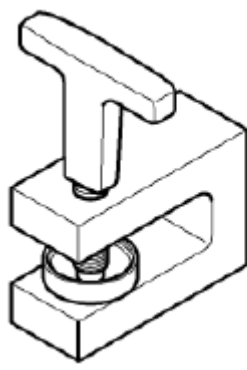
**NOTE:** (riveting tool) For riveting the seat belt limiters

**Storage Location**

C2

**SI number**

01 05 95 (932)



W 00 5 040

**Fig. 73: Identifying Tool (005040)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2405075 TOOL AM**

**NOTE:** Tool for M8 thin wall threaded insert

**Storage Location**

Individual

**SI number**

01 18 14 (106)



**Fig. 74: Identifying Tool (2405075)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2337974 TOOL MINIMUM SET: MEASURING AND TESTING EQUIPMENT MP**

**NOTE:** Cable shears. To professionally cut through cables with a cross-section of 10 mm<sup>2</sup> - 70 mm<sup>2</sup> .

**Storage Location**

A34

**SI number**

02 07 12 (859)



**Fig. 75: Identifying Tool (2337974)**

Courtesy of BMW OF NORTH AMERICA, INC.

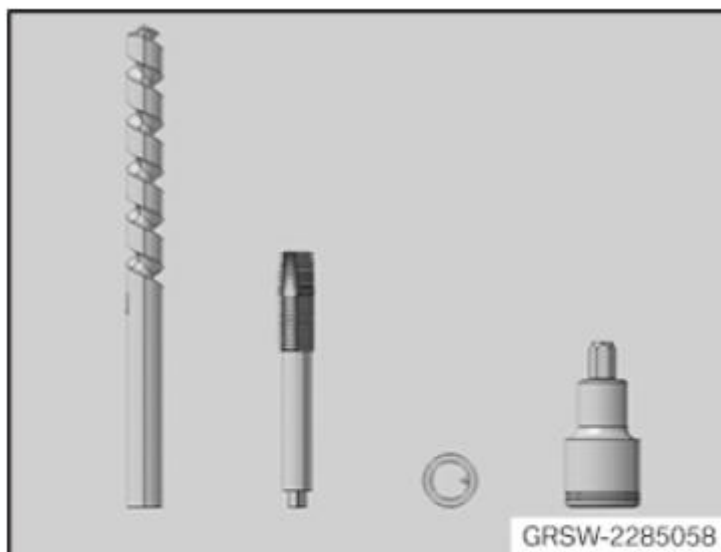
**2285058 TOOL SET AM**

**Storage Location**

Individual

**SI number**

01 02 14 (069)



**Fig. 76: Identifying Tool Set (2285058)**

Courtesy of BMW OF NORTH AMERICA, INC.

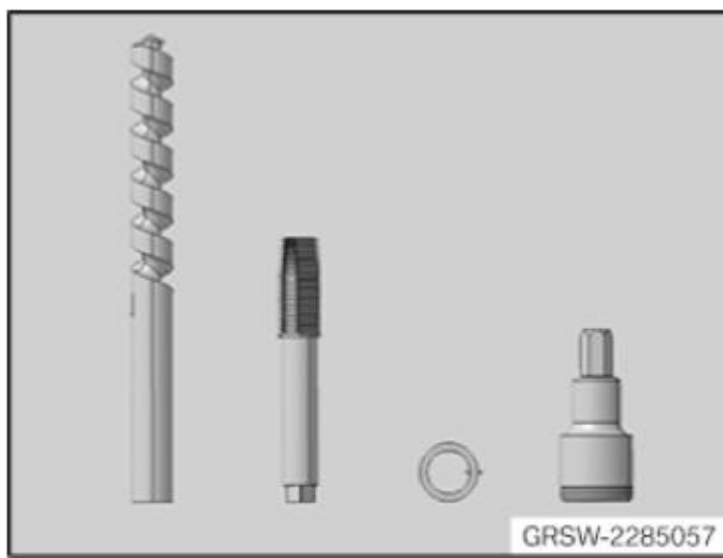
**2285057 TOOL SET AM**

**Storage Location**

Individual

**SI number**

01 02 14 (069)



**Fig. 77: Identifying Tool Set (2285057)**  
Courtesy of BMW OF NORTH AMERICA, INC.

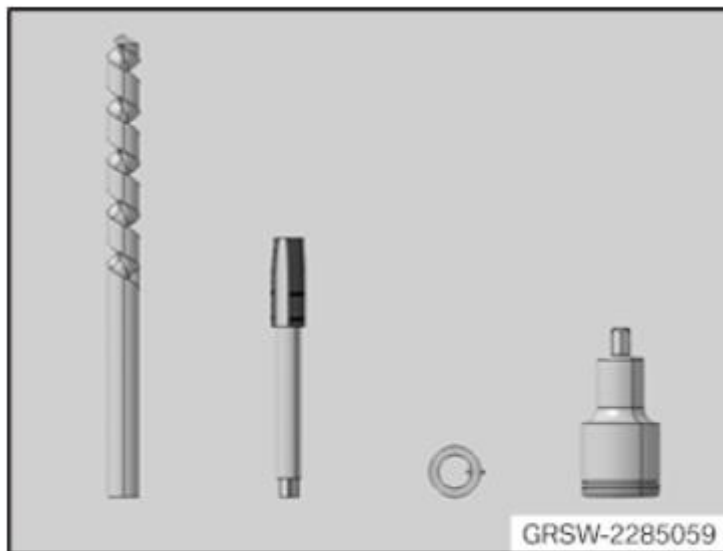
**2285059 TOOL SET AM**

**Storage Location**

Individual

**SI number**

01 02 14 (069)



**Fig. 78: Identifying Tool Set (2285059)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**0418188 TORQUE WRENCH MECHANICAL TOOL**

**NOTE:** Electronic torque/angle-of-rotation wrench. 10-200 Nm.

**SI number**

08 09 06 (297)



**Fig. 79: Identifying Torque Wrench (0418188)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2298612 TORQUE WRENCH MECHANICAL TOOL**

**NOTE:** Electronic torque/angle-of-rotation wrench 20-200 Nm.

SI number

08 09 11 (778)

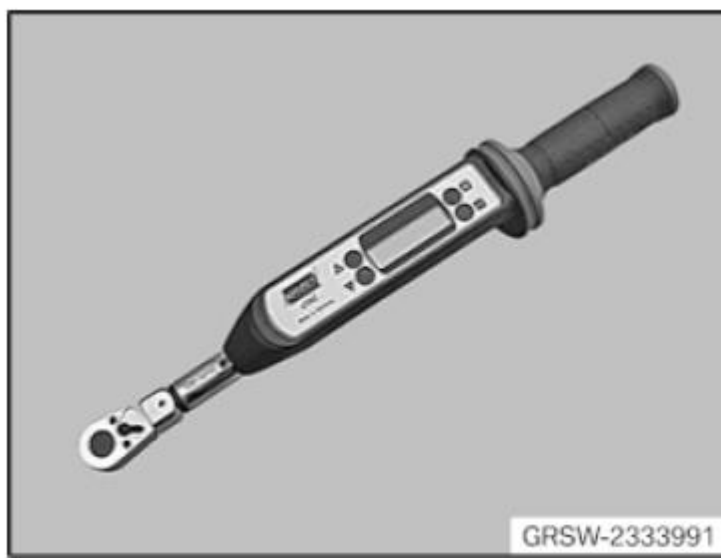


**Fig. 80: Identifying Torque Wrench (2298612)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2333991 TORQUE WRENCH AM**

**NOTE:** Electronic torque/torsion angle wrench 6-100 Nm.





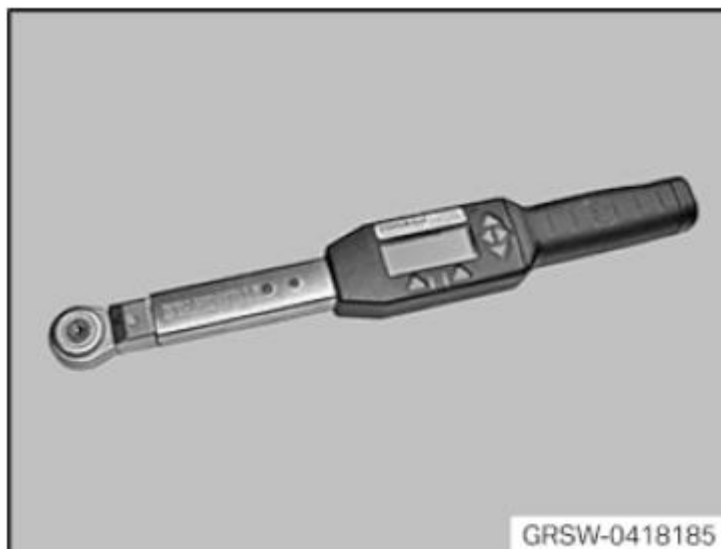
**Fig. 81: Identifying Torque Wrench (2333991)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**0418185 TORQUE WRENCH MECHANICAL TOOL**

**NOTE:** Electronic torque wrench 3-60 Nm.

**SI number**

08 09 06 (297)



**Fig. 82: Identifying Torque Wrench (0418185)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2356847 WASHER AM**

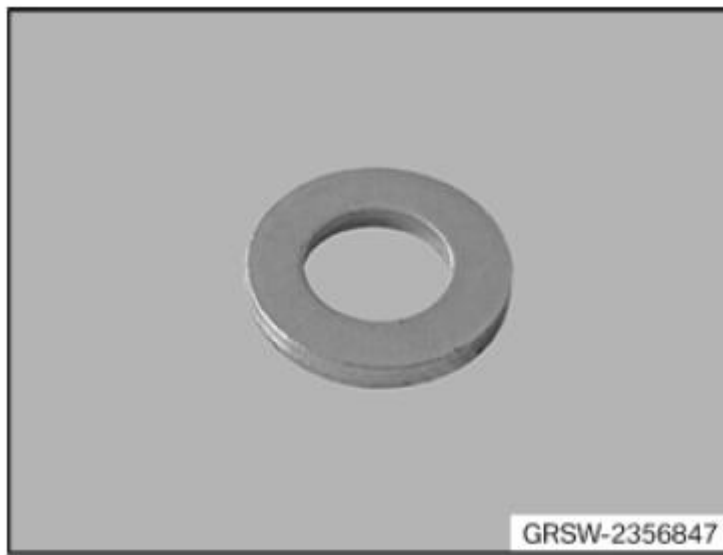
**NOTE:** Washer set of 100

**Storage Location**

Individual

**SI number**

00 22 13 (969)



**Fig. 83: Identifying Washer (2356847)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**009326 WEDGE AM**

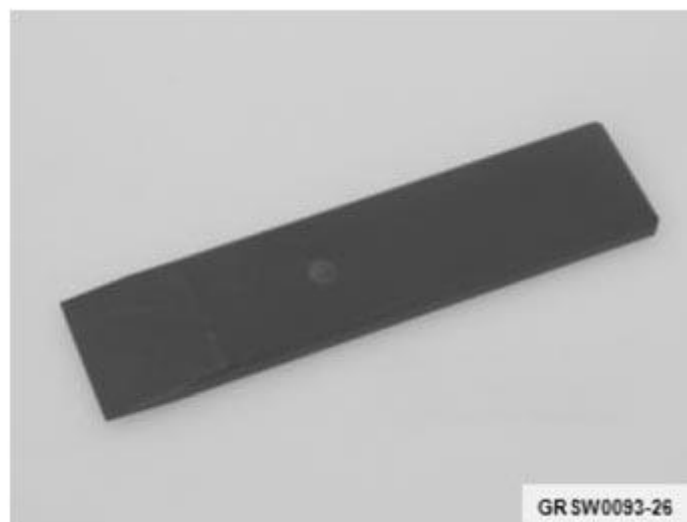
**NOTE:** (Universal wedge) From 11/2008 this special tool replaces panel wedge 009 318 (different material)

**Storage Location**

Individual

**SI number**

01 07 09 (530)



**Fig. 84: Identifying Wedge (009326)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**009315 WEDGE AM**

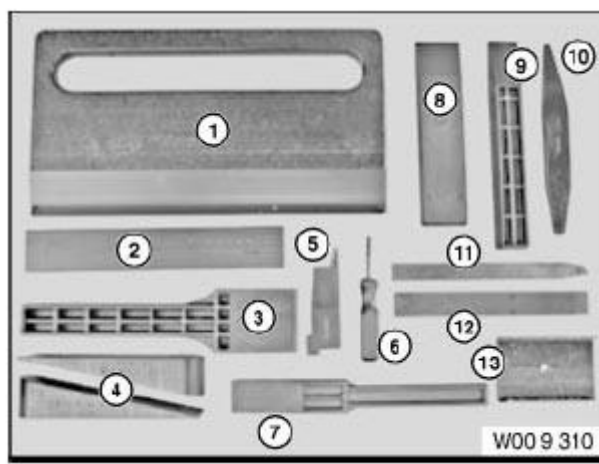
**NOTE:** (Gap dimension wedge)

**Storage Location**

Individual

**SI number**

01 07 09 (530)



**Fig. 85: Identifying Wedge (009315)**

Courtesy of BMW OF NORTH AMERICA, INC.

**009314 WEDGE AM**

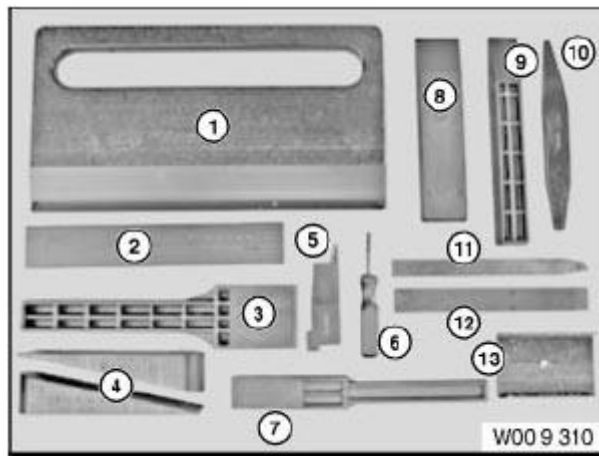
**NOTE:** (Adjusting wedges (2 x))

**Storage Location**

Individual

**SI number**

01 07 09 (530)



**Fig. 86: Identifying Wedge (009314)**

Courtesy of BMW OF NORTH AMERICA, INC.

**009322 WEDGE AM**

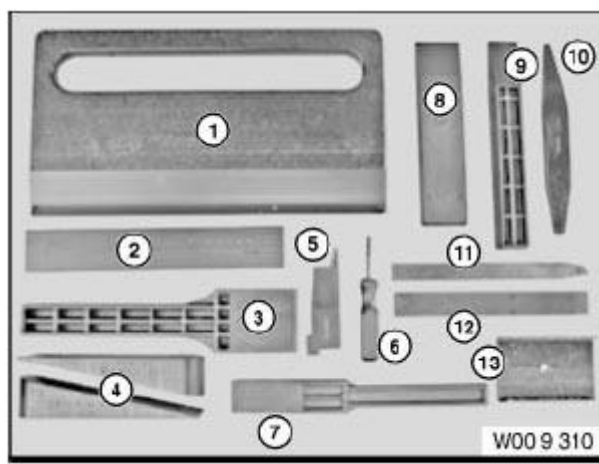
**NOTE:** (Panel wedge)

**Storage Location**

Individual

**SI number**

01 07 09 (530)

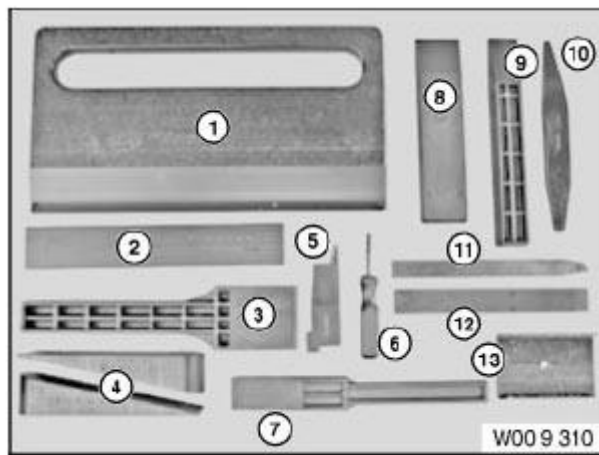


**Fig. 87: Identifying Wedge (009322)**

Courtesy of BMW OF NORTH AMERICA, INC.

**009310 WEDGE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** (Panel wedges (set in plastic case)) For straightening and installation work on the vehicle, e.g. feeding in trim panels, removing window cavity strips, removing minor dents, removing adhesive residue, measuring gap widths, levering out trim panels --> 12 pieces (item 6 = 009316 discontinued since 2009).



**Fig. 88: Identifying Wedge (009310)**

Courtesy of BMW OF NORTH AMERICA, INC.

**SI number**

01 07 09 (530)

Consisting of:

13 = 0495484

7 = 0496569

8 = 0496570

12 = 0496571

1 = 0490528

2 = 0490529

3 = 0490530

4 = 0490531

5 = 0490532

6 = 0490533

0490534

0490535

9 = 0490536

10 = 0490538

11 = 0490539

0490540

14 = 0493752

### **009325 WEDGE AM**

**NOTE:** (Panel wedge) From 11/2008 this special tool replaces panel wedge 00 9 317 (different material)

#### **Storage Location**

Individual

#### **SI number**

41 01 09 (507)



**Fig. 89: Identifying Wedge (009325)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **009030 WEDGE MINIMUM SET: MECHANICAL TOOLS AM**

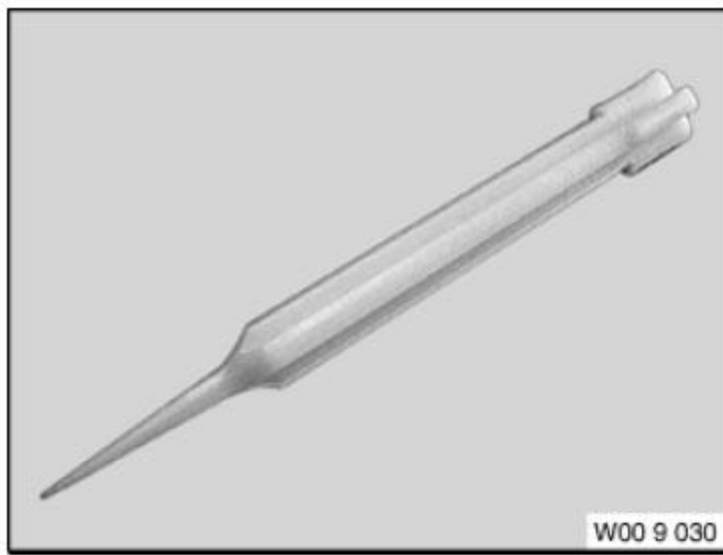
**NOTE:** For dismantling O-rings, gaskets and trim panels. This special tool replaces special tool 00 9 316.

#### **Storage Location**

A49

#### **SI number**

01 20 09 (581)



**Fig. 90: Identifying Wedge (009030)**

Courtesy of BMW OF NORTH AMERICA, INC.

**009327 WEDGE AM**

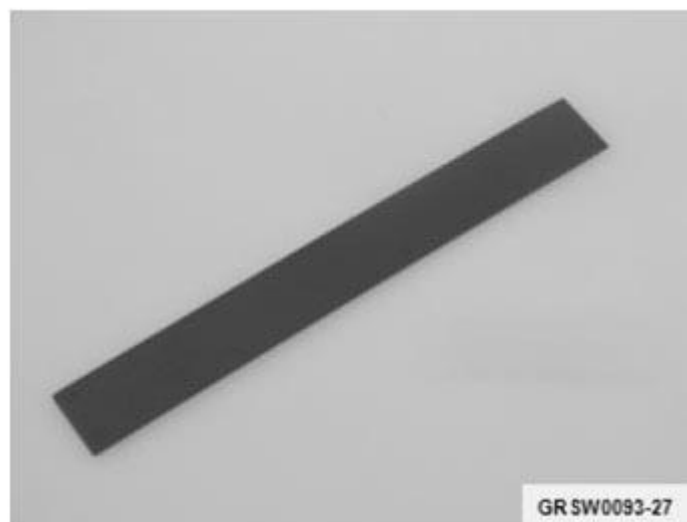
**NOTE:** (Cleaning wedge) From 11/2008 this special tool replaces panel wedge 00 9 323 (different material)

**Storage Location**

Individual

**SI number**

01 07 09 (530)



**Fig. 91: Identifying Wedge (009327)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2433205 WHEEL AM**

**NOTE:** Spare wheel for the workshop crane 81 23 2 220 718





**Fig. 92: Identifying Wheel (2433205)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2220718 WORKSHOP CRANE AM**



**Fig. 93: Identifying Workshop Crane (2220718)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE: WSK 1000**

**SI number**

06 01 11 (701)

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**GENERAL INFORMATION**

**Maintenance And General Information - Tightening Torques - All I3 Models - i3**

**EXCERPT FROM COMPANY STANDARD BMW GS 90003-2**

**00 00 EXCERPT FROM COMPANY STANDARD BMW GS 90003-2**

**TIGHTENING TORQUE SPECIFICATION - EXCERPT FROM COMPANY STANDARD BMW GS 90003-2**

Â	Type	Thread	Tightening specification	Measure
If there are no cross-references to tightening torques in the repair instructions, the excerpts from the company standard BMW GS 90003-2 must be observed.	Â	Â	Â	Â
There are different screws/nuts with surface color/(surface coating) -yellow (ZN) and silver (ZNS) The maximum tightening torques are: Surface color yellow (ZN): Applicable only to shank screws with metric coarse- and fine-pitch threads according to DIN 13-28 and nuts with nut height 0.8 x d according to DIN 934 and exclusively for a $\mu_{tot} = 0.125$ (screws phosphatized, nuts without subsequent treatment or galvanized. Lubrication condition: unlubricated and also oiled).	Â	Â	Â	Â
Surface color silver (ZNS): Applicable only to shank screws with metric coarse- and fine-pitch threads according to DIN 13-28 and nuts with nut height 0.8 x d according to DIN 934 and exclusively for a spread of $\mu = 0.09$ to 0.15 (screws cadmium-plated, nuts without subsequent treatment or galvanized. Lubrication condition: unlubricated and also oiled). The values specified in this table apply to all screw connections conforming to the aforementioned conditions. Not applicable when using a different surface or lubricant condition on the thread, or if the height of the nut differs.	Â	Â	Â	Â
Not applicable to necked-down bolts, self-tapping screw connections or to connections between parts made of different materials. Attention! To be able to carry out competent repairs, it is essential to comply with the specified tightening torques. This assumes that the required torque wrenches are proper working condition. Permitted tolerance of torque wrenches $\hat{A} \pm 2\%$ of scale value.	Â	Â	Â	Â

**M10 AND M10 X 1 - MAXIMUM TIGHTENING TORQUES**

**00 00 M10 AND M10 X 1 - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2**

**TIGHTENING TORQUE SPECIFICATION - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2**

Â	Type	Thread	Tightening specification	Measure

Â	Type	Thread	Tightening specification	Measure
Scope of applicability of tightening torques, refer to excerpt from <a href="#">COMPANY STANDARD BMW GS 90003-2</a>	Surface color/(surface coating)	Â	Â	Â
M10 thread	yellow (ZN)	M10 8.8	Â	47 Nm
	silver (ZNS)	M10 8.8	Â	38 Nm
	yellow (ZN)	M10 10.9	Â	66 Nm
	silver (ZNS)	M10 10.9	Â	56 Nm
	yellow (ZN)	M10 12.9	Â	79 Nm
	silver (ZNS)	M10 12.9	Â	62 Nm
M10x1 thread	yellow (ZN)	M10 x 1 8.8	Â	54 Nm
	silver (ZNS)	M10 x 1 8.8	Â	41 Nm
	yellow (ZN)	M10 x 1 10.9	Â	75 Nm
	silver (ZNS)	M10 x 1 10.9	Â	60 Nm
	yellow (ZN)	M10 x 1 12.9	Â	91 Nm
	silver (ZNS)	M10 x 1 12.9	Â	67 Nm

## M12 AND M12X1.5 - MAXIMUM TIGHTENING TORQUES

### 00 00 M12 AND M12X1.5 - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2

#### TIGHTENING TORQUE SPECIFICATION - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2

Â	Type	Thread	Tightening specification	Measure
Scope of applicability of tightening torques, refer to excerpt from <a href="#">COMPANY STANDARD BMW GS 90003-2</a>	Surface color/(surface coating)	Â	Â	Â
M12 thread	yellow (ZN)	M12 8.8	Â	82 Nm
	silver (ZNS)	M12 8.8	Â	66 Nm
	yellow (ZN)	M12 10.9	Â	115 Nm
	silver (ZNS)	M12 10.9	Â	98 Nm
	yellow (ZN)	M12 12.9	Â	140 Nm
	silver (ZNS)	M12 12.9	Â	108 Nm
M12x1.5 thread	yellow (ZN)	M12 x 1.5 8.8	Â	87 Nm
	silver (ZNS)	M12 x 1.5 8.8	Â	68 Nm

Â	Type	Thread	Tightening specification	Measure
	yellow (ZN)	M12 x 1.5 10.9	Â	123 Nm
	silver (ZNS)	M12 x 1.5 10.9	Â	100 Nm
	yellow (ZN)	M12 x 1.5 12.9	Â	147 Nm
	silver (ZNS)	M12 x 1.5 12.9	Â	110 Nm

## M14 AND M14X1.5 - MAXIMUM TIGHTENING TORQUES

### 00 00 M14 AND M14X1.5 - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2

#### TIGHTENING TORQUE SPECIFICATION - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2

Â	Type	Thread	Tightening specification	Measure
Scope of applicability of tightening torques, refer to excerpt from <a href="#">COMPANY STANDARD BMW GS 90003-2</a>	Surface color/(surface coating)	Â	Â	Â
M14 thread	yellow (ZN)	M14 8.8	Â	130 Nm
	silver (ZNS)	M14 8.8	Â	104 Nm
	yellow (ZN)	M14 10.9	Â	180 Nm
	silver (ZNS)	M14 10.9	Â	155 Nm
	yellow (ZN)	M14 12.9	Â	220 Nm
	silver (ZNS)	M14 12.9	Â	170 Nm
M14x1.5 thread	yellow (ZN)	M14 x 1.5 8.8	Â	143 Nm
	silver (ZNS)	M14 x 1.5 8.8	Â	110 Nm
	yellow (ZN)	M14 x 1.5 10.9	Â	200 Nm
	silver (ZNS)	M14 x 1.5 10.9	Â	165 Nm
	yellow (ZN)	M14 x 1.5 12.9	Â	240 Nm
	silver (ZNS)	M14 x 1.5 12.9	Â	180 Nm

## M16 AND M16X1.5 - MAXIMUM TIGHTENING TORQUES

**00 00 M16 AND M16X1.5 - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2**

**TIGHTENING TORQUE SPECIFICATION - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2**

Â	Type	Thread	Tightening specification	Measure
Scope of applicability of tightening torques, refer to excerpt from <a href="#">COMPANY STANDARD BMW GS 90003-2</a>	Surface color/(surface coating)	Â	Â	Â
M16 thread	yellow (ZN)	M16 8.8	Â	200 Nm
	silver (ZNS)	M16 8.8	Â	160 Nm
	yellow (ZN)	M16 10.9	Â	280 Nm
	silver (ZNS)	M16 10.9	Â	235 Nm
	yellow (ZN)	M16 12.9	Â	340 Nm
	silver (ZNS)	M16 12.9	Â	260 Nm
M16x1.5 thread	yellow (ZN)	M16 x 1.5 8.8	Â	216 Nm
	silver (ZNS)	M16 x 1.5 8.8	Â	170 Nm
	yellow (ZN)	M16 x 1.5 10.9	Â	303 Nm
	silver (ZNS)	M16 x 1.5 10.9	Â	250 Nm
	yellow (ZN)	M16 x 1.5 12.9	Â	364 Nm
	silver (ZNS)	M16 x 1.5 12.9	Â	275 Nm

**M18 AND M18X1.5 - MAXIMUM TIGHTENING TORQUES**

**00 00 M18 AND M18X1.5 - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2**

**TIGHTENING TORQUE SPECIFICATION - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2**

Â	Type	Thread	Tightening specification	Measure
Scope of applicability of tightening torques, refer to excerpt from <a href="#">COMPANY STANDARD BMW GS 90003-2</a>	Surface color/(surface coating)	Â	Â	Â
M18 thread	yellow (ZN)	M18 8.8	Â	280 Nm
	silver (ZNS)	M18 8.8	Â	225 Nm
	yellow (ZN)	M18 10.9	Â	390 Nm

Â	Type	Thread	Tightening specification	Measure
	silver (ZNS)	M18 10.9	Â	330 Nm
	yellow (ZN)	M18 12.9	Â	470 Nm
	silver (ZNS)	M18 12.9	Â	365 Nm
M18x1.5 thread	yellow (ZN)	M18 x 1.5 8.8	Â	313 Nm
	silver (ZNS)	M18 x 1.5 8.8	Â	245 Nm
	yellow (ZN)	M18 x 1.5 10.9	Â	440 Nm
	silver (ZNS)	M18 x 1.5 10.9	Â	360 Nm
	yellow (ZN)	M18 x 1.5 12.9	Â	527 Nm
	silver (ZNS)	M18 x 1.5 12.9	Â	400 Nm

## M4 AND M5 - MAXIMUM TIGHTENING TORQUES

### 00 00 M4 AND M5 - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2

#### TIGHTENING TORQUE SPECIFICATION - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2

Â	Type	Thread	Tightening specification	Measure
Scope of applicability of tightening torques, refer to excerpt from <a href="#">COMPANY STANDARD BMW GS 90003-2</a>	Surface color/(surface coating)	Â	Â	Â
M4 thread	yellow (ZN)	M4 8.8	Â	3 Nm
	silver (ZNS)	M4 8.8	Â	2 Nm
	yellow (ZN)	M4 10.9	Â	4 Nm
	silver (ZNS)	M4 10.9	Â	3 Nm
	yellow (ZN)	M4 12.9	Â	5 Nm
M5 thread	yellow (ZN)	M5 8.8	Â	6 Nm
	silver (ZNS)	M5 8.8	Â	5 Nm
	yellow (ZN)	M5 10.9	Â	8 Nm
	silver (ZNS)	M5 10.9	Â	7 Nm
	yellow (ZN)	M5 12.9	Â	10 Nm
	silver (ZNS)	M5 12.9	Â	8 Nm

## M6 AND M7 - MAXIMUM TIGHTENING TORQUES



**TIGHTENING TORQUE SPECIFICATION - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2**

Â	Type	Thread	Tightening specification	Measure
Scope of applicability of tightening torques, refer to excerpt from <a href="#">COMPANY STANDARD BMW GS 90003-2</a>	Surface color/(surface coating)	Â	Â	Â
M6 thread	yellow (ZN)	M6 8.8	Â	10 Nm
	silver (ZNS)	M6 8.8	Â	8 Nm
	yellow (ZN)	M6 10.9	Â	14 Nm
	silver (ZNS)	M6 10.9	Â	12 Nm
	yellow (ZN)	M6 12.9	Â	17 Nm
	silver (ZNS)	M6 12.9	Â	13 Nm
M7 thread	yellow (ZN)	M7 8.8	Â	15 Nm
	silver (ZNS)	M7 8.8	Â	13 Nm
	yellow (ZN)	M7 10.9	Â	21 Nm
	silver (ZNS)	M7 10.9	Â	19 Nm
	yellow (ZN)	M7 12.9	Â	26 Nm
	silver (ZNS)	M7 12.9	Â	21 Nm

**M8 AND M8 X 1 - MAXIMUM TIGHTENING TORQUES**

**TIGHTENING TORQUE SPECIFICATION - MAXIMUM TIGHTENING TORQUES ACCORDING TO BMW GS 90003-2**

Â	Type	Thread	Tightening specification	Measure
Scope of applicability of tightening torques, refer to excerpt from <a href="#">COMPANY STANDARD BMW GS 90003-2</a>	Surface color/(surface coating)	Â	Â	Â
M8 thread	yellow (ZN)	M8 8.8	Â	24 Nm
	silver (ZNS)	M8 8.8	Â	19 Nm
	yellow (ZN)	M8 10.9	Â	34 Nm
	silver (ZNS)	M8 10.9	Â	28 Nm
	yellow (ZN)	M8 12.9	Â	40 Nm
	silver (ZNS)	M8 12.9	Â	32 Nm
M8x1 thread	yellow (ZN)	M8 x 1 8.8	Â	26 Nm
	silver (ZNS)	M8 x 1 8.8	Â	21 Nm

Â	Type	Thread	Tightening specification	Measure
	yellow (ZN)	M8 x 1 10.9	Â	36 Nm
	silver (ZNS)	M8 x 1 10.9	Â	30 Nm
	yellow (ZN)	M8 x 1 12.9	Â	44 Nm
	silver (ZNS)	M8 x 1 12.9	Â	33 Nm

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## GENERAL INFORMATION

### Manual Transmission Trouble Shooting

#### \* PLEASE READ THIS FIRST \*

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

## INTRODUCTION

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

There are many times when the transmission is incorrectly blamed for shifting problems or noises that are actually caused by other reasons. Shift difficulties are frequently caused by conditions outside of the transmission or transaxle. Typical conditions include: shift linkage, shift cables, alignment of engine to transmission, worn engine mounts or clutch problems. Drive train noises may come from many sources such as tires, road surfaces, wheel bearings, differentials, engine or exhaust system. Repairing or overhauling transmission will not cure these problems.

No manufacturer makes a perfectly quiet transmission. Gear rollover noise is present in most constant mesh transmissions and will tend to disappear when the clutch is disengaged or transmission is placed in gear. If clutch is properly adjusted, clutch release bearing noise will disappear when release bearing is moved enough to slide release bearing away from pressure plate.

Trouble shooting can be helped by driving vehicle on a smooth level road to help eliminate tire and body noise. Note whether noise occurs on acceleration, coasting, deceleration or steady driving conditions. Some problems may only occur when transmission is either hot or cold. Gear lubricant that is too thick can cause hard shifting on cold mornings before engine is warm and vehicle has been driven.

## MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low Gear Oil Level, Loose Bellhousing Bolts, Worn Bearings Or Gears
Clunk On Deceleration (FWD Only)	Loose Engine Mounts, Worn Inboard CV Joints, Worn Differential Pinion Shaft, Oversized Side Gear Hub Counterbore in Case
Gear Clash When Shifting Forward Gears	Clutch Out Of Alignment, Shift Linkage Damaged Or Out Of Adjustment, Gears Or Synchronizers Damaged, Low Gear Oil Level
Transmission Noisy When Moving (RWD Only); Quiet In Neutral With Clutch Engaged	Worn Rear Output Shaft Bearing
Gear Rattle	Worn Bearings, Worn Gear Oil, Low Gear Oil, Worn Gears
Steady Ticking At Idle (Increases With RPM)	Broken Tooth On A Gear
Gear Clash When Shifting Forward Gears	Worn Or Broken Synchronizers, Faulty Clutch
Loud Whine In Reverse	Normal Condition (1)
Noise When Stepping On Clutch	Faulty Release Bearing, Worn Pilot Bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty Release Bearing, Uneven Pressure Plate Fingers
Click Or Snap When Clutch Is Engaged	Worn Clutch Fork, Worn Pivot Ball, Worn Or Broken Front Bearing Retainer

Condition	Possible Cause
Transmission Shifts Hard	Clutch Not Releasing, Incorrect Gear Oil, Shift Mechanism Binding, Clutch Installed Backward
Will Not Shift Into One Gear, Shifts Into All Others	Bent Shift Fork, Worn Detent Balls
Locked Into Gear, Cannot Shift	Clutch Adjustment, Worn Detent Balls
Transmission Jumps Out Of Gear	Pilot Bearing Worn, Bent Shift Fork, Worn Gear Teeth Or Face, Excessive Gear Train End Play, Worn Synchronizers, Missing Detent Ball Spring, Shift Mechanism Worn Or Out Of Adjustment, Engine Or Transmission Mount Bolts Loose, Transmission Not Aligned
Shift Lever Rattle	Worn Detents Or Shift Lever, Worn Shift Fork, Worn Synchronizer Sleeves
Shift Lever Hops Under Acceleration	Worn Engine Or Transmission Mounts
(1) Most units use spur cut gears in Reverse and are naturally noisy.	

## GENERAL INFORMATION

### Parasitic Load Explanation & Test Procedures

#### **\* PLEASE READ THIS FIRST \***

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

#### **GENERAL INFORMATION**

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

The term Parasitic Load refers to electrical devices that continue to use or draw current after the ignition switch is turned to OFF position. This small amount of continuous battery draw is expressed in milliamps (mA). On Chrysler vehicles, a typical Parasitic Load should be no more than 30 milliamps (0.030 amps). On Ford Motor Co. and General Motors vehicles produced after 1980, a typical Parasitic Load should be no more than 50 milliamps (0.050 amps).

Vehicles produced since 1980 have memory devices that draw current with ignition off for as long as 20 minutes before shutting down the Parasitic Drain. When Parasitic Load exceeds normal specifications, the vehicle may exhibit dead battery and no-start condition.

Follow test procedure for checking Parasitic Loads to completion. A brief overview of a suggested test procedure is included along with some typical Parasitic Load specifications. Refer to GENERAL MOTORS PARASITIC LOAD TABLE chart.

#### **TESTING FOR PARASITIC LOAD**

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

**CAUTION:** Always turn ignition off when connecting or disconnecting battery cables, battery chargers or jumper cables. **DO NOT** turn test switch to OFF position (which causes current to run through ammeter or vehicle electrical system).

**NOTE:** Memory functions of various accessories must be reset after the battery is reconnected.

The battery circuit must be opened to connect test switch (shunt) and ammeter into the circuit. When a battery cable is removed, timer circuits within the vehicle computer are interrupted and immediately begin to discharge. If in doubt about the condition of the ammeter fuse, test it with an ohmmeter prior to beginning test. An open fuse will show the same reading (00.00) as no parasitic drain. Begin test sequence with the meter installed and on the 10-amp scale. Select lower scale to read parasitic draw.

#### **CHRYSLER IGNITION OFF DRAW (IOD) TEST**

To test for excessive IOD, verify that all electrical accessories are OFF. Turn off all lights, remove ignition key, and close all doors and decklid. If the vehicle is equipped with electronic accessories (illuminated entry, automatic load leveler, body computer, or high line radio), allow the system to automatically shut off (time out), up to 3 minutes.

1. Raise the hood and disconnect both battery cables, negative first.

**CAUTION:** IOD greater than 3 amps may damage millampmeter.

2. Reconnect the negative cable and connect a typical 12-volt test light (low wattage bulb) between the positive cable clamp and the positive battery post. Remove the engine compartment lamp bulb. If the test light does not light, proceed to step [3](#). If the test light does light, proceed to step, [4](#). The test light will indicate IOD greater than 3 amps. After higher amperage IOD has been corrected, proceed to step [3](#).
3. With 12-volt test light still connected (not lit), connect an ammeter (milliampere scale) between the positive cable clamp and the positive battery post, disconnect test light, refer to instructions provided with ammeter being used. A reading of 30 milliamperes or less indicates normal electrical draw. If ammeter reads more than 30 milliamperes, excessive IOD must be corrected.
4. Locate the fuse panel and remove fuses or circuit breakers one at a time, and observe ammeter after each fuse or circuit breaker is removed. If test light goes out and the reading drops below 30 milliamperes when a certain fuse or circuit breaker is removed, that circuit may have a defect.
5. If IOD is detected after all fuses and circuit breakers have been removed, disconnect the 60-way connector at the Single Module Engine Control (SMEC), located outboard of the battery.
6. If excessive IOD is detected after all fused circuits and SMEC have been verified, disconnect the B+ terminal from the alternator. If reading drops below 30 milliamperes, reinstall all fuses and circuit breakers, reconnect B+ terminal at alternator, reconnect battery, and perform alternator diagnostics.
7. Install engine compartment lamp bulb.

## TEST PROCEDURE USING TEST SWITCH

1. Turn ignition off. Remove negative battery terminal cable. Install Disconnect Tool (J-38758) test switch male end to negative battery cable. Turn test switch knob to OFF position (current through meter). Install negative battery cable to the female end of test switch.
2. Turn test switch knob to ON position (current through switch). Road test vehicle with vehicle accessories on (radio, air conditioner, etc). After road test, turn ignition switch to LOCKED position and remove key. Connect ammeter terminals to test switch terminals. See [Fig.1](#). Select 10-amp scale.
3. Turn off all electrical accessories. Turn off interior lights, underhood lamp, trunk light, illuminated entry, etc. To avoid damaging ammeter or obtaining a false meter reading, all accessories must be off before turning test switch knob to OFF position.
4. Turn test switch knob to OFF position to allow current to flow through ammeter. If meter reads wrong polarity, turn test switch to ON position and reverse leads. Turn test switch to OFF position. Observe current reading. If reading is less than 2 amps, turn test switch to ON position to keep electrical circuits powered-up.
5. Select low amp scale. Switch lead to the correct meter position. Turn test switch to OFF position and compare results to normal current draw. See [GENERAL MOTORS PARASITIC LOAD TABLE \(MILLIAMPS\)](#). If current draw is unusually high for the vehicle's overall electrical system, remove system fuses one at a time until current draw returns to normal.
6. Turn test switch to ON position each time door is opened or fuse is removed. Turn switch to OFF position to read current draw value through meter. When the cause of excessive current drain has been located and repaired, remove test switch and reconnect negative battery cable to the negative battery terminal.

## INTERMITTENT PARASITIC LOAD PROBLEMS

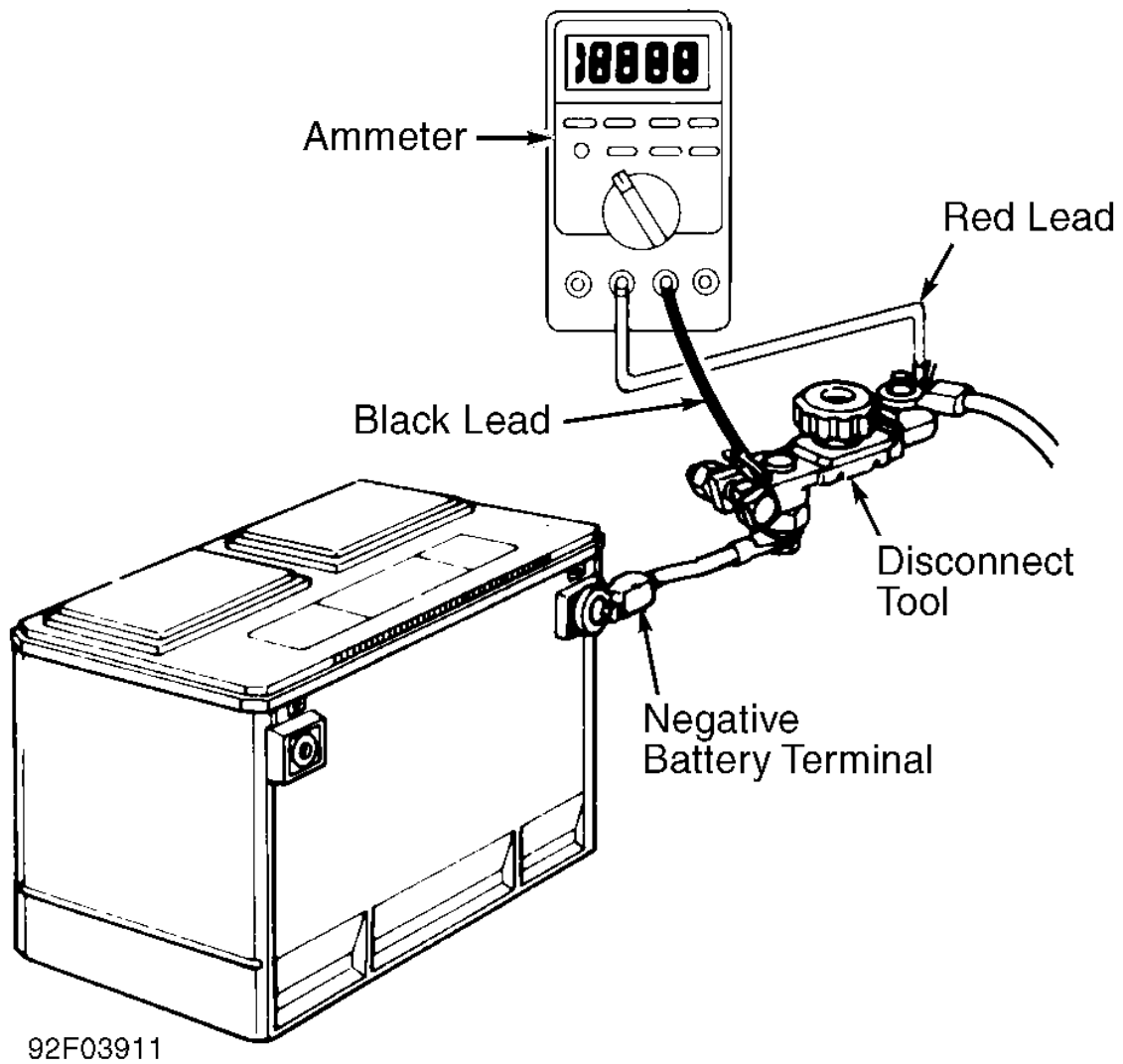
Intermittent parasitic load can occur because of a memory device that does not power down with ignition off. With an intermittent parasitic load, battery draw can be greater than 1.0 amp.

To find an intermittent problem requires that an ammeter and Disconnect Tool (J-38758) test switch be connected and left in the circuit. See [Fig.1](#). Road test vehicle. After road test, turn ignition off and remove key.

Monitor the milliamps scale for 15-20 minutes after ignition is turned off. This allows monitoring memory devices to determine if they time out and stop drawing memory current. The test switch is



needed to protect ammeter when the vehicle is started.



**Fig. 1: Connecting Kent-Moore Disconnect Tool (J-38758)**  
 Courtesy of GENERAL MOTORS CORP.

**GENERAL MOTORS PARASITIC LOAD**

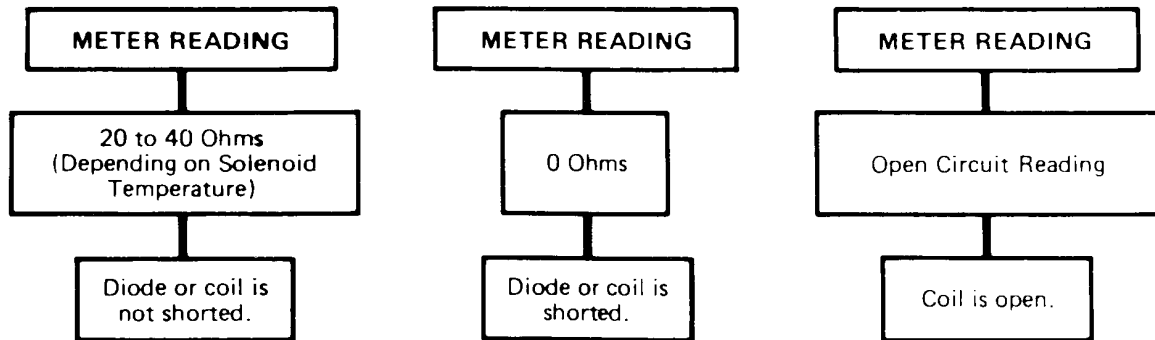
Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
Anti-Theft System	0.4	1.0	.....
Auto Door Lock	1.0	1.0	.....
Body Control Module	3.6	12.4	20
Central Processing System	1.6	2.7	20
Electronic Control Module	5.6	10.0	.....
Electronic Level Control	2.0	3.3	20
Heated Windshield Module	0.3	0.4	.....
HVAC Power Module	1.0	1.0	.....
Illuminated Entry	1.0	1.0	1
Light Control Module	0.5	1.0	.....
Oil Level Module	0.1	0.1	.....
Multi-Function Chime	1.0	1.0	.....

Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
Pass Key Decoder Module	0.75	1.0	.....
Power Control Module	5.0	7.0	.....
Retained Accessory Power	3.8	3.8	.....
Radio	7.0	8.0	15
Twilight Sentinel Module	1.0	1.0	.....
Voltage Regulator	1.4	2.0	.....

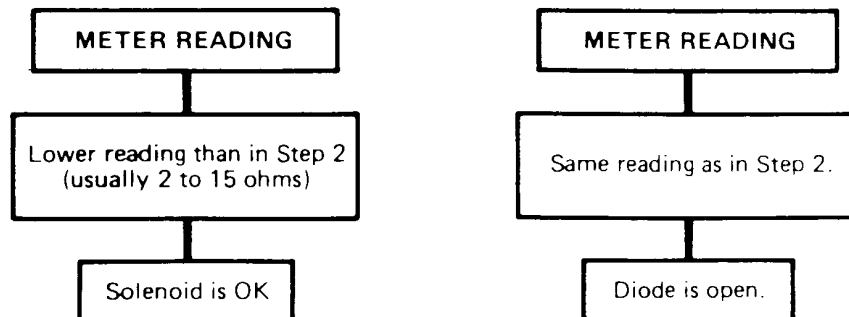
## DIODE CHECK & SOLENOID TEST

**Step 1)** Select the X1 SCALE and zero the needle.

**Step 2)** Attach the POSITIVE SOLENOID LEAD (Red lead) to the POSITIVE METER LEAD and the NEGATIVE SOLENOID LEAD (Black lead) to the NEGATIVE METER LEAD.



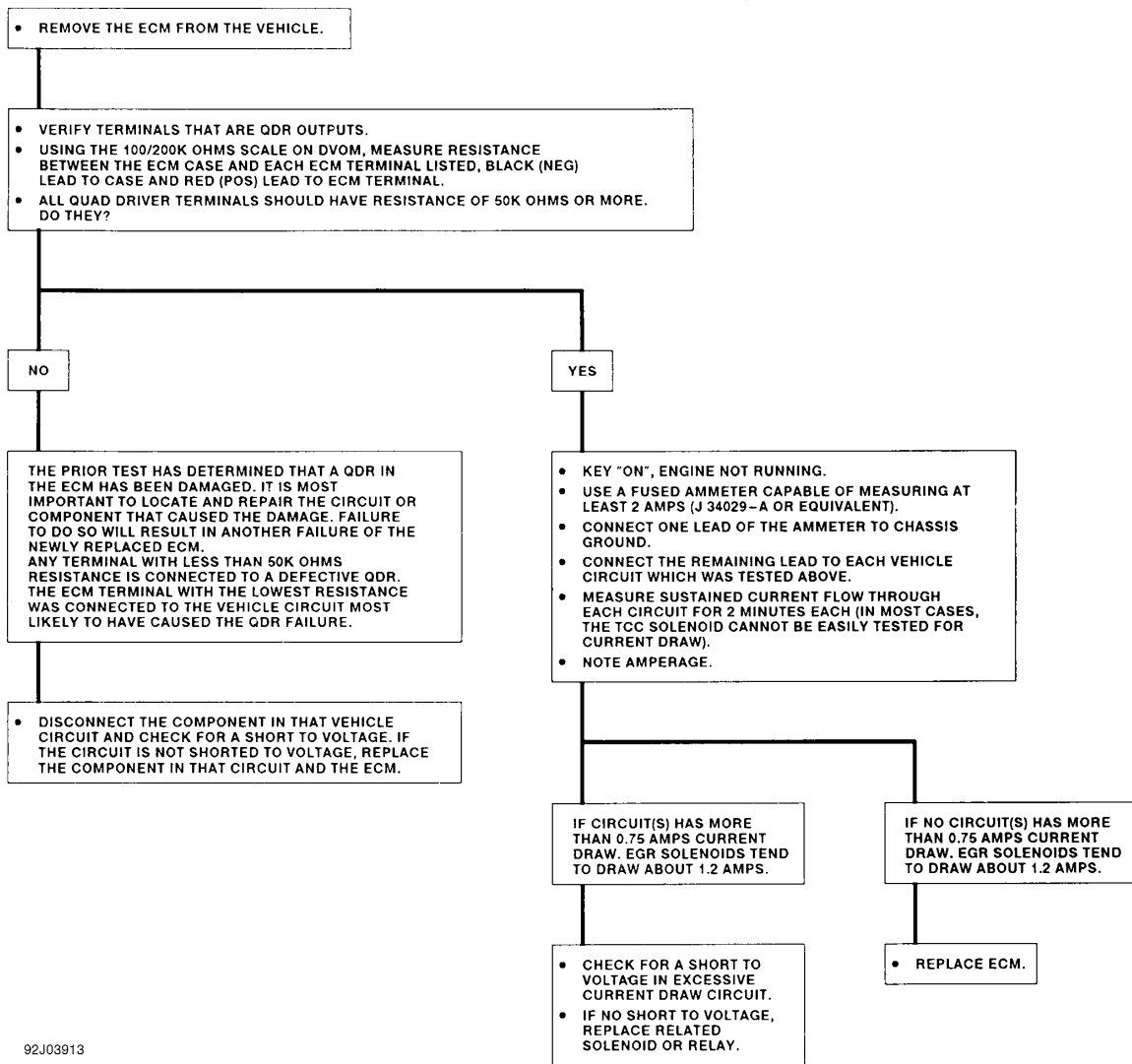
**Step 3)** Reverse the solenoid lead attachments.



92H03912

**Fig. 2: Diode Check & Solenoid Test**  
Courtesy of GENERAL MOTORS CORP.

## QUAD DRIVER TEST



92J03913

**Fig. 3: Quad Driver Test**  
 Courtesy of GENERAL MOTORS CORP.

**GENERAL INFORMATION**  
**State Emission Standards - Gasoline**

**ALASKA**

**NOTE:** Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.

**NOTE:** As of March 1, 2012, Alaska is not testing for tailpipe emissions.

**ALASKA EMISSION STANDARDS - ANCHORAGE & FAIRBANKS (2-SPEED IDLE TEST)**

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Passenger Cars <sup>(1)</sup>		
1968-71	1000 (5.0)	1000 (4.0)
1972-74	1000 (4.0)	1000 (3.0)
1975-80	1000 (2.0)	1000 (2.0)
1981-83	1000 (1.0)	1000 (1.0)
1984-93	750 (1.0)	750 (1.0)
1994-	200 (0.5)	200 (0.5)
Light & Medium Duty Trucks <sup>(1)</sup>		
1968-72	1000 (5.0)	1000 (4.0)
1973-78	1000 (4.0)	1000 (3.0)
1979-83	1000 (2.0)	1000 (2.0)
1984-93	750 (1.0)	750 (1.0)
1994-	220 (0.5)	220 (0.5)
Heavy Duty Vehicles <sup>(2)</sup>		
1968-73	1000 (5.0)	1000 (5.0)
1974-93	1000 (4.0)	1000 (4.0)
1994-	220 (1.0)	220 (1.0)
(1) 8500 GVWR or less. (2) 8500 GVWR or more.		

**ARIZONA**

**NOTE:** Curb idle only test are for vehicles with full-time 4WD, non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on 1967-80 light-duty gasoline powered vehicles and all heavy-duty gasoline powered vehicles.

**ARIZONA EMISSION STANDARDS - PHOENIX AREA (CURB IDLE & LOADED CRUISE TESTS)**

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<b>Application (1)</b>	<b>Idle HC ppm (CO %)</b>	<b>Loaded/Cruise HC ppm (CO %)</b>
<b>Light Duty Vehicles (6000 GVWR Or Less)</b>		
1967-71 4-Cyl. Or Less	500 (5.50)	500 (4.20)
1967-71 More Than 4-Cyl.	450 (5.00)	450 (3.75)
1972-74 4-Cyl. Or Less	400 (5.50)	400 (4.20)
1972-74 More Than 4-Cyl.	400 (5.00)	400 (3.75)
1975-78 4-Cyl. Or Less	250 (2.20)	250 (1.65)
1975-78 More Than 4-Cyl.	250 (2.00)	250 (1.50)
<b>Light Duty Vehicles (8500 GVWR Or Less)</b>		
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.20)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
<b>Light Duty Trucks (6000 GVWR Or Less)</b>		
1967-80	(3)	(3)
<b>Light Duty Trucks (6001-8500 GVWR)</b>		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.00)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
<b>Heavy Duty Trucks (Greater Than 8500 GVWR)</b>		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 & Newer	300 (4.00)	300 (3.00)
<b>Motorcycles</b>		
1967 & Newer	1800 (5.50)	.....
(1) 4-stroke engines only.		
(2) Except AWD, non-defeatable traction control and motorcycles.		
(3) Same as light duty vehicles.		

**ARIZONA EMISSION STANDARDS - PHOENIX AREA (IM147 TEST)**

<b>Application</b>	<b>HC gpm (CO gpm)</b>	<b>NOx gpm</b>
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Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1981-82	3.0 (25.0)	3.5
1983-85	2.4 (20.0)	3.5
1986-89	1.6 (15.0)	2.5
1990-93	1.0 (12.0)	2.5
1994 & Newer	0.8 (12.0)	2.0
Light Trucks (6000 GVWR Or Less)		
1981-85	4.0 (40.0)	5.5
1986-89	3.0 (25.0)	4.5
1990-93	2.0 (20.0)	4.0
1994 & Newer	1.6 (20.0)	3.0
Light Duty Trucks (6000-8500 GVWR)		
1981-85	4.4 (48.0)	7.0
1986-87	4.0 (40.0)	5.5
1988-89	3.0 (25.0)	5.5
1990-93	3.0 (25.0)	5.0
1994 & Newer	2.4 (25.0)	4.0

**NOTE:** Curb idle test only for 1967-80 light-duty gasoline vehicles, all vehicles with full-time 4WD and/or non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on all 1981 and later vehicles except those with full-time 4WD and/or non-defeatable traction control.

**ARIZONA EMISSION STANDARDS - TUCSON AREA (CURB IDLE & LOADED CRUISE TESTS)**

Application <sup>(1)</sup>	Idle HC ppm (CO %)	Loaded/Cruise HC ppm (CO %) <sup>(2)</sup>
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	.....
1967-71 More Than 4-Cyl.	450 (5.00)	.....
1972-74 4-Cyl. Or Less	400 (5.50)	.....
1972-74 More Than 4-Cyl.	400 (5.00)	.....
1975-78 4-Cyl. Or Less	250 (2.20)	.....



Application (1)	Idle HC ppm (CO %)	(2) Loaded/Cruise HC ppm (CO %)
1975-78 More Than 4-Cyl.	250 (2.00)	.....
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.20)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	(3)	(3)
Light Duty Trucks (6001-8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	.....
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.00)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	.....
1979-80	300 (4.00)	.....
1981 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....
<p>(1) 4-stroke engines only.</p> <p>(2) Except AWD, non-defeatable traction control and motorcycles.</p> <p>(3) Same as light duty vehicles.</p>		

## CALIFORNIA

### CALIFORNIA EMISSION STANDARDS ASM TESTS

Specific vehicle cutpoints are available on the California BAR web site at [www.bar.ca.gov](http://www.bar.ca.gov) under the Industry tab, then Cutpoints Application.



**PASS/FAIL EMISSION STANDARDS = A+B / VTW**

PASS/FAIL STANDARDS - Emission standards used to determine if a vehicle passes the emission inspection. A vehicle passes if the emission levels are equal to or less than the standards for HC, CO and NO for ASM 5015 and ASM 2525.

GROSS POLLUTER STANDARDS - Emission standards used to designate a vehicle as a gross polluter. A vehicle is designated as a gross polluter if the emission levels at the time of the initial inspection, before repairs are greater than the gross polluter standards for HC, CO or NO for ASM 5015 or ASM 2525.

**NOTE:** If test data on emission pass/fail rates or gross polluter identification rates indicate adjustments are required, the emission standards may be increased or decreased by the bureau by 30% or by the following tolerances, or standards may be set for any specific vehicle and engine configuration which the bureau determines has excessive errors of commission or omission, whichever is necessary to comply with Section 44001.5 of the Health and Safety Code.

**COLORADO****COLORADO EMISSION STANDARDS - ENHANCED PROGRAM (IM240)**

Application	HC gpm	CO gpm	NOx gpm
<b>Passenger Cars</b>			
1982	3.5	45	5.0
1983	3.5	30	4.5
1984	3.0	30	4.5
1985	2.5	20	4.5
1986	2.5	20	4.5
1987	2.5	20	4.0
1988 & 1989	2.0	20	4.0
1990	2.0	20	3.5
1991	1.5	20	3.5
1992	1.5	15	3.5
1993	1.5	15	3.5
1994	1.2	15	3.0
1995	1.2	15	2.5
1996	1.2	15	2.0
1997	1.2	15	2.0
1998 & Newer	1.2	15	1.5
<b>Light Duty Vehicles</b>			
1982	6.0	65	6.0
1983	6.0	65	6.0
1984	5.0	55	6.0
1985	4.5	45	6.0
1986	4.0	40	6.0
1987	3.5	30	5.5
1988 & 1989	3.0	25	5.0
1990	3.0	25	5.0
1991	2.5	25	4.5
1992	2.5	25	4.5
1993	2.5	25	4.5
1994	2.0	20	4.0
1995	2.0	20	4.0

Application	HC gpm	CO gpm	NOx gpm
1996	1.2	15	3.5
1997	1.2	15	3.0
1998	1.2	15	2.0
1999 & Newer	1.2	15	2.0

### COLORADO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm	CO %
<b>Passenger Cars &amp; Light Duty Trucks</b>		
1970 & Earlier	1000	3.5
1971	1000	3.0
1972	1000	3.0
1973	1000	3.0
1974	1000	3.0
1975	600	2.0
1976	600	2.0
1977	400	1.5
1978	400	1.5
1979	400	1.5
1980	400	1.5
1981 & Newer	220	1.2
<b>Heavy Duty Trucks (6000 GVWR Or Greater)</b>		
1967 Or Earlier	1500	7.0
1968-69	1200	6.5
1969	1200	6.5
1970	1000	5.5
1971	1000	5.5
1972	1000	5.5
1973	1000	5.5
1974	1000	5.5
1975	1000	5.5
1976	1000	5.5
1977	1000	5.5
1978	1000	5.5
<b>Heavy Duty Trucks (8501 GVWR Or Greater)</b>		
1979	800	4.0
1980	800	3.5
1981	600	3.0
1982	600	3.0
1983	600	3.0
1984	600	3.0
1985	600	3.0
1986 & Newer	300	2.0

## CONNECTICUT

### CONNECTICUT EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO)
<b>10,000 GVWR Or Less</b>	
1979	250 (2.1)
1980	225 (2.0)
1981-82	200 (1.2)
1983	175 (1.0)

Application	HC ppm (CO)
1984-87	150 (1.0)
1988 & Newer	125 (1.0)

## DELAWARE

### DELAWARE EMISSION STANDARDS - KENT, NEW CASTLE & SUSSEX COUNTIES (IDLE TEST)

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-70	900 (9.0)
1971-74	600 (6.0)
1975-79	400 (4.0)
1980	220 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1970-72	900 (9.0)
1973-78	600 (6.0)
1979-83	400 (4.0)
1984 & Newer	220 (1.2)

## DISTRICT OF COLUMBIA

### DISTRICT OF COLUMBIA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles & Trucks (26000 GVWR Or Less)	
1968-70	1250 (11.0)
1971-74	1200 (9.0)
1975-79	600 (6.5)
1980	300 (1.5)
1981 & Newer	220 (1.2)

## GEORGIA

**NOTE:** The Georgia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and older model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

### GEORGIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application (1)	HC ppm (CO %)
1979	500 (5.0)
1980	350 (3.5)
1981-83	250 (1.5)
1984 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

## IDAHO

### IDAHO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles	
8500 GVWR Or Less	
1965-74	900 (5.0)

Application	HC ppm (CO %)
1975-79	700 (3.0)
1980	400 (1.5)
1981 & Newer	220 (1.2)
<b>Heavy Duty Trucks</b>	
8501 GVWR Or More	
1965-74	900 (6.0)
1975-80	700 (5.0)
1981 & Newer	500 (3.0)

## ILLINOIS

### ILLINOIS EMISSION STANDARDS - IM240 TEST

Application	HC gpm	CO gpm
<b>Light Duty Vehicles (6000 GVWR Or Less)</b>		
1981-82	2.00	60.0
1983-87	2.00	30.0
1988-95	0.80	15.0
1996 & Newer	0.60	10.0
<b>Light Duty Trucks (6000 GVWR Or Less)</b>		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (3750 LVW Or More) <sup>(1)</sup>	0.80	13.0
1996 & Newer (3750 LVW Or Less) <sup>(1)</sup>	0.60	10.0
<b>Light Duty Trucks (6001-6500 GVWR)</b>		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (5750 ALVW Or More)	0.80	15.0
1996 & Newer (5750 ALVW Or Less)	0.80	13.0
(1) Loaded Vehicle Weight (LVW) is vehicle curb weight plus 300 lbs.		

### ILLINOIS EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
<b>Passenger Vehicles (6000 GVWR Or Less)</b>	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-77	700 (7.0)
1978-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
<b>Light Duty Vehicles (8000 GVWR Or Less)</b>	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-78	700 (7.0)
1979-80	600 (6.0)
1981-83	300 (3.0)
1984 & Newer	220 (1.2)
<b>Heavy Duty Vehicles (8001 GVWR Or More)</b>	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)



Application	HC ppm (CO %)
1985 & Newer	300 (3.0)

## INDIANA

### INDIANA EMISSION STANDARDS - IM93 TEST

Application	HC gpm (CO gpm)	NOx (gpm)
Passenger Cars		
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-90	1.4 (20)	3.0
1991-95	0.8 (15)	2.5
1996 & Newer	0.6 (10)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	3.5
1991-95	1.6 (40)	3.0
1996 & Newer	0.8 (20)	3.0
Light Duty Trucks (6001-8500 GVWR)		
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	5.0
1991-96	1.6 (40)	4.5
1997 & Newer	0.8 (20)	4.5
Heavy Duty Trucks (8501-9000 GVWR)		
1981-82	7.5 (100)	8.0
1983-84	6.0 (100)	8.0
1985-86	5.0 (75)	8.0
1987-90	3.0 (60)	8.0
1991-97	2.4 (40)	8.0
1998 & Newer	2.0 (30)	6.0

### INDIANA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1976-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)

## KENTUCKY

**NOTE:** Currently, there is no emission testing in Kentucky.

**KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES  
(IDLE TEST)**

<b>Application</b>	<b>HC ppm (CO)</b>
<b>Passenger Cars (Automobiles)</b>	
1968	950 (8.5)
1969	900 (8.5)
1970	850 (8.1)
1972	800 (8.0)
1973	800 (7.8)
1974	800 (7.6)
1975	700 (7.5)
1976	700 (6.5)
1977	650 (6.3)
1978	600 (5.5)
1979	600 (4.5)
1980	250 (2.5)
1981 & Newer	220 (1.2)
<b>Light Duty Trucks (6000 GVWR Or Less)</b>	
1968	1300 (8.0)
1969	1200 (8.0)
1970-71	1100 (8.0)
1972-73	1000 (7.8)
1974	950 (7.8)
1975	900 (7.0)
1976-77	700 (7.0)
1978	700 (6.3)
1979	450 (5.5)
1980	450 (4.0)
1981	350 (1.7)
1982 & Newer	220 (1.2)
<b>Light Duty Trucks (6001-10,000 GVWR)</b>	
1969	1500 (9.0)
1970	1100 (8.0)
1971	1000 (8.0)
1972-75	950 (7.5)
1976	900 (7.5)
1977	850 (7.5)
1978	700 (6.0)
1979	650 (5.5)
1980	550 (5.0)
1981	450 (4.0)
1982	400 (2.5)
1983	350 (2.0)
1984	220 (1.5)
1985 & Newer	220 (1.2)
<b>Heavy Duty Trucks (10,001-18,000 GVWR)</b>	
1968	1500 (9.0)
1969-70	1300 (8.5)
1971	1200 (8.5)
1972-76	1000 (7.0)
1977-80	900 (6.5)
1982-83	400 (3.0)
1984 & Newer	250 (1.5)

# MARYLAND

## MARYLAND EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1984-87	1.80 (30.0)	2.8
1988-90	1.40 (30.0)	2.5
1991-93	1.00 (20.0)	2.2
1994-95	0.90 (20.0)	2.1
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	2.80 (80.0)	5.8
1988-90	2.40 (80.0)	3.0
1991-93	2.00 (60.0)	2.7
1994-95	1.80 (60.0)	2.6
Light Duty Trucks (6001-8500 GVWR)		
1984-87	2.90 (80.0)	6.6
1988-90	2.40 (80.0)	4.2
1991-93	2.00 (60.0)	4.0
1994-95	1.80 (60.0)	3.7
Heavy Duty Trucks (8501-9999 GVWR)		
1984	5.80 (100.0)	7.7
1985-86	4.70 (80.0)	7.7
1987	3.00 (80.0)	7.7
1988-90	2.60 (80.0)	7.0
1991-97	2.50 (60.0)	5.5
1998 & Newer	2.20 (60.0)	4.0

## MARYLAND EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1977	500 (6.0)
1978	430 (5.5)
1979	400 (4.0)
1980	220 (1.7)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-9999 GVWR)	
1977	580 (7.0)

Application	HC ppm (CO %)
1978	550 (6.7)
1979	470 (5.0)
1980	350 (5.0)
1981	250 (3.0)
1982	220 (2.5)
1983	220 (1.5)
1984 & Newer	220 (1.2)
Heavy Duty Trucks (10,000-26,000 GVWR)	
1977-78	650 (7.0)
1979	650 (6.5)
1980-82	500 (6.0)
1983	500 (3.5)
1984-85	440 (3.0)
1986	280 (2.5)
1987 & Newer	220 (1.2)

## MASSACHUSETTS

### MASSACHUSETTS EMISSION STANDARDS - MA31 TEST

Application	HC gpm (CO gpm)	NOx gpm
Passenger Cars		
1984-90	2.0 (30)	3.0
1991-95	1.2 (20)	2.5
1996 & Newer	0.8 (13)	2.0
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	3.2 (80)	7.0
1988-1990	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
1996 & Newer (3750 LVW <sup>(1)</sup> Or Less)	0.8 (15)	2.0
1996 & Newer (3751 LVW <sup>(1)</sup> Or Greater)	1.0 (20)	2.5
Light Duty Trucks (6001-8500 GVWR)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer (5750 ALVW <sup>(2)</sup> Or Less)	1.0 (20)	2.5
1996 & Newer (5751 ALVW <sup>(2)</sup> Or Greater)	2.4 (60)	4.0
Heavy Duty Trucks (8501-10,000 Or Greater)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer	2.4 (60)	4.0
(1) Loaded Vehicle Weight (LVW).		
(2) Adjusted Loaded Vehicle Weight (ALVW).		

### MASSACHUSETTS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
All Vehicles	
1984-86	220 (0.80)
1987 & Newer	100 (0.60)

# MISSOURI

## MISSOURI EMISSION STANDARDS - JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	0.80 (30.0)	2.0
1983-95	0.80 (15.0)	2.0
1996 & Newer	0.60 (10.0)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	3.40 (70.0)	4.5
1984-87	1.60 (40.0)	4.5
1988-95	1.60 (40.0)	2.5
1996 & Newer (Less Than 3750 LVW)	0.80 (13.0)	1.8
1996 & Newer (3750 LVW Or Less)	0.60 (10.0)	1.5
Light Duty Trucks (6001-8500 GVWR)		
1981-83	3.4 (70.0)	4.5
1984-87	1.6 (40.0)	4.5
1988-95	1.60 (40.0)	3.5
1996 & Newer (5750 ALVW Or Less)	0.80 (13.0)	1.8
1996 & Newer (5750 ALVW Or More)	0.80 (15.0)	2.0

## MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IDLE TEST

Application (1)	HC ppm (CO %)
1971-74	700 (7.0)
1975-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

## MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - REMOTE SENSING CLEAN SCREEN TEST

Application (1)	HC ppm (CO %)	NOx ppm
All Vehicles (8500 GVWR Or Less)		
1971 & Newer	200 (0.5)	2000
(1) 8500 GVWR or less.		

# NEVADA

**NEVADA EMISSION STANDARDS - 2-SPEED IDLE TEST**

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1968-69	800 (4.0)
1970-74	700 (3.5)
1975-78	500 (2.5)
1979-80	500 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1400 (7.0)
1970-78	1400 (6.0)
1979	1000 (5.0)
1980	1000 (4.0)
1981 & Newer	1000 (3.5)

**NEW JERSEY**

**NOTE:** The New Jersey program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

**NEW JERSEY EMISSION STANDARDS - 2-SPEED IDLE TEST**

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)		
1967 & Earlier	1400 (8.5)	.....
1968-70	700 (7.0)	.....
1971-74	500 (5.0)	.....
1975-80	300 (3.0)	.....
1981 & Newer	220 (1.2)	100 (0.5)
Heavy Duty Vehicles (8501 GVWR Or Greater)		
1967 & Earlier	1400 (8.5)	.....
1968-70	1200 (8.5)	.....
1971-74	700 (6.0)	.....
1975-78	500 (4.0)	.....
1979 & Earlier	300 (3.0)	.....

**NEW MEXICO**

**NEW MEXICO EMISSION STANDARDS - 2-SPEED IDLE TEST**

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1975-78	500 (5.0)	500 (5.0)
1979-80	400 (4.0)	400 (4.0)
1981-85	220 (1.2)	220 (1.2)
1986-90	200 (1.2)	200 (1.2)
1991-95	180 (1.2)	180 (1.2)
Light Duty Trucks (6001-8000 GVWR)		
1975-78	600 (6.0)	600 (6.0)
1979-80	600 (4.5)	600 (4.5)
1981-82	400 (2.7)	400 (3.0)
1983-88	300 (1.2)	300 (3.0)



Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
1989-95	220 (1.2)	220 (1.2)
Medium Duty Trucks (8001-10,000 GVWR)		
1975 & Newer	650 (6.5)	650 (6.5)

## NEW YORK

### NEW YORK EMISSION STANDARDS - IM240 TEST

Application	HC gpm Composite	HC gpm Phase 2	CO gpm Composite	CO gpm Phase 2	NOx gpm Both
Light Duty Vehicles					
1981-82	0.80	0.50	30.0	24.0	2.0
1983-95	0.80	0.50	15.0	12.0	2.0
1996 & Newer	0.60	0.40	10.0	8.0	1.5
Light Duty Trucks (6000 GVWR Or Less)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	2.5
1996 & Newer (3750 LVW Or Less)	0.60	0.40	10.0	8.0	1.5
1996 & Newer (3751 LVW Or More)	0.80	0.50	13.0	10.0	1.8
Light Duty Trucks (6501-8500 GVWR)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	3.5
1996 & Newer (5750 ALVW Or Less)	0.80	0.50	13.0	10.0	1.8
1996 & Newer (5751 ALVW Or More)	0.80	0.50	15.0	12.0	2.0

### NEW YORK EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1978	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1978	600 (4.5)
1979 & Newer	300 (3.0)

## NORTH CAROLINA

### NORTH CAROLINA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1977	450 (4.5)
1978-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	250 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1977-78	500 (5.0)
1979 & Newer	400 (4.0)

## OHIO

**NOTE:** The Ohio program incorporates original U.S. EPA recommended start-up ASM2525 standards for all model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

**OHIO EMISSION STANDARDS - 2-SPEED IDLE TEST**

Application	HC ppm (CO %)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)

**OREGON**

**OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND ENHANCED AREA - BAR31**

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Passenger Cars		
1981-82	2.0 (64)	3.70
1983-89	2.0 (32)	3.70
1990-95	1.2 (30)	3.00
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	4.62
1990-95	2.4 (80)	3.75
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6001-8500 GVWR)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	6.47
1990-95	2.4 (80)	5.25
1996 & Newer	OBD-II Test	OBD-II Test

**OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA BASIC TEST - 2-SPEED IDLE TEST**

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Passenger Cars (6000 GVWR Or Less)		
1975-80 (No Catalyst)	300 (2.5)	-
1975-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1975 & Newer (2-Stroke)	n/a (7.0)	-
Light Duty Trucks (6001-8500 GVWR)		
1975-78 (All)	350 (2.5)	-
1979-80 (No Catalyst)	300 (2.5)	-
1979-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1996 & Newer (3750 LVW Or Less)	0.9 (20)	2.25

Application	Idle HC ppm (CO %)	2500 RPM
		HC ppm (CO %)
Heavy Duty Trucks (8501 GVWR Or More)		
1975-78 (Carbureted)	500 (4.0)	n/a (3.0)
1975-78 (Fuel Injection)	500 (4.0)	-
1979-84 (Carbureted)	350 (3.0)	n/a (3.0)
1979-84 (Fuel Injection)	350 (3.0)	-
1985 & Newer (No Catalyst)	350 (3.0)	n/a (3.0)
1985 & Newer (W/Catalyst)	220 (1.0)	220 (1.0)

#### OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA BASIC TEST - EXHAUST OPACITY TEST

Application	Opacity % @ Idle	Opacity % @ High Idle
1975 & Newer		
2-Cycle Engines	20	.....
Gasoline Engines	0	0

## PENNSYLVANIA

**NOTE:** The Pennsylvania (in Philadelphia area) program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

#### PENNSYLVANIA EMISSION STANDARDS - PITTSBURGH & OLDER PHILADELPHIA VEHICLES - IDLE TEST

Application	HC ppm (CO %)
6000 GVWR Or Less	
1975-79	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	130 (1.0)
6001-9000 GVWR	
1975-78	650 (6.0)
1979	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	180 (1.0)

## RHODE ISLAND

#### RHODE ISLAND EMISSION STANDARDS - RI2000 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1974 & Earlier	15.92 (132.44)	14.92
1975-76	6.74 (96.21)	9.92
1977-79	6.74 (96.21)	6.59
1980	2.25 (45.48)	6.59

Application	HC gpm (CO gpm)	NOx gpm
1981-82	2.25 (45.48)	3.25
1983-95	2.25 (23.74)	3.25
1996 & Newer	1.84 (16.50)	2.42
<b>Light Duty Trucks (6000 GVWR Or Less)</b>		
1975 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1988-90	3.88 (59.97)	4.09
1991-95	3.88 (59.97)	4.09
1996 & Newer (3750 LVW Or Less)	1.84 (16.50)	2.42
1996 & Newer (3751 LVW Or More)	2.25 (20.84)	2.92
<b>Light Duty Trucks (6001-8500 GVWR)</b>		
1974 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1989-90	3.88 (59.97)	5.75
1991-95	3.88 (59.97)	5.75
1996 & Newer (5750 LVW Or Less)	2.25 (20.84)	2.92
1996 & Newer (5751 LVW or More)	5.51 (23.74)	3.25

#### RHODE ISLAND EMISSION STANDARDS - 2-SPEED IDLE TEST

Application Idle (1)	HC ppm (CO %)
1967 & Earlier	800 (7.0)
1968-74	700 (6.0)
1975-78	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

## TENNESSEE

#### TENNESSEE EMISSION STANDARDS - MEMPHIS - IDLE TEST

Application	HC ppm (CO %)
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<b>Application</b>	<b>HC ppm (CO %)</b>
<b>Light Duty Vehicles (9000 GVWR Or Less)</b>	
1971 & Older	900 (8.9)
1972-74	700 (8.2)
1975-79	600 (7.5)
1980	400 (4.7)
1981 & Newer	220 (1.2)
<b>Heavy Duty Trucks (9001-25,999 GVWR)</b>	
1971 & Older	1000 (8.9)
1972-74	1000 (8.2)
1975-79	1000 (8.0)
1980	800 (6.0)
1981 & Newer	400 (4.0)

**TENNESSEE EMISSION STANDARDS - DAVIDSON & NASHVILLE COUNTIES - IDLE TEST**

<b>Application</b>	<b>HC ppm (CO %)</b>
<b>Light Duty Vehicles (6000 GVWR Or Less)</b>	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
<b>Medium Duty Trucks (6001-8500 GVWR)</b>	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

**TENNESSEE EMISSION STANDARDS - FOUR COUNTY AREA SURROUNDING NASHVILLE - IDLE TEST**

<b>Application</b>	<b>HC ppm (CO %)</b>
<b>Light Duty Vehicles (6000 GVWR Or Less)</b>	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
<b>Medium Duty Trucks (6001-8500 GVWR)</b>	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

**TEXAS**

**NOTE:** The Texas program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [\*\*U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.\*\*](#)

**TEXAS EMISSION STANDARDS - 2-SPEED IDLE TEST**

<b>Application</b>	<b>HC ppm (CO %)</b>
<b>Light Duty Vehicles (8500 GVWR Or Less)</b>	
1979	600 (6.0)
1980	400 (4.0)
1981 & Newer	220 (1.2)

Application	HC ppm (CO %)
Heavy Duty Vehicles (8501 GVWR Or More)	
1979-81	700 (7.0)
1982-84	500 (5.0)
1985 & Newer	300 (3.0)

## UTAH

### UTAH EMISSION STANDARDS - DAVIS COUNTY - DC98 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1989-90	2.00 (30)	3.0
1991-95	1.2 (20)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1989-90	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
Light Duty Trucks (6001-8500 GVWR)		
1989-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5

### UTAH EMISSION STANDARDS - DAVIS COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Vehicles (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

**NOTE:** The Salt Lake County program incorporates California style ASM2525 and ASM5015 standards for 1968 and newer model year vehicles; however, actual cutpoints are unique to this program and current information is not available at this time.

### UTAH EMISSION STANDARDS - SALT LAKE COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)



<b>Application</b>	<b>HC ppm (CO %)</b>
1980	300 (2.0)
1981 & Newer	220 (1.2)
<b>Light Duty Trucks (6000 GVWR Or Less)</b>	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
<b>Light Duty Trucks (6001-8500 GVWR)</b>	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
<b>Heavy Duty Trucks (8500 GVWR Or More)</b>	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

#### **UTAH EMISSION STANDARDS - UTAH & WEBER COUNTIES - 2-SPEED IDLE TEST**

<b>Application</b>	<b>HC ppm (CO %)</b>
<b>Light Duty Vehicles (6000 GVWR Or Less)</b>	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
<b>Light Duty Trucks (6000 GVWR Or Less)</b>	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
<b>Light Duty Trucks (6001-8500 GVWR)</b>	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
<b>Heavy Duty Trucks (8500 GVWR Or More)</b>	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

## **VIRGINIA**

**NOTE:** The Virginia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1981 and newer model year

**VIRGINIA EMISSION STANDARDS - 2-SPEED IDLE TEST**

Application	HC ppm (CO %)
8500 GVWR Or Less	
1975-90	400 (4.0)
1980	220 (2.0)
1981-89	220 (1.2)
1990-95	125 (1.0)
1996 & Newer	100 (0.75)
8501-10,000 GVWR	
1975-79	400 (4.0)
1980	220 (2.0)
1981-90	220 (1.2)
1991-96	150 (1.0)
1997 & Newer	125 (0.75)

**WASHINGTON**

**WASHINGTON EMISSION STANDARDS - ASM2525 TEST**

Application	HC ppm (CO %)
1980 & Earlier (Light-Duty Vehicles)	
1750 GVWR	400 (4.2)
1875 GVWR	380 (4.0)
2000 GVWR	350 (3.8)
2125 GVWR	340 (3.6)
2250 GVWR	320 (3.4)
2375 GVWR	300 (3.2)
2500 GVWR	290 (3.0)
2625 GVWR	270 (2.9)
2750 GVWR	260 (2.8)
2875 GVWR	250 (2.7)
3000 GVWR	240 (2.6)
3125 GVWR	230 (2.5)
3250 GVWR	220 (2.4)
3375 GVWR	220 (2.3)
3500 GVWR	210 (2.2)
3625 GVWR	200 (2.1)
3750 Or Greater GVWR (Passenger Cars Only)	200 (2.1)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)
1981 & Newer (Light-Duty Vehicles)	
1750 GVWR	250 (1.8)
1875 GVWR	240 (1.7)
2000 GVWR	220 (1.6)
2125 GVWR	210 (1.5)
2250 GVWR	200 (1.5)
2375 GVWR	190 (1.4)
2500 GVWR	180 (1.3)
2625 GVWR	180 (1.3)
2750 GVWR	171 (1.2)
2875 GVWR	160 (1.2)
3000 GVWR	160 (1.1)
3125 GVWR	150 (1.1)

<b>Application</b>	<b>HC ppm (CO %)</b>
3250 GVWR	150 (1.0)
3375 GVWR	150 (1.0)
3500 GVWR	150 (1.0)
3625 GVWR	150 (1.0)
3750 Or Greater GVWR (Passenger Cars Only)	150 (1.0)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)

### WASHINGTON EMISSION STANDARDS - 2-SPEED IDLE TEST

<b>Application</b>	<b>Idle/2500 RPM HC ppm (CO %)</b>
<b>Light Duty Vehicles (8500 GVWR Or Less)</b>	
1980 & Earlier	600 (3.0)
1981 & Newer	220 (1.2)
<b>Heavy Duty Trucks (8500 GVWR Or More)</b>	
1981 & Newer	400 (3.0)

## WISCONSIN

### WISCONSIN EMISSION STANDARDS - IM240 TEST

<b>Application</b>	<b>HC gpm (CO gpm)</b>	<b>NOx gpm</b>
<b>Light Duty Vehicles (6000 GVWR Or Less)</b>		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-76	3.0 (65)	6.0
1977-79	3.0 (65)	4.0
1980	2.0 (60)	4.0
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-93	0.8 (15)	2.0
1991-95	0.8 (15)	2.0
1996 & Newer	0.6 (10)	1.5
<b>Light Duty Trucks (6000 GVWR Or Less)</b>		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1987	1.6 (40)	4.5
1988-95	1.6 (40)	2.5
1996 & Newer (3750 LVW Or Less)	0.6 (10)	1.5
1996 & Newer (3751 LVW Or More)	0.8 (13)	1.8
<b>Light Duty Trucks (6001-8500 GVWR)</b>		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1988-96	1.6 (40)	3.5
1997 & Newer (5750 ALVW Or Less)	0.8 (13)	1.8
1997 & Newer (5751 ALVW Or More)	0.8 (15)	2.0
<b>Heavy Duty Trucks (8501-10,000 GVWR)</b>		

<b>Application</b>	<b>HC gpm (CO gpm)</b>	<b>NOx gpm</b>
1968-69	20.0 (200)	15.0
1970-73	10.0 (175)	10.0
1974-78	10.0 (150)	10.0
1979-84	7.5 (100)	8.0
1985-86	5.0 (80)	8.0
1987-90	2.0 (40)	6.0
1991-97	2.0 (40)	5.0
1998 & Newer	2.0 (30)	4.0
<b>Heavy Duty Trucks (10,001 GVWR or More)</b>		
1968-69	24.0 (250)	30.0
1970-73	13.0 (175)	20.0
1974-78	13.0 (150)	20.0
1979-84	11.5 (150)	16.0
1985-86	10.0 (150)	16.0
1987-90	3.5 (70)	11.0
1991-97	3.5 (70)	9.0
1998 & Newer	3.5 (60)	7.0

**WISCONSIN EMISSION STANDARDS - 2-SPEED IDLE TEST**

<b>Application</b>	<b>HC ppm (CO %)</b>
<b>Passenger Cars</b>	
1968-71	800 (8.0)
1972-74	550 (7.0)
1975-77	450 (5.5)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)
<b>Light Duty Trucks (6000 GVWR Or Less)</b>	
1968-71	800 (8.0)
1972-74	700 (7.0)
1975-77	500 (6.0)
1978	450 (5.0)
1979	300 (3.0)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
<b>Light Duty Trucks (6001-8500 GVWR)</b>	
1968-69	1450 (9.0)
1970-71	800 (8.0)
1972-74	700 (7.0)
1975-77	550 (6.5)
1978	450 (5.5)
1979	300 (3.0)

Application	HC ppm (CO %)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)
1985 & Newer	300 (3.0)

## U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS

### U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

**U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY VEHICLES**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846



Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

**U.S. EPA ASM EMISSION STANDARDS - 1975-76 LIGHT DUTY VEHICLES**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4980
1875	729 (3.70)	4990	717 (5.14)	4906
2000	688 (3.49)	4919	676 (4.85)	4838
2125	650 (3.31)	4853	638 (4.58)	4776
2250	615 (3.13)	4792	604 (4.34)	4720
2375	583 (2.98)	4736	573 (4.12)	4668
2500	554 (2.83)	4685	544 (3.91)	4620
2625	528 (2.70)	4639	518 (3.73)	4577
2750	503 (2.58)	4596	495 (3.56)	4374
2875	481 (2.47)	4484	473 (3.41)	4176
3000	461 (2.37)	4290	453 (3.27)	3996
3125	443 (2.28)	4114	435 (3.14)	3832
3250	426 (2.20)	3952	419 (3.02)	3681
3375	411 (2.12)	3804	404 (2.91)	3544
3500	397 (2.05)	3669	390 (2.82)	3418
3625	384 (1.99)	3544	377 (2.73)	3302
3750	372 (1.93)	3429	365 (2.64)	3195
3875	361 (1.87)	3323	355 (2.57)	3096
4000	351 (1.82)	3224	345 (2.49)	3003
4125	341 (1.77)	3131	335 (2.43)	2917
4250	332 (1.73)	3044	326 (2.36)	2836
4375	323 (1.68)	2961	318 (2.31)	2759
4500	315 (1.64)	2883	310 (2.25)	2686
4625	308 (1.61)	2807	302 (2.19)	2616
4750	300 (1.57)	2735	295 (2.14)	2549
4875	293 (1.53)	2665	288 (2.09)	2483
5000	286 (1.50)	2597	281 (2.04)	2420
5125	279 (1.46)	2530	274 (2.00)	2359
5250	272 (1.43)	2466	267 (1.95)	2298
5375	266 (1.40)	2403	261 (1.90)	2240
5500	259 (1.37)	2341	255 (1.86)	2183
5625	253 (1.34)	2282	248 (1.82)	2127
5750	247 (1.31)	2224	243 (1.78)	2074
5875	241 (1.28)	2168	237 (1.74)	2022
6000	236 (1.25)	2116	232 (1.70)	1973
6125	231 (1.23)	2066	227 (1.66)	1927
6250	226 (1.20)	2020	222 (1.63)	1884
6375	222 (1.18)	1979	218 (1.60)	1846
6500	218 (1.16)	1943	214 (1.57)	1813

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6625	215 (1.15)	1913	211 (1.55)	1785
6750	213 (1.14)	1890	209 (1.54)	1764
6875	211 (1.13)	1875	207 (1.52)	1750
7000	211 (1.12)	1870	207 (1.52)	1745
7125 Or More	211 (1.12)	1874	206 (1.52)	1745

**U.S. EPA ASM EMISSION STANDARDS - 1977-79 LIGHT DUTY VEHICLES**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4950
1875	729 (3.70)	4990	717 (5.14)	4655
2000	688 (3.49)	4707	676 (4.85)	4384
2125	650 (3.31)	4441	638 (4.58)	4136
2250	615 (3.13)	4197	604 (4.34)	3909
2375	583 (2.98)	3974	573 (4.12)	3701
2500	554 (2.83)	3771	544 (3.91)	3512
2625	528 (2.70)	3585	518 (3.73)	3339
2750	503 (2.58)	3416	495 (3.56)	3181
2875	481 (2.47)	3261	473 (3.41)	3037
3000	461 (2.37)	3120	453 (3.27)	2906
3125	443 (2.28)	2992	435 (3.14)	2787
3250	426 (2.20)	2874	419 (3.02)	2677
3375	411 (2.12)	2767	404 (2.91)	2577
3500	397 (2.05)	2668	390 (2.82)	2486
3625	384 (1.99)	2578	377 (2.73)	2401
3750	372 (1.93)	2494	365 (2.64)	2323
3875	361 (1.87)	2417	355 (2.57)	2251
4000	351 (1.82)	2345	345 (2.49)	2184
4125	341 (1.77)	2277	335 (2.43)	2122
4250	332 (1.73)	2214	326 (2.36)	2063
4375	323 (1.68)	2154	318 (2.31)	2007
4500	315 (1.64)	2096	310 (2.25)	1953
4625	308 (1.61)	2042	302 (2.19)	1903
4750	300 (1.57)	1989	295 (2.14)	1854
4875	293 (1.53)	1938	288 (2.09)	1806
5000	286 (1.50)	1889	281 (2.04)	1760
5125	279 (1.46)	1840	274 (2.00)	1715
5250	272 (1.43)	1793	267 (1.95)	1672
5375	266 (1.40)	1747	261 (1.90)	1629
5500	259 (1.37)	1703	255 (1.86)	1587
5625	253 (1.34)	1659	248 (1.82)	1547
5750	247 (1.31)	1617	243 (1.78)	1508
5875	241 (1.28)	1577	237 (1.74)	1471
6000	236 (1.25)	1539	232 (1.70)	1435
6125	231 (1.23)	1503	227 (1.66)	1401
6250	226 (1.20)	1469	222 (1.63)	1371
6375	222 (1.18)	1439	218 (1.60)	1343
6500	218 (1.16)	1413	214 (1.57)	1318
6625	215 (1.15)	1391	211 (1.55)	1298

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6750	213 (1.14)	1374	209 (1.54)	1283
6875	211 (1.13)	1364	207 (1.52)	1273
7000 Or More	211 (1.12)	1360	207 (1.52)	1269

**U.S. EPA ASM EMISSION STANDARDS - 1980 LIGHT DUTY VEHICLES**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	4990	282 (3.64)	4950
1875	275 (2.63)	4990	266 (3.43)	4655
2000	260 (2.48)	4707	252 (3.24)	4384
2125	246 (2.35)	4441	239 (3.06)	4136
2250	234 (2.23)	4197	227 (2.90)	3909
2375	223 (2.12)	3974	216 (2.76)	3701
2500	212 (2.02)	3771	206 (2.62)	3512
2625	203 (1.92)	3585	197 (2.50)	3339
2750	194 (1.84)	3416	189 (2.39)	3181
2875	187 (1.76)	3261	181 (2.29)	3037
3000	180 (1.69)	3120	174 (2.19)	2906
3125	173 (1.63)	2992	168 (2.11)	2787
3250	167 (1.57)	2874	162 (2.03)	2677
3375	162 (1.52)	2767	157 (1.96)	2577
3500	157 (1.47)	2668	152 (1.89)	2486
3625	152 (1.42)	2578	148 (1.84)	2401
3750	148 (1.38)	2492	144 (1.78)	2323
3875	144 (1.34)	2417	140 (1.73)	2251
4000	140 (1.31)	2345	137 (1.68)	2184
4125	137 (1.27)	2277	133 (1.64)	2122
4250	134 (1.24)	2214	130 (1.60)	2063
4375	131 (1.21)	2154	127 (1.56)	2007
4500	128 (1.18)	2096	124 (1.52)	1953
4625	125 (1.15)	2042	122 (1.48)	1903
4750	122 (1.13)	1989	119 (1.45)	1854
4875	120 (1.10)	1938	117 (1.42)	1806
5000	117 (1.08)	1889	114 (1.38)	1760
5125	115 (1.05)	1840	112 (1.35)	1715
5250	112 (1.03)	1793	110 (1.32)	1672
5375	110 (1.01)	1747	107 (1.29)	1629
5500	108 (0.99)	1703	105 (1.26)	1587
5625	106 (0.97)	1659	103 (1.24)	1547
5750	104 (0.94)	1617	101 (1.21)	1508
5875	102 (0.92)	1577	99 (1.18)	1471
6000	100 (0.91)	1539	97 (1.16)	1435
6125	98 (0.89)	1503	95 (1.13)	1401
6250	96 (0.87)	1469	94 (1.11)	1371
6375	95 (0.86)	1439	92 (1.09)	1343
6500	93 (0.84)	1413	91 (1.08)	1318
6625	92 (0.83)	1391	90 (1.06)	1298
6750	91 (0.82)	1374	89 (1.05)	1283
6875	91 (0.82)	1364	89 (1.04)	1273

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7000	91 (0.82)	1360	88 (1.04)	1269
7125 Or More	90 (0.81)	1360	88 (1.04)	1269

**U.S. EPA ASM EMISSION STANDARDS - 1981-82 LIGHT DUTY VEHICLES**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	2272	282 (3.64)	2114
1875	275 (2.63)	2181	266 (3.43)	1991
2000	260 (2.48)	2058	252 (3.24)	1877
2125	246 (2.35)	1944	239 (3.06)	1774
2250	234 (2.23)	1839	227 (2.90)	1678
2375	223 (2.12)	1744	216 (2.76)	1592
2500	212 (2.02)	1657	206 (2.62)	1512
2625	203 (1.92)	1577	197 (2.50)	1440
2750	194 (1.84)	1504	189 (2.39)	1374
2875	187 (1.76)	1438	181 (2.29)	1313
3000	180 (1.69)	1378	174 (2.19)	1258
3125	173 (1.63)	1323	168 (2.11)	1208
3250	167 (1.57)	1273	162 (2.03)	1163
3375	162 (1.52)	1227	157 (1.96)	1121
3500	157 (1.47)	1184	152 (1.89)	1082
3625	152 (1.42)	1146	148 (1.84)	1047
3750	148 (1.38)	1110	144 (1.78)	1014
3875	144 (1.34)	1077	140 (1.73)	984
4000	140 (1.31)	1046	137 (1.68)	956
4125	137 (1.27)	1017	133 (1.64)	930
4250	134 (1.24)	990	130 (1.60)	905
4375	131 (1.21)	964	127 (1.56)	882
4500	128 (1.18)	939	124 (1.52)	859
4625	125 (1.15)	916	122 (1.48)	838
4750	122 (1.13)	893	119 (1.45)	818
4875	120 (1.10)	872	117 (1.42)	798
5000	117 (1.08)	850	114 (1.38)	778
5125	115 (1.05)	830	112 (1.35)	760
5250	112 (1.03)	810	110 (1.32)	741
5375	110 (1.01)	790	107 (1.29)	723
5500	108 (0.99)	771	105 (1.26)	706
5625	106 (0.97)	752	103 (1.24)	689
5750	104 (0.94)	734	101 (1.21)	673
5875	102 (0.92)	717	99 (1.18)	657
6000	100 (0.91)	701	97 (1.16)	642
6125	98 (0.89)	685	95 (1.13)	628
6250	96 (0.87)	671	94 (1.11)	615
6375	95 (0.86)	658	92 (1.09)	604
6500	93 (0.84)	647	91 (1.08)	593
6625	92 (0.83)	638	90 (1.06)	585
6750	91 (0.82)	631	89 (1.05)	578
6875	91 (0.82)	626	89 (1.04)	574
7000	91 (0.82)	624	88 (1.04)	573

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7125 Or More	90 (0.81)	625	88 (1.04)	573

**U.S. EPA ASM EMISSION STANDARDS - 1983-90 LIGHT DUTY VEHICLES**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (1.64)	2272	282 (1.83)	2114
1875	275 (1.55)	2181	266 (1.72)	1991
2000	260 (1.47)	2058	252 (1.63)	1877
2125	246 (1.39)	1944	239 (1.54)	1774
2250	234 (1.31)	1839	227 (1.47)	1678
2375	223 (1.26)	1744	216 (1.39)	1592
2500	212 (1.20)	1657	206 (1.33)	1512
2625	203 (1.15)	1577	197 (1.27)	1440
2750	194 (1.10)	1504	189 (1.21)	1374
2875	187 (1.05)	1438	181 (1.16)	1313
3000	180 (1.01)	1378	174 (1.12)	1258
3125	173 (0.98)	1323	168 (1.08)	1208
3250	167 (0.94)	1273	162 (1.04)	1163
3375	162 (0.91)	1227	157 (1.00)	1121
3500	157 (0.88)	1184	152 (0.97)	1082
3625	152 (0.86)	1146	148 (0.94)	1047
3750	148 (0.83)	1110	144 (0.92)	1014
3875	144 (0.81)	1077	140 (0.89)	984
4000	140 (0.79)	1046	137 (0.87)	956
4125	137 (0.77)	1017	133 (0.85)	930
4250	134 (0.75)	990	130 (.83)	905
4375	131 (0.74)	964	127 (0.81)	882
4500	128 (0.72)	939	124 (0.79)	859
4625	125 (0.70)	916	122 (0.77)	838
4750	122 (0.69)	893	119 (0.76)	818
4875	120 (0.67)	872	117 (0.74)	798
5000	117 (0.66)	850	114 (0.73)	778
5125	115 (0.65)	830	112 (0.71)	760
5250	112 (0.63)	810	110 (0.70)	741
5375	110 (0.62)	790	107 (0.68)	723
5500	108 (0.61)	771	105 (0.67)	706
5625	106 (0.59)	752	103 (0.65)	689
5750	104 (0.58)	734	101 (0.64)	673
5875	102 (0.57)	717	99 (0.63)	657
6000	100 (0.56)	701	97 (0.62)	642
6125	98 (0.55)	685	95 (0.61)	628
6250	96 (0.54)	671	94 (0.60)	615
6375	95 (0.53)	658	92 (0.59)	604
6500	93 (0.52)	647	91 (0.58)	593
6625	92 (0.52)	638	90 (0.57)	585
6750	91 (0.51)	631	89 (0.57)	578
6875	91 (0.51)	626	89 (0.56)	574
7000	91 (0.51)	624	88 (0.56)	573
7125	90 (0.51)	625	88 (0.56)	573

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7250 Or More	90 (0.50)	625	88 (0.56)	573

**U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY VEHICLES**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457



**U.S. EPA ASM EMISSION STANDARDS - 1994 & NEWER + TIER 1 LIGHT DUTY VEHICLES**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311
6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

**U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

**U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

**U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776
2250	669 (4.04)	4792	658 (5.78)	4720
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

**U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

**U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

**U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	2725	381 (4.85)	2587
1875	368 (3.34)	2649	359 (4.57)	2435
2000	348 (3.16)	2499	339 (4.31)	2295
2125	329 (2.99)	2360	321 (4.08)	2167
2250	312 (2.83)	2232	305 (3.86)	2050



Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2375	297 (2.69)	2115	290 (3.66)	1943
2500	283 (2.56)	2009	276 (3.48)	1845
2625	270 (2.44)	1912	263 (3.32)	1756
2750	258 (2.33)	1823	252 (3.17)	1675
2875	247 (2.23)	1742	241 (3.03)	1601
3000	237 (2.14)	1668	232 (2.91)	1533
3125	228 (2.06)	1601	223 (2.79)	1471
3250	220 (1.99)	1539	215 (2.69)	1415
3375	213 (1.92)	1483	208 (2.60)	1363
3500	206 (1.86)	1432	201 (2.51)	1316
3625	200 (1.80)	1384	195 (2.43)	1273
3750	194 (1.74)	1340	189 (2.36)	1233
3875	188 (1.69)	1300	184 (2.29)	1195
4000	183 (1.65)	1262	179 (2.22)	1161
4125	179 (1.61)	1227	175 (2.16)	1126
4250	174 (1.56)	1194	170 (2.11)	1098
4375	170 (1.53)	1162	166 (2.06)	1069
4500	166 (1.49)	1132	162 (2.01)	1042
4625	162 (1.46)	1104	159 (1.96)	1015
4750	159 (1.42)	1076	155 (1.91)	990
4875	155 (1.39)	1049	152 (1.87)	966
5000	152 (1.36)	1023	148 (1.82)	942
5125	148 (1.33)	998	145 (1.78)	919
5250	145 (1.30)	974	142 (1.74)	896
5375	142 (1.27)	950	139 (1.70)	874
5500	139 (1.24)	926	136 (1.66)	853
5625	136 (1.12)	904	133 (1.62)	832
5750	133 (1.19)	882	130 (1.59)	812
5875	130 (1.16)	860	127 (1.55)	793
6000	127 (1.14)	840	124 (1.52)	774
6125	125 (1.11)	822	122 (1.49)	757
6250	123 (1.09)	804	120 (1.46)	741
6375	120 (1.07)	788	118 (1.43)	727
6500	119 (1.06)	775	116 (1.41)	714
6625	117 (1.04)	763	114 (1.39)	704
6750	116 (1.03)	755	113 (1.37)	696
6875	115 (1.02)	749	113 (1.36)	691
7000 Or More	115 (1.02)	747	112 (1.36)	689

**U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	2272	315 (3.64)	2114
1875	306 (2.63)	2181	297 (3.43)	1991
2000	289 (2.48)	2058	281 (3.24)	1877
2125	274 (2.35)	1944	267 (3.06)	1774
2250	260 (2.23)	1839	253 (2.90)	1678
2375	247 (2.12)	1744	241 (2.76)	1592
2500	236 (2.02)	1657	230 (2.62)	1512

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2625	225 (1.92)	1577	219 (2.50)	1440
2750	216 (1.84)	1504	210 (2.39)	1374
2875	207 (1.76)	1438	210 (2.29)	1313
3000	199 (1.69)	1378	194 (2.19)	1258
3125	191 (1.63)	1323	186 (2.11)	1208
3250	185 (1.57)	1273	180 (2.03)	1163
3375	179 (1.52)	1227	174 (1.96)	1121
3500	173 (1.47)	1184	169 (1.89)	1082
3625	168 (1.42)	1146	164 (1.84)	1047
3750	163 (1.38)	1110	159 (1.78)	1014
3875	159 (1.34)	1077	155 (1.73)	984
4000	155 (1.31)	1046	151 (1.68)	956
4125	151 (1.27)	1017	147 (1.64)	930
4250	147 (1.24)	990	143 (1.60)	905
4375	144 (1.21)	964	140 (1.56)	882
4500	141 (1.18)	939	137 (1.52)	859
4625	137 (1.15)	916	134 (1.48)	838
4750	134 (1.13)	893	131 (1.45)	818
4875	132 (1.10)	872	128 (1.42)	798
5000	129 (1.08)	850	126 (1.38)	778
5125	126 (1.05)	830	123 (1.35)	760
5250	123 (1.03)	810	120 (1.32)	741
5375	121 (1.01)	790	118 (1.29)	723
5500	118 (0.99)	771	115 (1.26)	706
5625	116 (0.97)	752	113 (1.24)	689
5750	113 (0.94)	734	111 (1.21)	673
5875	111 (0.92)	717	108 (1.18)	657
6000	109 (0.91)	701	106 (1.16)	642
6125	107 (0.89)	685	104 (1.13)	628
6250	105 (0.87)	671	102 (1.11)	615
6375	103 (0.86)	658	101 (1.09)	604
6500	102 (0.84)	647	99 (1.08)	593
6625	101 (0.83)	638	98 (1.06)	585
6750	100 (0.82)	631	97 (1.05)	578
6875	99 (0.82)	626	97 (1.04)	574
7000	99 (0.82)	624	96 (1.04)	573
7125 Or More	98 (0.81)	625	96 (1.04)	573

**U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3750 LWV OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311
6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

**U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3751 LW OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

**U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2640
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

**U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

**U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776
2250	669 (4.04)	4792	658 (5.78)	4720
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544



Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

**U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

**U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

**U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4084	381 (4.85)	4005
1875	368 (3.34)	4054	359 (4.57)	3767
2000	348 (3.16)	3824	339 (4.31)	3548
2125	329 (2.99)	3609	321 (4.08)	3348
2250	312 (2.83)	3411	305 (3.86)	3165
2375	297 (2.69)	3231	290 (3.66)	2998
2500	283 (2.56)	3066	276 (3.48)	2845
2625	270 (2.44)	2916	263 (3.32)	2706
2750	258 (2.33)	2779	252 (3.17)	2579
2875	247 (2.23)	2654	241 (3.03)	2463
3000	237 (2.14)	2539	232 (2.91)	2357
3125	228 (2.06)	2435	223 (2.79)	2260
3250	220 (1.99)	2340	215 (2.69)	2172
3375	213 (1.92)	2253	208 (2.60)	2092
3500	206 (1.86)	2174	201 (2.51)	2018
3625	200 (1.80)	2100	195 (2.43)	1950
3750	194 (1.74)	2033	189 (2.36)	1887

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3875	188 (1.69)	1970	184 (2.29)	1829
4000	183 (1.65)	1912	179 (2.22)	1775
4125	179 (1.61)	1857	175 (2.16)	1724
4250	174 (1.56)	1806	170 (2.11)	1677
4375	170 (1.53)	1757	166 (2.06)	1632
4500	166 (1.49)	1711	162 (2.01)	1589
4625	162 (1.46)	1666	159 (1.96)	1548
4750	159 (1.42)	1624	155 (1.91)	1508
4875	155 (1.39)	1583	152 (1.87)	1470
5000	152 (1.36)	1542	148 (1.82)	1433
5125	148 (1.33)	1503	145 (1.78)	1397
5250	145 (1.30)	1465	142 (1.74)	1362
5375	142 (1.27)	1428	139 (1.70)	1327
5500	139 (1.24)	1392	136 (1.66)	1294
5625	136 (1.12)	1357	133 (1.62)	1261
5750	133 (1.19)	1323	130 (1.59)	1230
5875	130 (1.16)	1290	127 (1.55)	1199
6000	127 (1.14)	1259	124 (1.52)	1171
6125	125 (1.11)	1230	122 (1.49)	1144
6250	123 (1.09)	1203	120 (1.46)	1119
6375	120 (1.07)	1179	118 (1.43)	1096
6500	119 (1.06)	1158	116 (1.41)	1077
6625	117 (1.04)	1140	114 (1.39)	1060
6750	116 (1.03)	1127	113 (1.37)	1048
6875	115 (1.02)	1118	113 (1.36)	1040
7000 Or More	115 (1.02)	1115	112 (1.36)	1037

**U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3631	315 (3.64)	3532
1875	306 (2.63)	3586	297 (3.43)	3323
2000	289 (2.48)	3383	281 (3.24)	3131
2125	274 (2.35)	3192	267 (3.06)	2955
2250	260 (2.23)	3018	253 (2.90)	2794
2375	247 (2.12)	2859	241 (2.76)	2646
2500	236 (2.02)	2714	230 (2.62)	2512
2625	225 (1.92)	2581	219 (2.50)	2389
2750	216 (1.84)	2460	210 (2.39)	2277
2875	207 (1.76)	2350	210 (2.29)	2175
3000	199 (1.69)	2249	194 (2.19)	2082
3125	191 (1.63)	2157	186 (2.11)	1997
3250	185 (1.57)	2073	180 (2.03)	1920
3375	179 (1.52)	1997	174 (1.96)	1849
3500	173 (1.47)	1926	169 (1.89)	1784
3625	168 (1.42)	1862	164 (1.84)	1724
3750	163 (1.38)	1802	159 (1.78)	1669
3875	159 (1.34)	1747	155 (1.73)	1618
4000	155 (1.31)	1695	151 (1.68)	1570

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4125	151 (1.27)	1647	147 (1.64)	1526
4250	147 (1.24)	1602	143 (1.60)	1484
4375	144 (1.21)	1559	140 (1.56)	1444
4500	141 (1.18)	1518	137 (1.52)	1406
4625	137 (1.15)	1479	134 (1.48)	1370
4750	134 (1.13)	1441	131 (1.45)	1336
4875	132 (1.10)	1405	128 (1.42)	1302
5000	129 (1.08)	1369	126 (1.38)	1269
5125	126 (1.05)	1335	123 (1.35)	1237
5250	123 (1.03)	1031	120 (1.32)	1206
5375	121 (1.01)	1269	118 (1.29)	1176
5500	118 (0.99)	1237	115 (1.26)	1147
5625	116 (0.97)	1206	113 (1.24)	1118
5750	113 (0.94)	1176	111 (1.21)	1090
5875	111 (0.92)	1147	108 (1.18)	1064
6000	109 (0.91)	1120	106 (1.16)	1039
6125	107 (0.89)	1094	104 (1.13)	1015
6250	105 (.087)	1070	102 (1.11)	993
6375	103 (0.86)	1049	101 (1.09)	973
6500	102 (0.84)	1030	99 (1.08)	956
6625	101 (0.83)	1014	98 (1.06)	941
6750	100 (0.82)	1003	97 (1.05)	931
6875	99 (0.82)	995	97 (1.04)	924
7000	99 (0.82)	992	96 (1.04)	921
7125 Or More	98 (0.81)	992	96 (1.04)	921

**U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5750 LVW OR LESS)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

**U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5751 LWV OR MORE)**

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3178	315 (3.64)	3060
1875	306 (2.63)	3117	297 (3.43)	2879
2000	289 (2.48)	2941	281 (3.24)	2713
2125	274 (2.35)	2776	267 (3.06)	2561
2250	260 (2.23)	2625	253 (2.90)	2422
2375	247 (2.12)	2487	241 (2.76)	2295
2500	236 (2.02)	2361	230 (2.62)	2179
2625	225 (1.92)	2246	219 (2.50)	2073
2750	216 (1.84)	2142	210 (2.39)	1976
2875	207 (1.76)	2046	210 (2.29)	1888
3000	199 (1.69)	1959	194 (2.19)	1808
3125	191 (1.63)	1879	186 (2.11)	1734
3250	185 (1.57)	1806	180 (2.03)	1667
3375	179 (1.52)	1740	174 (1.96)	1606
3500	173 (1.47)	1679	169 (1.89)	1550
3625	168 (1.42)	1623	164 (1.84)	1498
3750	163 (1.38)	1571	159 (1.78)	1451
3875	159 (1.34)	1523	155 (1.73)	1407
4000	155 (1.31)	1479	151 (1.68)	1365
4125	151 (1.27)	1437	147 (1.64)	1327
4250	147 (1.24)	1398	143 (1.60)	1291
4375	144 (1.21)	1360	140 (1.56)	1257



Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4500	141 (1.18)	1325	137 (1.52)	1224
4625	137 (1.15)	1291	134 (1.48)	1193
4750	134 (1.13)	1259	131 (1.45)	1163
4875	132 (1.10)	1227	128 (1.42)	1134
5000	129 (1.08)	1196	126 (1.38)	1106
5125	126 (1.05)	1167	123 (1.35)	1078
5250	123 (1.03)	1138	120 (1.32)	1051
5375	121 (1.01)	1109	118 (1.29)	1025
5500	118 (0.99)	1082	115 (1.26)	1000
5625	116 (0.97)	1055	113 (1.24)	975
5750	113 (0.94)	1029	111 (1.21)	951
5875	111 (0.92)	1004	108 (1.18)	928
6000	109 (0.91)	980	106 (1.16)	906
6125	107 (0.89)	958	104 (1.13)	886
6250	105 (.087)	937	102 (1.11)	867
6375	103 (0.86)	919	101 (1.09)	850
6500	102 (0.84)	902	99 (1.08)	835
6625	101 (0.83)	889	98 (1.06)	823
6750	100 (0.82)	879	97 (1.05)	813
6875	99 (0.82)	872	97 (1.04)	807
7000	99 (0.82)	870	96 (1.04)	805
7125 Or More	98 (0.81)	870	96 (1.04)	805

## U. S. EPA REVISED FINAL ASM EMISSION STANDARDS (ASM5015 & ASM2525)

**NOTE:** EPA has not published a revised final standards for High Altitude, Light Duty Trucks 2 (6000-8500 GVWR), or vehicles older than 1980 model year. EPA guidance as of February 2003 states that a program may choose to use combinations of the Original and the Revised Final Standards.

### U.S. EPA REVISED FINAL ASM EMISSION STANDARDS

Application	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
Passenger Cars				
1980	275 (1.3)	8500	500 (2.3)	4750
1981-82	275 (1.3)	3600	500 (2.3)	3500
1983-89	275 (1.1)	3600	500 (1.6)	3500
1990 & Newer	275 (1.1)	3600	300 (1.6)	3500
Light Duty Trucks (Less Than 6000 GVWR)				
1980-83	1140 (9.7)	14,145	340 (23.28)	32,200
1984-87	537 (5.4)	14,145	160 (12.96)	32,200
1988-95	537 (5.4)	7380	160 (12.96)	16,800

Application	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1996 & Newer	275 (1.1)	6150	82 (4.40)	14,000

## U.S. EPA IM240 EMISSION STANDARDS

### START-UP STANDARDS

Start-up standards should be used during the first 2 years of program operation. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles certified to Tier 1 standards as well.

### U.S. EPA IM240 HYDROCARBONS EMISSION START-UP STANDARDS

Application	Hydrocarbons (Grams/Mile)	
	Composite	Phase 2
<b>Light Duty Vehicles</b>		
1996 & Newer	0.80	0.50
1991-95	1.20	0.75
1983-90	2.00	1.25
1980-82	2.00	1.25
1975-79	7.50	5.00
1968-74	10.0	6.00
<b>High Altitude Light Duty Vehicles</b>		
1983-84	2.00	1.25
1982	2.00	1.25
<b>Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1996 & Newer (Less Than 3750 LVW)	0.80	0.50
1996 & Newer (More Than 3750 LVW)	1.00	0.63
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00
1975-78	8.00	5.00
1968-74	10.0	6.00
<b>High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
<b>Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1996 & Newer (Less Than 5750 ALVW)	1.00	0.63
1996 & Newer (More Than 5750 ALVW)	2.40	1.50
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00
1975-78	8.00	5.00
1968-74	10.0	6.00
<b>High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
<b>Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)</b>		
1998 & Newer	2.00	1.30
1987-97	3.00	1.90

<b>Application</b>	<b>Hydrocarbons (Grams/Mile)</b>	
	<b>Composite</b>	<b>Phase 2</b>
1985-86	5.00	3.10
1979-84	6.00	3.80
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

**U.S. EPA IM240 CARBON MONOXIDE EMISSION START-UP STANDARDS**

<b>Application</b>	<b>Carbon Monoxide (Grams/Mile)</b>	
	<b>Composite</b>	<b>Phase 2</b>
<b>Light Duty Vehicles</b>		
1996 & Newer	15.0	12.0
1991-95	20.0	16.0
1983-90	30.0	24.0
1980-82	60.0	48.0
1975-79	90.0	72.0
1968-74	150.0	120.0
<b>High Altitude Light Duty Vehicles</b>		
1983-84	60.0	48.0
1982	75.0	60.0
<b>Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1996 & Newer (Less Than 3750 LVW)	15.0	12.0
1996 & Newer (More Than 3750 LVW)	20.0	16.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
<b>High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
<b>Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1996 & Newer (Less Than 5750 ALVW)	20.0	16.0
1996 & Newer (More Than 5750 ALVW)	60.0	48.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
<b>High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
<b>Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)</b>		
1998 & Newer	30.0	24.0
1987-97	60.0	48.0
1985-86	75.0	60.0
1979-84	100.0	80.0
1974-78	150.00	120.0
1970-73	175.00	140.00

Application	Carbon Monoxide (Grams/Mile)	
	Composite	Phase 2
1969 & Earlier	200.0	160.0

### U.S. EPA IM240 OXIDES OF NITROGEN EMISSION START-UP STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
	Composite	Phase 2
<b>Light Duty Vehicles</b>		
1996 & Newer	2.0	2.0
1991-95	2.5	2.5
1981-90	3.0	3.0
1977-80	6.0	6.0
1973-76	9.0	9.0
1968-72	10.0	10.0
<b>High Altitude Light Duty Vehicles</b>		
1982-84	3.0	3.0
<b>Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1996 & Newer (Less Than 3750 LVW)	2.0	2.0
1996 & Newer (More Than 3750 LVW)	2.5	2.5
1991-95	3.0	3.0
1988-90	3.5	3.5
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
<b>High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1991 & Newer	3.0	3.0
1988-90	3.5	3.5
1982-87	7.0	7.0
<b>Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1996 & Newer (Less Than 5750 ALVW)	2.5	2.5
1996 & Newer (More Than 5750 ALVW)	4.0	4.0
1991-95	4.5	4.5
1988-90	5.0	5.0
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
<b>High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1991 & Newer	4.5	4.5
1988-90	5.0	5.0
1982-87	7.0	7.0
<b>Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)</b>		
1998 & Newer	4.0	4.0
1991-97	6.0	6.0
1979-90	8.0	8.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

### FINAL STANDARDS

Final standards are recommended for vehicles tested in calendar years 1997 and later. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles.

### U.S. EPA IM240 HYDROCARBONS EMISSION FINAL STANDARDS

<b>Application</b>	<b>Hydrocarbons (Grams/Mile)</b>	
	<b>Composite</b>	<b>Phase 2</b>
<b>Light Duty Vehicles</b>		
1996 & Newer	0.60	0.40
1980-95	0.80	0.50
1975-79	3.00	2.00
1968-74	7.00	4.50
<b>High Altitude Light Duty Vehicles</b>		
1982-84	1.20	0.75
<b>Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1996 & Newer (Less Than 3750 LVW)	0.60	0.40
1996 & Newer (More Than 3750 LVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
<b>High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
<b>Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1996 & Newer (Less Than 5750 ALVW)	0.80	0.50
1996 & Newer (More Than 5750 ALVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
<b>High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
<b>Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)</b>		
1998 & Newer	2.00	1.30
1987-97	2.00	1.30
1985-86	3.00	1.90
1979-84	5.00	3.10
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

**U.S. EPA IM240 CARBON MONOXIDE EMISSION FINAL STANDARDS**

<b>Application</b>	<b>Carbon Monoxide (Grams/Mile)</b>	
	<b>Composite</b>	<b>Phase 2</b>
<b>Light Duty Vehicles</b>		
1996 & Newer	10.0	8.0
1983-95	15.0	12.0
1980-82	30.0	24.0
1975-79	65.0	52.0
1968-74	120.0	96.0
<b>High Altitude Light Duty Vehicles</b>		
1983-84	30.0	24.0
1982	45.0	36.0

<b>Application</b>	<b>Carbon Monoxide (Grams/Mile)</b>	
<b>Composite</b>	<b>Phase 2</b>	
<b>Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1996 & Newer (Less Than 3750 LVW)	10.0	8.0
1996 & Newer (More Than 3750 LVW)	13.0	10.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
<b>High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1988 & Newer	60.0	48.0
1984-87	60.0	48.0
1982-83	90.0	72.0
<b>Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1996 & Newer (Less Than 5750 ALVW)	13.0	10.0
1996 & Newer (More Than 5750 ALVW)	15.0	12.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
<b>High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1984 & Newer	60.0	48.0
1982-83	90.0	72.0
<b>Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)</b>		
1998 & Newer	30.0	24.0
1987-97	40.0	32.0
1985-86	50.0	40.0
1979-84	75.0	60.0
1974-78	150.0	120.0
1970-73	175.0	140.0
1969 & Earlier	200.0	160.0

**U.S. EPA IM240 OXIDES OF NITROGEN EMISSION FINAL STANDARDS**

<b>Application</b>	<b>Oxides Of Nitrogen (Grams/Mile)</b>	
<b>Composite</b>	<b>Phase 2</b>	
<b>Light Duty Vehicles</b>		
1996 & Newer	1.5	1.5
1981-95	2.0	2.0
1977-80	4.0	4.0
1973-76	6.0	6.0
1968-72	7.0	7.0
<b>High Altitude Light Duty Vehicles</b>		
1982-84	2.0	2.0
<b>Light Duty Trucks (0-6000 Lbs. GVWR)</b>		
1996 & Newer (Less Than 3750 LVW)	1.5	1.5
1996 & Newer (More Than 3750 LVW)	1.8	1.8
1988-95	2.5	2.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
<b>High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)</b>		



<b>Application</b>	<b>Oxides Of Nitrogen (Grams/Mile)</b>	
	<b>Composite</b>	<b>Phase 2</b>
1988 & Newer	2.5	2.5
1982-87	4.5	4.5
<b>Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1996 & Newer (Less Than 5750 ALVW)	1.8	1.8
1996 & Newer (More Than 5750 ALVW)	2.0	2.0
1988-95	3.5	3.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
<b>High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)</b>		
1988 & Newer	3.5	3.5
1982-87	4.5	4.5
<b>Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)</b>		
1998 & Newer	4.0	4.0
1991-97	5.0	5.0
1979-90	6.0	6.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

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**GENERAL INFORMATION**  
**State Emission Standards**

**ARIZONA**

**NOTE:** Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.

**ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL OPACITY LOADED CRUISE TEST)**

Application	Altitude (Feet)	Opacity (% For 10 Seconds)
Light Duty Vehicles (8500 GVWR Or Less)		
All Years	Less Than 2000	20 Or Less
Â Â	2001-4000	30 Or Less
Â Â	Greater Than 4000	40 Or Less

**ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL J1667 SNAP IDLE TEST)**

Application	Altitude (Feet)	Opacity (% For 10 Seconds)
Heavy Duty Vehicles (8500 GVWR Or Greater)		
1990 & Earlier	All	55
1991 & Newer	All	40

**COLORADO**

**COLORADO EMISSION STANDARDS - DIESEL OPACITY**

Application	Opacity %
14,000 GVWR Or Less	
Non-Turbo	40
Turbo	35
14,000 GVWR Or More	
Non-Turbo	35
Turbo	20

**CONNECTICUT**

**CONNECTICUT EMISSION STANDARDS - DIESEL OPACITY**

Application	Opacity %
10,000 GVWR Or Less	
1979 & Newer	20
26,000 GVWR Or More	
1974 & Earlier	70
1974-90	55
1991 & Newer	40

**IDAHO**

**IDAHO EMISSION STANDARDS - DIESEL OPACITY**

Application	Opacity %
All Weight Range	

<b>Application</b>	<b>Opacity %</b>
1965-74	70
1975-91	55
1992 & Newer	40

## **KENTUCKY**

### **KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (DIESEL OPACITY)**

<b>Application</b>	<b>Opacity</b>
18,000 GVWR Or Less	
All Years	10% @ Idle

## **MASSACHUSETTS**

### **MASSACHUSETTS EMISSION STANDARDS - DIESEL OPACITY**

<b>Application</b>	<b>Opacity %</b>
Light Duty (8500 GVWR Or Less)	
1984 & Newer	20
Light Duty (8501-10,000 GVWR Or Less)	
1984 & Newer	40
Heavy Duty Buses (10,000 GVWR Or More)	
1984-93	40
1994 & Newer	30
Heavy Duty Trucks (10,000 Or Less GVWR)	
1984-90	55
1991 & Newer	40

## **NEW YORK**

### **NEW YORK EMISSION STANDARDS - DIESEL OPACITY TEST**

<b>Application</b>	<b>Opacity %</b>
Heavy Duty Vehicles (8500 GVWR Or More)	
1973 & Earlier	70
1974-90	55
1991 & Newer	40

## **OHIO**

### **OHIO EMISSION STANDARDS - DIESEL OPACITY TEST**

<b>Application</b>	<b>Opacity %</b>
Light Duty Diesel	20

## **RHODE ISLAND**

### **RHODE ISLAND EMISSION STANDARDS - DIESEL OPACITY TEST**

<b>Application</b>	<b>Opacity %</b>
All Model Years (8500 GVWR Or Less)	20

## **UTAH**

### **UTAH EMISSION STANDARDS - DAVIS COUNTY - DIESEL OPACITY TEST**

<b>Application</b>	<b>Opacity %</b>
Light Duty Diesel - Turbo (16,000 GVWR Or Less)	30
Light Duty Diesel - Non-Turbo (16,000 GVWR Or Less)	35

<b>Application</b>	<b>Opacity %</b>
Heavy Duty Diesel (16,000 GVWR Or More)	70

**UTAH EMISSION STANDARDS - SALT LAKE COUNTY - DIESEL OPACITY TEST**

<b>Application</b>	<b>Opacity %</b>
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

**UTAH EMISSION STANDARDS - UTAH COUNTY - DIESEL OPACITY TEST**

<b>Application</b>	<b>Opacity %</b>
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

**WASHINGTON**

**WASHINGTON EMISSION STANDARDS - DIESEL OPACITY TEST**

<b>Application</b>	<b>Opacity %</b>
Light Duty Diesel (8500 GVWR Or Less)	
All Model Years	20
Heavy Duty Diesel (8500 GVWR Or More)	
1991 & Earlier	55
1992 & Newer	40

## GENERAL INFORMATION

### Symptom Check List Worksheets

#### **\* PLEASE READ THIS FIRST \***

**NOTE:** This article is intended for general information purposes only. It does not apply specifically to one make or model.

#### **PURPOSE**

**NOTE:** This article is intended for general information purposes only. It does not apply specifically to one make or model.

#### **WHY USE THE SYMPTOM CHECK LIST WORKSHEETS?**

One of the most difficult and critical lines of communication is between the service customer and the technician. The clearer the technician understands the customer's concerns, the more likely the problem will be "fixed right the first time".

The Symptom Check List Worksheets in this article are designed to improve this communication. When used consistently, they can be helpful in reducing shop comebacks, increasing technician productivity, and producing satisfied customers. They also provide other benefits:

- Reduce "No Trouble Found" problems
- Increase customer involvement
- Customer perceive that "they really care and listen"
- Save time during peak write-up periods
- Reduce recontacting customers for additional information
- Improve night drop information
- Insure all the right questions are asked at write-up

#### **MAKING THE WORKSHEETS A PART OF YOUR NORMAL ROUTINE**

The following information contains ideas that may be helpful in forming habits that promote daily use of the Symptom Check Lists:

- HAVE THE SERVICE ADVISER FILL OUT THE FORM(S) WITH THE CUSTOMER WHENEVER POSSIBLE.
- Place them in your night drop for the customer to fill out, along with an instruction sheet to help them understand what to do.
- Hand out the worksheets to customers while they wait in line during the peak morning rush and ask them to fill it out. It will save time for all concerned and improve the quality of information received from the customer.
- Make sure it is attached to the hard copy when it goes to the technician.
- Place a copy with the final repair papers and review it with the customer at delivery.
- Put a new worksheet in the glovebox of all departing customers.
- Require that you personally see a copy of all worksheets filled out for shop comebacks.
- Hold a shop meeting to get employee buy-in and their ideas on how to make it effective in your shop.

There are many other ways to utilize the concept, but as with every other idea, successful implementation depends on employee involvement and buy-in.

# SYMPTOM CHECK LIST WORKSHEETS

## CONDENSED VERSION - ALL ON ONE PAGE

**NOTE:** Have the service adviser fill out this form with the customer whenever possible.

<b>DRIVEABILITY WORKSHEET</b> ( To Be Filled Out By Vehicle Owner )	
<b>Name:</b> _____ <b>Date:</b> _____ <b>Make:</b> _____ <b>Model:</b> _____ <b>Year:</b> _____ <b>Engine:</b> _____ <b>Mileage:</b> _____	
FAULT CHARACTERISTICS - SYMPTOMS - DESCRIPTION OF PROBLEM ( Please Check All That Apply In All Categories )	
<b>Starting Problems</b>	<input type="checkbox"/> Will Not Crank <input type="checkbox"/> Cranks, But Won't Start <input type="checkbox"/> Starts, But Takes A Long Time
<b>Engine Quits/Running Problems</b>	<b>Quits:</b> <input type="checkbox"/> Right After Starting <input type="checkbox"/> When Put Into Gear <input type="checkbox"/> Right After Vehicle Comes To A Stop <input type="checkbox"/> During Steady Speed Driving <input type="checkbox"/> While Idling <input type="checkbox"/> During Acceleration <input type="checkbox"/> When Parking
<b>Poor Idling Conditions</b>	<b>Idle Speed:</b> <input type="checkbox"/> Is Too Slow At All Times <input type="checkbox"/> Is Too Slow With A/C On <input type="checkbox"/> Is Too Fast <input type="checkbox"/> Is Rough Or Uneven <input type="checkbox"/> Fluctuates Up and Down
<b>Poor Running Conditions</b>	<input type="checkbox"/> Runs Rough <input type="checkbox"/> Lacks Power <input type="checkbox"/> Hesitates Or Stumbles On Acceleration <input type="checkbox"/> Bucks and Jerks <input type="checkbox"/> Engine Knocks, Pings, Rattles <input type="checkbox"/> Backfires <input type="checkbox"/> Poor Fuel Economy <input type="checkbox"/> Misfires or Cuts Out <input type="checkbox"/> Surges and/or Chuggles <input type="checkbox"/> Dieseling or Run-On <input type="checkbox"/> Engine Light Always On <input type="checkbox"/> Engine Light On Sometimes <input type="checkbox"/> Fuel, Gas, or Sulfur Smell
<b>Auto. Transmission Problems</b>	<input type="checkbox"/> Improper Shifting ( early/late ) <input type="checkbox"/> Changes Gear Randomly On Its Own <input type="checkbox"/> Vehicle Does Not Move When In Gear
<b>Poor Handling</b>	<input type="checkbox"/> Pulls To One Side <input type="checkbox"/> Hard Steering <input type="checkbox"/> Vehicle Shakes and/or Vibrates While Moving
<b>Noise Problems</b>	<b>Explain:</b> _____
<b>Odor Problems</b>	<b>Explain:</b> _____
<b>Problem Frequency</b>	<input type="checkbox"/> Always <input type="checkbox"/> Often <input type="checkbox"/> Occasionally
<b>Usually Occurs</b>	<input type="checkbox"/> Morning <input type="checkbox"/> Afternoon <input type="checkbox"/> Anytime
<b>Engine Temp.</b>	<input type="checkbox"/> Cold <input type="checkbox"/> Warm <input type="checkbox"/> Hot
<b>Vehicle Speed</b>	<input type="checkbox"/> Low <input type="checkbox"/> Cruising <input type="checkbox"/> High
<b>Driving Conditions During Occurrence</b>	<input type="checkbox"/> Short - Less Than 2 Miles <input type="checkbox"/> 2-10 Miles <input type="checkbox"/> Long - More Than 10 Miles <input type="checkbox"/> Stop & Go <input type="checkbox"/> While Turning <input type="checkbox"/> While Braking <input type="checkbox"/> At Gear Engagement <input type="checkbox"/> With A/C Operating <input type="checkbox"/> With Headlights On <input type="checkbox"/> During Acceleration <input type="checkbox"/> During Deceleration <input type="checkbox"/> Mostly Downhill <input type="checkbox"/> Mostly Uphill <input type="checkbox"/> Mostly Level <input type="checkbox"/> Mostly Curvy <input type="checkbox"/> Rough Road
<b>Driving Habits</b>	<input type="checkbox"/> Drive Hard Before Engine Is Warmed <input type="checkbox"/> Allow Engine To Warm <input type="checkbox"/> Mostly City Driving <input type="checkbox"/> Highway <input type="checkbox"/> Park Vehicle Inside <input type="checkbox"/> Outside <b>Drive Per Day:</b> <input type="checkbox"/> Less Than 10 Miles <input type="checkbox"/> 10-50 <input type="checkbox"/> More Than 50 <b>Fuel Octane:</b> <input type="checkbox"/> 87 <input type="checkbox"/> 89 <input type="checkbox"/> 91 <input type="checkbox"/> More Than 91 <b>Brand:</b> _____ <input type="checkbox"/> Gasohol <input type="checkbox"/> Propane Conversion
<b>Outside Weather</b>	<input type="checkbox"/> Cold <input type="checkbox"/> Warm <input type="checkbox"/> Hot <input type="checkbox"/> Wet/Rainy <input type="checkbox"/> Fog <input type="checkbox"/> Snow/Hail <input type="checkbox"/> Dust/Dirt <input type="checkbox"/> Dry <input type="checkbox"/> Humid

Fig. 1: Entire Vehicle - Symptom Check List For Customer

## FULL VERSION - ALL ON FOUR PAGES

**NOTE:** Have the service adviser fill out these forms with the customer whenever possible.



**Dear Valued Customer:**

Our goal is to fix your problem correctly and get you back on the road as soon as possible in the unlikely event you experience a problem with your vehicle. Help us identify the exact nature of the concern by taking a few moments to complete the appropriate section of this diagnostic worksheet. Thank you.

CUSTOMER NAME: \_\_\_\_\_

PHONE NO.: \_\_\_\_\_

REPAIR ORDER NO.: \_\_\_\_\_

# DIAGNOSTIC WORKSHEET

## DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

**SYMPTOM (CHECK ALL THAT APPLY)**  
**ENGINE**

- "Service Engine Soon"/"Malfunction Indicator Light" on
- Hard start/no start (cranks OK)
- Won't crank
- Engine stalls
- Engine miss
- Miss while driving
- Hesitates, stumbles or sags
- Rough idle
- Idle is too high  Idle is too low
- Poor power/performance
- Surge or chuggle, buck - jerk - skip
- Poor gas mileage  Highway  City
- Pings, detonates
- Suphur, rotten egg odor
- Backfires (popping noise) - underhood/tailpipe
- Exhaust smoke  Increased oil consumption
- Runs on after key is turned off
- Speed fluctuates without moving accelerator
- Engine noise (explain): \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- (whine, rattle, groan, clunk, etc.)
- Other: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**TRANSMISSION**

- Does not shift properly  Hard shift
- Will not shift  Up  Down
- Will not shift into overdrive
- Engine starts in other than "P" or "N"
- Noise (describe): \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- (whine, rattle, groan, clunk, buzz, etc.)
- Shifts into gear too early
- Overdrive doesn't work with speed control, but is otherwise OK
- Highway speed - shudder, surge, etc.
- Other: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

EXPLAIN: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**OPERATING CONDITIONS (CHECK ALL THAT APPLY)**  
**HOW OFTEN DOES IT OCCUR? (Engine and/or Transmission)**

- Always  Few seconds  Few minutes
- Few hours  Few days  Few weeks
- Few months  Variable  Only during event
- Every \_\_\_\_\_ to \_\_\_\_\_ miles  Unknown
- Other (explain): \_\_\_\_\_
- Just started  Getting better  Getting worse
- Since new

**WHEN DOES IT OCCUR? (Engine and/or Transmission)**  
**When Engine Temperature is:**

- Cold  Warm  Hot
- All the time  Only during warmup

**Weather Conditions:**

- Very cold - below 0 degrees F  Cold - 0 to 32 degrees F
- Cool - 32 to 60 degrees F  Warm - 60 to 80 degrees F
- Hot - Above 80 degrees F  Any environment
- Raining  Dry  Humid
- Snow/ice  Wet roads  Other (explain below)

**Driving Conditions:**

- Light throttle  Medium throttle  Hard throttle
- Starting  At idle  Decelerating
- Over bumps  When shifting  While turning
- Cruising steady at \_\_\_\_\_ MPH  While braking
- Anytime  Uphill  Downhill
- Highway  City/town  Stop and go
- Between \_\_\_\_\_ MPH and \_\_\_\_\_ MPH
- Only with A/C or Defrost on

**What Type of Fuel?**

- Regular UL  Mid range UL  Premium Unleaded
- Gasohol  Ethanol  Methanol
- Diesel #1  Diesel #2  Various brands

**What Brand? \_\_\_\_\_**

**When Gear Selector is in:**

- Park/Neutral  Reverse  Overdrive
- Drive/3  Drive/2  Drive/1

**Between Gears:**

- Park to R or D  Rev/Drive  First/Second
- Second/Third  Third/Overdrive

50G15061

**Fig. 2: Symptom Check List - Page 1**

**BRAKES - STEERING - SUSPENSION**

**SYMPTOM**

- |   |  |                                       |
|---|--|---------------------------------------|
| <input type="checkbox"/> Vehicle pulls right - When _____           | <input type="checkbox"/> Suspension bottoms out    | <input type="checkbox"/> Sits uneven  |
| <input type="checkbox"/> Vehicle pulls left - When _____            | <input type="checkbox"/> Leans or sways in corners | <input type="checkbox"/> "Dog" tracks |
| <input type="checkbox"/> Steering wheel vibrates at _____ MPH       | <input type="checkbox"/> Brake light on            | <input type="checkbox"/> ABS light on |
| <input type="checkbox"/> Excessive play in steering                 | <input type="checkbox"/> Traction control light on | <input type="checkbox"/> Soft ride    |
| <input type="checkbox"/> Erratic steering when braking              | <input type="checkbox"/> Uneven tire wear          |                                       |
| <input type="checkbox"/> Poor steering wheel return after cornering |  |                                       |

**Hard to steer**

- Effort                       Wanders  
 Steering wheel off center

Shimmy/vibration (check box below for location)		
<input type="checkbox"/> Front	<input type="checkbox"/> Rear	<input type="checkbox"/> Don't know
<input type="checkbox"/> Seat	<input type="checkbox"/> Floor	<input type="checkbox"/> Other _____

**Brake pedal**

- Noise                       Pulses                       Squeaks                       Hard                       Mushy                       Excessive travel

**WHEN DOES IT OCCUR?**

- |  |  |                                       |                                       |                                       |
|--|--|---------------------------------------|---------------------------------------|---------------------------------------|
| <input type="checkbox"/> Cold days         | <input type="checkbox"/> Hot days      | <input type="checkbox"/> Wet/rain     | <input type="checkbox"/> All the time | <input type="checkbox"/> Intermittent |
| <input type="checkbox"/> Parking maneuvers | <input type="checkbox"/> At road speed | <input type="checkbox"/> Accelerating | <input type="checkbox"/> Decelerating |                                       |

**EXPLAIN:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**SQUEAK - RATTLE - NOISE CONDITIONS**

**AREA OF NOISE**

- |  |                                  |                                      |                                 |                                     |
|--|----------------------------------|--------------------------------------|---------------------------------|-------------------------------------|
| <input type="checkbox"/> Engine Compartment    | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Front Suspension      | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Rear Suspension       | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Passenger Compartment | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Instrument Panel      | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Doors                 | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Rear seat area        | <input type="checkbox"/> Console | <input type="checkbox"/> Other _____ |                                 |                                     |

**NOISE SOUNDS LIKE**

- Knocks                       Hard metal                       Light metal                       Roars                       Ticking                       Whine  
 Squeaks                       Rattles                       Scraping                       Other \_\_\_\_\_

**HOW OFTEN DOES IT OCCUR?**

- Continuous                       Often                       Intermittent                       Just started                       Since new

**WHEN DOES IT OCCUR?**

- |  |   |  |  |                                       |   |
|--|---|--|--|---------------------------------------|---|
| <input type="checkbox"/> All the time  | <input type="checkbox"/> Speed          | <input type="checkbox"/> RPM             | <input type="checkbox"/> Only moving       | <input type="checkbox"/> On turns     | <input type="checkbox"/> Braking          |
| <input type="checkbox"/> Hard throttle | <input type="checkbox"/> Light throttle | <input type="checkbox"/> Decelerate      | <input type="checkbox"/> Steady speed      | <input type="checkbox"/> Idle in gear | <input type="checkbox"/> Idle out of gear |
| <input type="checkbox"/> Hot days      | <input type="checkbox"/> Cold days      | <input type="checkbox"/> Humid or rainy  | <input type="checkbox"/> Temperature _____ |                                       |   |
| <input type="checkbox"/> Heavy bumps   | <input type="checkbox"/> Light bumps    | <input type="checkbox"/> Smooth pavement |  |                                       |   |

**EXPLAIN:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**CUSTOMER NAME:**

**PHONE NO.:**

**REPAIR ORDER NO.:**

**SHOP USE ONLY:**

**VIN#:**

**MILES:**

**TECHNICIAN:**

**ADVISOR#:**

50H15062

**Fig. 3: Symptom Check List - Page 2**

**AIR CONDITIONING - HEATER - VENTILATION**

**SYSTEM OR AREA AFFECTED**

- |  |  |                                    |                                  |                                   |                                     |
|--|--|------------------------------------|----------------------------------|-----------------------------------|-------------------------------------|
| <input type="checkbox"/> Air conditioner | <input type="checkbox"/> Heater                        | <input type="checkbox"/> Defroster | <input type="checkbox"/> Vent    | <input type="checkbox"/> Bi-Level | <input type="checkbox"/> Fan/blower |
| <input type="checkbox"/> Max A/C         | <input type="checkbox"/> Automatic Temperature Control | <input type="checkbox"/> Mix/blend | <input type="checkbox"/> Economy | <input type="checkbox"/> All      |                                     |

**SYMPTOM**

- |  |  |  |   |
|--|--|--|---|
| <input type="checkbox"/> Does not work   | <input type="checkbox"/> Blows wrong temperature air | <input type="checkbox"/> No air comes out of vents | <input type="checkbox"/> Rapid cycling                |
| <input type="checkbox"/> Noisy (explain) | <input type="checkbox"/> Broken                      | <input type="checkbox"/> Odor                      | <input type="checkbox"/> Air comes from wrong outlets |
| <input type="checkbox"/> Leaks           | <input type="checkbox"/> Insufficient heat or cool   | <input type="checkbox"/> Other (explain below)     | <input type="checkbox"/> Blows fuse                   |

**WHEN DOES IT OCCUR?**

- |  |  |  |                                       |  |
|--|--|--|---------------------------------------|--|
| <input type="checkbox"/> All the time              | <input type="checkbox"/> Hot                   | <input type="checkbox"/> Cold                              | <input type="checkbox"/> Intermittent | <input type="checkbox"/> Right after startup |
| <input type="checkbox"/> When change controls only | <input type="checkbox"/> Other (explain below) | <input type="checkbox"/> Fan blower speed High / Med / Low |                                       |  |

**EXPLAIN:** \_\_\_\_\_

**ELECTRICAL - RADIO - TAPE/CD PLAYER**

**SYMPTOM - MUSIC SYSTEM**

- |   |                                     |  |                                     |                                      |   |
|---|-------------------------------------|--|-------------------------------------|--------------------------------------|---|
| <input type="checkbox"/> Does not work        | <input type="checkbox"/> Noisy      | <input type="checkbox"/> Static                | <input type="checkbox"/> Won't load | <input type="checkbox"/> Won't eject | <input type="checkbox"/> Poor reception |
| <input type="checkbox"/> Controls do not work | <input type="checkbox"/> Blows fuse | <input type="checkbox"/> Other (explain below) |                                     |                                      |   |

**SYSTEM AFFECTED**

- |                                      |                                    |   |   |  |
|--------------------------------------|------------------------------------|---|---|--|
| <input type="checkbox"/> Radio only  | <input type="checkbox"/> AM        | <input type="checkbox"/> FM                       | <input type="checkbox"/> FM stereo              | <input type="checkbox"/> Graphic equalizer |
| <input type="checkbox"/> Tape player | <input type="checkbox"/> CD player | <input type="checkbox"/> Whole system             | <input type="checkbox"/> Steering wheel buttons | <input type="checkbox"/> Phone             |
| <input type="checkbox"/> Speakers    | <input type="checkbox"/> Front     | <input type="checkbox"/> Rear                     | <input type="checkbox"/> Left                   | <input type="checkbox"/> Right             |
| <input type="checkbox"/> Antenna     | <input type="checkbox"/> Clock     | <input type="checkbox"/> Radio or player controls | <input type="checkbox"/> Rear seat controls     |  |

**ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES**

Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

- |       |   |   |  |                                  |
|-------|---|---|--|----------------------------------|
| _____ | <input type="checkbox"/> Inoperable                 | <input type="checkbox"/> Noisy                            | <input type="checkbox"/> No control                              | <input type="checkbox"/> Erratic |
|       | <input type="checkbox"/> Check light on or flashing | <input type="checkbox"/> Works improperly (explain below) |  |                                  |
|       | <input type="checkbox"/> Blows fuse                 | <input type="checkbox"/> Intermittent                     | <input type="checkbox"/> Related system affected (explain below) |                                  |
| _____ | <input type="checkbox"/> Inoperable                 | <input type="checkbox"/> Noisy                            | <input type="checkbox"/> No control                              | <input type="checkbox"/> Erratic |
|       | <input type="checkbox"/> Check light on or flashing | <input type="checkbox"/> Works improperly (explain below) |  |                                  |
|       | <input type="checkbox"/> Blows fuse                 | <input type="checkbox"/> Intermittent                     | <input type="checkbox"/> Related system affected (explain below) |                                  |
| _____ | <input type="checkbox"/> Inoperable                 | <input type="checkbox"/> Noisy                            | <input type="checkbox"/> No control                              | <input type="checkbox"/> Erratic |
|       | <input type="checkbox"/> Check light on or flashing | <input type="checkbox"/> Works improperly (explain below) |  |                                  |
|       | <input type="checkbox"/> Blows fuse                 | <input type="checkbox"/> Intermittent                     | <input type="checkbox"/> Related system affected (explain below) |                                  |

**WHEN DOES IT OCCUR?**

- |  |   |  |   |
|--|---|--|---|
| <input type="checkbox"/> All the time          | <input type="checkbox"/> Hot                          | <input type="checkbox"/> Cold                      | <input type="checkbox"/> Just after starting - malfunctions for a while |
| <input type="checkbox"/> Intermittent          | <input type="checkbox"/> After runs for _____ minutes | <input type="checkbox"/> Rough roads or bumps only |   |
| <input type="checkbox"/> Other (explain below) |   |  |   |

**EXPLAIN:** \_\_\_\_\_

**CUSTOMER NAME:**

**PHONE NO.:**

**REPAIR ORDER NO.:**

**SHOP USE ONLY:**

**VIN#:**

**MILES:**

**TECHNICIAN:**

**ADVISOR#:**

50115063

**Fig. 4: Symptom Check List - Page 3**

**WATER LEAK - WINDNOISE**

**WATER LEAK**

**Leak Occurs When?**

- Setting level       Any time it rains       While driving in the rain       Car wash only
- Back lower than front (facing uphill)       Front lower than back (facing downhill)

**Location of Leak (where water appears):**

- LF Door       RF Door       LR Door       RR Door       Windshield       Rear window
- LF window       RF window       LR window       RR window       Side door       Sunroof/T-Top
- Under instrument panel       Rear door/rear hatch

**WINDNOISE:**

**Location:**

- LF Door       RF Door       LR Door       RR Door       Windshield       Rear window
- LF window       RF window       LR window       RR window       Side door       Sunroof/T-Top
- Under instrument panel       Rear door/rear hatch

**EXPLAIN:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**MANUAL TRANSMISSION - CLUTCH**

**SYMPTOM - MANUAL GEAR SHIFT**

- Hard to shift       Doesn't shift
- Grinds going into \_\_\_\_\_ gear
- Noisy when in \_\_\_\_\_ gear or neutral \_\_\_\_\_
- Slips/pops out of gear
- Noise (describe): \_\_\_\_\_  
\_\_\_\_\_
- Upshift light stays on
- Upshift light doesn't light

**WHEN DOES IT OCCUR?**

- All the time       Light load
- Heavy load

**EXPLAIN:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**SYMPTOM - CLUTCH**

- Hard to push       Fail to release
- Noise when pressing pedal down (describe): \_\_\_\_\_  
\_\_\_\_\_
- Slips       Chattering (grabbing)
- Odor present       Pedal stays on the floor
- Squealing sound

**WHEN DOES IT OCCUR?**

**When Engine Temperature is:**

- Cold       Hot
- Accelerating       Decelerating

**COMMENTS:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CUSTOMER NAME:**

**PHONE NO.:**

**REPAIR ORDER NO:**

**SHOP USE ONLY:**

**VIN#:**

**MILES:**

**TECHNICIAN:**

**ADVISOR#:**

50J15064

[Fig. 5: Symptom Check List - Page 4](#)

**INDIVIDUAL SYSTEM-BASED CHECK LISTS**

**NOTE:** Have the service adviser fill out these forms with the customer whenever possible.

**SYMPTOM (CHECK ALL THAT APPLY)  
ENGINE**

- "Service Engine Soon"/Malfunction Indicator Light" on
- Hard start/no start (cranks OK)
- Won't crank
- Engine stalls
- Engine miss
- Miss while driving
- Hesitates, stumbles or sags
- Rough idle
- Idle is too high  Idle is too low
- Poor power/performance
- Surge or chuggle, buck - jerk - skip
- Poor gas mileage  Highway  City
- Ping, detonates
- Sulphur/rotten egg odor
- Backfires (popping noise) - underhood/tailpipe
- Exhaust smoke  Increased oil consumption
- Runs on after key is turned off
- Speed fluctuates without moving accelerator
- Engine noise (explain): \_\_\_\_\_

(whine, rattle, groan, clunk, etc.)

- Other: \_\_\_\_\_

**TRANSMISSION**

- Does not shift properly  Hard shift
- Will not shift  Up  Down
- Will not shift into overdrive
- Engine starts in other than "P" or "N"
- Noise (describe): \_\_\_\_\_

(whine, rattle, groan, clunk, buzz, etc.)

- Shifts into next gear too early
- Overdrive doesn't work with speed control, but is otherwise OK
- Highway speed - shudder, surge, etc.
- Other: \_\_\_\_\_

**EXPLAIN:** \_\_\_\_\_

**CUSTOMER NAME:** \_\_\_\_\_

**SHOP USE ONLY:**

VIN#: \_\_\_\_\_

50H15054

MILES: \_\_\_\_\_

**PHONE NO.:** \_\_\_\_\_

**TECHNICIAN:** \_\_\_\_\_

**REPAIR ORDER NO.:** \_\_\_\_\_

**ADVISOR#:** \_\_\_\_\_

**OPERATING CONDITIONS (CHECK ALL THAT APPLY)  
HOW OFTEN DOES IT OCCUR? (Engine &/or Transmission)**

- Always  Few Seconds  Few minutes
- Few hours  Few days  Few weeks
- Few months  Variable  Only during event
- Every \_\_\_\_\_ to \_\_\_\_\_ miles  Unknown
- Other (explain): \_\_\_\_\_
- Just started  Getting better  Getting worse
- Since new

**WHEN DOES IT OCCUR? (Engine and/or Transmission)  
When Engine Temperature is:**

- Cold  Warm  Hot
- All the time  Only during warmup

**Weather Conditions:**

- Very cold - below 0°F  Cold - 0 to 32°F
- Cool - 32 to 60°F  Warm - 60 to 80°F
- Hot - above 80°F  Any environment
- Raining  Dry  Humid
- Snow/Ice  Wet roads
- Other (explain): \_\_\_\_\_

**Driving Conditions:**

- Light throttle  Medium throttle  Hard throttle
- Starting  At idle  Decelerating
- Over bumps  When shifting  While turning
- Cruising - steady at \_\_\_\_\_ MPH  While braking
- Anytime  Uphill  Downhill
- Highway  City/town  Stop and go
- Between \_\_\_\_\_ MPH and \_\_\_\_\_ MPH
- Only with A/C or Defrost on

**What Type of Fuel?**

- Regular UL  Midrange UL  Premium UL
- Gasohol  Ethanol  Methanol
- Diesel #1  Diesel #2  Various brands

**What Brand?**

**When Gear Selector is in:**

- Park/Neutral  Reverse  Overdrive
- Drive/3  Drive/2  Drive/1

**Between Gears:**

- Park to R or D  Reverse/Drive  First/Second
- Second/Third  Third/Overdrive

**Fig. 6: Engine Driveability & Automatic Transmission**

**BRAKES - STEERING - SUSPENSION**

**SYMPTOM**

- |   |  |                                       |
|---|--|---------------------------------------|
| <input type="checkbox"/> Vehicle pulls right - When _____           | <input type="checkbox"/> Suspension bottoms out    | <input type="checkbox"/> Sits uneven  |
| <input type="checkbox"/> Vehicle pulls left - When _____            | <input type="checkbox"/> Leans or sways in corners | <input type="checkbox"/> "Dog" tracks |
| <input type="checkbox"/> Steering wheel vibrates at _____ MPH       | <input type="checkbox"/> Brake light on            | <input type="checkbox"/> ABS light on |
| <input type="checkbox"/> Excessive play in steering                 | <input type="checkbox"/> Traction control light on | <input type="checkbox"/> Soft ride    |
| <input type="checkbox"/> Erratic steering when braking              | <input type="checkbox"/> Uneven tire wear          |                                       |
| <input type="checkbox"/> Poor steering wheel return after cornering |  |                                       |

**Hard to steer**

- Effort                       Wanders  
 Steering wheel off center

Shimmy/vibration (check box below for location)		
<input type="checkbox"/> Front	<input type="checkbox"/> Rear	<input type="checkbox"/> Don't know
<input type="checkbox"/> Seat	<input type="checkbox"/> Floor	<input type="checkbox"/> Other _____

**Brake pedal**

- Noise                       Pulsed                       Squeaks                       Hard                       Mushy                       Excessive travel

**WHEN DOES IT OCCUR?**

- |  |  |                                       |                                       |                                       |
|--|--|---------------------------------------|---------------------------------------|---------------------------------------|
| <input type="checkbox"/> Cold days         | <input type="checkbox"/> Hot days      | <input type="checkbox"/> Wet/rain     | <input type="checkbox"/> All the time | <input type="checkbox"/> Intermittent |
| <input type="checkbox"/> Parking maneuvers | <input type="checkbox"/> At road speed | <input type="checkbox"/> Accelerating | <input type="checkbox"/> Decelerating |                                       |

**EXPLAIN:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**CUSTOMER NAME:** \_\_\_\_\_                      **PHONE NO.:** \_\_\_\_\_                      **REPAIR ORDER NO:** \_\_\_\_\_

**SHOP USE ONLY:**  
**VIN#:** \_\_\_\_\_                      **MILES:** \_\_\_\_\_                      **TECHNICIAN:** \_\_\_\_\_                      **ADVISOR#:** \_\_\_\_\_

50C15059

**Fig. 7: Brakes, Steering, & Suspension**

**AIR CONDITIONING - HEATER - VENTILATION**

**SYSTEM OR AREA AFFECTED**

- |  |  |                                    |                                  |                                   |                                     |
|--|--|------------------------------------|----------------------------------|-----------------------------------|-------------------------------------|
| <input type="checkbox"/> Air conditioner | <input type="checkbox"/> Heater                        | <input type="checkbox"/> Defroster | <input type="checkbox"/> Vent    | <input type="checkbox"/> Bi-Level | <input type="checkbox"/> Fan/blower |
| <input type="checkbox"/> Max A/C         | <input type="checkbox"/> Automatic Temperature Control | <input type="checkbox"/> Mix/blend | <input type="checkbox"/> Economy | <input type="checkbox"/> All      |                                     |

**SYMPTOM**

- |  |   |   |  |
|--|---|---|--|
| <input type="checkbox"/> Does not work   | <input type="checkbox"/> Blows wrong temperature air          | <input type="checkbox"/> No air comes out of vents    | <input type="checkbox"/> Rapid cycling |
| <input type="checkbox"/> Noisy (explain) | <input type="checkbox"/> Broken <input type="checkbox"/> Odor | <input type="checkbox"/> Air comes from wrong outlets | <input type="checkbox"/> Blows fuse    |
| <input type="checkbox"/> Leaks           | <input type="checkbox"/> Insufficient heat or cool            | <input type="checkbox"/> Other (explain below)        |  |

**WHEN DOES IT OCCUR?**

- |  |  |  |                                       |  |
|--|--|--|---------------------------------------|--|
| <input type="checkbox"/> All the time              | <input type="checkbox"/> Hot                   | <input type="checkbox"/> Cold                              | <input type="checkbox"/> Intermittent | <input type="checkbox"/> Right after startup |
| <input type="checkbox"/> When change controls only | <input type="checkbox"/> Other (explain below) | <input type="checkbox"/> Fan blower speed High / Med / Low |                                       |  |

**EXPLAIN:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**CUSTOMER NAME:** \_\_\_\_\_                      **PHONE NO.:** \_\_\_\_\_                      **REPAIR ORDER NO:** \_\_\_\_\_

**SHOP USE ONLY:**  
**VIN#:** \_\_\_\_\_                      **MILES:** \_\_\_\_\_                      **TECHNICIAN:** \_\_\_\_\_                      **ADVISOR#:** \_\_\_\_\_

50A15057

**Fig. 8: Air Conditioning, Heater & Ventilation**



**ELECTRICAL - RADIO - TAPE/CD PLAYER**

**SYMPTOM - MUSIC SYSTEM**

- Does not work
- Noisy
- Static
- Won't load
- Won't eject
- Poor reception
- Controls do not work
- Blows fuse
- Other (explain below)

**SYSTEM AFFECTED**

- Radio only
- AM
- FM
- FM stereo
- Graphic equalizer
- Tape player
- CD player
- Whole system
- Steering wheel buttons
- Phone
- Speakers
- Front
- Rear
- Left
- Right
- Antenna
- Clock
- Radio or player controls
- Rear seat controls

**ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES**

Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

- \_\_\_\_\_  Inoperable       Noisy       No control       Erratic
- \_\_\_\_\_  Check light on or flashing       Works improperly (explain below)
- \_\_\_\_\_  Blows fuse       Intermittent       Related system affected (explain below)
  
- \_\_\_\_\_  Inoperable       Noisy       No control       Erratic
- \_\_\_\_\_  Check light on or flashing       Works improperly (explain below)
- \_\_\_\_\_  Blows fuse       Intermittent       Related system affected (explain below)
  
- \_\_\_\_\_  Inoperable       Noisy       No control       Erratic
- \_\_\_\_\_  Check light on or flashing       Works improperly (explain below)
- \_\_\_\_\_  Blows fuse       Intermittent       Related system affected (explain below)

**WHEN DOES IT OCCUR?**

- All the time
- Intermittent
- Other (explain below)
- Hot
- After runs for \_\_\_\_\_ minutes
- Cold
- Just after starting - malfunctions for a while
- Rough roads or bumps only

**EXPLAIN:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CUSTOMER NAME:** \_\_\_\_\_      **PHONE NO.:** \_\_\_\_\_      **REPAIR ORDER NO:** \_\_\_\_\_  
**SHOP USE ONLY:**      **VIN#:** \_\_\_\_\_      **MILES:** \_\_\_\_\_      **TECHNICIAN:** \_\_\_\_\_      **ADVISOR#:** \_\_\_\_\_

50B15058

**Fig. 9: Electrical, Radio & Tape/CD Player**

**MANUAL TRANSMISSION - CLUTCH**

**SYMPTOM - MANUAL GEAR SHIFT**

- Hard to shift                       Doesn't shift
- Grinds going into \_\_\_\_\_ gear
- Noisy when in \_\_\_\_\_ gear or neutral \_\_\_\_\_
- Slips/pops out of gear
- Noise (describe): \_\_\_\_\_  
\_\_\_\_\_
- Upshift light stays on
- Upshift light doesn't light

**WHEN DOES IT OCCUR?**

- All the time                       Light load
- Heavy load

**EXPLAIN:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**SYMPTOM - CLUTCH**

- Hard to push                       Fail to release
- Noise when pressing pedal down (describe): \_\_\_\_\_  
\_\_\_\_\_
- Slips                                       Chattering (grabbing)
- Odor present                       Pedal stays on the floor
- Squealing sound

**WHEN DOES IT OCCUR?**

**When Engine Temperature is:**

- Cold                                       Hot
- Accelerating                       Decelerating

**CUSTOMER NAME:**

**PHONE NO.:**

**REPAIR ORDER NO.:**

**SHOP USE ONLY:**

**VIN#:**

**MILES:**

**TECHNICIAN:**

**ADVISOR#:**

50J15056

**Fig. 10: Manual Transmission & Clutch**

**SQUEAK - RATTLE - NOISE CONDITIONS**

**AREA OF NOISE**

- |  |                                  |                                      |                                 |                                     |
|--|----------------------------------|--------------------------------------|---------------------------------|-------------------------------------|
| <input type="checkbox"/> Engine Compartment    | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Front Suspension      | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Rear Suspension       | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Passenger Compartment | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Instrument Panel      | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Doors                 | <input type="checkbox"/> Left    | <input type="checkbox"/> Right       | <input type="checkbox"/> Center | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> Rear seat area        | <input type="checkbox"/> Console | <input type="checkbox"/> Other _____ |                                 |                                     |

**NOISE SOUNDS LIKE**

- Knocks                       Hard metal                       Light metal                       Roars                       Ticking                       Whine
- Squeaks                       Rattles                       Scraping                       Other \_\_\_\_\_

**HOW OFTEN DOES IT OCCUR?**

- Continuous                       Often                       Intermittent                       Just started                       Since new

**WHEN DOES IT OCCUR?**

- All the time                       Speed                       RPM                       Only moving                       On turns                       Braking
- Hard throttle                       Light throttle                       Decelerate                       Steady speed                       Idle in gear                       Idle out of gear
- Hot days                       Cold days                       Humid or rainy                       Temperature \_\_\_\_\_
- Heavy bumps                       Light bumps                       Smooth pavement

**EXPLAIN:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CUSTOMER NAME:**

**PHONE NO.:**

**REPAIR ORDER NO.:**

**SHOP USE ONLY:**

**VIN#:**

**MILES:**

**TECHNICIAN:**

**ADVISOR#:**

50F15060

**Fig. 11: Squeak, Rattle, & Noise Conditions**

**WATER LEAK**

**Leak Occurs When?**

- Setting level
- Any time it rains
- While driving in the rain
- Car wash only
- Back lower than front (facing uphill)
- Front lower than back (facing downhill)

**Location of Leak (where water appears):**

- LF Door
- RF Door
- LR Door
- RR Door
- Windshield
- Rear window
- LF window
- RF window
- LR window
- RR window
- Side door
- Sunroof/T-Top
- Under instrument panel
- Rear door/rear hatch

**WINDNOISE:**

**Location:**

- LF Door
- RF Door
- LR Door
- RR Door
- Windshield
- Rear window
- LF window
- RF window
- LR window
- RR window
- Side door
- Sunroof/T-Top
- Under instrument panel
- Rear door/rear hatch

**EXPLAIN:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CUSTOMER NAME:**

**PHONE NO.:**

**REPAIR ORDER NO:**

**SHOP USE ONLY:**

**VIN#:**

**MILES:**

**TECHNICIAN:**

**ADVISOR#:**

50115055

**Fig. 12: Water Leak & Wind Noise**

## GENERAL INFORMATION

### Trouble Shooting - Basic Procedures

#### \* PLEASE READ THIS FIRST \*

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT, DIAGNOSTIC, or TESTING** articles available in the section(s) you are accessing.

## ACCESSORIES & ELECTRICAL

### CHARGING SYSTEM TROUBLE SHOOTING

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### BASIC CHARGING SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Vehicle Will Not Start	
Dead battery	Check battery cells, alternator belt tension and alternator output
Loose or corroded battery connections	Check all charging system connections
Ignition circuit or switch malfunction	Check and replace as necessary
Alternator Light Stays On With Engine Running	
Loose or worn alternator drive belt	Check alternator drive tension and condition, See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Loose alternator wiring connections	Check all charging system connections
Short in alternator light wiring	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Defective alternator stator or diodes	See Bench Tests in ALTERNATOR article

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Defective regulator	See Regulator Check in ALTERNATOR article
<b>Alternator Light Stays Off With Ignition Switch ON</b>	
Blown fuse	See WIRING DIAGRAMS
Defective alternator	See Testing in ALTERNATOR article
Defective indicator light bulb or socket	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
<b>Alternator Light Stays OFF With Ignition Switch ON</b>	
Short in alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective rectifier bridge	See Bench Tests in ALTERNATOR article
<b>Lights or Fuses Burn Out Frequently</b>	
Defective alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article
Defective battery	Check and replace as necessary
<b>Ammeter Gauge Shows Discharge</b>	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Defective wiring	Check all wires and wire connections
Defective alternator or regulator	See Bench Tests and On-Vehicle Tests in ALTERNATOR article
Defective ammeter, or improper ammeter wiring connection	See Testing in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
<b>Noisy Alternator</b>	
Loose drive pulley	Tighten drive pulley attaching nut
Loose mounting bolts	Tighten all alternator mounting bolts
Worn or dirty bearings	See Bearing Replacement ALTERNATOR article
Defective diodes or stator	See Bench Test in ALTERNATOR article
<b>Battery Does Stay Charged</b>	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in appropriate TUNE-UP article in the TUNE-UP section
Loose or corroded battery connections	Check all charging system connections

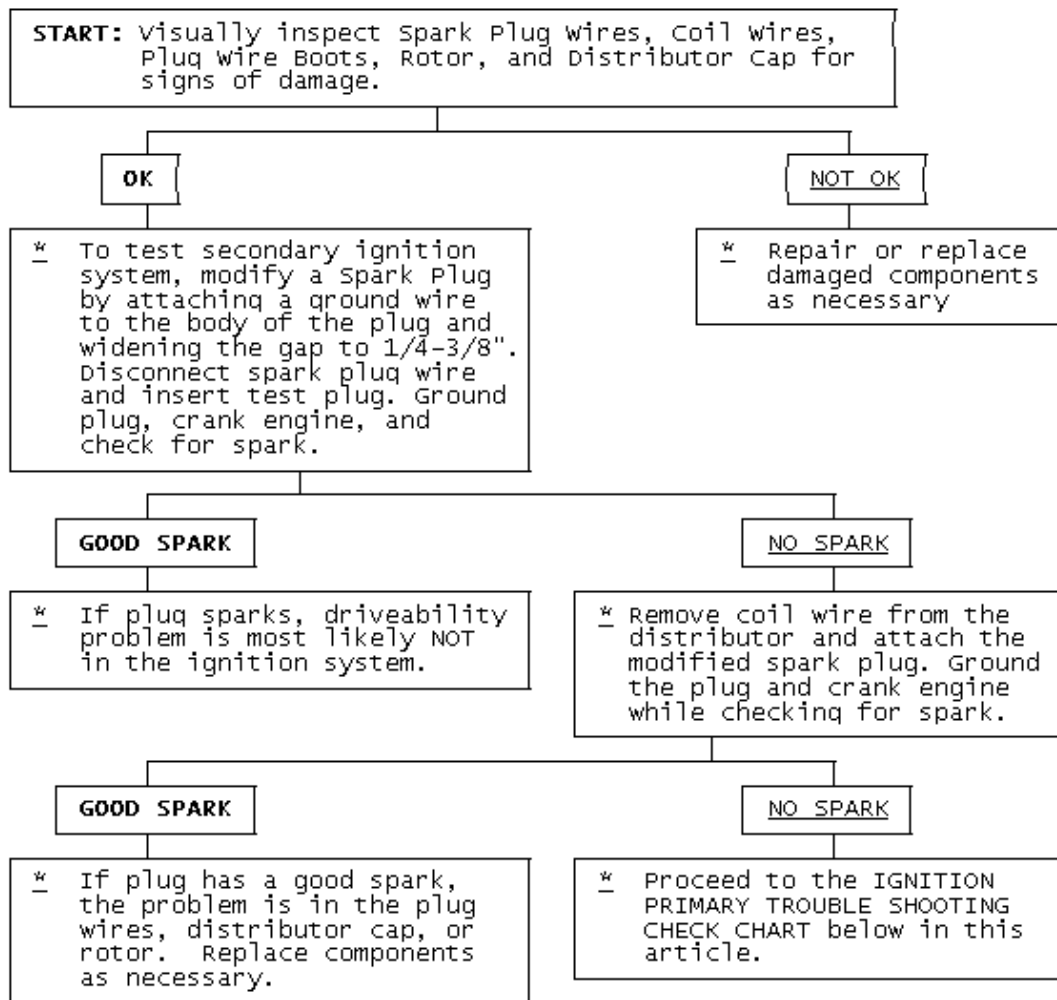
<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Loose alternator connections	Check all charging system connections
Defective alternator or battery	See On-Vehicle Tests and Bench Tests in ALTERNATOR article
Add-on electrical accessories exceeding alternator capacity	Install larger alternator
<b>Battery Overcharged-Uses Too Much Water</b>	
Defective battery	Check alternator output and repair as necessary
Defective alternator	See On-Vehicle Test and Bench Tests in ALTERNATOR article
Excessive alternator voltage	Check alternator output and repair as necessary

## **IGNITION SYSTEM TROUBLE SHOOTING**

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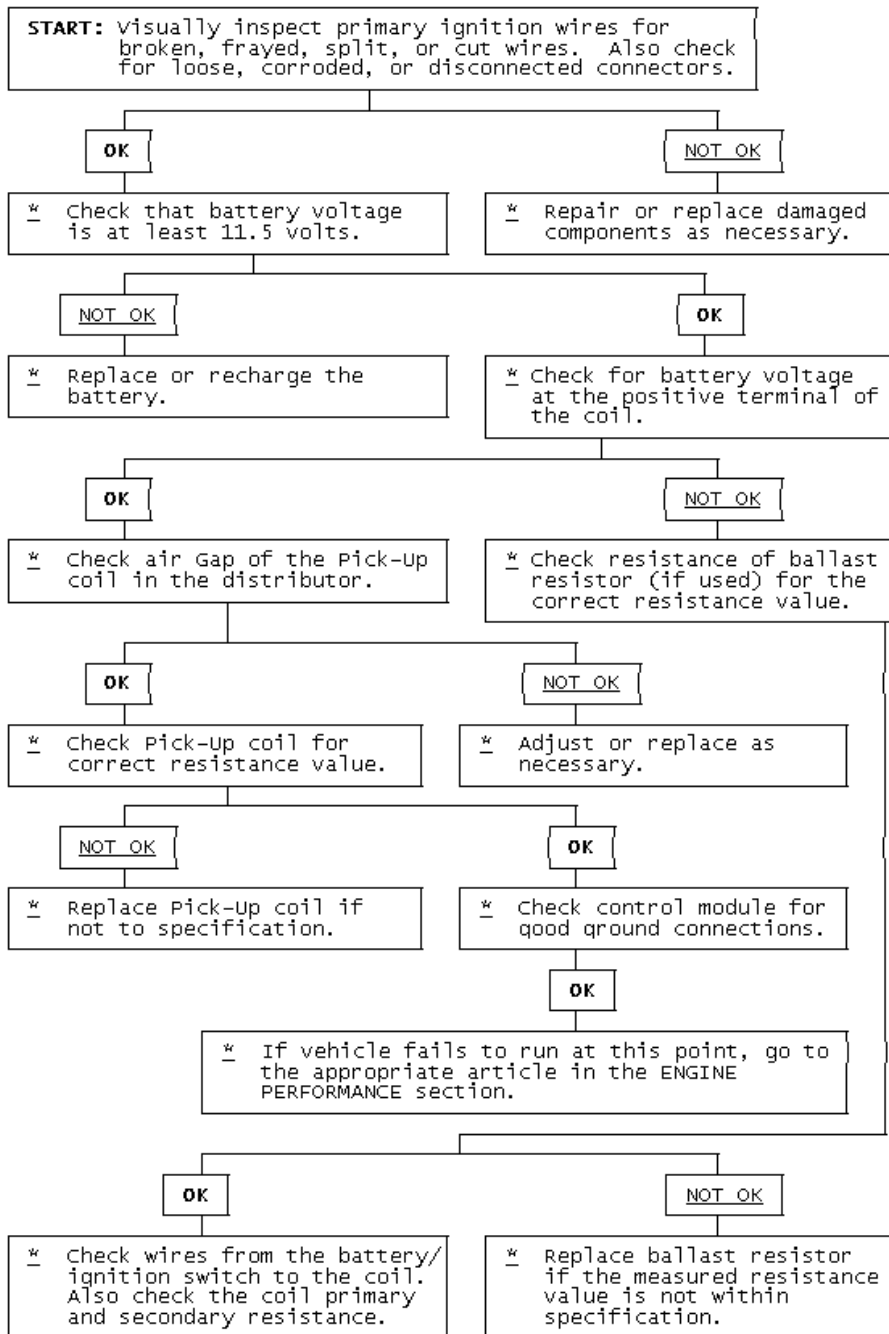


### Ignition Secondary Trouble Shooting Chart



**Fig. 1: Ignition Secondary Trouble Shooting Chart**

Ignition Primary Trouble Shooting Chart



**Fig. 2: Ignition Primary Trouble Shooting Chart**

**STARTER TROUBLE SHOOTING**

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**BASIC STARTER TROUBLE SHOOTING CHART**

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	Testing in STARTER article
<b>Starter Does Not Operate and Headlights Dim</b>	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole	See STARTER article shoes
<b>Starter Turns but Engine Does Not Rotate</b>	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
<b>Starter Will Not Crank Engine</b>	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
<b>Starter Cranks Engine Slowly</b>	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used

CONDITION & POSSIBLE CAUSE	CORRECTION
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearing	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
<b>Starter Engages Engine Only Momentarily</b>	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
<b>Starter Drive Will Not Engage</b>	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
<b>Starter Relay Does Not Close</b>	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
<b>Starter Drive Will Not Disengage</b>	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch	Replace ignition switch contacts sticking
<b>Starter Relay Operates but Solenoid Does Not</b>	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	solenoid
Low Current Draw	
Worn brushes or weak brush springs	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

## AIR CONDITIONING & HEAT

### AIR CONDITIONING TROUBLE SHOOTING

**WARNING:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

#### BASIC AIR CONDITIONING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Compressor Not Working	Compressor clutch circuit open.
.....	Compressor clutch coil inoperative.
.....	Poor clutch ground connection.
.....	Fan belts loose.
.....	Thermostatic switch inoperative.
.....	Thermostatic switch not adjusted.
.....	Ambient temperature switch open.
.....	Superheat fuse blown.
Excessive Noise or Vibration	Missing or loose mounting bolts.
.....	Bad idler pulley bearings.
.....	Fan belts not tightened correctly.
.....	Compressor clutch contacting body.
.....	Excessive system pressure.
.....	Compressor oil level low.
.....	Damaged clutch bearings.
.....	Damaged reed valves.
.....	Damaged compressor.

CONDITION	POSSIBLE CAUSE
Insufficient or No Cooling; Compressor Working	Expansion valve inoperative.
.....	Heater control valve stuck open.
.....	Low system pressure.
.....	Blocked condenser fins.
.....	Blocked evaporator fins.
.....	Vacuum system leak.
.....	Vacuum motors inoperative.
.....	Control cables improperly adjusted.
.....	Restricted air inlet.
.....	Mode doors binding.
.....	Blower motor inoperative.
.....	Temperature above system capacity.

## HEATER SYSTEM TROUBLE SHOOTING

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

### BASIC HEATER SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Insufficient, Erratic, or No Heat	Low Coolant Level
.....	Incorrect thermostat.
.....	Restricted coolant flow through core.
.....	Heater hoses plugged.
.....	Misadjusted control cable.
.....	Sticking heater control valve.
.....	Vacuum hose leaking.
.....	Vacuum hose blocked.
.....	Vacuum motors inoperative.
.....	Blocked air inlet.
.....	Inoperative heater blower motor.
.....	Oil residue on heater core fins.
.....	Dirt on heater core fins.
Too Much Heat	Improperly adjusted cables.
.....	Sticking heater control valve.
.....	No vacuum to heater control valve.
.....	Temperature door stuck open.
Air Flow Changes During Acceleration	Vacuum system leak.
.....	Bad check valve or reservoir.
Air From Defroster At All Times	Vacuum system leak.
.....	Improperly adjusted control cables.
.....	Inoperative vacuum motor.
Blower Does Not Operate Correctly	Blown fuse.
.....	Blower motor windings open.
.....	Resistors burned out.
.....	Motor ground connection loose.
.....	Wiring harness connections loose.



CONDITION	POSSIBLE CAUSE
.....	Blower motor switch inoperative.
.....	Blower relay inoperative.
.....	Fan binding or foreign object in housing.
.....	Fan blades broken or bent.

## BRAKES

### BRAKE SYSTEM TROUBLE SHOOTING

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### BRAKE SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
<b>Brakes Pull Left or Right</b>	
Incorrect tire pressure	Inflate tires to proper pressure
Front end out of alignment	See WHEEL ALIGNMENT
Mismatched tires	Check tires sizes
Restricted brake lines or hoses	Check hose routing
Loose or malfunctioning caliper	See DISC BRAKES or BRAKE SYSTEM
Bent shoe or oily linings	See DRUM BRAKES or BRAKE SYSTEM
Malfunctioning rear brakes	See DRUM, DISC BRAKES or BRAKE SYSTEM
Loose suspension parts	See SUSPENSION
<b>Noises Without Brakes Applied</b>	
Front linings worn out	Replace linings
Dust or oil on drums or rotors	See DRUM, DISC BRAKES or BRAKE SYSTEM
<b>Noises With Brakes Applied</b>	
Insulator on outboard shoe damaged	See DISC BRAKES or BRAKE SYSTEM
Incorrect pads or linings	Replace pads or linings
<b>Brake Rough, Chatters or Pulsates</b>	
Excessive lateral runout	Check rotor runout
Parallelism not to specifications	Reface or replace rotor
Wheel bearings not adjusted	See SUSPENSION
Rear drums out-of-round	Reface or replace drums
Disc pad reversed, steel against rotor	Remove and reinstall pad
<b>Excessive Pedal Effort</b>	
Malfunctioning power unit	See POWER BRAKES or BRAKE SYSTEM
Partial system failure	Check fluid and pipes
Worn disc pad or lining	Replace pad or lining
Caliper piston stuck or sluggish	See DISC BRAKES or BRAKE SYSTEM

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Master cylinder piston stuck	See MASTER CYLINDERS or BRAKE SYSTEM
Brake fade due to incorrect pads for linings	Replace pads or linings
Linings or pads glazed	Replace pads or linings
Worn drums	Reface or replace drums
<b>Excessive Pedal Travel</b>	
Partial brake system failure	Check fluid and pipes
Insufficient fluid in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Air trapped in system	See BRAKE BLEEDING or BRAKE SYSTEM
Rear brakes not adjusted	See Adjustments in DRUM BRAKES or BRAKE SYSTEM
Bent shoe or lining	See DRUM BRAKES or BRAKE SYSTEM
Plugged master cylinder cap	See MASTER CYLINDERS or BRAKE SYSTEM
Improper brake fluid	Replace brake fluid
<b>Pedal Travel Decreasing</b>	
Compensating port plugged	See MASTER CYLINDERS or BRAKE SYSTEM
Swollen cup in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Master cylinder piston not returning	See MASTER CYLINDERS or BRAKE SYSTEM
Weak shoe retracting springs	See DRUM BRAKES BRAKE SYSTEM
Wheel cylinder piston sticking	See DRUM BRAKES or BRAKE SYSTEM
<b>Dragging Brakes</b>	
Master cylinder pistons not returning	See MASTER CYLINDERS BRAKE SYSTEM
Restricted brake lines or hoses	Check line routing
Incorrect parking brake adjustment	See DRUM BRAKES BRAKE SYSTEM
Parking Brake cables frozen	See DRUM BRAKES BRAKE SYSTEM
Incorrect installation of inboard disc pad	Remove and replace correctly
Power booster output rod too long	See POWER BRAKE UNITS BRAKE SYSTEM
Brake pedal not returning freely	See DISC, DRUM BRAKES BRAKE SYSTEM
<b>Brakes Grab or Uneven Braking Action</b>	
Malfunction of combination valve	See CONTROL VALVE or BRAKE SYSTEM

CONDITION & POSSIBLE CAUSE	CORRECTION
Malfunction of power brake unit	See POWER BRAKE UNITS or BRAKE SYSTEM
Binding brake pedal	See DISC, DRUM BRAKES or BRAKE SYSTEM
Pulsation or Roughness	
Uneven pad wear caused by caliper	See DISC BRAKES or BRAKE SYSTEM
Uneven rotor wear	See DISC BRAKES or BRAKE SYSTEM
Drums out-of-round	Reface or replace drums

## ENGINE MECHANICAL

### COOLING SYSTEM TROUBLE SHOOTING

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### COOLING SYSTEM TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Overheating	
Coolant Leak	Fill/Pressure Test System
A/C Condenser Fins Clogged	Remove/Clean Condenser
Radiator Fins Clogged	Remove/Clean Radiator
Thermostat Stuck Closed	Replace Thermostat
Clogged Cooling System Passages	Clean/Flush Cooling System
Water Pump Malfunction	Replace Water Pump
Fan Clutch Malfunction	Replace Fan Clutch
Retarded Ignition Timing	Reset Ignition Timing
Cooling Fan Malfunction	Test Cooling Fan/Circuit
Cooling Fan Motor Malfunction	Test Fan Motor
Cooling Fan Relay Malfunction	Test Fan Relay
Faulty Radiator Cap	Replace Radiator Cap
Broken/Slipping Fan Belt	Replace Fan Belt
Restricted Exhaust	Repair Exhaust System
Corrosion	
Impurities In Coolant	Clean/Flush System
Coolant Leakage	
Damaged hose	Replace Hose
Leaky Water Pump	Replace Water Pump
Damaged Radiator Seam	Replace/Repair Radiator
Leaky Thermostat Cover	Replace Thermostat Cover
Cylinder Head Problem	Check Head/Head Gasket
Leaky Freeze Plugs	Replace Freeze Plugs
Recovery System Inoperative	
Loose and/or Defective Radiator Cap	Replace Radiator Cap
Overflow Tube Clogged and/or Leaking	Repair Tube

CONDITION & POSSIBLE CAUSE	CORRECTION
Recovery Bottle Vent Restricted	Clean Vent
No Heater Core Flow	
Collapsed Heater Hose	Replace Heater Hose
Plugged Heater Core	Clean/Replace Heater Core
Faulty Heater Valve	Replace Heater Valve

## GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING

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### BASIC GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Lopes At Idle	
Intake manifold-to-head leaks	Replace manifold gasket, See ENGINES
Blown head gasket	Replace head gasket, See ENGINES
Worn timing gears, chain or sprocket	Replace gears, chain or sprocket
Worn camshaft lobes	Replace camshaft, See ENGINES
Overheated engine	Check cooling system, See COOLING
Blocked crankcase vent valve	Remove restriction
Leaking EGR valve	Repair leak and/or replace valve
Faulty fuel pump	Replace fuel pump
Engine Has Low Power	
Leaking fuel pump	Repair leak and/or replace fuel pump
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Sticking valves or weak valve springs	Check valve train components, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES
Worn camshaft lobes	Replace camshaft, See ENGINES
Blown head gasket	Replace head gasket. See ENGINES.
Clutch slipping	Adjust pedal and/or replace components, See ENGINES
Engine overheating	Check cooling system, See COOLING
Auto. Trans. pressure regulator valve faulty	Replace pressure regulator valve
Auto. Trans. fluid level too low	Add fluid as necessary

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Improper vacuum diverter valve operation	Replace vacuum diverter valve
Vacuum leaks	Inspect vacuum system and repair as required
Leaking piston rings	Replace piston rings, See ENGINES
<b>Faulty High Speed Operation</b>	
Low fuel pump volume	Replace fuel pump
Leaking valves or worn	Replace valves and/or springs, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES
Intake manifold restricted	Remove restriction
Worn distributor shaft	Replace distributor
<b>Faulty Acceleration</b>	
Improper fuel pump stroke	Remove pump and reset pump stroke
Incorrect ignition timing	Reset ignition timing, See TUNE-UP
Leaking valves	Replace valves, See ENGINES
Worn fuel pump diaphragm or piston	Replace diaphragm or piston
<b>Intake Backfire</b>	
Improper ignition timing	Reset ignition timing, See TUNE-UP
Faulty accelerator pump discharge	Replace accelerator pump
Improper choke operation	Check choke and adjust as required
Defective EGR valve	Replace EGR valve
Fuel mixture too lean	Reset air/fuel mixture, See TUNE-UP
Choke valve initial clearance too large	Reset choke valve initial clearance
<b>Exhaust Backfire</b>	
Vacuum leak	Inspect and repair vacuum system
Faulty vacuum diverter valve	Replace vacuum diverter valve
Faulty choke operation	Check choke and adjust as required
Exhaust system leak	repair exhaust system leak
<b>Engine Detonation</b>	
Ignition timing too far advanced	Reset ignition timing, See TUNE-UP
Faulty ignition system	Check ignition timing, See TUNE-UP
Spark plugs loose or faulty	Retighten or replace plugs
Fuel delivery system clogged	Inspect lines, pump and filter for clog
EGR valve inoperative	Replace EGR valve
PCV system inoperative	Inspect and/or replace hoses or valve
Vacuum leaks	Check vacuum system and repair leaks

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Excessive combustion chamber deposits	Remove built-up deposits
Leaking, sticking or broken valves	Inspect and/or replace valves
<b>External Oil Leakage</b>	
Fuel pump improperly seated or worn gasket	Remove pump, replace gasket and seat properly
Oil pan gasket broken or pan bent	Straighten pan and replace gasket
Timing chain cover gasket broken	Replace timing chain cover gasket
Rear main oil seal worn	Replace rear main oil seal
Oil pan drain plug not seated properly	Remove and reinstall drain plug
Camshaft bearing drain hole blocked	Remove restriction
Oil pressure sending switch leaking	Remove and reinstall sending switch
<b>Excessive Oil Consumption</b>	
Worn valve stems or guides	Replace stems or guides, See ENGINES
Valve "O" ring seals damaged	Replace "O" ring seals, See ENGINES
Plugged oil drain back holes	Remove restrictions
Improper PCV valve operation	Replace PCV valve
Engine oil level too high	Remove excess oil
Engine oil too thin	Replace thicker oil
Valve stem oil deflectors damaged	Replace oil deflectors
Incorrect piston rings	Replace piston rings, See ENGINES
Piston ring gaps not staggered	Reinstall piston rings, See ENGINES
Insufficient piston ring tension	Replace rings, See ENGINES
Piston ring grooves or oil return	slots clogged Replace piston rings, See ENGINES
Piston rings sticking in grooves	Replace piston rings, See ENGINES
Piston ring grooves excessively worn	Replace piston and rings, See ENGINES
Compression rings installed upside down	Replace compression rings correctly, See ENGINES
Worn or scored cylinder walls	Rebore cylinders or replace block
Mismatched oil ring expander and rail	Replace oil ring expander and rail, See ENGINES
Intake gasket dowels too long	Replace intake gasket dowels
Excessive main or connecting rod bearing clearance	Replace main or connecting rod bearings, See ENGINES
<b>No Oil Pressure</b>	
Low oil level	Add oil to proper level
Oil pressure sender or gauge broken	Replace sender or gauge
Oil pump malfunction	Remove and overhaul oil pump, See ENGINES



<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Oil pressure relief valve sticking	Remove and reinstall valve
Oil pump passages blocked	Overhaul oil pump, See ENGINES
Oil pickup screen or tube blocked	Remove restriction
Loose oil inlet tube	Tighten oil inlet tube
Loose camshaft bearings	Replace camshaft bearings, See ENGINES
Internal leakage at oil passages	Replace block or cylinder head
<b>Low Oil Pressure</b>	
Low engine oil level	Add oil to proper level
Engine oil too thin	Remove and replace with thicker oil
Excessive oil pump clearance	Reduce oil pump clearance, See ENGINES
Oil pickup tube or screen blocked	Remove restrictions
Main, rod or cam bearing clearance excessive	Replace bearing to reduce clearance, See ENGINES
<b>High Oil Pressure</b>	
Improper grade of oil	Replace with proper oil
Oil pressure relief valve stuck closed	Eliminate binding
Oil pressure sender or gauge faulty	Replace sender or gauge
<b>Noisy Main Bearings</b>	
Inadequate oil supply	Check oil delivery to main bearings
Excessive main bearing clearance	Replace main bearings, See ENGINES
Excessive crankshaft end play	Replace crankshaft, See ENGINES
Loose flywheel or torque converter	Tighten attaching bolts
Loose or damaged vibration damper	Tighten or replace vibration damper
Crankshaft journals out-of-round	Re-grind crankshaft journals
Excessive belt tension	Loosen belt tension
<b>Noisy Connecting Rods</b>	
Excessive bearing clearance or missing bearing	Replace bearing, See ENGINES
Crankshaft rod journal out-of-round	Re-grind crankshaft journal
Misaligned connecting rod or cap	Remove rod or cap and realign
Incorrectly tightened rod bolts	Remove and re-tighten rod bolts
<b>Noisy Pistons and Rings</b>	
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Bore tapered or out-of-round	Rebore block
Piston ring broken	Replace piston rings, See ENGINES
Piston pin loose or seized	Replace piston pin, See ENGINES
Connecting rods misaligned	Realign connecting rods

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Ring side clearance too loose or tight	Replace with larger or smaller rings
Carbon build-up on piston	Remove carbon
<b>Noisy Valve Train</b>	
Worn or bent push rods	Replace push rods, See ENGINES
Worn rocker arms or bridged pivots	Replace push rods, See ENGINES
Dirt or chips in valve lifters	Remove lifters and remove dirt/chips
Excessive valve lifter leak-down	Replace valve lifters, See ENGINES
Valve lifter face worn	Replace valve lifters, See ENGINES
Broken or cocked valve springs	Replace or reposition springs
Too much valve stem-to-guide clearance	Replace valve guides, See ENGINES
Valve bent	Replace valve, See ENGINES
Loose rocker arms	Retighten rocker arms, See ENGINES
Excessive valve seat run-out	Reface valve seats, See ENGINES
Missing valve lock	Install new valve lock
Excessively worn camshaft lobes	Replace camshaft, See ENGINES
Plugged valve lifter oil holes	Eliminate restriction or replace lifter
Faulty valve lifter check ball	Replace lifter check ball, See ENGINES
Rocker arm nut installed upside down	Remove and reinstall correctly
Valve lifter incorrect for engine	Remove and replace valve lifters
Faulty push rod seat or lifter plunger	Replace plunger or push rod
<b>Noisy Valves</b>	
Improper valve lash	Re-adjust valve lash, See ENGINES
Worn or dirty valve lifters	Clean and/or replace lifters
Worn valve guides	Replace valve guides, See ENGINES
Excessive valve seat or face run-out	Reface seats or valve face
Worn camshaft lobes	Replace camshaft, See ENGINES
Loose rocker arm studs	Re-tighten rocker arm studs, See ENGINES
Bent push rods	Replace push rods, See ENGINES
Broken valve springs	Replace valve springs, See ENGINES
<b>Burned, Sticking or Broken Valves</b>	
Weak valve springs or warped valves	Replace valves and/or springs, See ENGINES

CONDITION & POSSIBLE CAUSE	CORRECTION
Improper lifter clearance	Re-adjust clearance or replace lifters
Worn guides or improper guide clearance	Replace valve guides, See ENGINES
Out-of-round valve seats or improper seat width	Re-grind valve seats
Gum deposits on valve stems, seats or guide	Remove deposits
Improper spark timing	Re-adjust spark timing
<b>Broken Pistons/Rings</b>	
Undersize pistons	Replace with larger pistons, See ENGINES
Wrong piston rings	Replace with correct rings, See ENGINES
Out-of-round cylinder bore	Re-bore cylinder bore
Improper connecting rod alignment	Remove and realign connecting rods
Excessively worn ring grooves	Replace pistons, See ENGINES
Improperly assembled piston pins	Re-assemble pin-to-piston, See ENGINES
Insufficient ring gap clearance	Install new rings, See ENGINES
Engine overheating	Check cooling system
Incorrect ignition timing	Re-adjust ignition timing, See TUNE-UP
<b>Excessive Exhaust Noise</b>	
Leaks at manifold to head, or to pipe	Replace manifold or pipe gasket
Exhaust manifold cracked or broken	Replace exhaust manifold, See ENGINES

## ENGINE PERFORMANCE

### CARBURETOR TROUBLE SHOOTING:

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### BASIC COLD START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
<b>Engine Won't Start</b>	
Choke not closing	Check choke operation, see FUEL SYSTEMS
Choke linkage bent	Check linkage, see FUEL SYSTEM
<b>Engine Starts, Then Dies</b>	
Choke vacuum kick setting too wide	Check setting and adjust see, FUEL SYSTEMS
Fast idle RPM too low	Reset RPM to specification, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Vacuum leak	Inspect vacuum system for leaks
Low fuel pump outlet	Repair or replace pump, see FUEL SYSTEMS
Low carburetor fuel level	Check float setting see FUEL SYSTEM
<b>Engine Quits Under Load</b>	
Choke vacuum kick setting incorrect	Reset vacuum kick setting, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEM
Incorrect hot fast idle speed RPM	Reset fast idle RPM, see TUNE-UP
<b>Engine Starts, Runs Up, Then Idles, Slowly With Black Smoke</b>	
Choke vacuum kick set too narrow	Reset vacuum kick, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Hot fast idle RPM too low	Reset fast idle RPM, see TUNE-UP

#### **BASIC HOT START SYMPTOMS TROUBLE SHOOTING CHART**

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
<b>Engine Won't Start</b>	
Engine flooded	Allow fuel to evaporate

#### **BASIC COLD ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART**

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
<b>Engine Stalls in Gear</b>	
Choke vacuum kick setting incorrect	Reset choke vacuum kick, see FUEL SYSTEMS
Fast idle RPM incorrect	Reset fast idle RPM, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam see FUEL SYSTEMS
<b>Acceleration Sag or Stall</b>	
Defective choke control switch	Replace choke control switch
Choke vacuum kick setting incorrect	Reset choke vacuum kick see, FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, FUEL SYSTEMS
Accelerator pump defective	Repair or replace pump see FUEL SYSTEMS
Secondary throttles not closed	Inspect lockout adjustment, see FUEL SYSTEMS
<b>Sag or Stall After Warmup</b>	
Defective choke control switch	Replace choke control switch, see FUEL SYSTEMS
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, see FUEL SYSTEMS
<b>Backfiring &amp; Black Smoke</b>	

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Plugged heat crossover system	Remove restriction

### BASIC WARM ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
<b>Hesitation With Small Amount of Gas Pedal Movement</b>	
Vacuum leak	Inspect vacuum lines
Accelerator pump weak or inoperable	Replace pump, see FUEL SYSTEMS
Float level setting too low	Reset float level, see, FUEL SYSTEMS
Metering rods sticking or binding	Inspect and/or replace rods, see FUEL SYSTEMS
Carburetor idle or transfer system plugged	Inspect system and remove restriction
Frozen or binding heated air inlet	Inspect heated air door for binding
<b>Hesitation With Heavy Gas Pedal Movement</b>	
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Metering rod carrier sticking or binding	Remove restriction
Large vacuum leak	Inspect vacuum system and repair leak
Float level setting too low	Reset float level, see FUEL SYSTEMS
Defective fuel pump, lines or filter	Inspect pump, lines and filter
Air door setting incorrect	Adjust air door setting, see FUEL

### DIESEL ENGINE TROUBLE SHOOTING

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**NOTE:** Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

### BASIC DIESEL ENGINE TROUBLE SHOOTING CHART

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
<b>Engine Won't Crank</b>	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Bad starter connections or bad starter	Check connections and/or replace starter
<b>Engine Cranks Slowly, Won't Start</b>	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Engine oil too heavy	Replace engine oil
<b>Engine Cranks Normally, But Will Not Start</b>	
Glow plugs not functioning	Check glow plug system, see FUEL SYSTEMS

CONDITION & POSSIBLE CAUSE	CORRECTION
Glow plug control not functioning	Check controller, see FUEL SYSTEMS
Fuel not injected into cylinders	Check fuel injectors, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Fuel filter blocked	Replace fuel filter
Fuel tank filter blocked	Replace fuel tank filter
Fuel pump not operating	Check pump operation and/or replace pump
Fuel return system blocked	Inspect system and remove restriction
No voltage to fuel solenoid	Check solenoid and connections
Incorrect or contaminated fuel	Replace fuel
Incorrect injection pump timing	Re-adjust pump timing, see FUEL SYSTEMS
Low compression	Check valves, pistons, rings, see ENGINES
Injection pump malfunction	Inspect and/or replace injection pump
<b>Engine Starts, Won't Idle</b>	
Incorrect slow idle adjustment	Reset idle adjustment, see TUNE-UP
Fast idle solenoid malfunctioning	Check solenoid and connections
Fuel return system blocked	Check system and remove restrictions
Glow plugs go off too soon	See glow plug diagnosis in FUEL SYSTEMS
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Incorrect or contaminated fuel	Replace fuel
Low compression	Check valves, piston, rings, see ENGINES
Injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Fuel solenoid closes in RUN position	Check solenoid and connections
<b>Engines Starts/Idles Rough W/out Smoke or Noise</b>	
Incorrect slow idle adjustment	Reset slow idle, see TUNE-UP
Injection line fuel leaks	Check lines and connections
Fuel return system blocked	Check lines and connections
Air in fuel system	Bleed air from system
Incorrect or contaminated fuel	Replace fuel
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
<b>Engines Starts and Idles Rough W/out Smoke or Noise, But Clears After Warm-Up</b>	
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Engine not fully broken in	Put more miles on engine
Air in system	Bleed air from system



CONDITION & POSSIBLE CAUSE	CORRECTION
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engine Idles Correctly, Misfires Above Idle	
Blocked fuel filter	Replace fuel filter
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Incorrect or contaminated fuel	Replace fuel
Engine Won't Return To Idle	
Fast idle adjustment incorrect	Reset fast idle, see TUNE-UP
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
External linkage binding	Check linkage and remove binding
Fuel Leaks On Ground	
Loose or broken fuel line	Check lines and connections
Internal injection pump seal leak	Replace injection pump, see FUEL SYSTEMS
Cylinder Knocking Noise	
Injector nozzles sticking open	Test injectors, see FUEL SYSTEMS
Very low nozzle opening pressure	Test injectors and/or replace
Loss of Engine Power	
Restricted air intake	Remove restriction
EGR valve malfunction	Replace EGR valve
Blocked or damaged exhaust system	Remove restriction and/or replace components
Blocked fuel tank filter	Replace filter
Restricted fuel filter	Remove restriction and/or replace filter
Block vent in gas cap	Remove restriction and/or replace cap
Tank-to-injection pump fuel supply blocked	Check fuel lines and connections
Blocked fuel return system	Remove restriction
Incorrect or contaminated fuel	Replace fuel
Blocked injector nozzles	Check nozzle for blockage, see FUEL SYSTEMS
Low compression	Check valves, rings, pistons, see ENGINES
Loud Engine Noise With Black Smoke	
Basic timing incorrect	Reset timing, see FUEL SYSTEMS
EGR valve malfunction	Replace EGR valve
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Incorrect injector pump housing pressure	Check pressure, see FUEL SYSTEMS
Engine Overheating	
Cooling system leaks	Check cooling system and repair leaks
Belt slipping or damaged	Check tension and/or replace belt

CONDITION & POSSIBLE CAUSE	CORRECTION
Thermostat stuck closed	Remove and replace thermostat, see ENGINE COOLING
Head gasket leaking	Replace head gasket
Oil Light on at Idle	
Low oil pump pressure	Check oil pump operation, see ENGINES
Oil cooler or line restricted	Remove restriction and/or replace cooler
Engine Won't Shut Off	
Injector pump fuel solenoid does not return fuel valve to OFF position	Remove and check solenoid and replace if needed

### VACUUM PUMP DIAGNOSIS

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

### FUEL INJECTION TROUBLE SHOOTING

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### BASIC FUEL INJECTION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start (Crank Normal)	
Cold start valve inoperative	Test valve and circuit
Poor connection, vacuum or wiring	Check vacuum and electrical connections
Contaminated fuel	Test fuel for water or alcohol
Defective fuel pump relay or circuit	Test relay and wiring
Battery too low	Charge and test battery
Low fuel pressure	Test pressure regulator and fuel pump, check for restricted lines and filters
No distributor reference pulses	Repair ignition system as necessary
Open coolant temperature sensor circuit	Test sensor and wiring
Shorted W.O.T. switch in T.P.S.	Disconnect W.O.T. switch, engine should start
Defective ECM	Replace ECM
Fuel tank residual pressure valve leaks	Test for fuel pressure drop after shut down
Hard Starting	

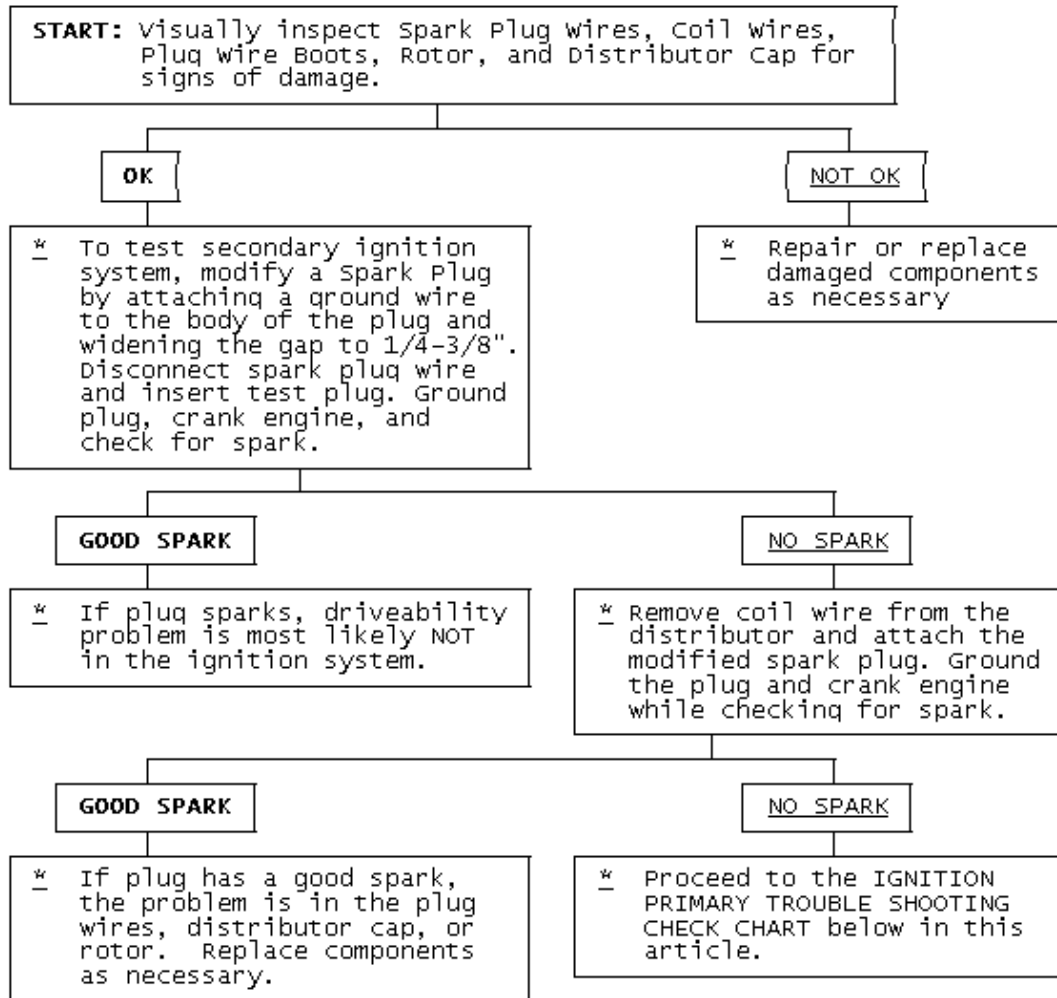
CONDITION & POSSIBLE CAUSE	CORRECTION
Disconnected hot air tube to air cleaner	Reconnect tube and test control valve
Defective Idle Air Control (IAC) valve	Test valve operation and circuit
Shorted, open or misadjusted T.P.S.	Test and adjust or replace T.P.S.
EGR valve open	Test EGR valve and control circuit
Poor Oxygen sensor signal	Test for shorted or circuit
Incorrect mixture from PCV system	Test PCV for flow, check sealing of oil filter cap
<b>Poor High Speed Operation</b>	
Low fuel pump volume	Faulty pump or restricted fuel lines or filters
Poor MAP sensor signal	Test MAP sensor, vacuum hose and wiring
Poor Oxygen sensor signal	Test for shorted or open sensor or circuit
Open coolant temperature sensor circuit	Test sensor and wiring
Faulty ignition operation	Check wires for cracks or poor connections, test secondary voltage with oscilloscope
Contaminated fuel	Test fuel for water or alcohol
Intermittent ECM ground	Test ECM ground connection for resistance
Restricted air cleaner	Replace air cleaner
Restricted exhaust system	Test for exhaust manifold back pressure
Poor MAF sensor signal	Check leakage between sensor and manifold
Poor VSS signal	If tester for ALCL hook-up is available check that VSS reading matches speedometer
<b>Ping or Knock on Acceleration</b>	
Poor Knock sensor signal	Test for shorted or open sensor or circuit
Poor Baro sensor signal	Test for shorted or open sensor or circuit
Improper ignition timing	See VEHICLE EMISSION CONTROL LABEL (where applicable)
Check for engine overheating problems	Low coolant, loose belts or electric cooling fan inoperative

**NOTE:** For additional electronic fuel injection trouble shooting information, see the appropriate article in the ENGINE PERFORMANCE section (not all vehicles have Computer Engine Control articles). Information is provided there for diagnosing fuel system problems on vehicles with electronic fuel injection.

**NOTE:**

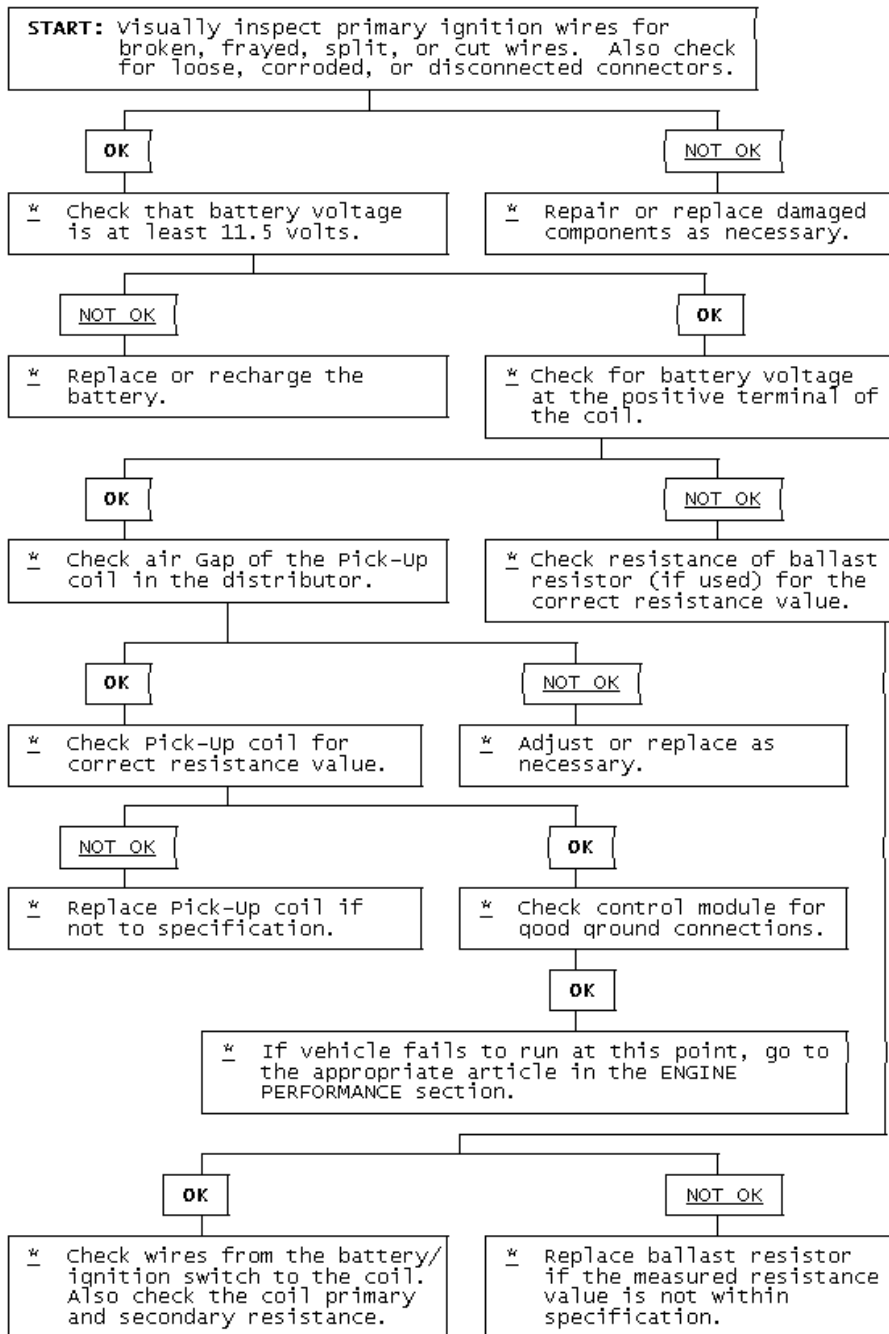
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Ignition Secondary Trouble Shooting Chart



**Fig. 3: Ignition Secondary Trouble Shooting Chart**

Ignition Primary Trouble Shooting Chart



**Fig. 4: Ignition Primary Trouble Shooting Chart**

**STARTER TROUBLE SHOOTING**

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**BASIC STARTER TROUBLE SHOOTING CHART**

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	See Testing in STARTER article
<b>Starter Does Not Operate and Headlights Dim</b>	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole shoes	See STARTER article
<b>Starter Turns but Engine Does Not Rotate</b>	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
<b>Starter Will Not Crank Engine</b>	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
<b>Starter Cranks Engine Slowly</b>	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used



CONDITION & POSSIBLE CAUSE	CORRECTION
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearings	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch contacts sticking	Replace ignition switch
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	Replace solenoid
Low Current Draw	
Worn brushes or weak	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

## TUNE-UP TROUBLE SHOOTING - GAS ENGINE VEHICLES

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### BASIC SPARK PLUG TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Normal Spark Plug Condition	
Light Tan or Gray deposits	No Action
Electrode not burned or fouled	No Action
Gap tolerance not changed	No Action
Cold Fouling or Carbon Deposits	
Overrich air/fuel mixture	Adjust air/fuel mixture, see ENGINE PERFORMANCE section
Faulty choke	Replace choke assembly, see ENGINE PERFORMANCE section
Clogged air filter	Clean and/or replace air filter
Incorrect idle speed or dirty carburetor	Reset idle speed and/ or clean carburetor
Faulty ignition wires	Replace ignition wiring
Prolonged operation at idle	Shut engine off during long idle
Sticking valves or worn valve guide seals	Check valve train
Wet Fouling or Oil Deposits	

CONDITION & POSSIBLE CAUSE	CORRECTION
Worn rings and pistons	Install new rings and pistons
Excessive cylinder wear	Rebore or replace block
Excessive valve guide clearance	Worn or loose bearing
Gap Bridged	
Deposits in combustion chamber becoming fused to electrode	Clean combustion chamber of deposits
Blistered Electrode	
Engine overheating	Check cooling system
Wrong type of fuel	Replace with correct fuel
Loose spark plugs	Retighten spark plugs
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Pre-Ignition or Melted Electrodes	
Incorrect type of fuel	Replace with correct fuel
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Burned valves	Replace valves
Engine Overheating	Check cooling system
Wrong type of spark plug, too hot	Replace with correct spark plug, see ENGINE PERFORMANCE
Chipped Insulators	
Severe detonation	Check for over-advanced timing or combustion
Improper gapping procedure	Re-gap spark plugs
Rust Colored Deposits	
Additives in unleaded fuel	Try different fuel brand
Water In Combustion Chamber	
Blown head gasket or cracked head	Repair or replace head or head gasket

**NOTE:** Before diagnosing an electronic ignition system, ensure that all wiring is connected properly between distributor, wiring connector and spark plugs. Ignition problem will show up either as: Engine Will Not Start or Engine Runs Rough.

#### BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Open circuit between distributor and bulkhead connector	Repair circuit
Open circuit between bulkhead connector and ignition switch	Repair circuit
Open circuit between ignition switch and starter solenoid	Repair circuit
Engine Runs Rough	
Fuel lines leaking or clogged	Tighten fitting, remove restriction
Initial timing incorrect	Reset ignition timing see ENGINE PERFORMANCE
Centrifugal advance malfunction	Repair distributor advance
Defective spark plugs or wiring	Replace plugs or plug wiring
Component Failure	

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Spark arc-over on cap, rotor or coil	Replace cap, rotor or coil
Defective pick-up coil	Replace pick-up coil
Defective ignition coil	Replace ignition coil
Defective vacuum unit	Replace vacuum unit
Defective control module	Replace control module

### **BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS - USING OSCILLOSCOPE PATTERNS**

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
<b>Firing Voltage Lines are the Same, but Abnormally High</b>	
Retarded ignition timing	Reset ignition timing, see ENGINE PERFORMANCE section
Fuel mixture too lean	Readjust carburetor, see ENGINE PERFORMANCE
High resistance in coil wire	Replace coil wire
Corrosion in coil tower terminal	Clean and/or replace coil
Corrosion in distributor coil terminal	Clean and/or replace distributor cap
<b>Firing Voltage Lines are the Same but Abnormally Low</b>	
Fuel mixture too rich	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in coil wire causing arcing	Replace coil wire
Cracked coil tower causing arcing	Replace coil
Low coil output	Replace coil
Low engine compression	Determine cause and repair
<b>One or More, But Not All Firing Voltage Lines are Higher Than Others</b>	
Carburetor idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
EGR valve stuck open	Clean and/or replace valve
High resistance in spark plug wires	Replace spark plug wires
Cracked or broken spark plug insulator	Replace spark plugs
Intake vacuum leak	Repair leak
Defective spark plugs	Replace spark plugs
Corroded spark plug terminals	Replace spark plugs
<b>One or More, But Not All Firing Voltage Lines Are Lower Than Others</b>	
Carburetor idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in plug wires	Replace plug wires causing arcing
Cracked coil tower causing arcing	Replace coil
Low compression	Determine cause and repair
Defective spark plugs	Replace spark plugs
Corroded spark plugs	Replace spark plugs
<b>Cylinders Not Firing</b>	
Cracked distributor cap terminals	Replace distributor cap
Shorted spark plug wire	Determine cause and repair

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Mechanical problem in engine	Determine cause and repair
Defective spark plugs	Replace spark plugs
Spark plugs fouled	Replace spark plugs

### **BASIC DRIVEABILITY PROBLEMS TROUBLE SHOOTING**

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
<b>Hard Starting</b>	
Binding carburetor linkage	Eliminate binding
Binding choke linkage	Eliminate binding
Binding choke piston	Eliminate binding
Restricted choke vacuum	Check vacuum lines for blockage
Worn or dirty needle valve and seat	Clean carburetor, see ENGINE PERFORMANCE
Float sticking	Readjust or replace float see the ENGINE PERFORMANCE section
Incorrect choke adjustment	Reset choke adjustment see ENGINE PERFORMANCE
Defective coil	Replace coil
Improper spark plug gap	Regap spark plugs
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
<b>Detonation</b>	
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective spark plugs	Replace spark plugs
Fuel lines clogged	Clean fuel lines
EGR system malfunction	Check and repair EGR system
PCV system malfunction	Repair PCV system
Vacuum leaks	Check and repair vacuum system
Loose fan belts	Tighten or replace fan belts, see ENGINE PERFORMANCE
Restricted airflow	Remove restriction
Vacuum advance malfunction	Check distributor operation
<b>Dieseling</b>	
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate binding
Binding choke linkage or fast idle cam	Eliminate binding
Defective idle solenoid	Replace idle solenoid see ENGINE PERFORMANCE
Improper base idle speed	Reset idle speed, see ENGINE PERFORMANCE

CONDITION & POSSIBLE CAUSE	CORRECTION
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Incorrect idle mixture setting	Reset idle mixture, see ENGINE PERFORMANCE
Faulty Acceleration	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Engine cold and choke too lean	Adjust choke and allow engine to warm-up
Defective spark plugs	Replace spark plugs
Defective coil	Replace coil
Faulty Low Speed Operation	
Clogged idle transfer slots	Clean idle transfer slots, see FUEL
Restricted idle air bleeds and passages	Disassemble and clean carburetor, see FUEL
Clogged air cleaner	Replace air filter
Defective spark plugs	Replace spark plugs
Defective ignition wires	Replace ignition wire see ENGINE PERFORMANCE
Defective distributor cap	Replace distributor cap
Faulty High Speed Operation	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective distributor centrifugal advance	Replace advance mechanism
Defective distributor vacuum advance	Replace advance unit
Incorrect spark plugs or plug gap	Check gap and/or replace spark plugs
Faulty choke operation	Check choke and repair as required
Clogged vacuum passages	Remove restrictions
Improper size or clogged main jet	Check jet size and clean, see FUEL
Restricted air cleaner	Check filter and replace as necessary
Defective distributor cap, rotor or coil	Replace cap, rotor or coil
Misfire at All Speeds	
Defective spark plugs	Replace spark plugs
Defective spark plug wires	Replace spark plug wires
Defective distributor cap, rotor, or coil	Replace cap, rotor, or coil
Cracked or broken vacuum hoses	Replace vacuum hoses
Vacuum leaks	Repair vacuum leaks
Fuel lines clogged	Remove restriction
Hesitation	
Cracked or broken vacuum hoses	Replace vacuum hoses hoses
Vacuum leaks	Repair Vacuum leaks
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate binding



CONDITION & POSSIBLE CAUSE	CORRECTION
Binding choke linkage or fast idle cam	Eliminate binding
Improper float setting	Readjust float setting, see FUEL
Cracked or broken ignition wires	Replace ignition wires
Rough Idle, Missing or Stalling	
Incorrect curb idle or fast idle speed	Reset idle speed, see see ENGINE PERFORMANCE
Incorrect basic timing	Reset ignition timing see ENGINE PERFORMANCE
Improper idle mixture adjustment	Reset idle mixture, see ENGINE PERFORMANCE
Improper feedback system operation	Check feedback system see ENGINE PERFORMANCE
Incorrect spark plug gap	Reset spark plug gap, see ENGINE PERFORMANCE
Moisture in ignition components	Dry components
Loose or broken ignition wires	Replace ignition wires
Damaged distributor cap or or rotor	Replace distributor cap or rotor
Faulty ignition coil	Replace ignition coil
Fuel filter clogged or worn	Replace fuel filter
Damaged idle mixture screw	Replace idle mixture screw, see FUEL
Improper fast idle cam adjustment	Reset fast idle cam adjustment, see TUNE-see ENGINE PERFORMANCE
Improper EGR valve operation	Replace EGR valve
Faulty PCV valve air flow	Replace PCV valve
Choke binding or improper choke setting	Reset choke or eliminate binding
Vacuum leak	Repair vacuum leak
Improper float bowl fuel level	Reset float adjustment, see FUEL
Clogged air bleed or idle passages	Clean carburetor passages, see FUEL
Clogged or worn air cleaner filter	Replace air filter
Faulty choke vacuum diaphragm	Replace diaphragm, see ENGINE PERFORMANCE
Exhaust manifold heat valve inoperative	Replace heat valve
Improper distributor spark advance	Check distributor operation
Leaking valves or valve components	Check and repair valvetrain
Improper carburetor mounting	Remove and remount carburetor
Excessive play in distributor shaft	Replace distributor
Loose or corroded wiring connections	Repair or replace as required

CONDITION & POSSIBLE CAUSE	CORRECTION
<b>Engine Surges</b>	
Improper PCV valve airflow	Replace PCV valve
Vacuum leaks	Repair vacuum leaks
Clogged air bleeds	Remove restriction
EGR valve malfunction	Replace EGR valve
Restricted air cleaner filter	Replace air filter
Cracked or broken vacuum hoses	Replace vacuum hoses
Cracked or broken ignition wires	Replace ignition wires
Vacuum advance malfunction	Check unit and replace as necessary
Defective or fouled spark plugs	Replace spark plugs
<b>Ping or Spark Knock</b>	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Distributor centrifugal or vacuum advance malfunction	Check operation and replace as necessary
Carburetor setting too lean	Readjust mixture setting, see ENGINE PERFORMANCE
Vacuum leak	Eliminate vacuum leak
EGR valve malfunction	Replace EGR valve
<b>Poor Gasoline Mileage</b>	
Cracked or broken vacuum hoses	Replace vacuum hoses
Vacuum leaks	Repair vacuum leaks
Defective ignition wires	Replace wires
Incorrect choke setting	Readjust setting, see ENGINE PERFORMANCE
Defective vacuum advance	Replace vacuum advance
Defective spark plugs	Replace spark plugs
Binding carburetor power piston	Eliminate binding
Dirt in carburetor jets	Clean and/or replace jets
Incorrect float adjustment	Readjust float setting, see FUEL
Defective power valve	Replace power valve, see ENGINE PERFORMANCE
Incorrect idle speed	Readjust idle speed
<b>Engine Stalls</b>	
Improper float level	Readjust float level
Leaking needle valve and seat	Replace needle valve and seat
Vacuum leaks	Eliminate vacuum leaks

## VACUUM PUMP - DIESEL TROUBLE SHOOTING

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**NOTE:** Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

### VACUUM PUMP (DIESEL) TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

## MANUAL TRANSMISSION

### MANUAL TRANSMISSION TROUBLE SHOOTING

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### MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low gear oil level, Loose bell housing bolts, Worn bearings or gears
Clunk On Deceleration (FWD Only)	Loose engine mounts, Worn inboard CV joints, Worn differential pinion shaft, Side gear hub counterbore in case worn oversize
Gear Clash When Shifting Forward Gears	Clutch Out Of Adjustment, Shift linkage damaged or out of adjustment, Gears or synchronizers damaged, Low gear oil level
Transmission Noisy When Moving (RWD Only) Quiet In Neutral With Clutch Engaged	Worn rear outputshaft bearing
Gear Rattle	Worn bearings, Wrong gear oil, Low gear oil, Worn gears
Steady Ticking At Idle (Increases With RPM)	Broken tooth on gear
Gear Clash When Shifting Forward Gears	Worn or broken synchronizers
Loud Whine In Reverse	Normal condition (1)
Noise When Stepping On Clutch	Bad release bearing, Worn pilot bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty release bearing, Uneven pressure plate fingers
Click Or Snap When Clutch Is Engaged	Worn clutch fork, Worn or broken front bearing retainer
Transmission Shifts Hard	Clutch not releasing, Shift mechanism binding, Clutch installed backwards
Will Not Shift Into One Gear, Shifts Into All Others	Bent shift fork, Worn detent balls
Locked Into Gear, Cannot Shift	Clutch adjustment, Worn detent balls

Condition	Possible Cause
Transmission Jumps Out Of Gear	Pilot bearing worn, Bent shift fork, Worn gear teeth or face, Excessive gear train end play, Worn synchronizers, Missing detent ball spring, Shift mechanism worn or out of adjustment, Engine or transmission mount bolts loose or out of adjustment, Transmission not aligned
Shift Lever Rattle	Worn shift lever or detents, Worn shift forks, Worn synchronizers sleeve
Shift Lever Hops Under Acceleration	Worn engine or transmission mounts
(1) Most units use spur cut gears in reverse and are noisy	

## POWERTRAIN

### CLUTCH TROUBLE SHOOTING

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#### BASIC CLUTCH TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Chattering or Grabbing	
Incorrect clutch adjustment	Adjust clutch
Oil, grease or glaze on facings	Disassemble and clean or replace
Loose "U" joint flange	See DRIVE AXLES article
Worn input shaft spline	Replace input shaft
Binding pressure plate	Replace pressure plate
Binding release lever	See CLUTCH article
Binding clutch disc hub	Replace clutch disc
Unequal pressure plate contact	Replace worn/misaligned components
Loose/bent clutch disc	Replace clutch disc
Incorrect transmission alignment	Realign transmission
Worn pressure plate, disc or flywheel	Replace damaged components
Broken or weak pressure springs	Replace pressure plate
Sticking clutch pedal	Lubricate clutch pedal & linkage
Incorrect clutch disc facing	Replace clutch disc
Engine loose in chassis	Tighten all mounting bolts
Failure to Release	
Oil or grease on clutch facings	Clean or replace clutch clutch disc
Incorrect release lever or pedal adjustment	See CLUTCH article
Worn or broken clutch facings	Replace clutch disc
Bent clutch disc or pressure plate	Replace damaged components
Clutch disc hub binding on input shaft	Clean or replace clutch disc and/or input shaft
Binding pilot bearing	Replace pilot bearing

CONDITION & POSSIBLE CAUSE	CORRECTION
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Binding clutch cable	See CLUTCH article
Defective clutch master	Replace master cylinder
Defective clutch slave	Replace slave cylinder
Air in hydraulic system	Bleed hydraulic system
<b>Rattling</b>	
Weak or broken release lever spring	Replace spring and check alignment
Damaged pressure plate	Replace pressure plate
Broken clutch return spring	Replace return spring
Worn splines on clutch disc or input shaft	Replace clutch disc and/or input shaft
Worn clutch release bearing	Replace release bearing
Dry or worn pilot bearing	Lubricate or replace pilot bearing
Unequal release lever contact	Align or replace release lever
Incorrect pedal free play	Adjust free play
Warped or damaged clutch disc	Replace damaged components
<b>Slipping</b>	
Pressure springs worn or	Release pressure plate
Oily, greasy or worn facings	Clean or replace clutch disc
Incorrect clutch alignment	Realign clutch assembly
Warped clutch disc or pressure plate	Replace damaged components
Binding release levers or clutch pedal	Lubricate and/or replace release components
<b>Squeaking</b>	
Worn or damaged release	Replace release bearing
Dry or worn pilot or release bearing	Lubricate or replace assembly
Pilot bearing turning in crankshaft	Replace pilot bearing and/or crankshaft
Worn input shaft bearing	Replace bearing and seal
Incorrect transmission alignment	Realign transmission
Dry release fork between pivot	Lubricate release fork and pivot
<b>Heavy and/or Stiff Pedal</b>	
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Dry or binding clutch pedal hub	Lubricate and align components
Floor mat interference with pedal	Lay mat flat in proper area
Dry or binding ball/fork pivots	Lubricate and align components
Faulty clutch cable	Replace clutch cable
<b>Noisy Clutch Pedal</b>	
Faulty interlock switch	Replace interlock switch
Self-adjuster ratchet noise	Lubricate or replace self-adjuster
Speed control interlock switch	Lubricate or replace interlock switch

CONDITION & POSSIBLE CAUSE	CORRECTION
Clutch Pedal Sticks Down	
Binding clutch cable	See CLUTCH article
Springs weak in pressure plate	Replace pressure plate
Binding in clutch linkage	Lubricate and free linkage
Noisy	
Dry release bearing	Lubricate or replace release bearing
Dry or worn pilot bearing	Lubricate or replace bearing
Worn input shaft bearing	Replace bearing
Transmission Click	
Weak springs in pressure	Replace pressure plate plate
Release fork loose on ball stud	Replace release fork and/or ball stud
Oil on clutch disc damper	Replace clutch disc
Broken spring in slave cylinder	Replace slave cylinder

## DRIVE AXLE - NOISE DIAGNOSIS

### Unrelated Noises

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. Ensure cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any of its parts.

### Non-Drive Axle Noises

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and wheel trim rings.

In certain conditions, the pitch of the exhaust gases may e gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings also can cause a whistling or whining noise. Ensure none of these components are causing the noise before disassembling the drive axle.

### Gear Noise

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear ke sure that tires, exhaust, and vehicle trim have been checked as possible causes.

### Chuckle

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused ive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough the cause the noise.



This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

### **Knock**

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

### **Clunk**

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in Drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in Drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, drive axle is not the source of clunk noise.

### **Bearing Whine**

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at drive shaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

### **Bearing Rumble**

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of drive shaft speed.

### **Chatter On Turns**

This is a condition where the entire front or rear of vehicle vibrates when vehicle is moving. The vibration is plainly felt as well as heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates this chatter.

### **Axle Shaft Noise**

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (Drive, cruise, coast and float), and will persist with transmission in Neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect parts, replace wheel seals and install a new set of bearings. Re-evaluate vehicle for noise before removing any internal components.

### **Vibration**

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Resonance vibrations of the body and frame structures caused by rotating of unbalanced parts.

- Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

## DRIVE AXLE - RWD TROUBLE SHOOTING

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### DRIVE AXLE (RWD) TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Knocking or Clunking	
Differential Side Gear Clearance	Check Clearance
Worn Pinion Shaft	Replace Pinion Shaft
Axle Shaft End Play	Check End Play
Missing Gear Teeth	Check Differential/Replace Gear
Wrong Axle Backlash	Check Backlash
Misaligned Driveline	Realign Driveline
Clinking During Engagement	
Side Gear Clearance	Check Clearance
Ring and Pinion Backlash	Check Backlash
Worn/Loose Pinion Shaft	Replace Shaft/Bearing
Bad "U" Joint	Replace "U" Joint
Sticking Slip Yoke	Lube Slip Yoke
Broken Rear Axle Mount	Replace Mount
Loose Drive Shaft Flange	Check Flange
Click/Chatter On Turns	
Differential Side Gear Clearance	Check Clearance
Wrong Turn On Plates (1)	Replace Clutch Plates
Wrong Differential Lubricant (1)	Change Lubricant
Knock Or Click	
Flat Spot on Rear Wheel Bearing	Replace Wheel Bearing
Low Vibration At All Speeds	
Faulty Wheel Bearing	Replace Wheel Bearing
Faulty "U" Joint	Replace "U" Joint
Faulty Drive Shaft	Balance Drive Shaft
Faulty Companion Flange	Replace Flange
Faulty Slip Yoke Flange	Replace Flange
(1) Limited slip differential only.	

## FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING

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### BASIC FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING CHART

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CONDITION	POSSIBLE CAUSE
Grease Leaks	CV boot torn or cracked
Clicking Noise on Cornering	Damaged outer CV
Clunk Noise on Acceleration	Damaged inner CV
Vibration or Shudder on Acceleration	Sticking, damaged or worn CV Misalignment or spring height

## STEERING & SUSPENSION

### MANUAL STEERING GEAR TROUBLE SHOOTING

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#### BASIC MANUAL STEERING GEAR TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise in Rack and Pinion	
Rack and pinion mounting bracket loose	Tighten all mounting bolts
Lack of/or incorrect lubricant	Correct as necessary
Steering gear mounting bolts loose	Tighten all mounting bolts
Excessive Play	
Front wheel bearing improperly adjusted	See FRONT SUSPENSION article
Loose or worn steering linkage	See STEERING LINKAGE article
Loose or worn steering gear shift	See MANUAL STEERING GEAR article
Steering arm loose on gear shaft	See MANUAL STEERING GEAR article
Steering gear housing bolts loose	Tighten all mounting bolts
Steering gear adjustment too loose	See MANUAL STEERING GEAR article
Steering arms loose on knuckles	Tighten and check steering linkage
Rack and pinion mounting loose	Tighten all mounting bolts
Rack and pinion out of adjustment	See adjustment in STEERING article
Tie rod end loose	Tighten and check steering linkage
Excessive Pitman shaft-to-ball nut lash	Repair as necessary
Poor Returnability	
Lack of lubricant in ball joint or linkage	Lubricate and service systems
Binding in linkage or ball joints	See STEERING LINKAGE and SUSPENSION article
Improper front end alignment	See WHEEL ALIGNMENT article
Improper tire pressure	Inflate to proper pressure
Tie rod binding	Inflate to proper pressure
Shaft seal rubbing shaft	See STEERING COLUMN article

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Vertical Motion	
Improper tire pressure	Inflate to proper pressure
Tires, wheels or rotors out of balance	Balance tires then check wheels and rotors
Worn or faulty shock absorbers	Check and replace if necessary
Loose tie rod ends or steering	Tighten or replace if necessary
Loose or worn wheel bearings	See SUSPENSION article
Steering Pulls to One Side	
Improper tire pressure	Inflate to proper pressure
Front tires are different sizes	Rotate or replace if necessary
Wheel bearings not adjusted properly	See FRONT SUSPENSION article
Bent or broken suspension components	See FRONT SUSPENSION article
Improper wheel alignment	See WHEEL ALIGNMENT article
Brakes dragging	See BRAKES article
Instability	
Low or uneven tire pressure	Inflate to proper pressure
Loose or worn wheel bearings	See FRONT SUSPENSION article
Loose or worn idler arm bushing	See FRONT SUSPENSION article
Loose or worn strut bushings	See FRONT SUSPENSION article
Incorrect front wheel alignment	See WHEEL ALIGNMENT article
Steering gear not centered	See MANUAL STEERING GEARS article
Springs or shock	Check and replace if necessary
Improper cross shaft	See MANUAL STEERING GEARS article

## POWER STEERING TROUBLE SHOOTING

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

### BASIC POWER STEERING TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise	
Pressure hoses touching engine parts	Adjust to proper clearance
Loose Pitman shaft	Adjust or replace if necessary
Tie rods ends or Pitman arm loose	Tighten and check system
Rack and pinion mounts loose	Tighten all mounting bolts

CONDITION & POSSIBLE CAUSE	CORRECTION
Free play in worm gear	See POWER STEERING GEAR article
Loose sector shaft or thrust bearing adjustment	See POWER STEERING GEAR
Free play in pot coupling	See STEERING COLUMN article
Worn shaft serrations	See STEERING COLUMN article
<b>Growl in Steering Pump</b>	
Excessive pressure in hoses	Restricted hoses, see POWER STEERING GEAR article
Scored pressure plates	See POWER STEERING GEAR article
Scored thrust plates or rotor	See POWER STEERING GEAR article
Extreme wear of cam ring	See POWER STEERING GEAR article
<b>Rattle in Steering Pump</b>	
Vanes not installed	See POWER STEERING PUMP article
Vanes sticking in rotor	See POWER STEERING PUMP article
<b>Swish noise in Pump</b>	
Defective flow control valve	See POWER STEERING PUMP article
<b>Groan in Steering Pump</b>	
Air in fluid	See POWER STEERING PUMP article
Poor pressure hose connection	Tighten and check, replace if necessary
<b>Squawk When Turning</b>	
Damper "O" ring on valve spool cut	See POWER STEERING PUMP article
<b>Moan or Whine in Pump</b>	
Pump shaft bearing scored	Replace bearing and fluid
Air in fluid or fluid level low	See POWER STEERING PUMP article
Hose or column grounded	Check and replace if necessary
Cover "O" ring missing or damaged	See POWER STEERING PUMP article
Valve cover baffle missing or damaged	See POWER STEERING PUMP article
Interference of components in pump	See POWER STEERING PUMP article
Loose or poor bracket alignment	Correct or replace if necessary
<b>Hissing When Parking</b>	
Internal leakage in steering gear	Check valved assembly first
<b>Chirp in Steering Pump</b>	
Loose or worn power steering belt	Adjust or replace if necessary
<b>Buzzing When Not Steering</b>	

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Noisy pump	See POWER STEERING PUMP article
Free play in steering shaft bearing	See STEERING COLUMN article
Bearing loose on shaft serrations	See STEERING COLUMN article
<b>Clicking Noise in Pump</b>	
Pump slippers too long	See POWER STEERING PUMP article
Broken slipper springs	See POWER STEERING PUMP article
Excessive wear or nicked rotors	See POWER STEERING PUMP article
Damaged cam contour	See POWER STEERING PUMP article
<b>Poor Return of Wheel</b>	
Wheel rubbing against turn signal	See STEERING COLUMN SWITCHES article
Flange rubbing steering gear adjuster	See STEERING COLUMN article
Tight or frozen steering shaft bearing	See STEERING COLUMN article
Steering gear out of adjustment	See POWER STEERING GEAR article
Sticking or plugged spool valve	See POWER STEERING PUMP article
Improper front end alignment	See WHEEL ALIGNMENT article
Wheel bearings worn or loose	See FRONT SUSPENSION article
Ties rods or ball joints binding	Check and replace if necessary
Intermediate shaft joints binding	See STEERING COLUMN article
Kinked pressure hoses	Correct or replace if necessary
Loose housing head spanner nut	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Sector shaft adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Worm thrust bearing adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Reaction ring sticking in cylinder	See POWER STEERING GEAR article
Reaction ring sticking in housing head	See POWER STEERING GEAR article
Steering pump internal leakage	See POWER STEERING PUMP article
Steering gear-to-column misalignment	See STEERING COLUMN article
Lack of lubrication in linkage	Service front suspension



<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Lack of lubrication in ball joints	Service front suspension
<b>Increased Effort When Turning Wheel Fast Foaming, Milky Power Steering Fluid, Low Fluid Level or Low Pressure</b>	
High internal pump leakage	See POWER STEERING PUMP article
Power steering pump belt slipping	Adjust or replace if necessary
Low fluid level	Check and fill to proper level
Engine idle speed too low	Adjust to correct setting
Air in pump fluid system	See POWER STEERING PUMP article
Pump output low	See POWER STEERING PUMP article
Steering gear malfunctioning	See POWER STEERING GEAR article
<b>Wheel Surges or Jerks</b>	
Low fluid level	Check and fill to proper level
Loose fan belt	Adjust or replace if necessary
Insufficient pump pressure	See POWER STEERING PUMP article
Sticky flow control valve	See POWER STEERING PUMP article
Linkage hitting oil pan at full turn	Replace bent components
<b>Kick Back or Free Play</b>	
Air in pump fluid system	See POWER STEERING PUMP article
Worn poppet valve in steering gear	See POWER STEERING PUMP article
Excessive over center lash	See POWER STEERING GEAR article
Thrust bearing out of adjustment	See POWER STEERING GEAR article
Free play in pot coupling	See POWER STEERING PUMP article
Steering gear coupling loose on shaft	See POWER STEERING PUMP article
Steering disc mounting bolts loose	Tighten or replace if necessary
Coupling loose on worm shaft	Tighten or replace if necessary
Improper sector shaft adjustment	See POWER STEERING GEAR article
Excessive worm piston side play	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Universal joint loose	Tighten or replace if necessary
Defective rotary valve	See POWER STEERING GEAR article
<b>No Power When Parking</b>	

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Sticking flow control valve	See POWER STEERING PUMP article
Insufficient pump pressure output	See POWER STEERING PUMP article
Excessive internal pump leakage	See POWER STEERING PUMP article
Excessive internal gear leakage	See POWER STEERING PUMP article
Flange rubs against gear adjust plug	See STEERING COLUMN article
Loose pump belt	Adjust or replace if necessary
Low fluid level	Check and add proper amount of fluid
Engine idle too low	Adjust to correct setting
Steering gear-to-column misaligned	See STEERING COLUMN article
<b>No Power, Left Turn</b>	
Left turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Left turn reaction seal damaged/missing	See POWER STEERING GEAR article
Cylinder head "O" ring damaged	See POWER STEERING PUMP article
<b>No Power, Right Turns</b>	
Column pot coupling bottomed	See STEERING COLUMN article
Right turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Right turn reaction seal damaged	See POWER STEERING GEAR article
Internal leakage through piston end plug	See POWER STEERING GEAR article
Internal leakage through side plugs	See POWER STEERING GEAR article
<b>Lack of Effort in Turning</b>	
Left and/or right reaction seal sticking in cylinder head	Replace, see POWER STEERING GEAR article
<b>Wanders to One Side</b>	
Front end alignment incorrect	See WHEEL ALIGNMENT article
Unbalanced steering gear valve	See POWER STEERING GEAR article
<b>Low Pressure Due to Steering Pump</b>	
Flow control valve stuck or inoperative	See POWER STEERING PUMP article
Pressure plate not flat against cam ring	See POWER STEERING PUMP article
Extreme wear of cam ring	Replace and check adjustments
Scored plate, thrust plate or rotor	See POWER STEERING PUMP article
Vanes not installed properly	See POWER STEERING PUMP article

CONDITION & POSSIBLE CAUSE	CORRECTION
Vanes sticking in rotor slots	See POWER STEERING PUMP article
Cracked/broken thrust or pressure plate	See POWER STEERING PUMP article

## STEERING COLUMN TROUBLE SHOOTING

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### BASIC STEERING COLUMN TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
<b>Noise in Steering</b>	
Coupling pulled apart	See STEERING COLUMNS article
Column not correctly aligned	See STEERING COLUMNS article
Broken lower joint	Replace joint
Horn contact ring not	See STEERING COLUMN article
Bearing not lubricated	See STEERING COLUMN article
Shaft snap ring not properly seated	Reseat or replace snap ring
Plastic spherical joint not lubricated	See STEERING COLUMN article
Shroud or housing loose	Tighten holding screws
Lock plate retaining ring not seated	See STEERING COLUMN article
Loose sight shield	Tighten holding screws
<b>High Steering Shaft Effort</b>	
Column assembly misaligned	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Tight steering universal joint	See STEERING COLUMN article
<b>High Shift Effort</b>	
Column is out of alignment	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Seals or bearings not lubricated	See STEERING COLUMNS article
Mounting bracket screws too long	Replace with new shorter screws
Burrs on shift tube	Remove burrs or replace tube
Lower bowl bearing assembled wrong	See STEERING COLUMN article
Shift tube bent or broken	Replace as necessary
Improper adjustment of shift levers	See STEERING COLUMN article
<b>Improper Trans. Shifting</b>	
Sheared shift tube joint	Replace as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Sheared lower shaft lever	Replace as necessary
Improper shift lever adjustment	See STEERING COLUMN article
Improper gate plate adjustment	See STEERING COLUMN article
Excess Play in Column	
Instrument panel bracket bolts loose	Tighten bolts and check bracket
Broken weld nut on jacket	See STEERING COLUMN article
Instrument bracket capsule sheared	See STEERING COLUMN article
Column bracket/jacket bolts loose	Tighten bolts and check bracket
Steering Locks in Gear	
Release lever mechanism	See STEERING COLUMN article

## SUSPENSION TROUBLE SHOOTING

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### BASIC SUSPENSION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Front End Noise	
Loose or worn wheel	See Wheel Bearing Adjustment in SUSPENSION
Worn shocks or shock mountings	Replace struts or strut mountings
Worn struts or strut mountings	Replace struts or strut mountings
Loose or worn lower control arm	See SUSPENSION
Loose steering gear-to-frame bolts	See STEERING
Worn control arm bushings	See SUSPENSION
Ball joints not lubricated	Lubricate ball joints & see Ball Joint Checking in SUSPENSION
Front Wheel Shake, Shimmy, or Vibration	
Tires or wheels out of balance	Check tire balance
Incorrect wheel alignment	See WHEEL ALIGNMENT
Drive shaft unbalanced	Check drive shaft balance
Loose or worn wheel bearings	See WHEEL ALIGNMENT
Loose or worn tie rod ends	See SUSPENSION
Worn upper ball joints	See Ball Joint Checking in SUSPENSION
Worn shock absorbers	Replace shock absorbers
Worn strut bushings	Replace strut bushings
Car Pulls to One Side	

CONDITION & POSSIBLE CAUSE	CORRECTION
Mismatched or uneven tires	Check tire condition
Broken or sagging springs	See SUSPENSION
Loose or worn strut bushings	See SUSPENSION
Improper wheel alignment	See WHEEL ALIGNMENT
Improper rear axle alignment	Check rear axle alignment
Power steering gear unbalanced	See STEERING
Front brakes dragging	See BRAKES
<b>Abnormal Tire Wear</b>	
Unbalanced tires	Check tire balance & rotation
Sagging or broken springs	See SUSPENSION
Incorrect front end alignment	See WHEEL ALIGNMENT
Faulty shock absorbers	Replace shock absorbers
<b>Scuffed Tires</b>	
Toe-In incorrect	See WHEEL ALIGNMENT
Suspension arm bent or twisted	See appropriate SUSPENSION article
<b>Springs Bottom or Sag</b>	
Bent or broken springs	See SUSPENSION
Leaking or worn shock absorbers	Replace shock absorbers
Frame misalignment	Check frame for damage
<b>Spring Noises</b>	
Loose "U" Bolts	See SUSPENSION
Loose or worn bushings	See SUSPENSION
Worn or missing interliners	See SUSPENSION
<b>Shock Absorber Noise</b>	
Loose shock mountings	Check & tighten mountings
Worn bushings	Replace bushings
Air in system	Bleed air from system
Undercoating on shocks	Remove undercoating
<b>Car Leans or Sways on Corners</b>	
Loose stabilizer bar	See SUSPENSION
Faulty shocks or mountings	Replace shocks or mountings
Broken or sagging springs	See SUSPENSION
<b>Shock Absorbers Leaking</b>	
Worn seals or reservoir tube crimped	See SUSPENSION
<b>Broken Springs</b>	
Loose "U" bolts	See SUSPENSION
Inoperative shock absorbers	Replace shock absorbers

## WHEEL ALIGNMENT TROUBLE SHOOTING

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**BASIC WHEEL ALIGNMENT TROUBLE SHOOTING CHART**

<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
<b>Premature Tire Wear</b>	
Improper tire inflation	Check tire pressure
Front alignment out of tolerance	See ALIGNMENT SPECS in WHEEL ALIGNMENT section
Suspension components worn	See SUSPENSION section
Steering system components worn	See STEERING section
Improper standing height	See WHEEL ALIGNMENT
Uneven or sagging springs	See SUSPENSION section
Bent wheel	See WHEEL ALIGNMENT
Improper torsion bar adjustment	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARING ADJ. in SUSPENSION section
Worn or defective shock	Replace shock absorbers
Tires out of balance	Check tire balance
<b>Pulls to One Side</b>	
Improper tire inflation	Check tire pressure
Brake dragging	See BRAKE section
Mismatched tires	See WHEEL ALIGNMENT
Broken or sagging spring	See SUSPENSION section
Broken torsion bar	See SUSPENSION section
Power steering valve not centered	See STEERING section
Front alignment out of tolerance	See WHEEL ALIGNMENT section
Defective wheel bearing	See WHEEL BEARINGS in SUSPENSION section
Uneven sway bar links	See SUSPENSION section
Frame bent	Check for frame damage
Steering system bushing worn	See STEERING section
<b>Hard Steering</b>	
Idler arm bushing too tight	See STEERING LINKAGE in STEERING section
Ball joint tight or seized	See SUSPENSION section
Steering linkage too tight	See STEERING LINKAGE in STEERING section
Power steering fluid low	Add proper amount of fluid
Power steering drive belt loose	See STEERING section
Power steering pump defective	See STEERING section
Steering gear out of adjustment	See STEERING section
Incorrect wheel alignment	See WHEEL ALIGNMENT
Damaged steering gear	See STEERING section
Damaged suspension	See SUSPENSION section
Bent steering knuckle or supports	See SUSPENSION section
<b>Vehicle "Wanders"</b>	
Strut rod or control arm bushing worn	See SUSPENSION section



<b>CONDITION &amp; POSSIBLE CAUSE</b>	<b>CORRECTION</b>
Loose or worn wheel bearings	See WHEEL BEARINGS in SUSPENSION section
Improper tire inflation	Check tire pressure
Stabilizer bar missing or defective	See SUSPENSION section
Wheel alignment out of tolerance	See Adjustment in WHEEL ALIGNMENT section
Broken spring	See SUSPENSION section
Defective shock absorber	Replace shock absorbers
Worn steering & suspension components	See SUSPENSION section
<b>Front End Shimmy</b>	
Tire out of balance/round	Check tire balance
Excessive wheel runout	See WHEEL ALIGNMENT
Insufficient or improper caster	See WHEEL ALIGNMENT section
Worn suspension or steering components	See SUSPENSION section
Defective shock absorbers	Replace shock absorber
Wheel bearings worn or loose	See WHEEL BEARING ADJ. in SUSPENSION section
Power steering reaction Bracket loose	See STEERING section
Steering gear box (rack) mounting loose	See STEERING section
Steering gear adjustment loose	See STEERING section
Worn spherical joints	See SUSPENSION section
<b>Toe-In Not Adjustable</b>	
Lower control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
<b>Camber Not Adjustable</b>	
Control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Hub & bearing not seated properly	See SUSPENSION section

## GENERAL INFORMATION

### TROUBLE SHOOTING

#### **\* PLEASE READ THIS FIRST \***

**NOTE:** This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

#### **ENGINE PERFORMANCE**

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#### **TUNE-UP TROUBLE SHOOTING**

<b>Problem &amp; Possible Cause</b>	<b>Action</b>
<b>Carbon Fouled Plugs</b>	
Clogged Air Filter	Replace Air Filter
Incorrect Idle Speed	Reset Idle Speed
Faulty Ignition Wiring	Replace Ignition Wiring
Sticky Valves/Worn Valve Seal	Check Valve Train
Fuel Injection Operation	Check Fuel Injection
<b>Wet/Oil Fouled Plugs</b>	
Worn Rings/Pistons	Overhaul/Replace Engine
Excessive Cylinder Wear	Overhaul/Replace Engine
<b>Plug Gap Bridged</b>	
Combustion Chamber Carbon Deposits	Clean Combustion Chamber
<b>Blistered Electrode</b>	
Engine Overheating	Check Cooling System
Loose Spark Plugs	Clean/Torque Plugs
Over-Advanced Timing	Reset Timing
Wrong Plug Heat Range	Install Correct Plug
<b>Melted Electrodes</b>	
Incorrect Timing	Reset Timing
Burned Valves	Replace Valves
Engine Overheating	Check Cooling System
Wrong Plug Heat Range	Install Correct Plug
<b>Engine Won't Start</b>	
Loose Connections	Check Connections
No Power	Check Fuses/Battery
Loose/Worn Timing Belt/Chain/Gears	Check Belt/Chain/Gears
<b>Engine Runs Rough</b>	
Leaky/Clogged Fuel Injectors	Repair Fuel Injectors

<b>Problem &amp; Possible Cause</b>	<b>Action</b>
Leaky/Clogged Fuel Lines	Repair Fuel Lines
Clogged Fuel Filter	Replace Fuel Filter
Incorrect Timing	Reset Timing/Check Advance
Faulty Plugs/Wires	Replace Plugs/Wires
Uneven Compression	Overhaul/Replace Engine
<b>Poor Acceleration</b>	
Incorrect Ignition Timing	Reset Timing
Leaky Valves	Check Compression
<b>Component Failure</b>	
Spark Arcing	Replace Faulty Part
Defective Pick-Up Coil	Replace Pick-Up Coil
Defective Ignition Coil	Replace Ignition Coil
Defective Control Unit	Replace Control Unit
<b>Ignition Diagnosis By Scope Pattern</b>	
<b>All Firing Lines Abnormally High</b>	
Retarded Ignition Timing	Reset Ignition Timing
Lean Air/Fuel Mixture	Adjust Fuel Mixture
High Secondary Resistance	Repair Secondary Ignition
<b>All Firing Lines Abnormally Low</b>	
Rich Air/Fuel Mixture	Adjust Air/Fuel Mixture
Arcing Coil Wire	Replace Coil Wire
Cracked Coil	Replace Coil
Low Coil Output	Replace Coil
Low Compression	Check/Repair Engine
<b>Several High Firing Lines</b>	
Fuel Mixture Unbalanced	Check Fuel System
EGR Valve Stuck Open	Clean/Replace EGR Valve
High Plug Wire Resistance	Replace Plug Wire
Cracked/Broken Plugs	Replace Plugs
Intake Vacuum Leak	Repair Leak
<b>Several Low Firing Lines</b>	
Fuel Mixture Unbalanced	Adjust Fuel Mixture
Plug Wires Arcing	Replace Plug Wires
Cracked Coil Arcing	Replace Coil
Uneven Compression	Check/Repair Engine
Faulty Spark Plugs	Replace Plugs
<b>Cylinders Not Firing</b>	
Cracked Distributor Cap	Replace Cap

<b>Problem &amp; Possible Cause</b>	<b>Action</b>
Shorted Plug Wires	Replace Plug Wires
Mechanical Engine Fault	Check/Repair Engine
Spark Plugs Fouled	Replace Plugs
Carbon Track in Distributor Cap	Replace Cap
<b>Hard Starting</b>	
Defective Ignition Coil(s)	Replace Coil(s)
Fouled Spark Plugs	Replace Plugs
Incorrect Timing	Reset Ignition Timing

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### FUEL INJECTION TROUBLE SHOOTING

<b>Problem &amp; Possible Cause</b>	<b>Action</b>
Cold Start Valve Inoperative	Test Cold Start Valve
Poor Vacuum/Electrical Connection	Repair Connections
Contaminated Fuel	Test Fuel for Water/Alcohol
Bad Fuel Pump Relay/Circuit	Test Relay/Wiring
Battery Voltage Low	Charge/Test Battery
Low Fuel Pressure	Test Press. Regulator/Pump
No Distributor Reference Pulse	Repair Ignition System
Coolant Temp. Sensor Defective	Test Temp. Sensor/Circuit
No Power To Injectors	Check Injector Fuse/Relay
<b>Hard Starting</b>	
Defective Idle Air Control (IAC)	Test IAC and Circuit
EGR Valve Open	Test EGR Valve/Control Circuit
Restricted Fuel Lines	Inspect/Replace Fuel Lines
Poor MAP Sensor Signal	Test MAP Sensor/Circuit
Engine Stalls During Parking Maneuver	Check P.S. Press. Switch
<b>Rough Idle</b>	
Dirty Fuel Injectors	Clean/Replace Injectors
Poor MAP Sensor Signal	Test MAP Sensor/Circuit
Intermittent Fuel Injector Operation	Check Harness Connectors
Erratic Vehicle Speed Sensor Inputs	Harness Too Close to Plug Wires
Poor O <sub>2</sub> Sensor Signal	Test O <sub>2</sub> Sensor/Circuit
Faulty PCV System	Check PCV Valve and Hoses
<b>Poor Acceleration</b>	
Weak Fuel Pump	Replace Fuel Pump

<b>Problem &amp; Possible Cause</b>	<b>Action</b>
Dirty Fuel Injectors	Clean/Replace Injectors
Excessive Intake Valve Deposits	Clean Intake System
<b>Poor High Speed Operation</b>	
Low Fuel Pump Volume	Faulty Fuel Pump/Filter
Poor MAP Sensor Signal	Test Speed Sensor/Circuit
<b>Acceleration Ping/Knock</b>	
Faulty EGR System	Check EGR Valve and Hoses
Poor Knock Sensor Signal	Test Knock Sensor/Circuit
Poor Baro Sensor Signal	Test Baro Sensor/Circuit
Improper Ignition Timing	Adjust Timing
Engine Overheating	Check Cooling System
Poor Quality Fuel	Use Different Fuel
Carbon Build-Up	Decarbon Engine

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## GENERAL INFORMATION

### INTRODUCTION

Mitchell1® obtains wiring diagrams and technical service bulletins, containing wiring diagram changes, from the domestic and import manufacturers. These are checked for accuracy and are all redrawn into a consistent format for easy use. All system wiring diagrams are available in color format and may be viewed and or printed in color or black and white, depending on your program settings and available printer hardware.

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires, and diagrams seldom exceeded 4 pages in length. Today, some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Removing some of the wiring maze reduces eyestrain and time wasted searching across several pages. Today, the majority of Mitchell1® diagrams follow a much improved format, which permits space for internal switch details, and component and ground locations.

Components shown with a dashed line instead of a solid line indicate not all circuits are shown in this particular diagram (circuits shown in system diagrams are typically applicable to that system only). The remaining circuits connected to that component will be shown in the appropriate system that they apply to.

Today, the wiring diagram necessary to support a given repair procedure is included within that article or a link is provided to the appropriate SYSTEM WIRING DIAGRAM article. For example, the wiring diagram for a Ford EEC-IV system may be included in ENGINE PERFORMANCE and WIRING DIAGRAMS articles for Ford Motor Co. The wiring diagram for a cruise control system may be included in ACCESSORIES & EQUIPMENT section for the specific vehicle manufacturer, and the wiring diagram for an anti-lock brake system may be included in BRAKES and WIRING DIAGRAMS for the specific manufacturer.

WIRING DIAGRAMS contains all wiring diagrams not included in STARTING & CHARGING SYSTEMS and ACCESSORIES & EQUIPMENT. This includes: Data Link Connectors, Ground Distribution, Power Distribution, Engine Performance, Electric Cooling Fans, Anti-Lock Brakes, Electronic Suspension and Electronic Steering wiring diagrams. The Data Link Connectors wiring diagrams show the circuits by which the various on-board computers exchange information, and the diagnostic connectors used for diagnosis and their location. The Ground Distribution wiring diagrams show all vehicle ground points, their location, and the components common to those ground points. The Power Distribution wiring diagrams show the power feed circuits and the components common to those power feeds.

Wiring diagrams used to support the information in ACCESSORIES & EQUIPMENT are drawn in a "top-down" format. The diagrams are drawn with the power source at the top of the diagram and the ground point at the bottom of the diagram. Component locations are identified on the wiring diagrams. Any wires that do not connect directly to a component are identified on the diagram to indicate where they go.

### WIRING DIAGRAM COLOR ABBREVIATIONS

#### COLOR ABBREVIATIONS

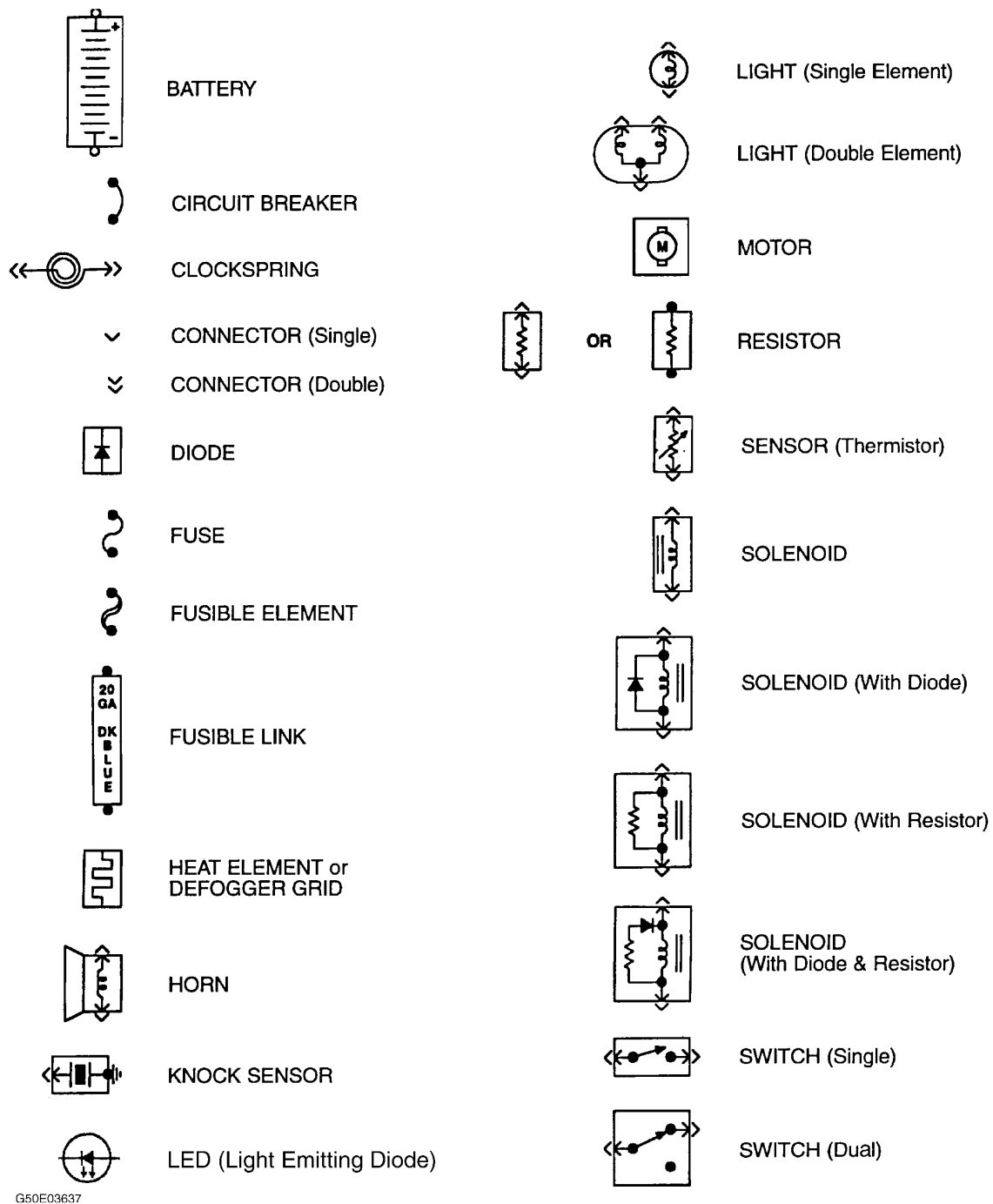
Color	Normal	Optional	Misc. Euro Models
Black	BLK	BK	B
Blue	BLU	BU	U
Brown	BRN	BN	N
Clear	CLR	CR	L



<b>Color</b>	<b>Normal</b>	<b>Optional</b>	<b>Misc. Euro Models</b>
Dark Blue	DK BLU	DK BU	-
Dark Green	DK GRN	DK GN	-
Green	GRN	GN	G
Gray	GRY	GY	S
Light Blue	LT BLU	LT BU	-
Light Green	LT GRN	LT GN	-
Orange	ORG	OG	O
Pink	PNK	PK	K
Purple	PPL	PL	P
Red	RED	RD	R
Tan	TAN	TN	-
Violet	VIO	VI	-
White	WHT	WT	W
Yellow	YEL	YL	Y

## **WIRING DIAGRAM SYMBOLS**

**NOTE:** Standard wiring symbols are used on all wiring diagrams. The list below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.

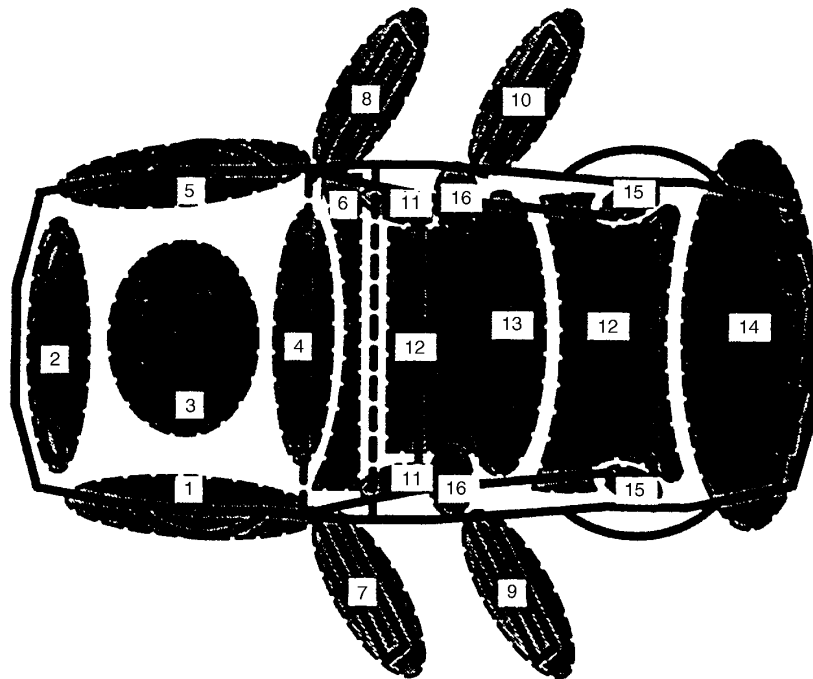


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**Fig. 1: Identifying Standard Wiring Diagram Symbols**

## WIRING DIAGRAM GROUND NUMBER LOCATIONS

**NOTE:** The following illustration depicts standardized ground numbers and locations to be used in conjunction with Mitchell's <sup>®</sup> wiring diagrams applying to 2001 and prior model years only. See [Fig. 2](#). Wiring diagrams applying to newer model years depict manufacturer-specified ground numbers and locations. Do not utilize the illustration with 2002 and newer model year wiring diagrams.



- |   |   |  |
|---|---|--|
| <p><b>1) Left Fender</b><br/>           G100 ..... Front Of Fender<br/>           G102 ..... On Shock Tower<br/>           G104 ..... Rear Of Fender</p> <p><b>2) Front of Vehicle</b><br/>           G106 ..... Behind Left Headlight<br/>           G107 ..... Behind Right Headlight<br/>           G108 ..... Left Radiator Support<br/>           G109 ..... Right Radiator Support</p> <p><b>3) Engine</b><br/>           G110 ..... Left Front Of Engine<br/>           G111 ..... Left Front Behind Battery<br/>           G112 ..... Left Side Of Engine<br/>           G114 ..... Left Rear Of Engine<br/>           G115 ..... Rear Of Engine<br/>           G117 ..... Right Rear Of Engine<br/>           G119 ..... Right Front Of Engine<br/>           G120 ..... Right Side Of Engine<br/>           G125 ..... Front Of Engine<br/>           G127 ..... Left Underside Of Hood<br/>           G128 ..... Right Underside Of Hood<br/>           G129 ..... Top Center Of Transaxle</p> <p><b>4) Safety Wall</b><br/>           G116 ..... Left Side Of Safety Wall<br/>           G121 ..... Center Of Safety Wall<br/>           G123 ..... Right Side Of Safety Wall</p> <p><b>5) Right Fender</b><br/>           G101 ..... Front Of Fender<br/>           G103 ..... On Shock Tower<br/>           G105 ..... Rear Of Fender</p> | <p><b>6) Instrument Panel</b><br/>           G200 ..... Left Kick Panel<br/>           G201 ..... Right Side Of I/P<br/>           G202 ..... Left Side Of I/P<br/>           G203 ..... Right Kick Panel<br/>           G204 ..... Left Rear Of Steering Support<br/>           G205 ..... Right Rear Of Steering Support<br/>           G206 ..... Center Of I/P<br/>           G207 ..... Top Of Steering Column</p> <p><b>7) Left Front Door</b><br/>           G500 ..... Left Front Door</p> <p><b>8) Right Front Door</b><br/>           G600 ..... Right Front Door</p> <p><b>9) Left Rear Door</b><br/>           G700 ..... Left Rear Door</p> <p><b>10) Right Rear Door</b><br/>           G800 ..... Right Rear Door</p> <p><b>11) "A" Pillars</b><br/>           G900 ..... Left "A" Pillar<br/>           G901 ..... Right "A" Pillar</p> <p><b>12) Passenger Compartment</b><br/>           G300 ..... Below Left Front Seat<br/>           G301 ..... Below Right Front Seat<br/>           G302 ..... Below Center Console<br/>           G303 ..... Below Right Rear Seat<br/>           G304 ..... Below Left Rear Seat<br/>           G306 ..... Below Center Of Rear Seat<br/>           G307 ..... Below Right Rear Window<br/>           G309 ..... Left Front Door Sill<br/>           G310 ..... Behind Right Rear Seat<br/>           G311 ..... Center Of Rear Shelf<br/>           G312 ..... Behind Left Rear Seat</p> | <p><b>13) Roof</b><br/>           G902 ..... Left Front Of Roof<br/>           G903 ..... Right Front Of Roof<br/>           G906 ..... Left Rear Of Roof<br/>           G907 ..... Right Rear Of Roof<br/>           G908 ..... Center Front Of Roof<br/>           G909 ..... Center Rear Of Roof</p> <p><b>14) Rear Of Vehicle</b><br/>           G400 ..... Left Front Side Of Trunk<br/>           G401 ..... Right Front Side Of Trunk<br/>           G402 ..... Left Rear Wheelwell<br/>           G403 ..... Right Rear Wheelwell<br/>           G404 ..... Left Rear Side Of Trunk<br/>           G405 ..... Right Rear Side Of Trunk<br/>           G406 ..... Center Rear Of Trunk Lid<br/>           G407 ..... Center Rear Of Trunk<br/>           G408 ..... Center Front Of Trunk<br/>           G409 ..... Rear Of Cargo Bed</p> <p><b>15) "C" Pillars</b><br/>           G904 ..... Left "C" Pillar<br/>           G905 ..... Right "C" Pillar</p> <p><b>16) "B" Pillars</b><br/>           G305 ..... Right "B" Pillar<br/>           G308 ..... Left "B" Pillar</p> |
|---|---|--|

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**Fig. 2: Ground Numbers & Locations (2001 & Prior Model Years)**

## **WIRING DIAGRAM COMPONENT LOCATIONS**

When trying to locate a component in a wiring diagram and you don't know the specific system where it is located, use this handy component locator to find the system wiring diagram in which the component is located. Then, go to that system and locate the component within the wiring diagram.

For example, if you don't know the specific system in which the ignition switch is located, look up ignition switch in the wiring diagram component location tables and go to the appropriate wiring diagram(s) which contain either full or partial views of the ignition switch. The full view of the ignition switch is located in Power Distribution.

The first listing for the component will be the full or most complete view of the component. Additional listings will be partial views of the component. Not all components are used on all models.

All components will have a partial view in Ground Distribution and Power Distribution. Data Link Connectors show connecting circuits between modules. Alternate names for components may be listed in wiring diagram component locations tables.

**WIRING DIAGRAM COMPONENT LOCATIONS**

<b>Component</b>	<b>Wiring Diagram</b>
ABS Electronic Control Unit	Anti-Lock Brakes; Data Link Connectors
ABS Hydraulic Unit	Anti-Lock Brakes
Acceleration Sensor	Anti-Lock Brakes
Accessory Delay Relay	Power Windows
A/C Compressor Clutch Relay	Engine Performance
A/C Sensor	Engine Performance
A/C Pressure Switch	Engine Performance
Adaptive Lamp Control Module	Exterior Lights
Air Bag(s)	Air Bag Restraint System
Air Bag Module	Air Bag Restraint System
Air Bag Sensor(s)	Air Bag Restraint System
Air Injection Pump Relay	Engine Performance
Air Temperature Sensor	Overhead Console
Alternator (Generator)	Generators & Regulators
Anti-Theft Control Module	Anti-Theft System; Starters
Autolamp Control Relay	Headlight Systems; Daytime Running Lights
Automatic Shutdown (ASD) Relay	Engine Performance; Generators & Regulators
Autostick Switch	Engine Performance
Auxiliary Battery Relay	Generators & Regulators
Back-Up Lights	Back-Up Lights; Exterior Lights
Barometric (BARO) Pressure Sensor	Engine Performance
Battery	Power Distribution
Battery Temperature Sensor	Engine Performance
Body Control Module	Body Control Computer; Anti-Theft System; Daytime Running Lights; Engine Performance; Headlight Systems; Warning Systems
Boost Control Solenoid	Engine Performance
Boost Sensor	Engine Performance
Brake Fluid Level Switch	Analog Instrument Panels
Brake On/Off (BOO) Switch	Cruise Control Systems; Engine Performance; Shift Interlock Systems
Buzzer Module	Warning Systems
Camshaft Position (CMP) Sensor	Engine Performance
Central Control Module	Anti-Theft System
Clockspring	Air Bag Restraint System; Cruise Control Systems; Steering Column Switches
Clutch Pedal Position Switch	Starters
Clutch Start Switch	Starters
Combination Meter	Analog Instrument Panels
Constant Control Relay Module (CCRM)	Engine Performance; Electric Cooling Fans
Convenience Center	Power Distribution; Illumination/Interior Lights
Convertible Top Motor	Power Convertible Top
Convertible Top Switch	Power Convertible Top
Crankshaft Position (CKP) Sensor	Engine Performance
Cruise Control Module	Cruise Control Systems
Cruise Control Switch	Cruise Control Systems
Condenser Fan Relay(s)	Electric Cooling Fans
Data Link Connector (DLC)	Engine Performance
Daytime Running Lights Module	Daytime Running Lights; Exterior Lights
Defogger Relay	Rear Window Defogger
Diagnostic Energy Reserve Module (DERM)	Air Bag Restraint System
Discriminating Sensor (Air Bag)	Air Bag Restraint System

<b>Component</b>	<b>Wiring Diagram</b>
Distributor	Engine Performance
Door Lock Actuators	Power Door Locks; Remote Keyless Entry
Door Lock Relay(s)	Power Door Locks
Electrochromic Mirror	Power Mirrors
Electronic Level Control (ELC) Height Sensor	Electronic Suspension
Electronic Level Control (ELC) Module	Electronic Suspension
Engine Coolant Temperature (ECT) Sending Unit	Analog Instrument Panels
Engine Coolant Temperature (ECT) Sensor	Engine Performance
Engine Control Module	Engine Performance; Generators & Regulators; Starters
ETACS ECU	Warning Systems; Power Windows; Remote Keyless Entry
Evaporative (EVAP) Emissions Canister	Engine Performance
EVAP Canister Purge Solenoid	Engine Performance
EVAP Canister Vent Solenoid	Engine Performance
Exhaust Gas Recirculation (EGR) Valve	Engine Performance
Fuel Tank Vacuum Sensor	Engine Performance
Fog Lights	Headlight Systems; Daytime Running Lights
Fog Light Relay	Headlight Systems; Daytime Running Lights
Fuel Door Release Solenoid	Power Fuel Door Release
Fuel Gauge Sending Unit	Analog Instrument Panels
Fuel Injectors	Engine Performance
Fuel Pump	Engine Performance
Fuel Pump Relay	Engine Performance; Power Distribution
Fuse/Relay Block	Power Distribution
Fusible Links	Power Distribution; Generators & Regulators; Starters
Generator	Generators & Regulators; Engine Performance; Power Distribution
Generic Electronic Module (GEM)	Body Control Modules; Electronic Suspension
Glow Plug Relay	Engine Performance
Glow Plugs	Engine Performance
Grounds	Ground Distribution
Headlight Door Module	Headlight Doors
Headlight Relay	Headlight Systems; Daytime Running Lights
Headlights	Headlight Systems; Daytime Running Lights
Heated Oxygen Sensor(s) (HO2S)	Engine Performance
Heated Windshield Control Module	Heated Windshields
Height Sensor	Electronic Suspension
Horns	Steering Column Switches
Horn Relay	Steering Column Switches
Idle Air Control (IAC) Motor/Valve	Engine Performance
Ignition Coil(s)	Engine Performance
Ignition Key Lock Cylinder	Anti-Theft System
Ignition Module	Engine Performance
Ignition Switch	Power Distribution; Engine Performance; Generators & Regulators; Starters
Illuminated Entry Module	Illumination/Interior Lights
Illumination Lights	Illumination/Interior Lights
Impact Sensor	Air Bag Restraint System
Inertia Fuel Shutoff Switch	Engine Performance
Inhibit Relay	Starters

<b>Component</b>	<b>Wiring Diagram</b>
Instrument Cluster	Analog Instrument Panels
Intake Air Temperature (IAT) Sensor	Engine Performance
Interior Lights	Illumination/Interior Lights
Interlock Switch	Starters
Junction Block	Power Distribution
Keyless Entry Receiver	Remote Keyless Entry
Key Reminder Switch	Starters
Knock Sensor	Engine Performance
Lamp Control Module	Exterior Lights
License Plate Lamp	Exterior Lights
Lighting Control Module	Lighting Control Modules; Anti-Theft System; Daytime Running Lights; Headlight Systems
Lower Relay	Power Convertible Top
Malfunction Indicator Light (MIL)	Engine Performance; Instrument Panels
Manifold Absolute Pressure (MAP) Sensor	Engine Performance
Mass Airflow (MAF) Sensor	Engine Performance
Mega Fuse	Generators & Regulators
Memory Seat/Mirror Module	Memory Systems
Mirror Defogger	Rear Window Defogger
Moon Roof Motor	Power Moon Roof
Moon Roof Relay	Power Moon Roof
Multi-Function Control Module	Warning Systems
Neutral Safety Switch	Starters
Oil Level Switch	Engine Performance
Oil Pressure Switch/Sending Unit	Analog Instrument Panels; Engine Performance
Overhead Console	Overhead Console
Oxygen Sensor(s) (O2S)	Engine Performance
Parking Brake Switch	Analog Instrument Panels
Park Lights	Exterior Lights
Park/Neutral Position Switch	Starters; Engine Performance; Anti-Theft System; Body Control Module
Perimeter Lighting Control Relay	Exterior Lights
Power Amplifier	Power Antennas
Power Antenna Module	Power Antennas
Power Antenna Motor	Power Antennas
Power Distribution Center	Power Distribution; Generators & Regulators; Starters
Power Door Lock Motors	Power Door Locks
Power Mirror Motors	Power Mirrors; Memory Systems
Power Sliding Door Controller	Power Sliding Side Door
Power Seat Motors	Power Seats; Memory Systems
Power Steering Pressure Switch	Engine Performance
Power Top Motor	Power Convertible Top
Power Top Relay(s)	Power Convertible Top
Powertrain Control Module	Engine Performance; Analog Instrument Panels; Cruise Control Systems; Data Link Connectors; Generators & Regulators; Starters
Power Window Motors	Power Windows
Power Window Relay(s)	Power Windows
Radiator Fan Motor(s)	Electric Cooling Fans
Radiator Fan Relay(s)	Engine Performance; Electric Cooling Fans;
Rainsense Module	Wiper/Washer Systems
Raise Relay	Power Convertible Top



<b>Component</b>	<b>Wiring Diagram</b>
Remote Anti-Theft Personality (RAP) Module	Anti-Theft System; Starters; Warning Systems
Seat Belt Pretensioners	Air Bag Restraint System
Seat Belt Retractor Solenoid	Passive Restraints
Seat Belt Switch	Air Bag Restraint System; Passive Restraints
Shift Interlock Solenoid	Shift Interlock Systems
Shift Lock Actuator	Shift Interlock Systems
Side Marker Lights	Exterior Lights
SIR Coil Assembly (Clockspring)	Air Bag Restraint System
Slip Ring (Clockspring)	Air Bag Restraint System; Steering Column Switches
SRS Control Module	Air Bag Restraint System
Starter Motor	Starters
Starter Interrupt Relay	Starters
Starter Solenoid	Starters
Starter Relay	Starters
Steering Wheel Position Sensor	Anti-Lock Brakes
Stoplights	Exterior Lights
Stoplight Switch	Engine Performance; Cruise Control Systems; Anti-Lock Brakes
Sun Roof ECU	Power Sun Roof
Sun Roof Motor	Power Sun Roof
Sun Roof Position Sensor	Power Sun Roof
Taillights	Exterior Lights
Throttle Position (TP) Sensor	Engine Performance
Torque Converter Clutch Solenoid/Switch	Engine Performance
Traction Control Switch	Anti-Lock Brakes
Trailer Tow Connector	Exterior Lights
Trailer Tow Relay	Exterior Lights
Transmission/Transaxle	Engine Performance
Transmission Control Module (TCM)	Engine Performance; Starters
Transmission Range Sensor	Starters; Back-Up Lights; Engine Performance
Transmission Range Switch	Back-Up Lights; Engine Performance; Anti-Theft System
Turn Signal Flasher	Exterior Lights
Turn Signal Lights	Exterior Lights
Twilight Sentinel Switch	Headlight Systems; Daytime Running Lights
Vapor Canister Leak Detection Pump	Engine Performance
Vehicle Control Module (VCM)	Engine Performance
Vehicle Dynamic Module	Electronic Suspension
Vehicle Speed Control Servo	Cruise Control Systems
Vehicle Speed Sensor	Data Link Connectors; Analog Instrument Panels; Cruise Control Systems; Electronic Suspension
Voltage Regulator	Generators & Regulators
Water-In-Fuel Sensor	Engine Performance; Analog Instrument Panels
Wheel Speed Sensors	Anti-Lock Brakes
Window Timer Module	Power Convertible Top
Windshield Intermittent Wiper Relay	Wiper/Washer Systems
Windshield Washer Motor	Wiper/Washer Systems
Wiper Motor	Wiper/Washer Systems



## GENERAL INFORMATION

### Waveforms - Injector Pattern Tutorial

#### **\* PLEASE READ THIS FIRST \***

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

#### **PURPOSE OF THIS ARTICLE**

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Learning how to interpret injector drive patterns from a Lab Scope can be like learning ignition patterns all over again. This article exists to ease you into becoming a skilled injector pattern interpreter.

You will learn:

- How a DVOM and noid light fall short of a lab scope.
- The two types of injector driver circuits, voltage controlled & current controlled.
- The two ways injector circuits can be wired, constant ground/switched power & constant power/switched ground.
- The two different pattern types you can use to diagnose with, voltage & current.
- All the valuable details injector patterns can reveal.

#### **SCOPE OF THIS ARTICLE**

This is **NOT** a manufacturer specific article. All different types of systems are covered here, regardless of the specific year/make/model/engine.

The reason for such broad coverage is because there are only a few basic ways to operate a solenoid-type injector. By understanding the fundamental principles, you will understand all the major points of injector patterns you encounter. Of course there are minor differences in each specific system, but that is where a waveform library helps out.

If this is confusing, consider a secondary ignition pattern. Even though there are many different implementations, each still has a primary voltage turn-on, firing line, spark line, etc.

If specific waveforms are available in On Demand for the engine and vehicle you are working on, you will find them in the Engine Performance section under the Engine Performance category.

#### **IS A LAB SCOPE NECESSARY?**

##### **INTRODUCTION**

You probably have several tools at your disposal to diagnose injector circuits. But you might have questioned "Is a lab scope necessary to do a thorough job, or will a set of noid lights and a multifunction DVOM do just as well?"

In the following text, we are going to look at what noid lights and DVOMs do best, do not do very well, and when they can mislead you. As you might suspect, the lab scope, with its ability to look inside an active circuit, comes to the rescue by answering for the deficiencies of these other tools.

##### **OVERVIEW OF NOID LIGHT**

The noid light is an excellent "quick and dirty" tool. It can usually be hooked to a fuel injector harness fast and the flashing light is easy to understand. It is a dependable way to identify a no-pulse situation.

However, a noid light can be very deceptive in two cases:

- If the wrong one is used for the circuit being tested. Beware: Just because a connector on a noid light fits the harness does not mean it is the right one.
- If an injector driver is weak or a minor voltage drop is present.

### Use the Right Noid Light

In the following text we will look at what can happen if the wrong noid light is used, why there are different types of noid lights (besides differences with connectors), how to identify the types of noid lights, and how to know the right type to use.

First, let's discuss what can happen if the incorrect type of noid light is used. You might see:

- A dimly flashing light when it should be normal.
- A normal flashing light when it should be dim.

A noid light will flash dim if used on a lower voltage circuit than it was designed for. A normally operating circuit would appear underpowered, which could be misinterpreted as the cause of a fuel starvation problem.

Here are the two circuit types that could cause this problem:

- Circuits with external injector resistors. Used predominately on some Asian & European systems, they are used to reduce the available voltage to an injector in order to limit the current flow. This lower voltage can cause a dim flash on a noid light designed for full voltage.
- Circuits with current controlled injector drivers (e.g. "Peak and Hold"). Basically, this type of driver allows a quick burst of voltage/current to flow and then throttles it back significantly for the remainder of the pulse width duration. If a noid light was designed for the other type of driver (voltage controlled, e.g. "Saturated"), it will appear dim because it is expecting full voltage/current to flow for the entire duration of the pulse width.

Let's move to the other situation where a noid light flashes normally when it should be dim. This could occur if a more sensitive noid light is used on a higher voltage/amperage circuit that was weakened enough to cause problems (but not outright broken). A circuit with an actual problem would thus appear normal.

Let's look at why. A noid light does not come close to consuming as much amperage as an injector solenoid. If there is a partial driver failure or a minor voltage drop in the injector circuit, there can be adequate amperage to fully operate the noid light BUT NOT ENOUGH TO OPERATE THE INJECTOR.

If this is not clear, picture a battery with a lot of corrosion on the terminals. Say there is enough corrosion that the starter motor will not operate; it only clicks. Now imagine turning on the headlights (with the ignition in the RUN position). You find they light normally and are fully bright. This is the same idea as noid light: There is a problem, but enough amp flow exists to operate the headlights ("noid light"), but not the starter motor ("injector").

How do you identify and avoid all these situations? By using the correct type of noid light. This requires that you understand the types of injector circuits that your noid lights are designed for. There are three. They are:

- Systems with a voltage controlled injector driver. Another way to say it: The noid light is designed for a circuit with a "high" resistance injector (generally 12 ohms or above).
- Systems with a current controlled injector driver. Another way to say it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) without an external injector resistor.
- Systems with a voltage controlled injector driver and an external injector resistor. Another way of saying it: The noid light is designed for a circuit with a low resistance injector (generally less than

12 ohms) and an external injector resistor.

**NOTE: Some noid lights can meet both the second and third categories simultaneously.**

If you are not sure which type of circuit your noid light is designed for, plug it into a known good car and check out the results. If it flashes normally during cranking, determine the circuit type by finding out injector resistance and if an external injector resistor is used. You now know enough to identify the type of injector circuit. Label the noid light appropriately.

Next time you need to use a noid light for diagnosis, determine what type of injector circuit you are dealing with and select the appropriate noid light.

Of course, if you suspect a no-pulse condition you could plug in any one whose connector fit without fear of misdiagnosis. This is because it is unimportant if the flashing light is dim or bright. It is only important that it flashes.

In any cases of doubt regarding the use of a noid light, a lab scope will overcome all inherent weaknesses.

## **OVERVIEW OF DVOM**

A DVOM is typically used to check injector resistance and available voltage at the injector. Some techs also use it check injector on-time either with a built-in feature or by using the dwell/duty function.

There are situations where the DVOM performs these checks dependably, and other situations where it can deceive you. It is important to be aware of these strengths and weaknesses. We will cover the topics above in the following text.

### **Checking Injector Resistance**

If a short in an injector coil winding is constant, an ohmmeter will accurately identify the lower resistance. The same is true with an open winding. Unfortunately, an intermittent short is an exception. A faulty injector with an intermittent short will show "good" if the ohmmeter cannot force the short to occur during testing.

Alcohol in fuel typically causes an intermittent short, happening only when the injector coil is hot and loaded by a current high enough to jump the air gap between two bare windings or to break down any oxides that may have formed between them.

When you measure resistance with an ohmmeter, you are only applying a small current of a few milliamps. This is nowhere near enough to load the coil sufficiently to detect most problems. As a result, most resistance checks identify intermittently shorted injectors as being normal.

There are two methods to get around this limitation. The first is to purchase a tool that checks injector coil windings under full load. The Kent-Moore J-39021 is such a tool, though there are others. The Kent-Moore costs around \$240 at the time of this writing and works on many different manufacturer's systems.

The second method is to use a lab scope. Remember, a lab scope allows you to see the regular operation of a circuit in real time. If an injector is having an short or intermittent short, the lab scope will show it.

### **Checking Available Voltage At the Injector**

Verifying a fuel injector has the proper voltage to operate correctly is good diagnostic technique. Finding an open circuit on the feed circuit like a broken wire or connector is an accurate check with a DVOM. Unfortunately, finding an intermittent or excessive resistance problem with a DVOM is unreliable.

Let's explore this drawback. Remember that a voltage drop due to excessive resistance will only occur when a circuit is operating? Since the injector circuit is only operating for a few milliseconds at a time, a DVOM will only see a potential fault for a few milliseconds. The remaining 90+% of the time the unloaded injector circuit will show normal battery voltage.

Since DVOMs update their display roughly two to five times a second, all measurements in between are averaged. Because a potential voltage drop is visible for such a small amount of time, it gets "averaged out", causing you to miss it.

Only a DVOM that has a "min-max" function that checks EVERY MILLISECOND will catch this fault consistently (if used in that mode). The Fluke 87 among others has this capability.

A "min-max" DVOM with a lower frequency of checking (100 millisecond) can miss the fault because it will probably check when the injector is not on. This is especially true with current controlled driver circuits. The Fluke 88, among others fall into this category.

Outside of using a Fluke 87 (or equivalent) in the 1 mS "min-max" mode, the only way to catch a voltage drop fault is with a lab scope. You will be able to see a voltage drop as it happens.

One final note. It is important to be aware that an injector circuit with a solenoid resistor will always show a voltage drop when the circuit is energized. This is somewhat obvious and normal; it is a designed-in voltage drop. What can be unexpected is what we already covered--a voltage drop disappears when the circuit is unloaded. The unloaded injector circuit will show normal battery voltage at the injector. Remember this and do not get confused.

### Checking Injector On-Time With Built-In Function

Several DVOMs have a feature that allows them to measure injector on-time (mS pulse width). While they are accurate and fast to hookup, they have three limitations you should be aware of:

- They only work on voltage controlled injector drivers (e.g "Saturated Switch"), NOT on current controlled injector drivers (e.g. "Peak & Hold").
- A few unusual conditions can cause inaccurate readings.
- Varying engine speeds can result in inaccurate readings.

Regarding the first limitation, DVOMs need a well-defined injector pulse in order to determine when the injector turns ON and OFF. Voltage controlled drivers provide this because of their simple switch-like operation. They completely close the circuit for the entire duration of the pulse. This is easy for the DVOM to interpret.

The other type of driver, the current controlled type, start off well by completely closing the circuit (until the injector pintle opens), but then they throttle back the voltage/current for the duration of the pulse. The DVOM understands the beginning of the pulse but it cannot figure out the throttling action. In other words, it cannot distinguish the throttling from an open circuit (de-energized) condition.

Yet current controlled injectors will still yield a millisecond on-time reading on these DVOMs. You will find it is also always the same, regardless of the operating conditions. This is because it is only measuring the initial completely-closed circuit on-time, which always takes the same amount of time (to lift the injector pintle off its seat). So even though you get a reading, it is useless.

The second limitation is that a few erratic conditions can cause inaccurate readings. This is because of a DVOM's slow display rate; roughly two to five times a second. As we covered earlier, measurements in between display updates get averaged. So conditions like skipped injector pulses or intermittent long/short injector pulses tend to get "averaged out", which will cause you to miss important details.

The last limitation is that varying engine speeds can result in inaccurate readings. This is caused by the quickly shifting injector on-time as the engine load varies, or the RPM moves from a state of acceleration to stabilization, or similar situations. It too is caused by the averaging of all measurements in between DVOM display periods. You can avoid this by checking on-time when there are no RPM or load changes.

A lab scope allows you to overcome each one of these limitations.

### Checking Injector On-Time With Dwell Or Duty

If no tool is available to directly measure injector millisecond on-time measurement, some techs use a simple DVOM dwell or duty cycle functions as a replacement.



While this is an approach of last resort, it does provide benefits. We will discuss the strengths and weaknesses in a moment, but first we will look at how a duty cycle meter and dwell meter work.

### How A Duty Cycle Meter and Dwell Meter Work

All readings are obtained by comparing how long something has been OFF to how long it has been ON in a fixed time period. A dwell meter and duty cycle meter actually come up with the same answers using different scales. You can convert freely between them. See [RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS TABLE](#).

The DVOM display updates roughly one time a second, although some DVOMs can be a little faster or slower. All measurements during this update period are tallied inside the DVOM as ON time or OFF time, and then the total ratio is displayed as either a percentage (duty cycle) or degrees (dwell meter).

For example, let's say a DVOM had an update rate of exactly 1 second (1000 milliseconds). Let's also say that it has been measuring/tallying an injector circuit that had been ON a total of 250 mS out of the 1000 mS. That is a ratio of one-quarter, which would be displayed as 25% duty cycle or 15° dwell (six-cylinder scale). Note that most duty cycle meters can reverse the readings by selecting the positive or negative slope to trigger on. If this reading were reversed, a duty cycle meter would display 75%.

### Strengths of Dwell/Duty Meter

The obvious strength of a dwell/duty meter is that you can compare injector on-time against a known-good reading. This is the only practical way to use a dwell/duty meter, but requires you to have known-good values to compare against.

Another strength is that you can roughly convert injector mS on-time into dwell reading with some computations.

A final strength is that because the meter averages everything together it does not miss anything (though this is also a severe weakness that we will look at later). If an injector has a fault where it occasionally skips a pulse, the meter registers it and the reading changes accordingly.

Let's go back to figuring out dwell/duty readings by using injector on-time specification. This is not generally practical, but we will cover it for completeness. You NEED to know three things:

- Injector mS on-time specification.
- Engine RPM when specification is valid.
- How many times the injectors fire per crankshaft revolution.

The first two are self-explanatory. The last one may require some research into whether it is a bank-fire type that injects every 360° of crankshaft rotation, a bank-fire that injects every 720°, or an SFI that injects every 720°. Many manufacturers do not release this data so you may have to figure it out yourself with a frequency meter.

Here are the four complete steps to convert millisecond on-time:

1. Determine the injector pulse width and RPM it was obtained at. Let's say the specification is for one millisecond of on-time at a hot idle of 600 RPM.
2. Determine injector firing method for the complete 4 stroke cycle. Let's say this is a 360° bank-fired, meaning an injector fires each and every crankshaft revolution.
3. Determine how many times the injector will fire at the specified engine speed (600 RPM) in a fixed time period. We will use 100 milliseconds because it is easy to use. Six hundred crankshaft Revolutions Per Minute (RPM) divided by 60 seconds equals 10 revolutions per second. Multiplying 10 times .100 yields one; the crankshaft turns one time in 100 milliseconds. With exactly one crankshaft rotation in 100 milliseconds, we know that the injector fires exactly one time.
4. Determine the ratio of injector on-time vs. off-time in the fixed time period, then figure duty cycle and/or dwell. The injector fires one time for a total of one millisecond in any given 100 millisecond period. One hundred minus one equals 99. We have a 99% duty cycle. If we wanted to know the dwell (on 6 cylinder scale), multiple 99% times .6; this equals 59.4° dwell.

## Weaknesses of Dwell/Duty Meter

The weaknesses are significant. First, there is no one-to-one correspondence to actual mS on-time. No manufacturer releases dwell/duty data, and it is time-consuming to convert the mS on-time readings. Besides, there can be a large degree of error because the conversion forces you to assume that the injector(s) are always firing at the same rate for the same period of time. This can be a dangerous assumption.

Second, all level of detail is lost in the averaging process. This is the primary weakness. You cannot see the details you need to make a confident diagnosis.

Here is one example. Imagine a vehicle that has a faulty injector driver that occasionally skips an injector pulse. Every skipped pulse means that that cylinder does not fire, thus unburned O<sub>2</sub> gets pushed into the exhaust and passes the O<sub>2</sub> sensor. The O<sub>2</sub> sensor indicates lean, so the computer fattens up the mixture to compensate for the supposed "lean" condition.

A connected dwell/duty meter would see the fattened pulse width but would also see the skipped pulses. It would tally both and likely come back with a reading that indicated the "pulse width" was within specification because the rich mixture and missing pulses offset each other.

This situation is not a far-fetched scenario. Some early GM 3800 engines were suffering from exactly this. The point is that a lack of detail could cause misdiagnosis.

As you might have guessed, a lab scope would not miss this.

### RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS

Dwell Meter (2)	Duty Cycle Meter
1°	1%
15°	25%
30°	50%
45°	75%
60°	100%

(1) These are just some examples for your understanding. It is okay to fill in the gaps.  
(2) Dwell meter on the six-cylinder scale.

## THE TWO TYPES OF INJECTOR DRIVERS

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

### OVERVIEW

There are two types of transistor driver circuits used to operate electric fuel injectors: voltage controlled and current controlled. The voltage controlled type is sometimes called a "saturated switch" driver, while the current controlled type is sometimes known as a "peak and hold" driver.

The basic difference between the two is the total resistance of the injector circuit. Roughly speaking, if a particular leg in an injector circuit has total resistance of 12 or more ohms, a voltage control driver is used. If less than 12 ohms, a current control driver is used.

It is a question of what is going to do the job of limiting the current flow in the injector circuit; the inherent "high" resistance in the injector circuit, or the transistor driver. Without some form of control, the current flow through the injector would cause the solenoid coil to overheat and result in a damaged injector.

### VOLTAGE CONTROLLED CIRCUIT ("SATURATED SWITCH")

The voltage controlled driver inside the computer operates much like a simple switch because it does not need to worry about limiting current flow. Recall, this driver typically requires injector circuits with a total leg resistance of 12 or more ohms.

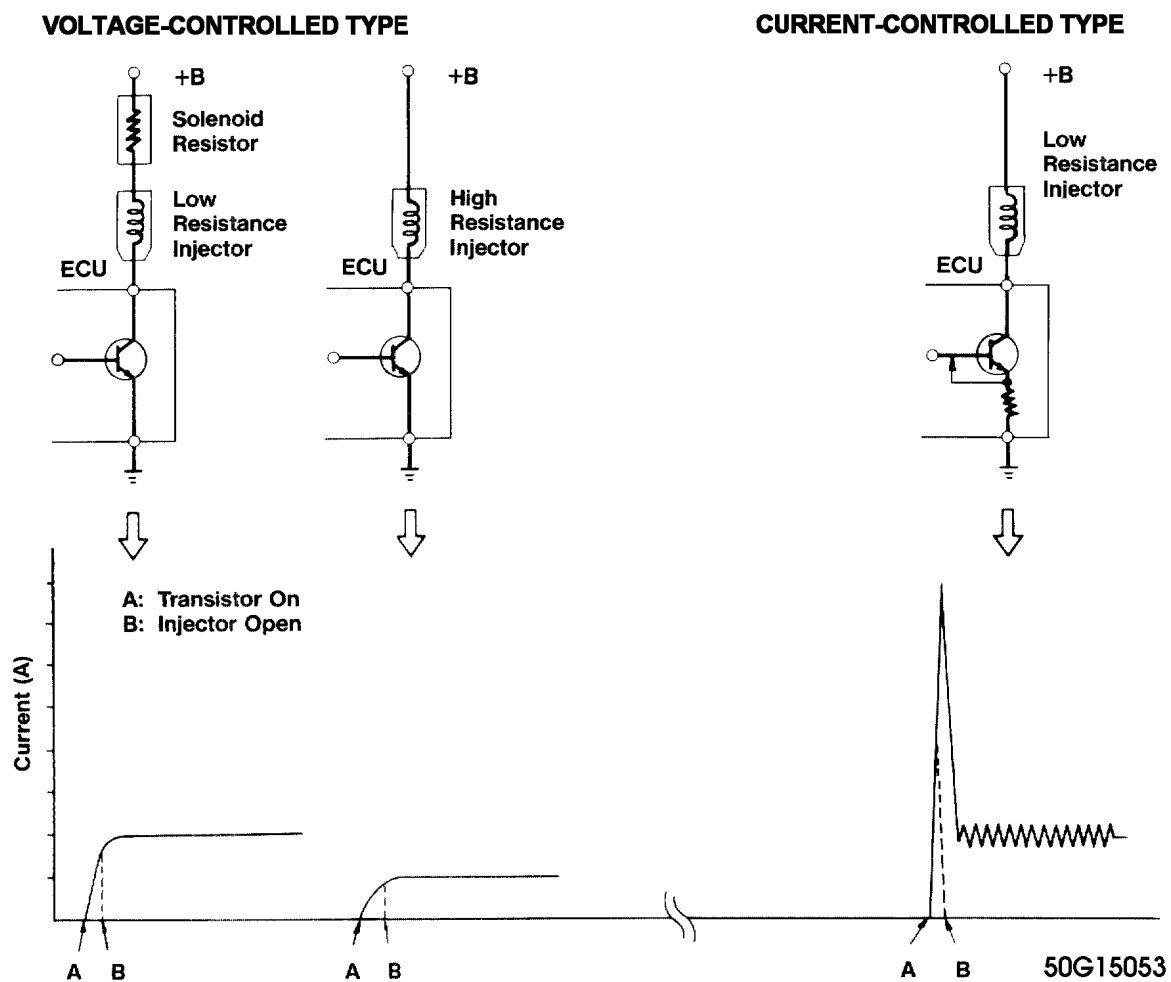
The driver is either ON, closing/completing the circuit (eliminating the voltage-drop), or OFF, opening the circuit (causing a total voltage drop).

Some manufacturers call it a "saturated switch" driver. This is because when switched ON, the driver allows the magnetic field in the injector to build to saturation. This is the same "saturation" property that you are familiar with for an ignition coil.

There are two ways "high" resistance can be built into an injector circuit to limit current flow. One method uses an external solenoid resistor and a low resistance injector, while the other uses a high resistance injector without the solenoid resistor. See the left side of Fig. [Fig. 1](#).

In terms of injection opening time, the external resistor voltage controlled circuit is somewhat faster than the voltage controlled high resistance injector circuit. The trend, however, seems to be moving toward use of this latter type of circuit due to its lower cost and reliability. The ECU can compensate for slower opening times by increasing injector pulse width accordingly.

**NOTE:** Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.



**Fig. 1: Injector Driver Types - Current and Voltage**

### CURRENT CONTROLLED CIRCUIT ("PEAK & HOLD")

The current controlled driver inside the computer is more complex than a voltage controlled driver because as the name implies, it has to limit current flow in addition to its ON-OFF switching function. Recall, this driver typically requires injector circuits with a total leg resistance of less than 12 ohms.

Once the driver is turned ON, it will not limit current flow until enough time has passed for the injector pintle to open. This period is preset by the particular manufacturer/system based on the amount of current flow needed to open their injector. This is typically between two and six amps. Some manufacturers refer to this as the "peak" time, referring to the fact that current flow is allowed to "peak" (to open the injector).

Once the injector pintle is open, the amp flow is considerably reduced for the rest of the pulse duration to protect the injector from overheating. This is okay because very little amperage is needed to hold the injector open, typically in the area of one amp or less. Some manufacturers refer to this as the "hold" time, meaning that just enough current is allowed through the circuit to "hold" the already-open injector open.

There are a couple methods of reducing the current. The most common trims back the available voltage for the circuit, similar to turning down a light at home with a dimmer.

The other method involves repeatedly cycling the circuit ON-OFF. It does this so fast that the magnetic field never collapses and the pintle stays open, but the current is still significantly reduced. See the right side of Fig. [Fig. 1](#) for an illustration.

The advantage to the current controlled driver circuit is the short time period from when the driver transistor goes ON to when the injector actually opens. This is a function of the speed with which current flow reaches its peak due to the low circuit resistance. Also, the injector closes faster when the driver turns OFF because of the lower holding current.

**NOTE: Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.**

## THE TWO WAYS INJECTOR CIRCUITS ARE WIRED

**NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Like other circuits, injector circuits can be wired in one of two fundamental directions. The first method is to steadily power the injectors and have the computer driver switch the ground side of the circuit. Conversely, the injectors can be steadily grounded while the driver switches the power side of the circuit.

There is no performance benefit to either method. Voltage controlled and current controlled drivers have been successfully implemented both ways.

However, 95% percent of the systems are wired so the driver controls the ground side of the circuit. Only a handful of systems use the drivers on the power side of the circuit. Some examples of the latter are the 1970's Cadillac EFI system, early Jeep 4.0 EFI (Renix system), and Chrysler 1984-87 TBI.

## INTERPRETING INJECTOR WAVEFORMS

**NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

## INTERPRETING A VOLTAGE CONTROLLED PATTERN

**NOTE: Voltage controlled drivers are also known as "Saturated Switch" drivers. They typically require injector circuits with a total leg resistance of 12 ohms or more.**

**NOTE: This example is based on a constant power/switched ground circuit.**

- See [Fig. 2](#) for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This can occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Note that circuits with external injector resistors will not be any different because the resistor does not affect open circuit voltage.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

The points between "B" and "D" represent the time in milliseconds that the injector is being energized or held open. This line at Point "C" should remain flat. Any distortion or upward bend indicates a ground problem, short problem, or a weak driver. Alert readers will catch that this is exactly opposite of the current controlled type drivers (explained in the next section), because they bend upwards at this point.

How come the difference? Because of the total circuit resistance. Voltage controlled driver circuits have a high resistance of 12+ ohms that slows the building of the magnetic field in the injector. Hence, no counter voltage is built up and the line remains flat.

On the other hand, the current controlled driver circuit has low resistance which allows for a rapid magnetic field build-up. This causes a slight inductive rise (created by the effects of counter voltage) and hence, the upward bend. You should not see that here with voltage controlled circuits.

Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts at the top of Point "D".

If you do see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning the injector has a weak winding.

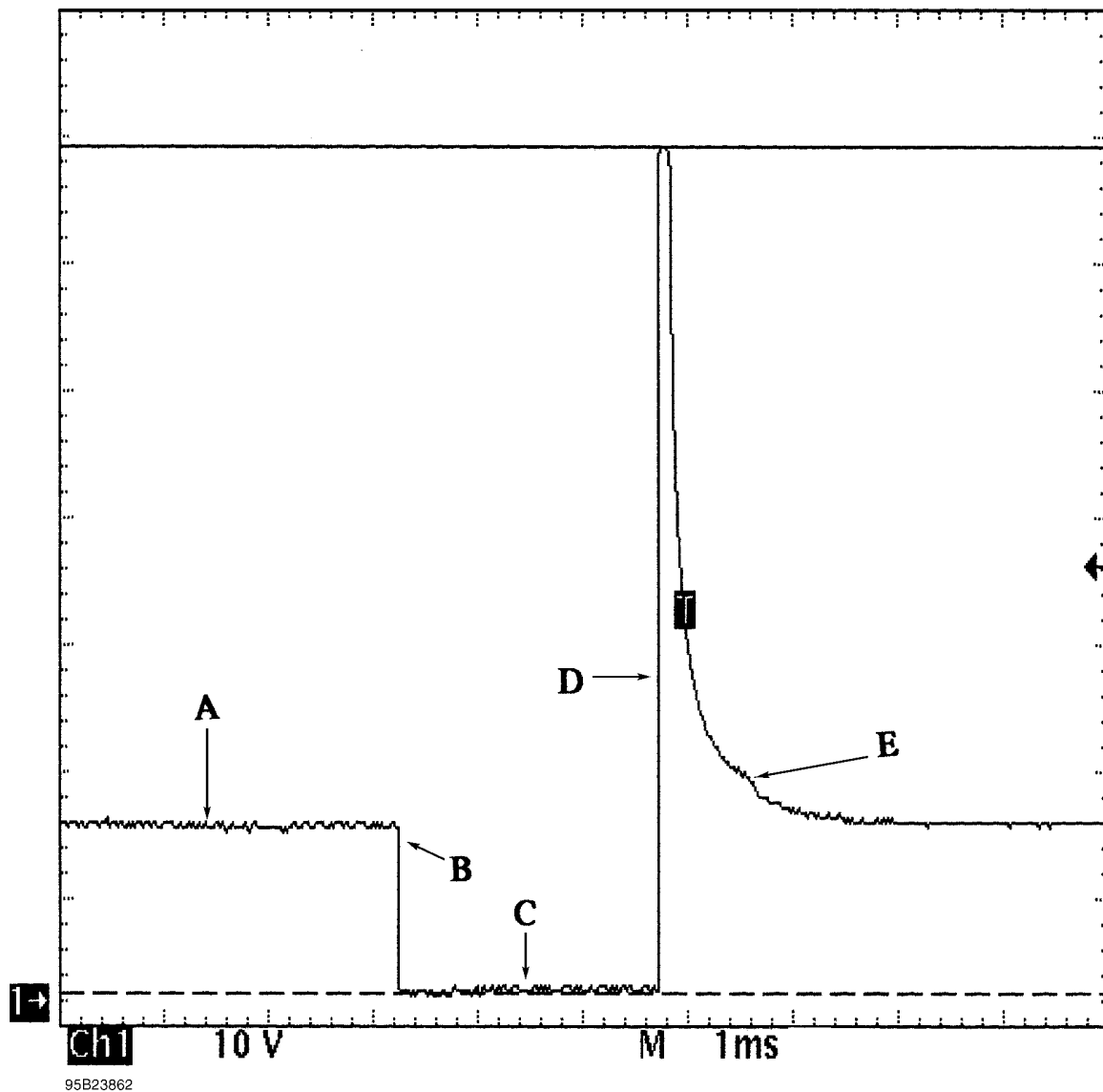
If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

Point "E" brings us to a very interesting section. As you can see, the voltage dissipates back to supply value after the peak of the inductive kick. Notice the slight hump? This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking because of a faulty injector

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.



**Fig. 2: Identifying Voltage Controlled Type Injector Pattern**

**INTERPRETING A CURRENT CONTROLLED PATTERN**

**NOTE:** Current controlled drivers are also known as "Peak and Hold" drivers. They typically require injector circuits with a total leg resistance with less than 12 ohm.

**NOTE:** This example is based on a constant power/switched ground circuit.

- See [Fig. 3](#) for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This could occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.



Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

Right after Point "C", something interesting happens. Notice the trace starts a normal upward bend. This slight inductive rise is created by the effects of counter voltage and is normal. This is because the low circuit resistance allowed a fast build-up of the magnetic field, which in turn created the counter voltage.

Point "D" is the start of the current limiting, also known as the "Hold" time. Before this point, the driver had allowed the current to free-flow ("Peak") just to get the injector pintle open. By the time point "D" occurs, the injector pintle has already opened and the computer has just significantly throttled the current back. It does this by only allowing a few volts through to maintain the minimum current required to keep the pintle open.

The height of the voltage spike seen at the top of Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts.

If you see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning there is a problem with a weak injector winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

At Point "E", notice that the trace is now just a few volts below system voltage and the injector is in the current limiting, or the "Hold" part of the pattern. This line will either remain flat and stable as shown here, or will cycle up and down rapidly. Both are normal methods to limit current flow. Any distortion may indicate shorted windings.

Point "F" is the actual turn-off point of the driver (and injector). To measure the millisecond on-time of the injector, measure between points "C" and "F". Note that we used cursors to do it for us; they are measuring a 2.56 mS on-time.

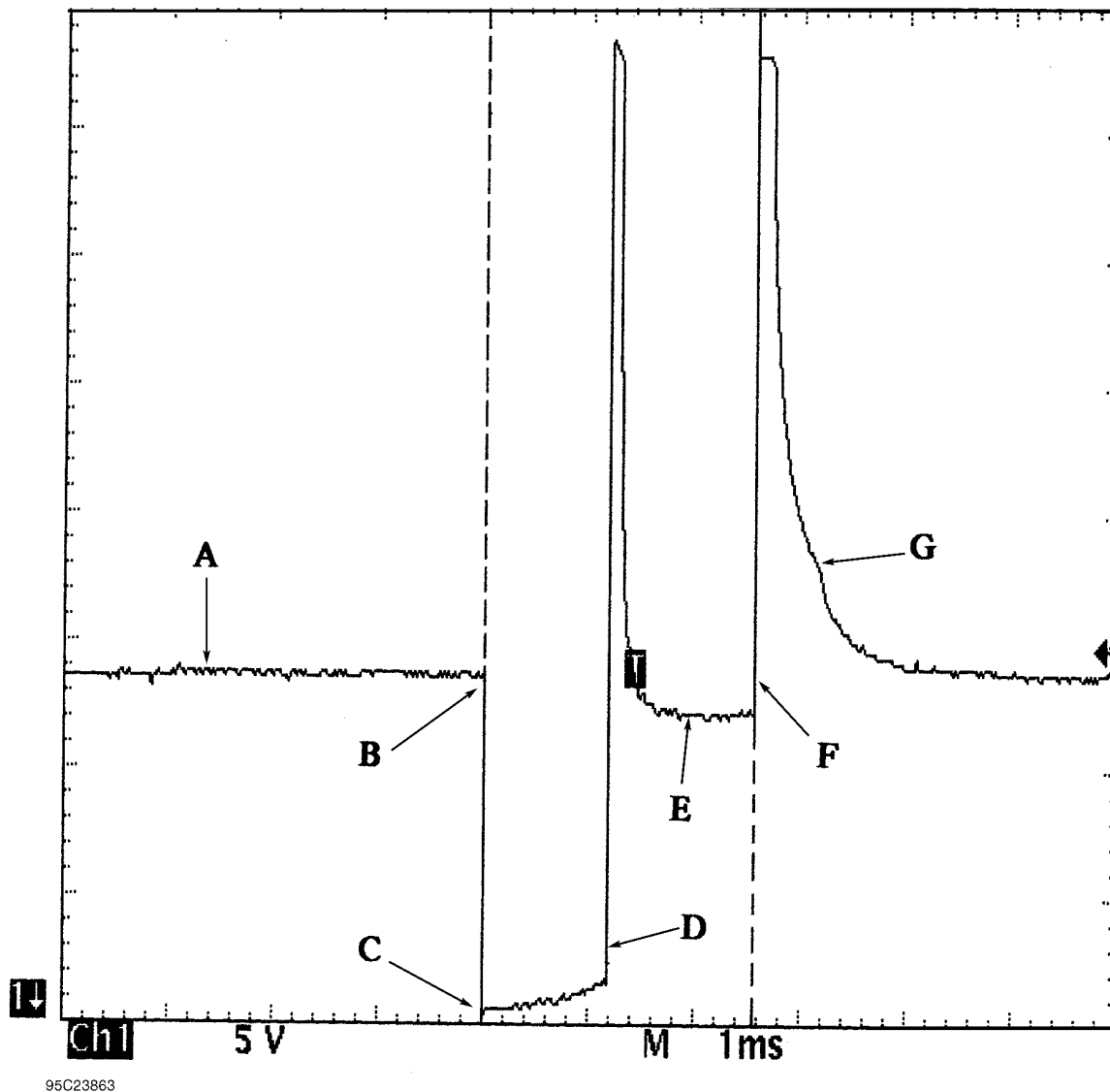
The top of Point "F" (second inductive kick) is created by the collapsing magnetic field caused by the final turn-off of the driver. This spike should be like the spike on top of point "D".

Point "G" shows a slight hump. This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking. Some older Nissan TBI systems suffered from this.

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.



**Fig. 3: Identifying Current Controlled Type Injector Pattern**

## CURRENT WAVEFORM SAMPLES

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

### EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

The waveform pattern shown in Fig. [Fig. 4](#) indicate a normal current waveform from a Ford 3.0L V6 VIN [U] engine. This voltage controlled type circuit pulses the injectors in groups of three injectors. Injectors No. 1, 3, and 5 are pulsed together and cylinders 2, 4, and 6 are pulsed together. The specification for an acceptable bank resistance is 4.4 ohms. Using Ohm's Law and assuming a hot run voltage of 14 volts, we determine that the bank would draw a current of 3.2 amps.

However this is not the case because as the injector windings become saturated, counter voltage is created which impedes the current flow. This, coupled with the inherent resistance of the driver's transistor, impedes the current flow even more. So, what is a known good value for a dynamic current draw on a voltage controlled bank of injectors? The waveform pattern shown below indicates a good parallel injector current flow of 2 amps. See [Fig. 4](#).

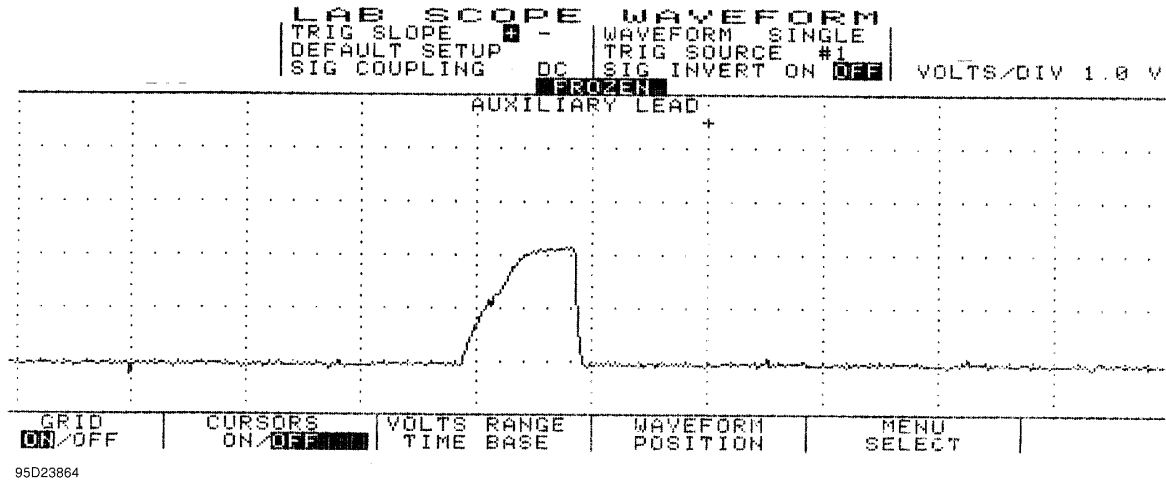
Note that if just one injector has a resistance problem and partially shorts, the entire parallel bank that it belongs to will draw more current. This can damage the injector driver.

The waveform pattern in Fig. [Fig. 5](#) indicates this type of problem with too much current flow. This is on other bank of injectors of the same vehicle; the even side. Notice the Lab Scope is set on a one amp

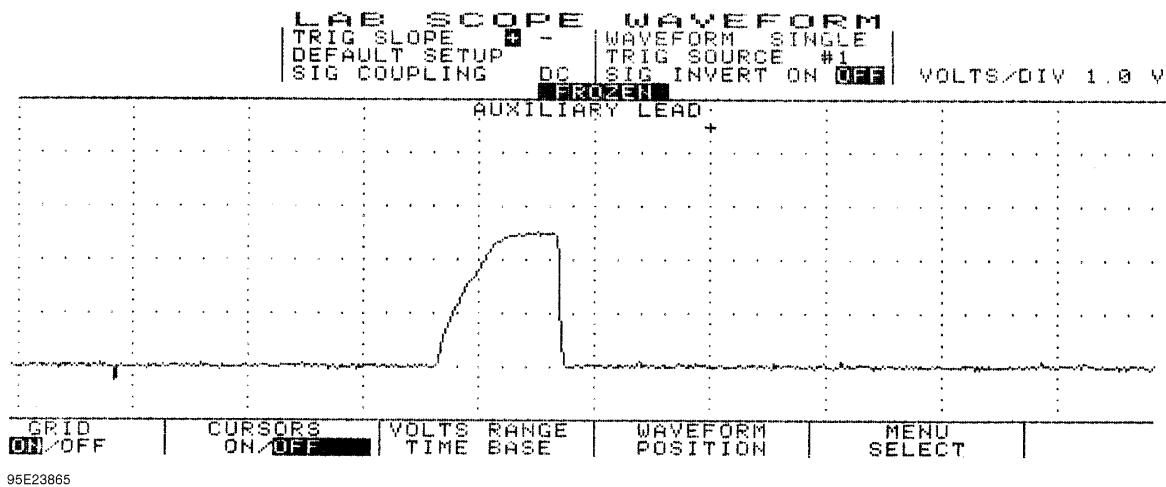
per division scale. As you can see, the current is at an unacceptable 2.5 amps.

It is easy to find out which individual injector is at fault. All you need to do is inductively clamp onto each individual injector and compare them. To obtain a known-good value to compare against, we used the good bank to capture the waveform in Fig. [Fig. 6](#). Notice that it limits current flow to 750 milliamps.

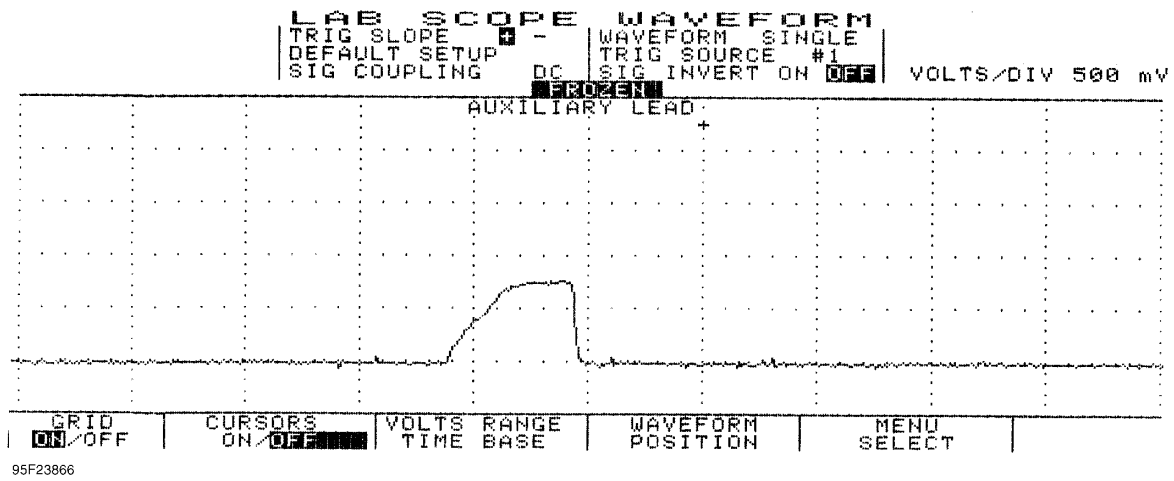
The waveform shown in Fig. [Fig. 7](#) illustrates the problem injector we found. This waveform indicates an unacceptable current draw of just over one amp as compared to the 750 milliamp draw of the known-good injector. A subsequent check with a DVOM found 8.2 ohms, which is under the 12 ohm specification.



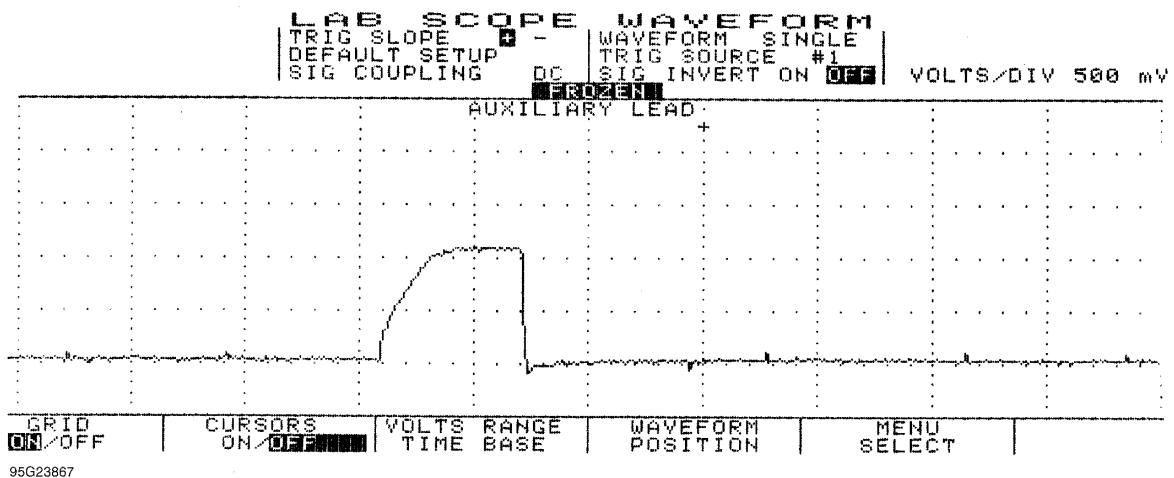
**[Fig. 4: Injector Bank w/Normal Current Flow - Current Pattern](#)**



**[Fig. 5: Injector Bank w/Excessive Current Flow - Current Pattern](#)**



**Fig. 6: Single Injector w/Normal Current Flow - Current Pattern**



**Fig. 7: Single Injector w/Excessive Current Flow - Current Pattern**

**EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER**

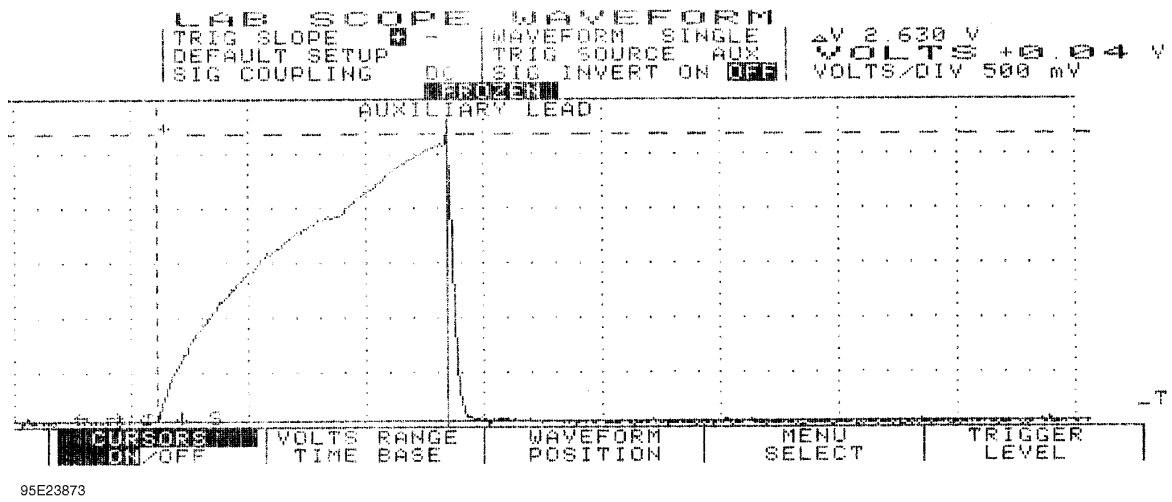
This time we will look at a GM 3.1L V6 VIN [T]. Fig. [Fig. 8](#) shows the 1, 3, 5 (odd) injector bank with the current waveform indicating about a 2.6 amp draw at idle. This pattern, taken from a known good vehicle, correctly stays at or below the maximum 2.6 amps current range. Ideally, the current for each bank should be very close in comparison.

Notice the small dimple on the current flow's rising edge. This is the actual injector opening or what engineers refer to as the "set point." For good idle quality, the set point should be uniform between the banks.

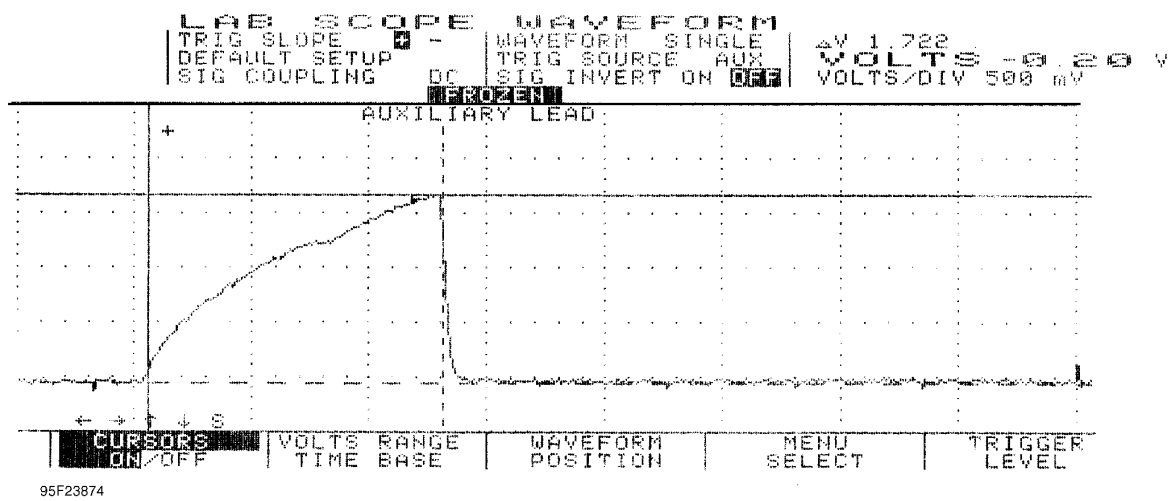
When discussing Ohm's Law as it pertains to this parallel circuit, consider that each injector has specified resistance of 12.2 ohms. Since all three injectors are in parallel the total resistance of this parallel circuit drops to 4.1 ohms. Fourteen volts divided by four ohms would pull a maximum of 3.4 amps on this bank of injectors. However, as we discussed in [EXAMPLE #1](#) above, other factors knock this value down to roughly the 2.6 amp neighborhood.

Now we are going to take a look at the even bank of injectors; injectors 2, 4, and 6. See [Fig. 9](#). Notice this bank peaked at 1.7 amps at idle as compared to the 2.6 amps peak of the odd bank (Fig. [Fig. 8](#)). Current flow between even and odd injectors banks is not uniform, yet it is not causing a driveability problem. That is because it is still under the maximum amperage we figured out earlier. But be aware this vehicle could develop a problem if the amperage flow increases any more.

Checking the resistance of this even injector group with a DVOM yielded 6.2 ohms, while the odd injector group in the previous example read 4.1 ohms.



**Fig. 8: Injector Odd Bank w/Normal Current Flow - Current Pattern**



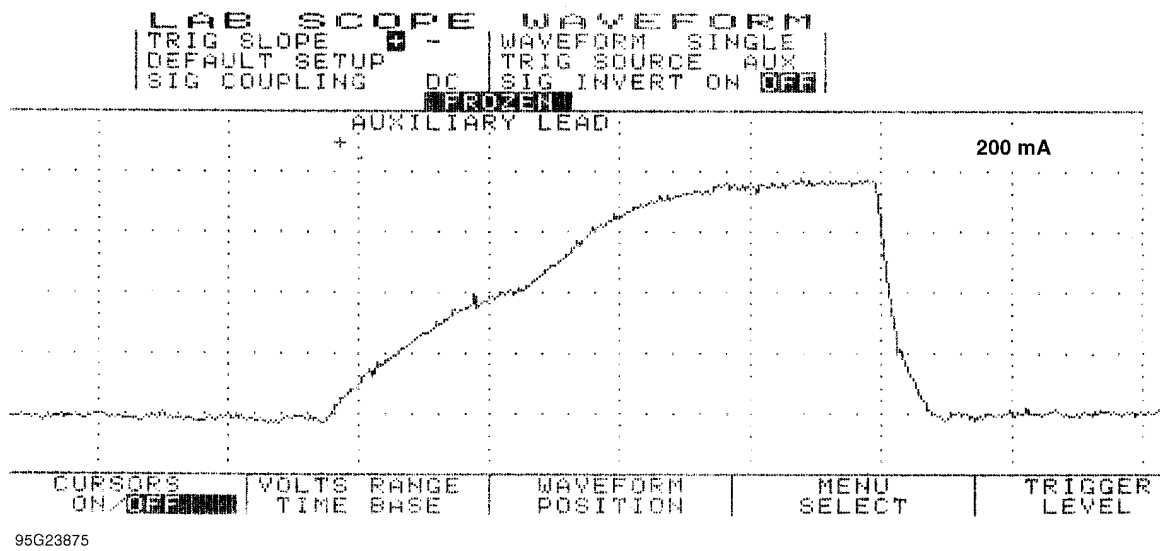
**Fig. 9: Injector Even Bank w/Normal Current Flow - Current Pattern**

**EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER**

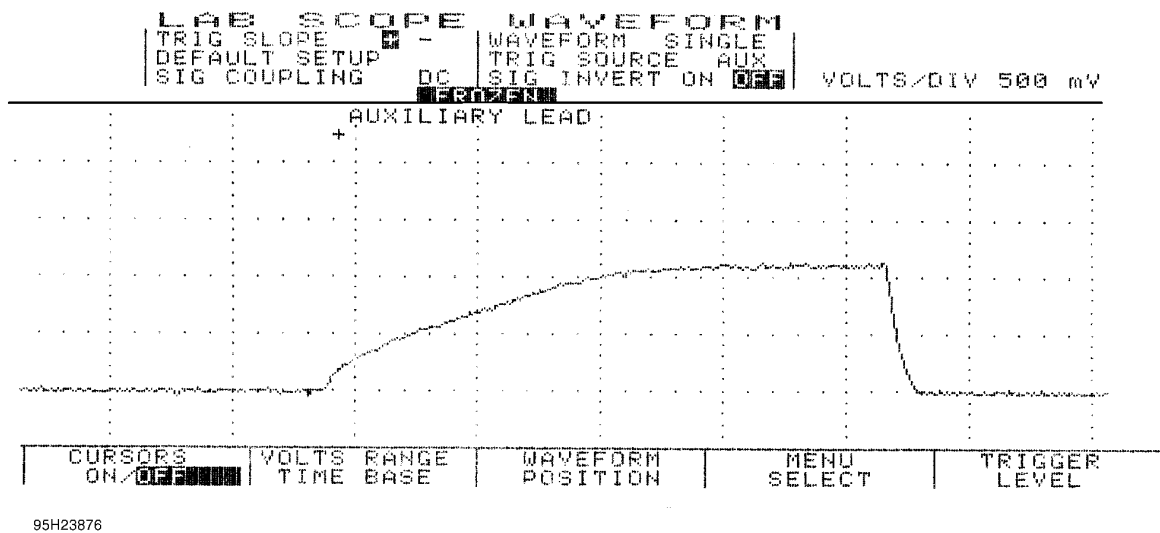
Example #3 is of a Ford 5.0L V8 SEFI. Fig. **Fig. 10** shows a waveform of an individual injector at idle with the Lab Scope set on 200 milliamps per division. Notice the dimple in the rising edge. This dimple indicates the actual opening of the injector (set point) occurred at 400 milliamps and current peaked at 750 milliamps. This is a good specification for this engine.

The next waveform pattern in Fig. **Fig. 11** shows an abnormality with another injector. With the Lab Scope set on 500 milliamps per division, you can see that the current waveform indicates a 1200 milliamp draw. This is a faulty injector.

Abnormally low resistance injectors create excessive current draw, causing rough idle, and possible computer driver damage.



**Fig. 10: Single Injector w/Normal Current Flow - Current Pattern**



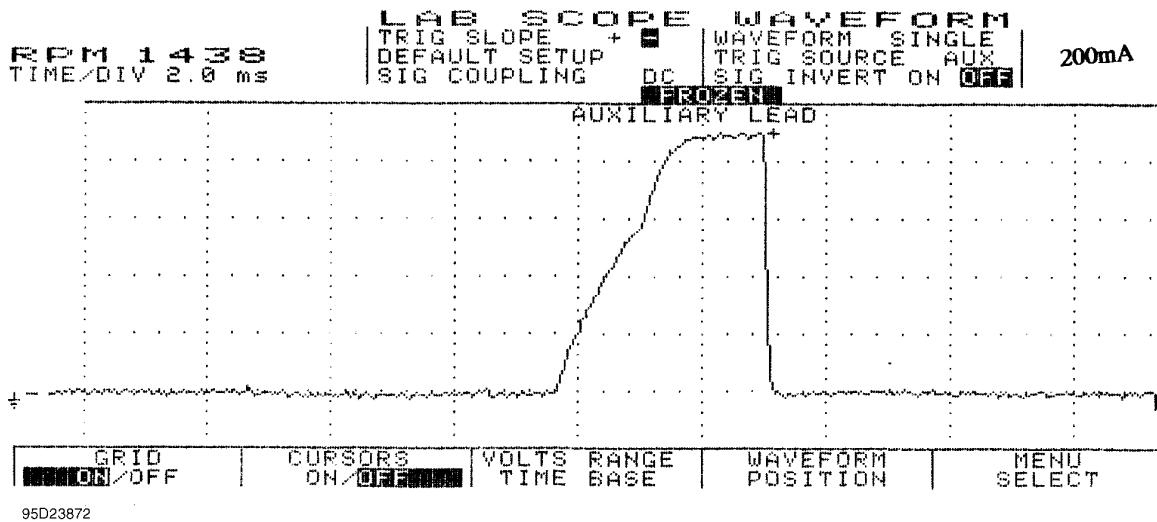
**Fig. 11: Single Injector w/Excessive Current Flow - Current Pattern**

**EXAMPLE #4 - CURRENT CONTROLLED DRIVER**

Example #4 is of a Ford 4.6L SEFI VIN [W]. See [Fig. 12](#) for the known-good waveform pattern. This Ford system is different from the one above in [EXAMPLE #3](#) as it peaks at 900 milliamps and the actual opening of the injector (set point) is just below 600 milliamps.

This is offered as a comparison against the Ford pattern listed above, as they are both Ford SEFI injectors but with different operating ranges. The point is that you should not make any broad assumptions for any manufacturer.

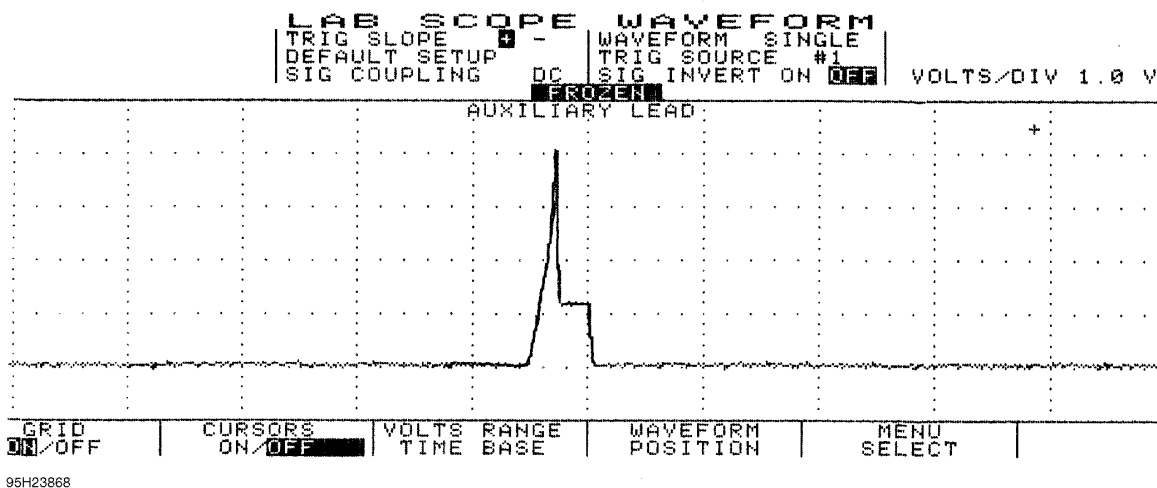




**Fig. 12: Single Injector w/Normal Current Flow - Current Pattern**

**EXAMPLE #5 - CURRENT CONTROLLED DRIVER**

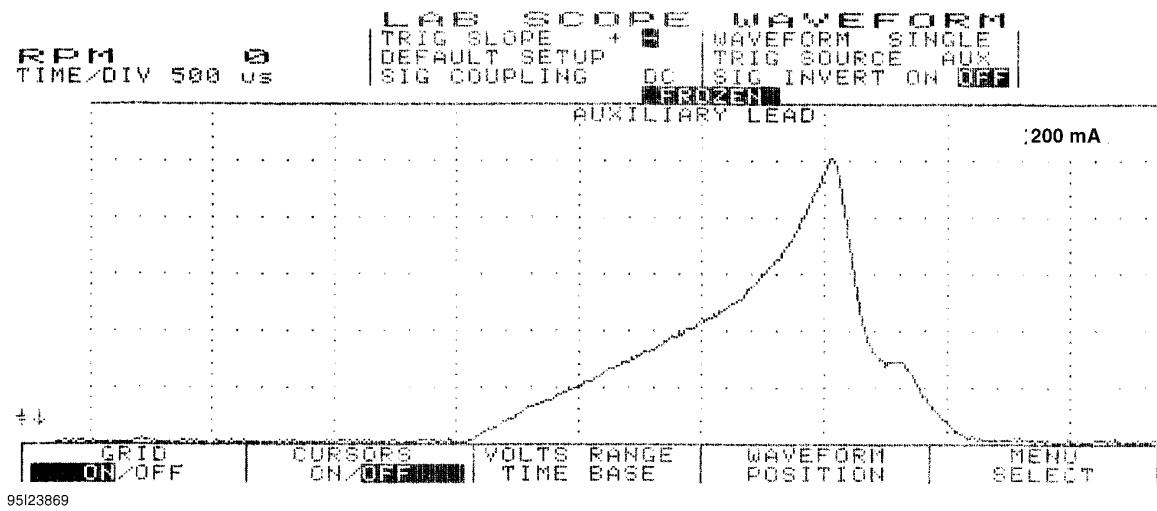
The known-good waveform in Fig. Fig. 13 is from a Chrysler 3.0L V6 PFI VIN [3]. It is a perfect example of the peak and hold theory. The waveform shows a 1-amp per division current flow, ramping to 4 amps and then decreasing to 1-amp to hold the injector open.



**Fig. 13: Injector Bank w/Normal Current Flow - Current Pattern**

**EXAMPLE #6 - CURRENT CONTROLLED DRIVER**

This next known-good waveform is from a Ford 5.0L V8 CFI VIN [F]. See Fig. 14. The pattern, which is set on a 250 milliamps scale, indicates a 1.25 amp peak draw and a hold at 350 milliamps.

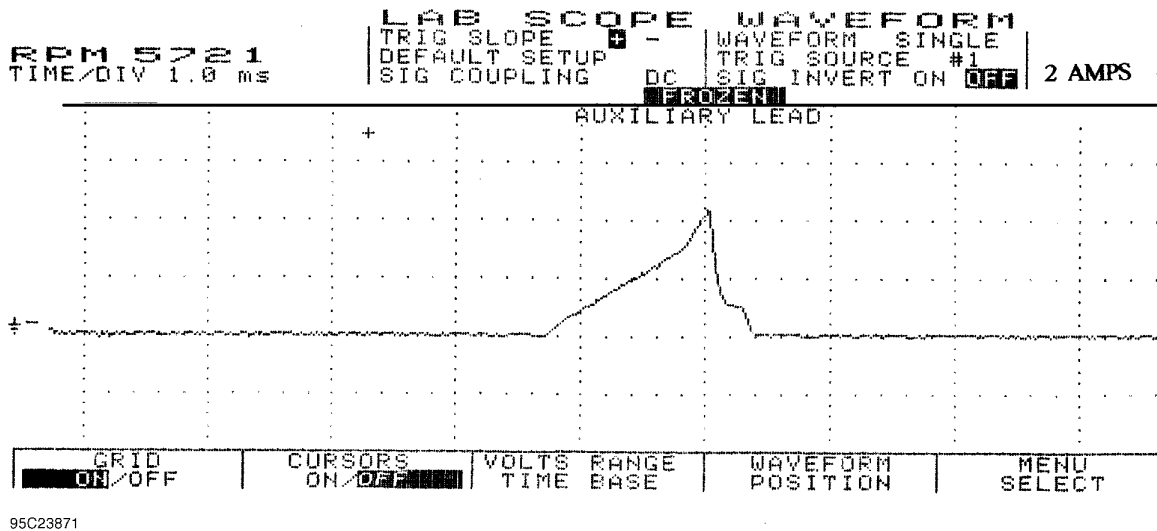


**Fig. 14: Single Injector w/Normal Current Flow - Current Pattern**

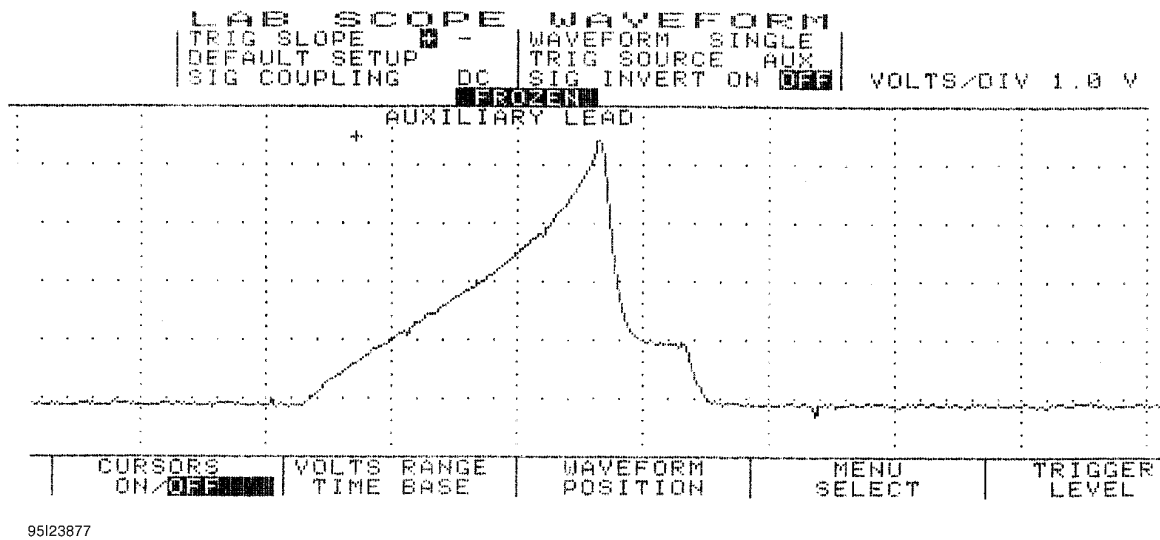
**EXAMPLE #7 - CURRENT CONTROLLED DRIVER**

The known-good current controlled type waveform in Fig. [Fig. 15](#) is from a GM 2.0L TBI VIN [1]. With the lab scope set at 2 amps per division, notice that this system peaks at 4 amps and holds at 1 amp.

The next waveform is from the same type of engine, except that it shows a faulty injector. See [Fig. 16](#). Notice that the current went to almost 5 amps and stayed at 1 amp during the hold pattern. Excessive amounts of current flow from bad injectors are a common source of intermittent computer shutdown. Using a current waveform pattern is the most accurate method of pinpointing this problem.



**Fig. 15: Single Injector w/Normal Current Flow - Current Pattern**

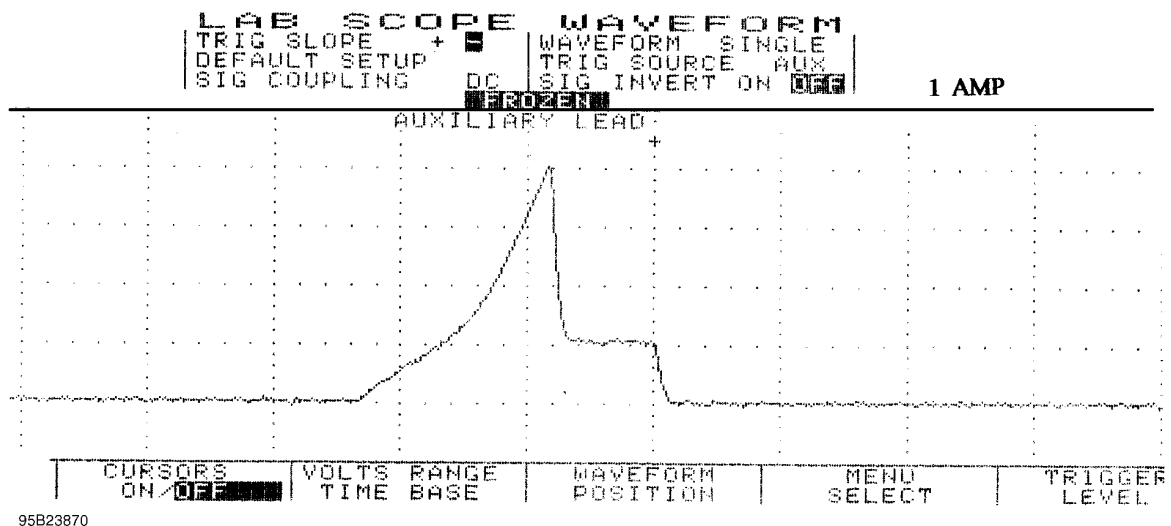


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**Fig. 16: Single Injector w/Excessive Current Flow - Current Pattern**

### **EXAMPLE #8 - CURRENT CONTROLLED DRIVER**

This known-good CPI system waveform from a GM 4.3L V6 CPI VIN [W] peaks at 4 amps and holds at 1-amp. See [Fig. 17](#) for waveform.



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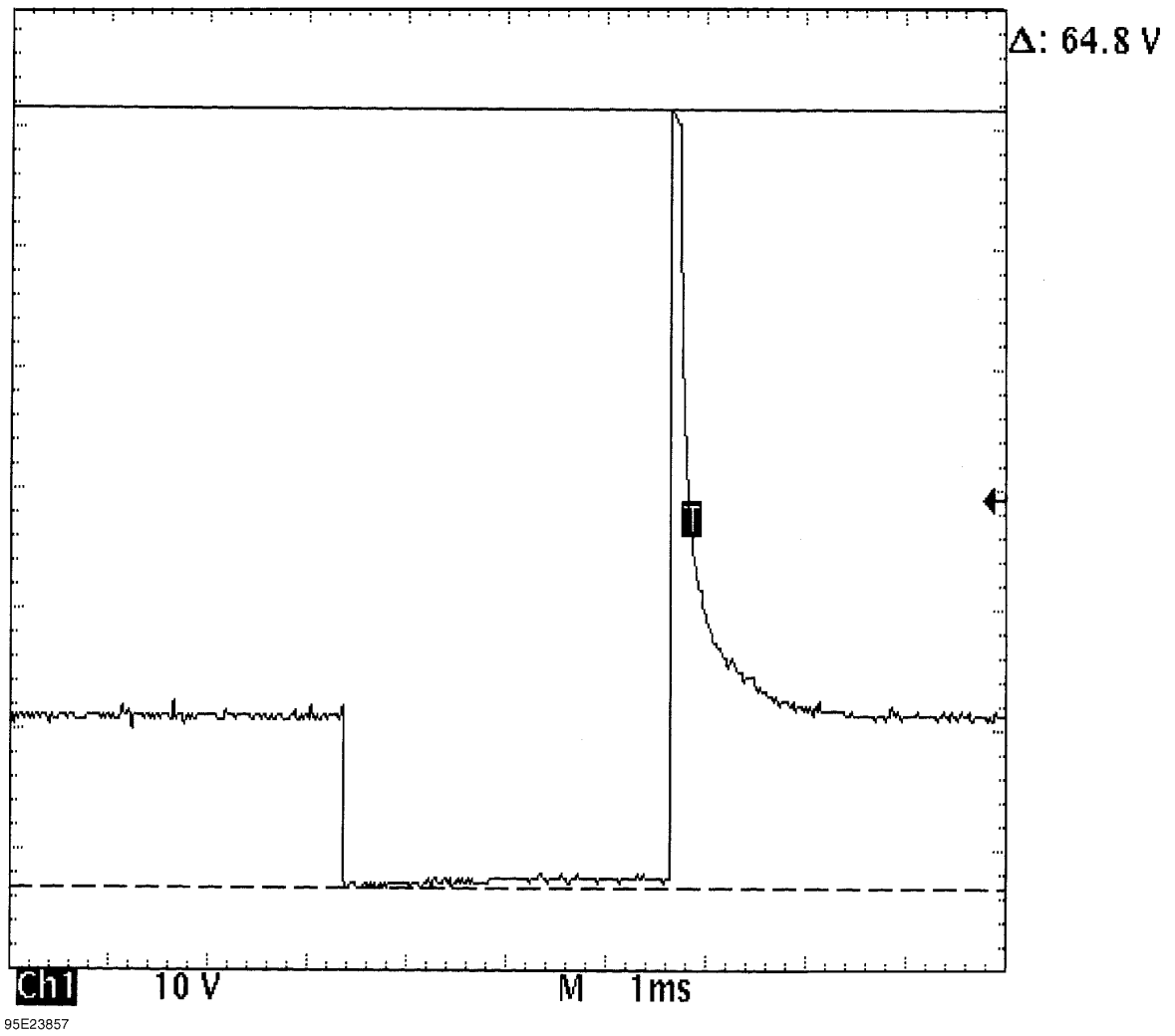
**Fig. 17: Single Injector w/Normal Current Flow - Current Pattern**

## **VOLTAGE WAVEFORM SAMPLES**

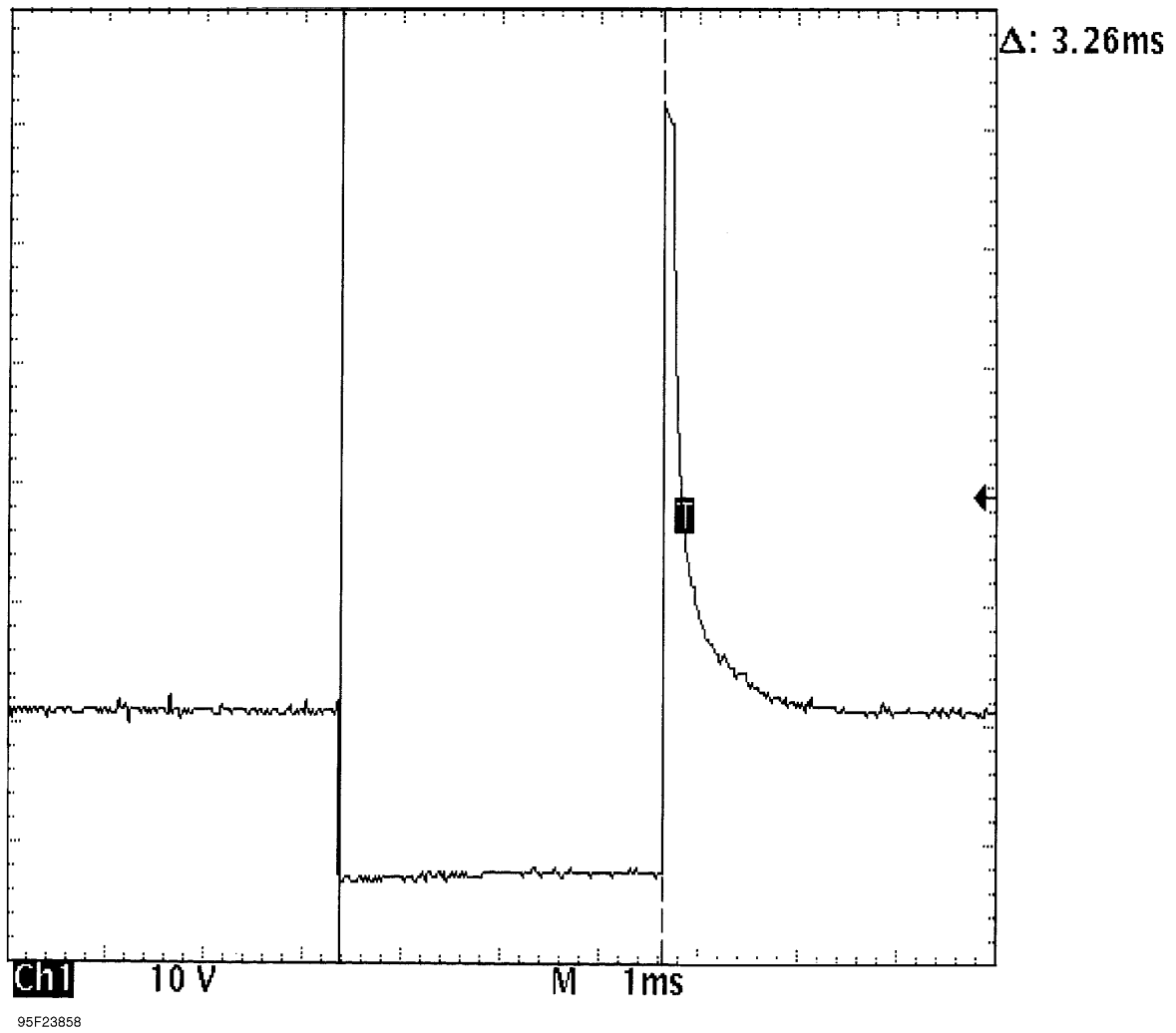
**NOTE:** This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

### **EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER**

These two known-good waveform patterns are from a Ford 4.6L V8 VIN [W]. Fig. [Fig. 18](#) illustrates the 64 volt inductive kick on this engine, indicating no clamping is occurring. The second pattern, Fig. [Fig. 19](#), was taken during hot idle, closed loop, and no load.



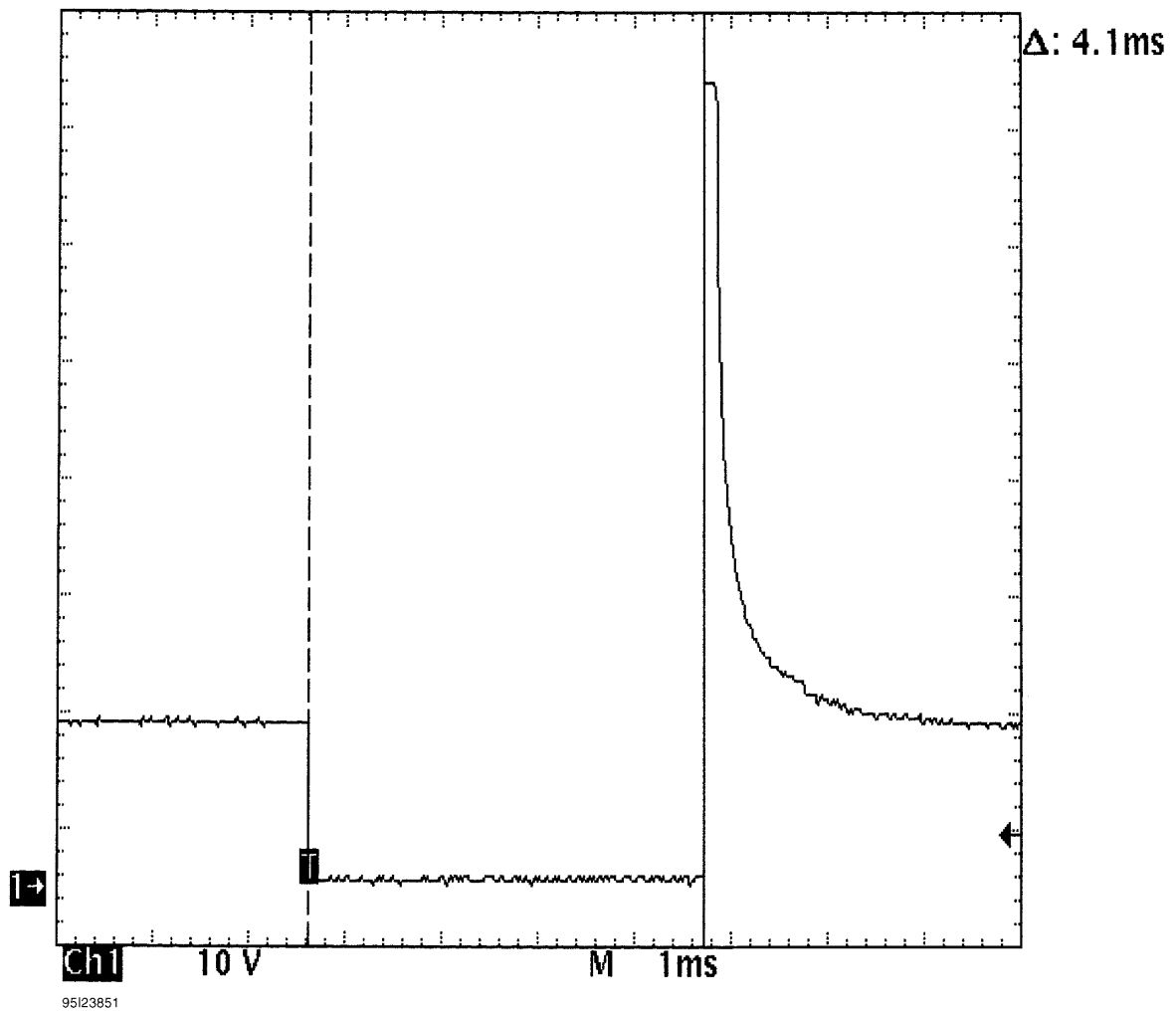
**Fig. 18: Injector Bank - Known Good - Voltage Pattern**



**Fig. 19: Injector Bank - Known Good - Voltage Pattern**

**EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER**

The known-good waveform pattern in Fig. [Fig. 20](#) is from a GM 3.8L V6 PFI VIN [3]. It was taken during hot idle, closed loop and no load.

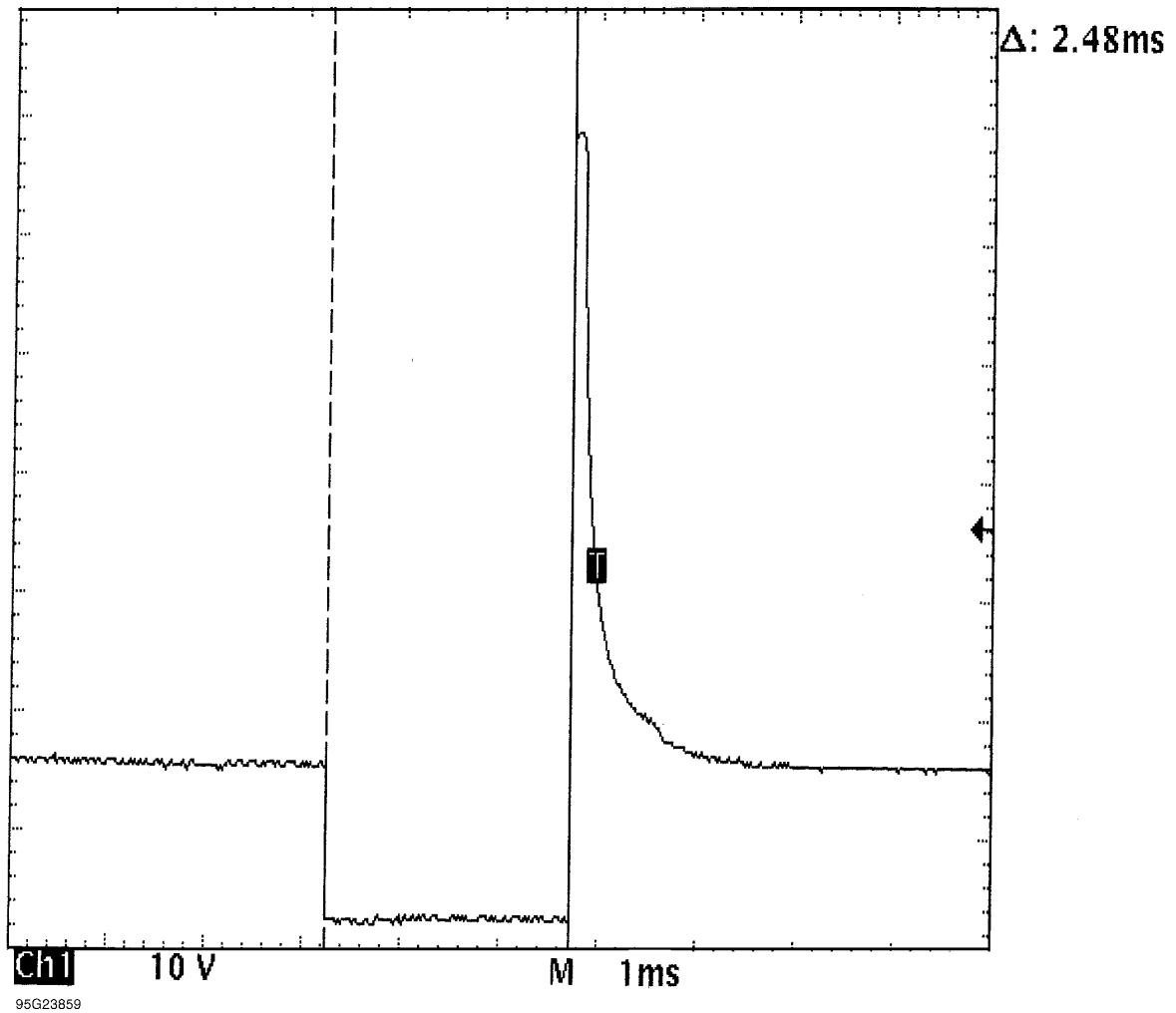


**Fig. 20: Injector Bank - Known Good - Voltage Pattern**

**EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER**

This known-good waveform pattern, Fig. [Fig. 21](#), is from a GM 5.0L V8 TPI VIN [F]. It was taken during hot idle, closed loop and no load.



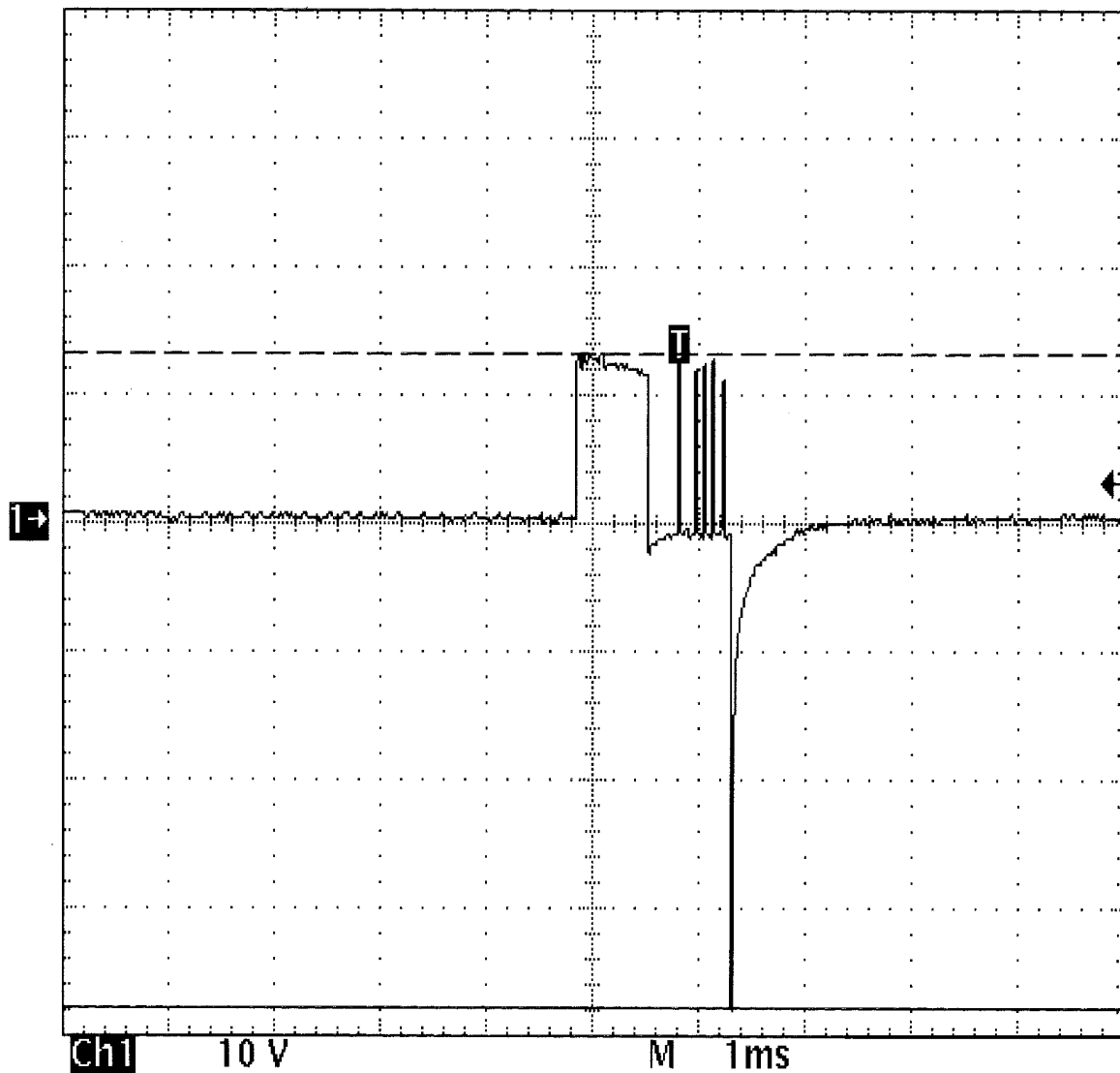


**Fig. 21: Injector Bank - Known Good - Voltage Pattern**

**EXAMPLE #4 - CURRENT CONTROLLED DRIVER**

From 1984 to 1987, Chrysler used this type injector drive on their TBI-equipped engines. See [Fig. 22](#) for a known-good pattern. Instead of the ground side controlling the injector, Chrysler permanently grounds out the injector and switches the power feed side. Most systems do not work this way.

These injectors peak at 6 amps of current flow and hold at 1 amp.

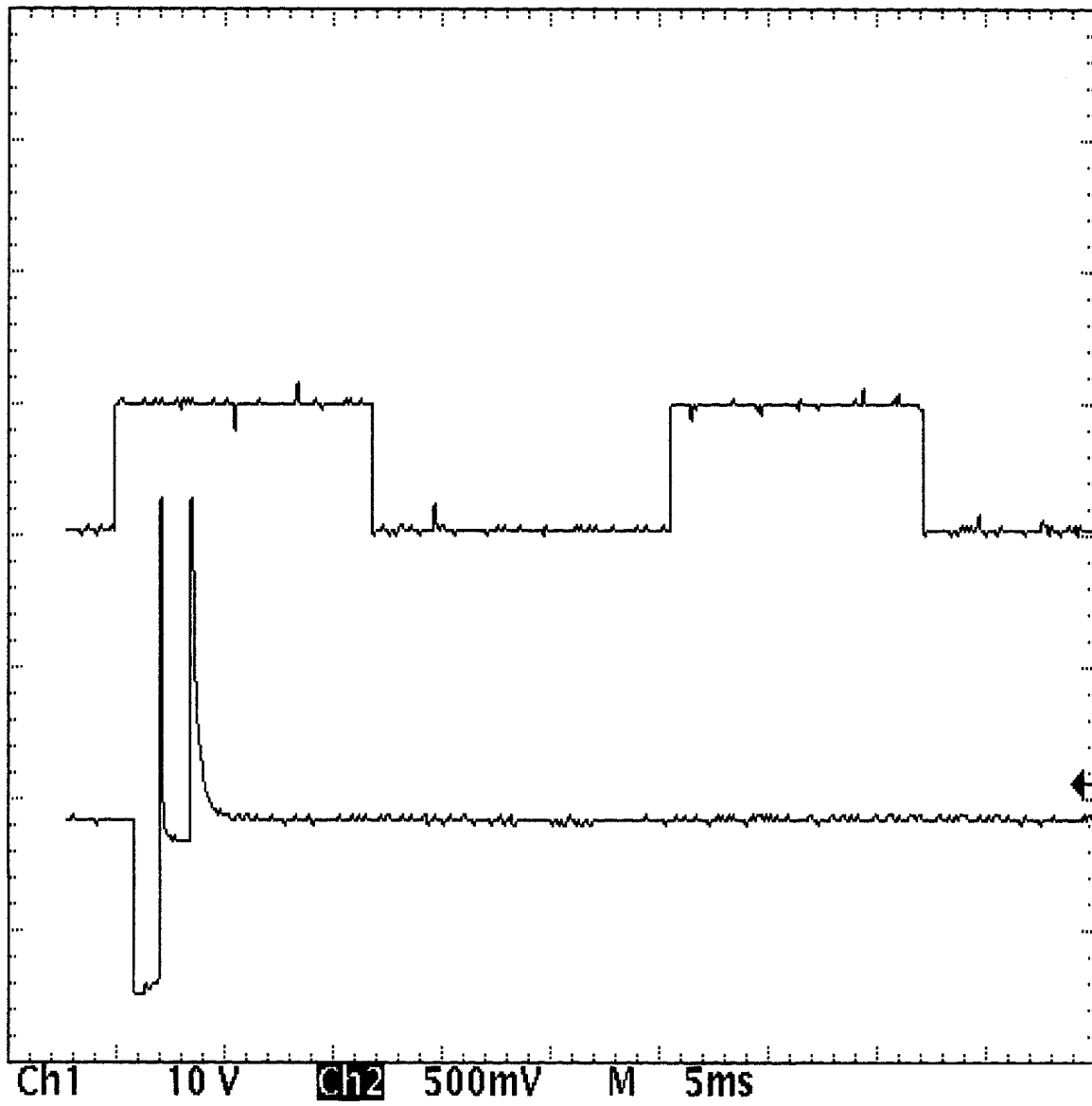


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**Fig. 22: Single Injector - Known Good - Voltage Pattern**

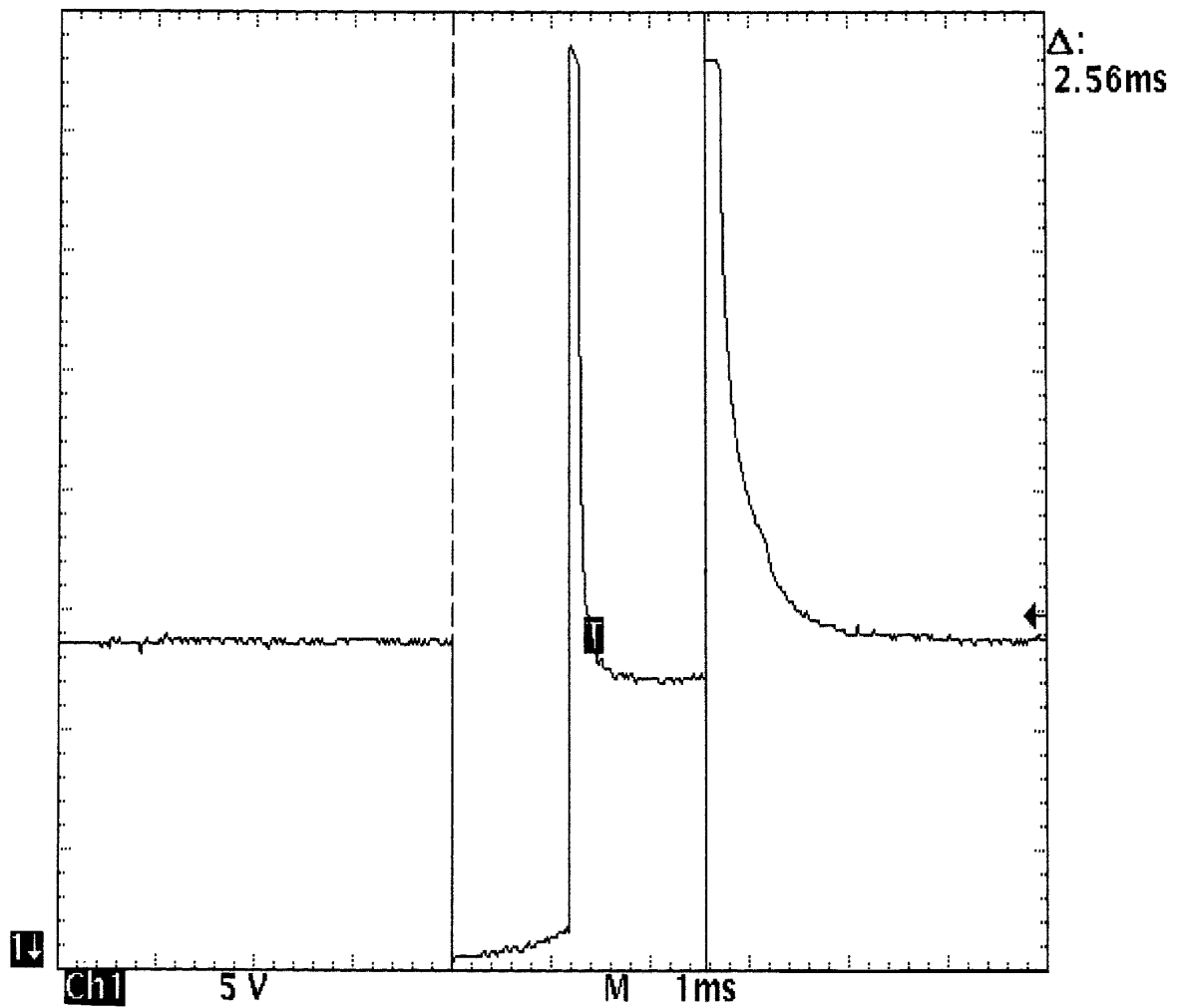
**EXAMPLE #5 - CURRENT CONTROLLED DRIVER**

These two known-good waveform patterns are from a Chrysler 3.0L V6 VIN [3]. The first waveform, Fig. [Fig. 23](#), is a dual trace pattern that illustrates how Chrysler uses the rising edge of the engine speed signal to trigger the injectors. The second waveform, Fig. [Fig. 24](#), was taken during hot idle, closed loop, and no load.



95A23861

**Fig. 23: Injector Bank - Known Good - Voltage Pattern**

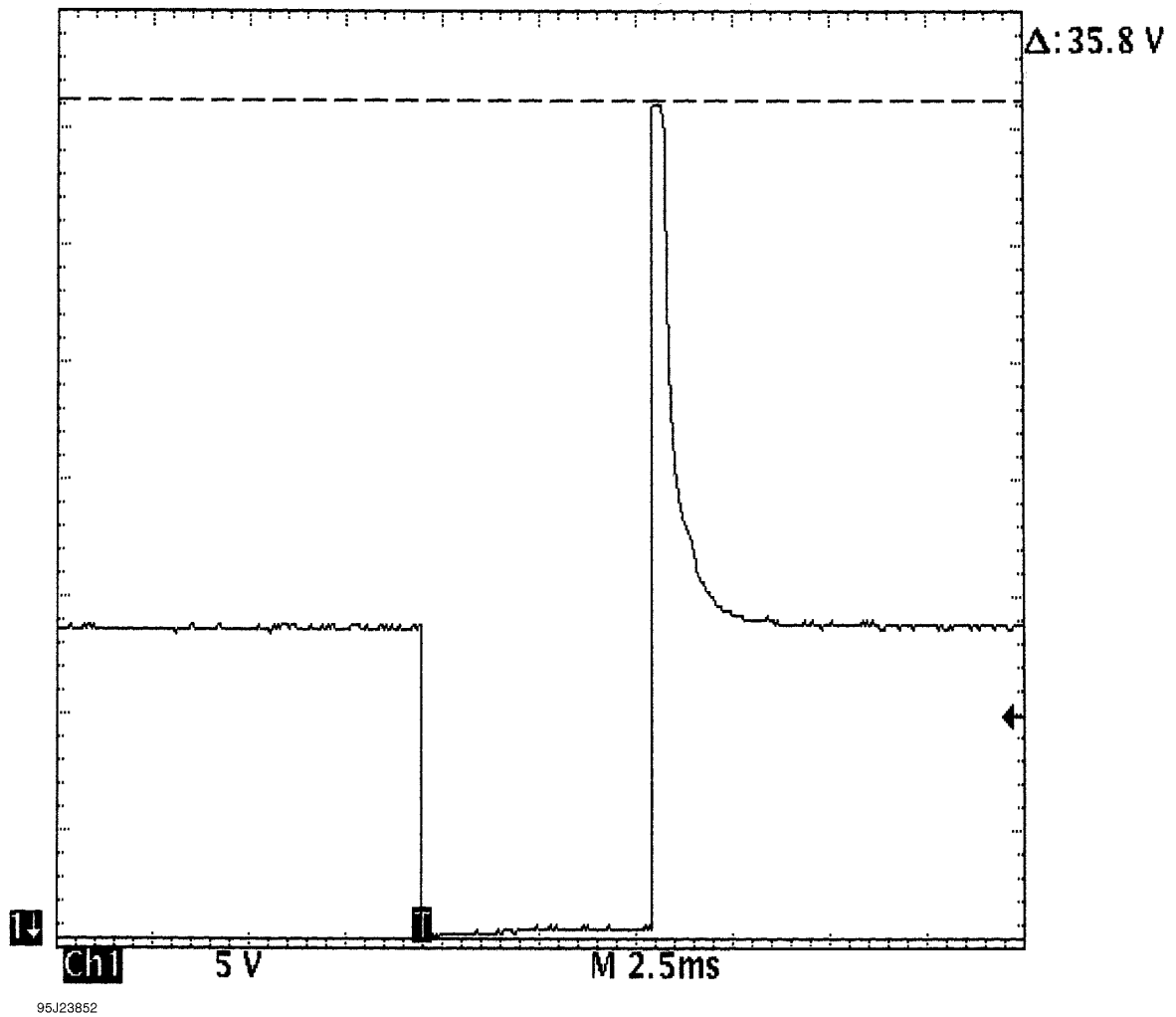


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**Fig. 24: Injector Bank - Known Good - Voltage Pattern**

**EXAMPLE #6 - CURRENT CONTROLLED DRIVER**

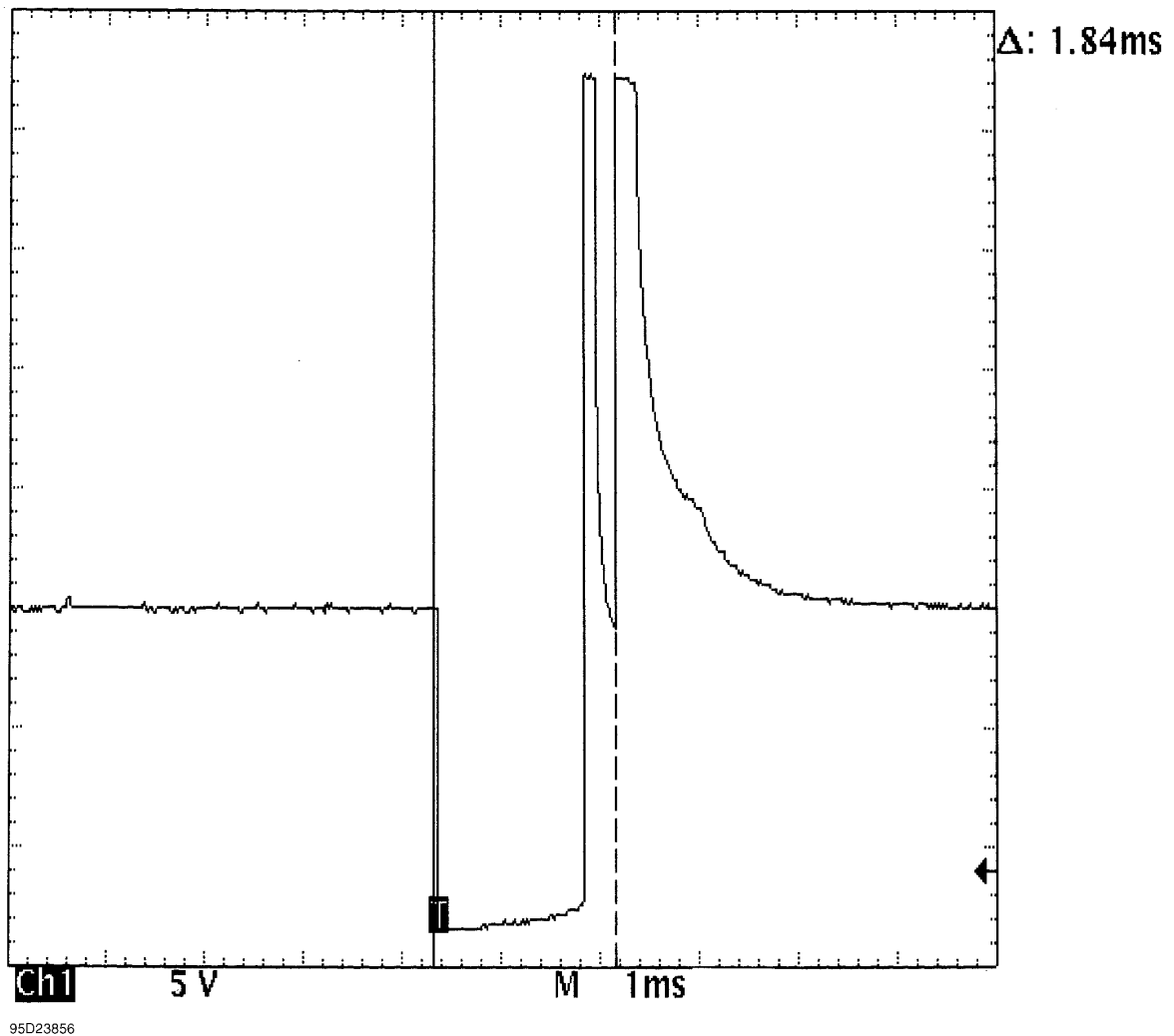
This known-good pattern from a Ford 3.0L V6 PFI VIN [U] illustrates that a zener diode inside the computer is used to clamp the injector's inductive kick to 35-volts on this system. See [Fig. 25](#).



**Fig. 25: Injector Bank - Known Good - Voltage Pattern**

**EXAMPLE #7 - CURRENT CONTROLLED DRIVER**

This known-good waveform from a Ford 5.0L V8 CFI VIN [F] was taken during hot idle, closed loop, and no load. See [Fig. 26](#).

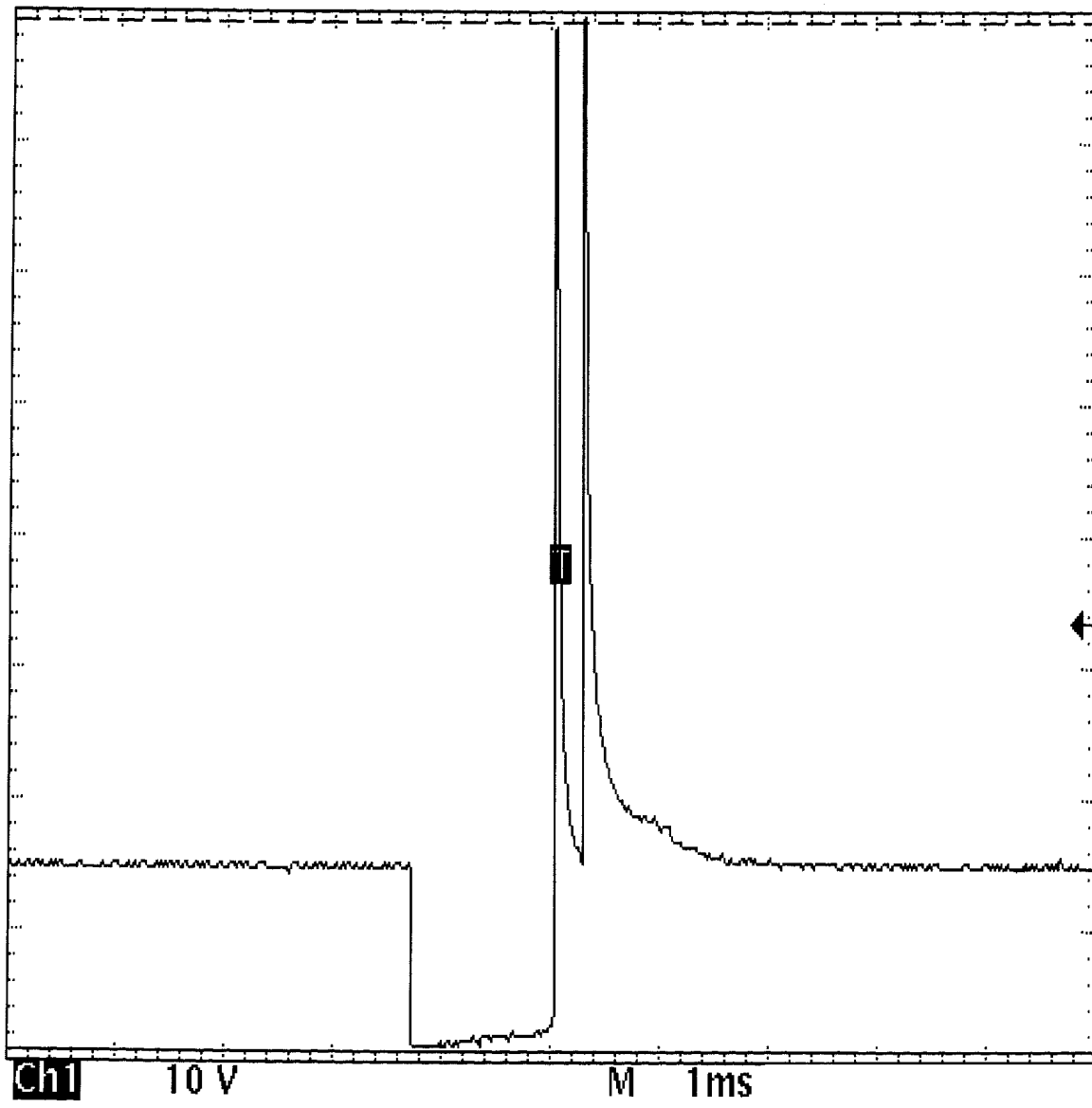


**Fig. 26: Single Injector - Known Good - Voltage Pattern**

**EXAMPLE #8 - CURRENT CONTROLLED DRIVER**

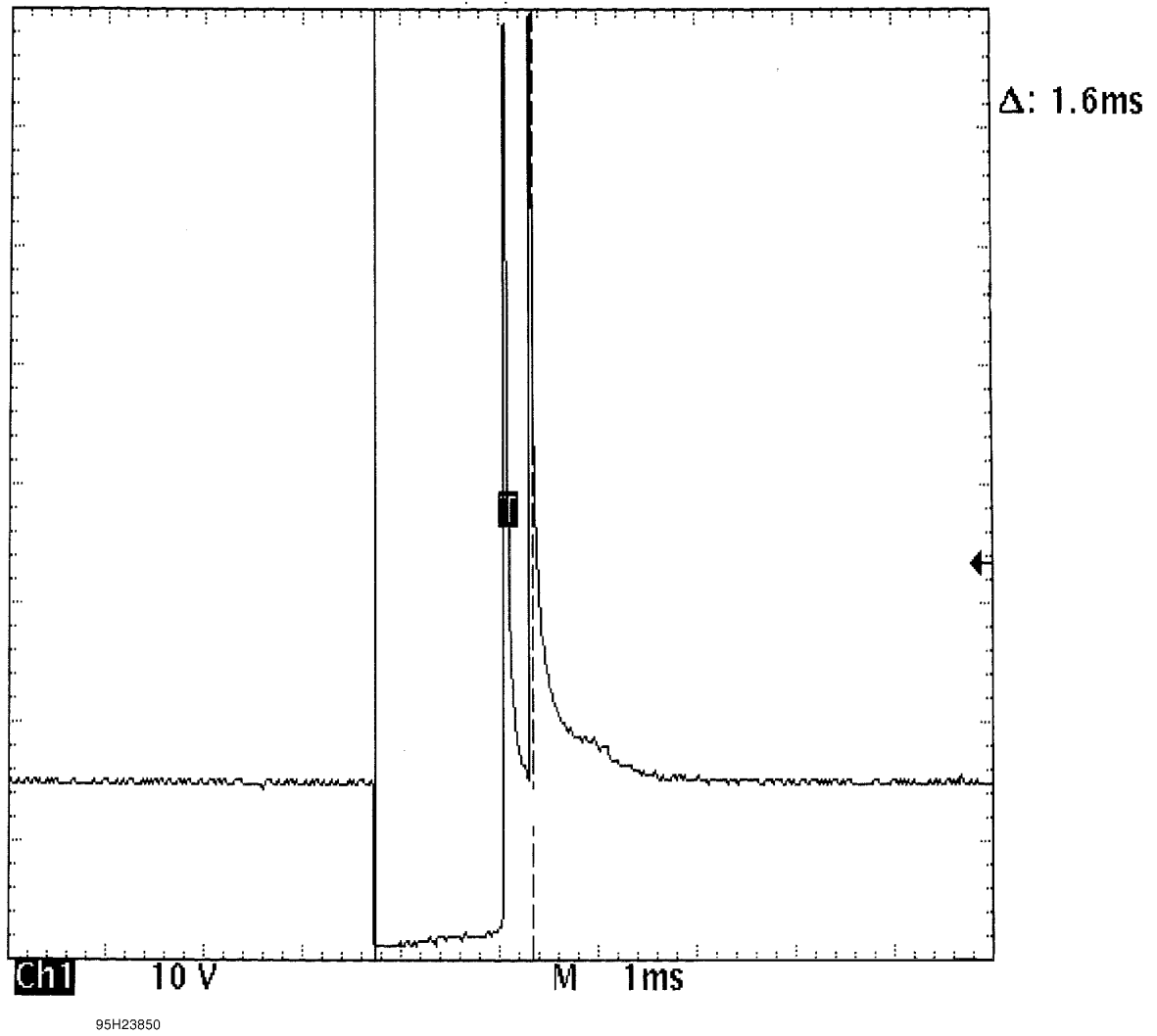
These two known-good waveform patterns are from a GM 2.0L In-Line 4 VIN [1]. Fig. [Fig. 27](#) illustrates the 78 volt inductive spike that indicates a zener diode is not used. The second waveform, Fig. [Fig. 28](#), was taken during hot idle, closed loop, and no load.





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**Fig. 27: Single Injector - Known Good - Voltage Pattern**



**Fig. 28: Single Injector - Known Good - Voltage Pattern**

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## GENERAL INFORMATION

### Wheel Alignment Theory & Operation

#### \* PLEASE READ THIS FIRST \*

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

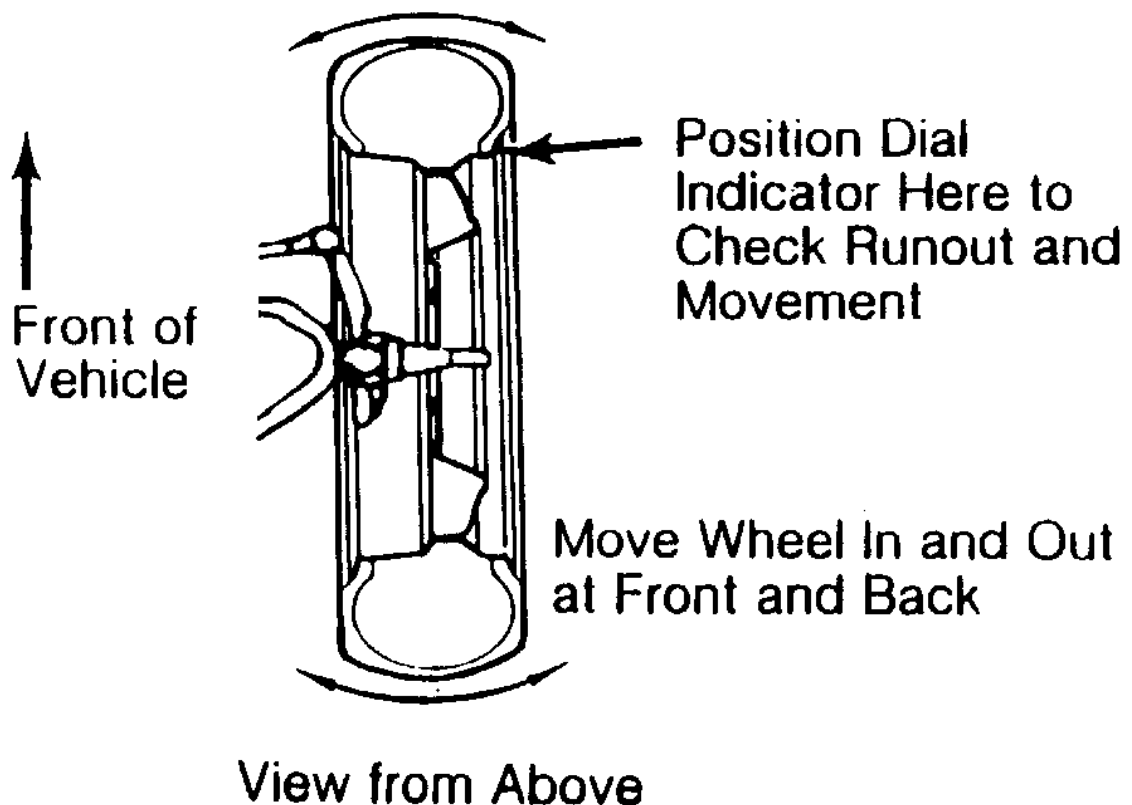
#### PRE-ALIGNMENT INSTRUCTIONS

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

#### GENERAL ALIGNMENT CHECKS

Before adjusting wheel alignment, check the following:

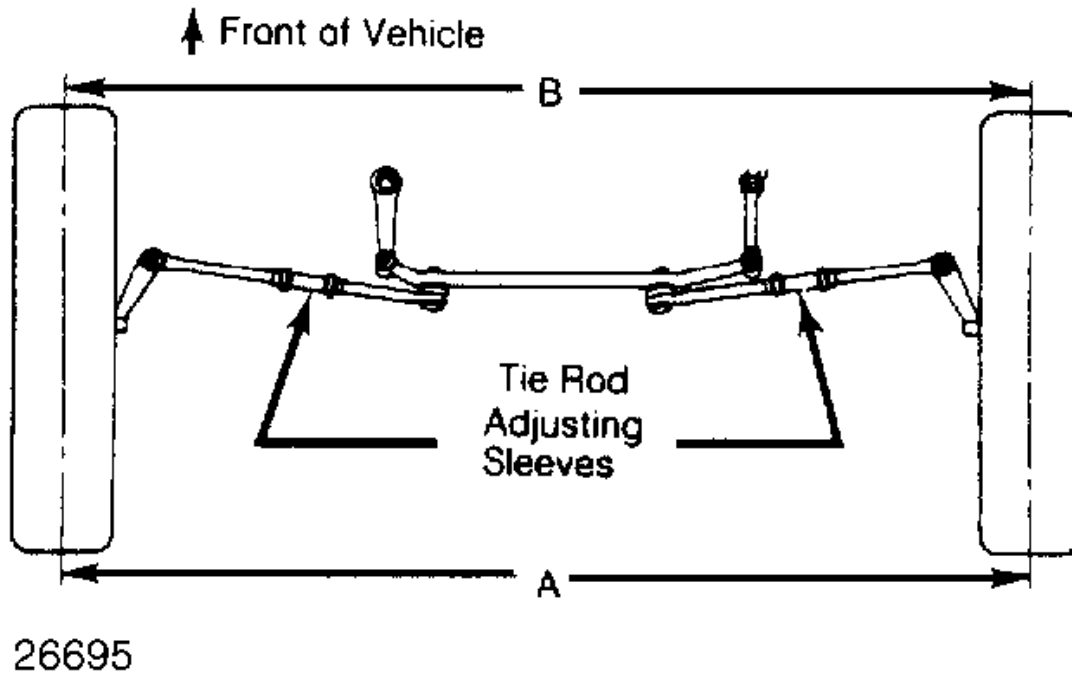
- Each axle uses tires of same construction and tread style, equal in tread wear and overall diameter. Verify that radial and axial runout is not excessive. Inflation should be at manufacturer's specifications.
- Steering linkage and suspension must not have excessive play. Check for wear in tie rod ends and ball joints. Springs must not be sagging. Control arm and strut rod bushings must not have excessive play. See [Fig.1](#).



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- Vehicle must be on level floor with full fuel tank, no passenger load, spare tire in place and no load in trunk. Bounce front and rear end of vehicle several times. Confirm vehicle is at normal riding height.
- Steering wheel must be centered with wheels in straight ahead position. If required, shorten one tie rod adjusting sleeve and lengthen opposite sleeve (equal amount of turns). See [Fig. 2](#).
- Wheel bearings should have the correct preload and lug nuts must be tightened to manufacturer's specifications. Adjust camber, caster and toe-in using this sequence. Follow instructions of the alignment equipment manufacturer.

**CAUTION:** DO NOT attempt to correct alignment by straightening parts. Damaged parts MUST be replaced.



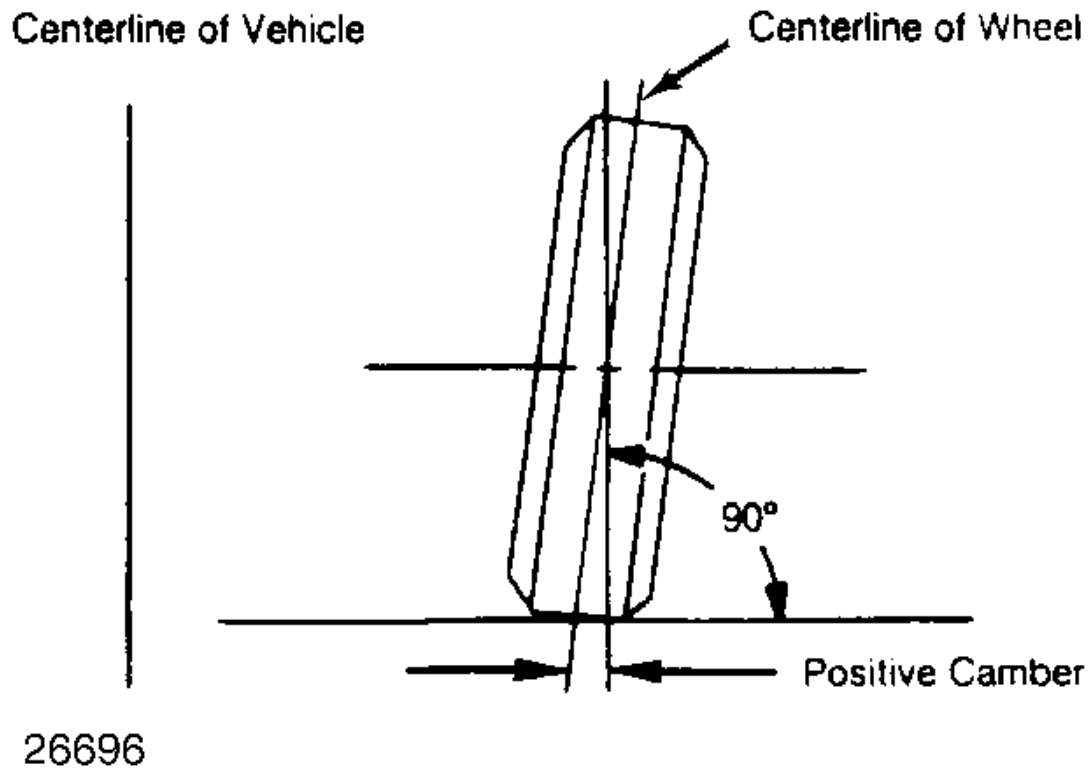
[Fig. 2: Adjusting Tie Rod Sleeves \(Top View\)](#)

## ADJUSTMENTS

**NOTE:** This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

## CAMBER

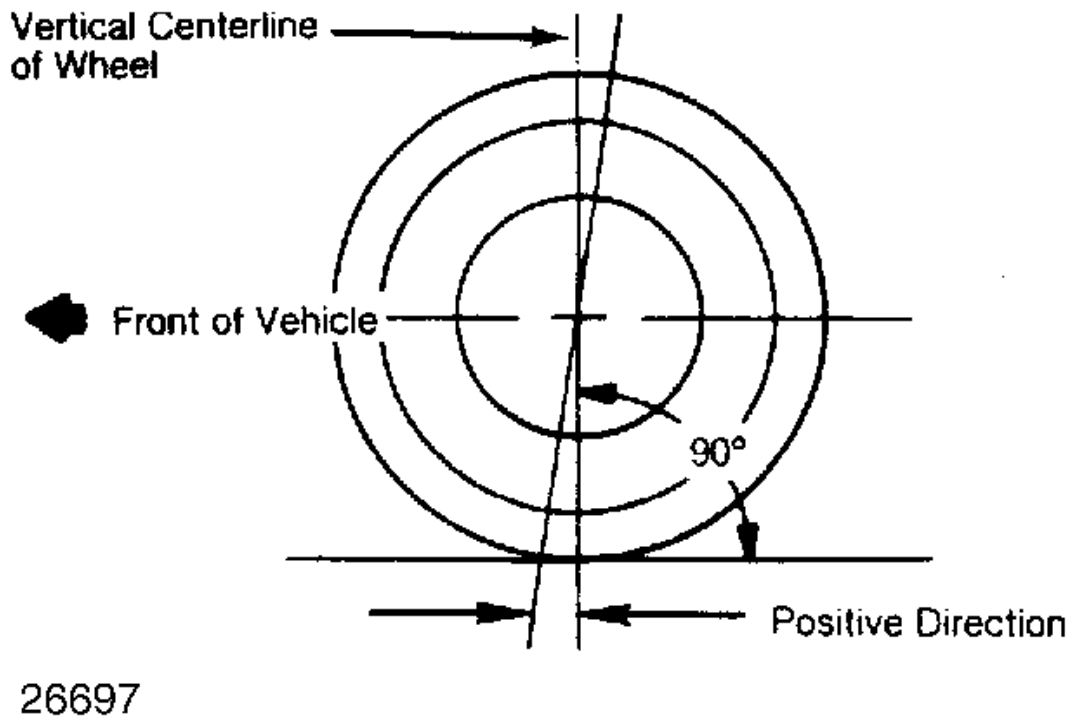
1. Camber is the tilting of the wheel, outward at either top or bottom, as viewed from front of vehicle. See [Fig. 3](#).
2. When wheels tilt outward at the top (from centerline of vehicle), camber is positive. When wheels tilt inward at top, camber is negative. Amount of tilt is measured in degrees from vertical.



**Fig.3: Determining Camber Angle**

### **CASTER**

1. Caster is tilting of front steering axis either forward or backward from vertical, as viewed from side of vehicle. See [Fig. 4](#).
2. When axis is tilted backward from vertical, caster is positive. This creates a trailing action on front wheels. When axis is tilted forward, caster is negative, causing a leading action on front wheels.



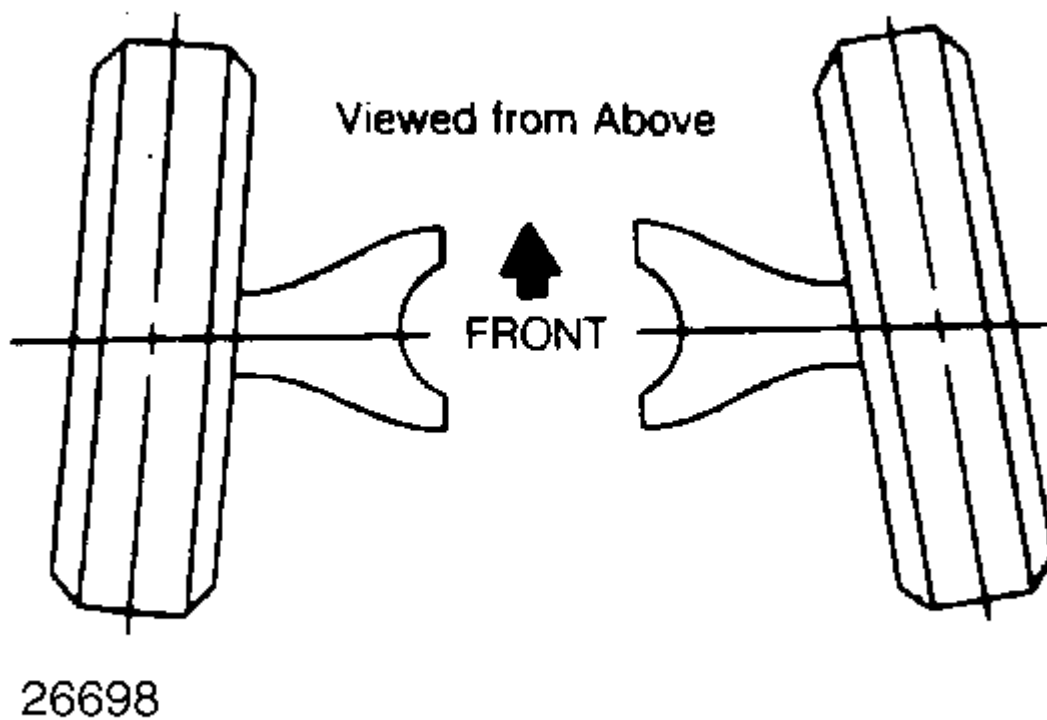
**Fig. 4: Determining Caster Angle**

### **TOE-IN ADJUSTMENT**

Toe-in is the width measured at the rear of the tires subtracted by the width measured at the front of the tires at about spindle height. A positive figure would indicate toe-in and a negative figure would indicate toe-out. If the distance between the front and rear of the tires is the same, toe measurement would be zero. To adjust:

- 1) Measure toe-in with front wheels in straight ahead position and steering wheel centered. To adjust toe-in, loosen clamps and turn adjusting sleeve or adjustable end on right and left tie rods. See [Fig. 2](#) and [Fig. 5](#).
- 2) Turn equally and in opposite directions to maintain steering wheel in centered position. Face of tie rod end must be parallel with machined surface of steering rod end to prevent binding.
- 3) When tightening clamps, make certain that clamp bolts are positioned so there will be no interference with other parts throughout the entire travel of linkage.





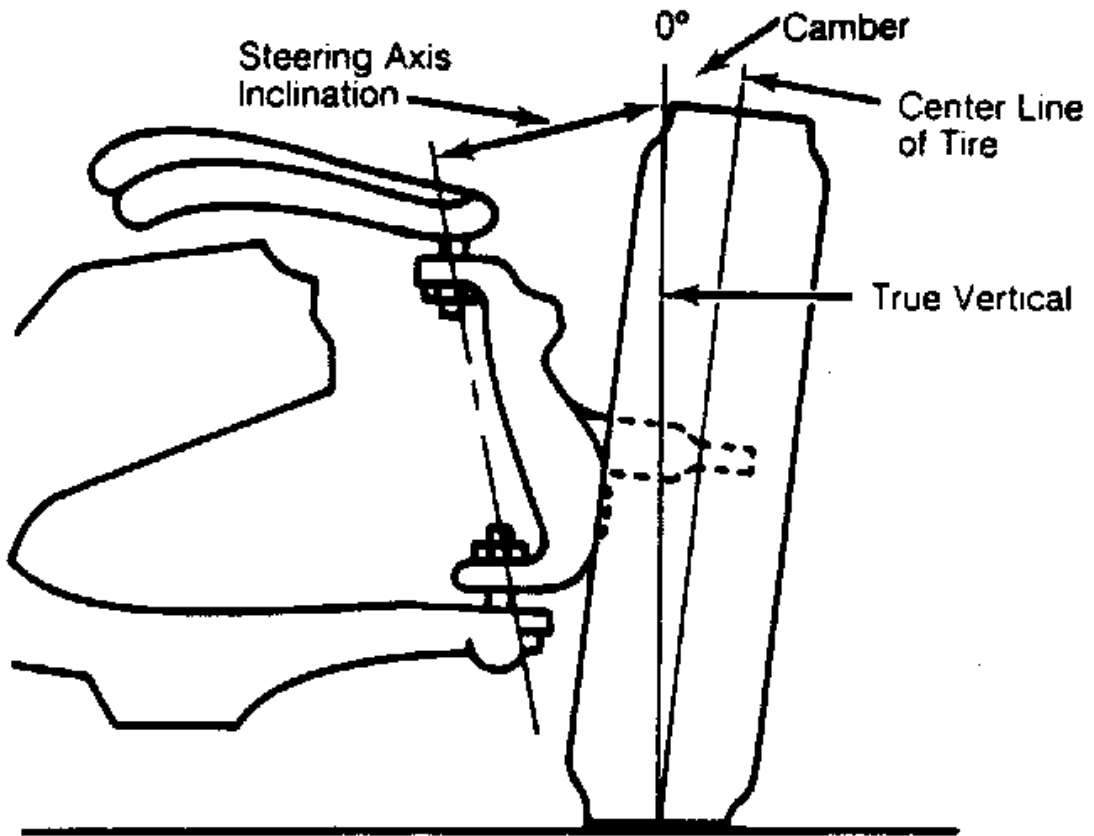
**Fig. 5: Wheel Toe-In (Dimension A Less Dimension B)**

### **TOE-OUT ON TURNS**

1. Toe-out on turns (turning radius) is a check for bent or damaged parts, and not a service adjustment. With caster, camber, and toe-in properly adjusted, check toe-out with weight of vehicle on wheels.
2. Use a full floating turntable under each wheel, repeating test with each wheel positioned for right and left turns. Incorrect toe-out generally indicates a bent steering arm. Replace arm, if necessary, and recheck wheel alignment.

### **STEERING AXIS INCLINATION**

1. Steering axis inclination is a check for bent or damaged parts, and not a service adjustment. Vehicle must be level and camber should be properly adjusted. See [Fig. 6](#).
2. If camber cannot be brought within limits and steering axis inclination is correct, steering knuckle is bent. If camber and steering axis inclination are both incorrect by approximately the same amount, the upper and lower control arms are bent.



**Fig. 6: Checking Steering Axis Inclination**

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## HVAC

### Heating And Air Conditioning - Repair - All I3 Models - i3

## SAFETY INFORMATION

### 64 50... SAFETY INFORMATION FOR HANDLING TETRAFLUORETHANE REFRIGERANT R134A

**WARNING:** Danger of injury!

**Refrigerant circuit is under high pressure! Work on the refrigerant circuit may only be carried out by experts!**

**Draw off refrigerant without fail BEFORE all repair work on the refrigerant circuit.**

**The refrigerant circuit is depressurized AFTER drawing off.**

**IMPORTANT:**

- The pressure gauge on the A/C service unit must be checked for the actual pressure drop prior to repair work.

It is absolutely essential to read and observe the relevant operating instructions for the A/C service unit used!

#### Protective measures/rules of conduct:

- Wear safety goggles
- Wear oil-resistant protective gloves
- Do not smoke!
- Observe country-specific safety regulations.

#### First aid measures:

- **Eye contact:** In the event of contact with the eyes, rinse immediately with plenty of running water and consult an ophthalmologist.
- **Skin contact:** In the event of contact with skin, remove affected clothing immediately and rinse with plenty of water.
- **After inhalation:** If refrigerant vapors are inhaled in greater concentrations, remove the person affected to an area of fresh air and keep them under supervision. Call for a doctor. If breathing problems are experienced, breathe additional oxygen. If the person affected is breathing with difficulty or has stopped breathing, incline the person's head at the neck and administer the kiss of life.

### 64 50... SAFETY INFORMATION FOR HANDLING REFRIGERANT R1234YF

**WARNING:** Danger of injury!

**Refrigerant circuit is under high pressure! Work on the refrigerant circuit may only be carried out by experts!**

**Draw off refrigerant without fail BEFORE all repair work on the refrigerant circuit.**

**The refrigerant circuit is depressurized AFTER drawing off.**

**At high temperatures, R1234yf is flammable.**

- The pressure gauge on the A/C service unit must be checked for the actual pressure drop prior to repair work.

**IMPORTANT:**

It is absolutely essential to read and observe the manufacturer's operating instructions for the A/C service unit.

**Protective measures/rules of conduct:**

- Wear safety goggles
- Wear oil-resistant protective gloves
- Do not smoke!
- Observe country-specific safety regulations.

**First aid measures:**

- **Eye contact:** In the event of contact with the eyes, rinse immediately with plenty of running water and consult an ophthalmologist.
- **Skin contact:** In the event of contact with skin, remove affected clothing immediately and rinse with plenty of water.
- **After inhalation:** If refrigerant vapors are inhaled in greater concentrations, remove the person affected to an area of fresh air and keep them under supervision. Call for a doctor. If breathing problems are experienced, breathe additional oxygen. If the person affected is breathing with difficulty or has stopped breathing, incline the person's head at the neck and administer the kiss of life.

**64 50... SAFETY INFORMATION FOR HANDLING REFRIGERANT OIL**

**WARNING:**

**Danger of injury!**

**Refrigerant circuit is under high pressure! Work on the refrigerant circuit may only be carried out by experts !**

**Draw off refrigerant without fail BEFORE all repair work on the refrigerant circuit.**

**The refrigerant circuit is depressurized AFTER drawing off!**

- **Before conducting repairs, check the actual pressure drop on the pressure gauge of the A/C service station**

**Read and comply with the relevant operating instructions for the A/C service station used!**

**Protective measures/rules of conduct:**

- Wear safety goggles
- Wear oil-resistant protective gloves
- Do not smoke!
- Observe country-specific safety regulations.

**First aid measures:**

- **If swallowed:** Do NOT induce vomiting, unless expressly instructed to do so by medical personnel. Do not administer anything to an unconscious person through their mouth. Consult a doctor immediately if larger quantities of this substance are swallowed. Loosen tight-fitting items of clothing (e.g. collar, tie, belt or similar).
- **Eye contact:** Remove contact lenses if worn. In the event of eye contact, rinse eyes for at least 15 minutes with plenty of water. **It is essential to use WARM WATER. Consult a doctor.**
- **Skin contact:** In the event of skin contact, rinse immediately with plenty of water. Remove contaminated clothes and shoes. Wash affected clothes before wearing again. Clean shoes thoroughly before reusing. **Call for a doctor.**

- **After inhalation:** If inhaled, take the person affected outside into fresh air immediately and keep them under supervision. **Call for a doctor** . If breathing difficulties are experienced, administer additional oxygen. If the person affected stops breathing, administer the kiss of life.

Refrigerant is hygroscopic and must therefore be stored in suitable containers that are sealed airtight!

refrigerant oil is non-combustible and non-explosive at normal temperatures.

Nevertheless, the following points must be observed:

IMPORTANT:

- Do not store in the vicinity of flames, heat sources or strongly oxidizing materials
- Suitable extinguishants are carbon dioxide (CO<sub>2</sub>) dry extinguishant and foam

## Recycling

Catch and dispose of emerging refrigerant oil.

Observe country-specific waste disposal regulations.

Absorb escaping refrigerant oil with fluid-binding material.

Notify the relevant authorities if larger amounts of refrigerant are discharged into aboveground water supplies, drainage systems or subsoil.

## (61 00... SAFETY INFORMATION FOR HANDLING ELECTRIC/HYBRID VEHICLES)

### 1. *Qualification:*

All repair work on high-voltage components may **only be performed by specially trained personnel** (qualification: Work on high-voltage inherently safe vehicles) must be performed by qualified technicians. Each electric vehicle requires additional vehicle-specific training with training achievement controls.

Required training is offered by the BMW Training Academy.

### 2. *Identification:*

Observe **warning notices** on high-voltage components. When replacing individual high-voltage components, check if warning stickers are present. Independently attaching warnings is only allowed on the locations provided for them. Use only approved and appropriately identified original new parts.

### 3. *Rules of conduct/protective measures:*

- Note operating instructions for handling high-voltage battery units.
- Do not under any circumstances touch open high-voltage cables and high-voltage components on damaged vehicle before shutting down the high-voltage electrical system.
- In the event of damage (mechanical, thermal) transition metal oxides, carbon, electrolyte solvents and their products of decomposition may be released.

Damaged high-voltage battery units must be stored in an acid-resistant pan in a location in the open that is protected against the weather (sun, rain) and secured against unauthorized access. Do not inhale escaping gasses.

- Prevent escaping substances from entering drains, pits and the sewer system.
- Collect any material that is discharged and have it disposed of according to the work instruction, wear acid-resistant protective clothing when doing so.
- Notify the fire brigade if fire breaks out, clear the area immediately and make accident scene safe.

Attempt to extinguish the fire without putting persons in danger (suitable extinguishant: water and water foam).

- A cut 2nd emergency separation point must be repaired with a butt connector.

#### 4. Measures before starting work:

- Each job on the vehicle must be assigned by appropriately trained personnel. Before work is started, this electrician must place the vehicle in the operating condition required to perform the relevant activity. The qualified personnel's instructions and directions absolutely must be followed. **No work may be carried out without this qualified personnel being consulted first.**
- The readiness to drive must be ended before shutting off the voltage of the high-voltage system. The readiness to drive is ended when the driver is absent only under the following conditions:
  1. seat belt buckle unlocked **and**
  2. the driver's door is open **and**
  3. no brake activated **and**
  4. no accelerator pressing **and**
  5. speed < 3 km/h (2 mph)
- Work on live high-voltage components is expressly prohibited. Before each operation on the high-voltage system, the system must be isolated from the power supply by qualified personnel (high-voltage safety connector Off) and secured against unauthorized return to service (padlock).
- Before beginning work, it is mandatory to check that the equipment is de-energized and is protected against being energized again.

Work is only permitted to begin if:

1. Corresponding display in instrument cluster: **High-voltage system switched off**

When a high-voltage warning is active (indicator light, Check Control, etc.), it is essential to determine and eliminate the cause of this warning via the diagnosis system before continuing with any other work.

**If it cannot be definitively established that the equipment is de-energized**, work is not permitted to begin. **Danger to life!** Before work begins, a qualified electrician (1000 V DC) must verify that the system is de-energized using appropriate measuring devices and procedures.

**=> In this case, a qualified electrician or Technical Support must be contacted!**

- Do not carry out any work whatsoever on high-voltage components while the batteries are charging. Before starting work, disconnect the charging cable from the vehicle.
- The vehicle must not be charged and refuelled at the same time.
- No repair work may be carried out at the high-voltage system when a combustion engine is currently running.
- The coolant pump and electric fan can be switched on automatically when terminal 15 is switched on or the high-voltage battery unit is charging. The following preliminary work must be performed prior to working on the electric fan to prevent injuries caused by an automatically activated electric fan.
  1. Disconnect any connected charging cables.
  2. Switch off terminal 15.
  3. Disconnect high-voltage system from power.
  4. Disconnect plug connections from the electric fan.

#### 5. Measures during/after activities:

- Identifiable mechanical damage to or tampering with high-voltage components must be reported immediately to the qualified personnel in charge.
- When carrying out any work on the high-voltage system, it is prohibited to drive externally all the drive train components (wheels, gearbox, drive shafts, etc.).
- Check all connectors and plug connections of the high-voltage components for damages after disconnecting them and/or before connecting them.



- High-voltage cables (orange coating) and their connectors and ferrules **may not** be repaired. If damaged, a cable must always be replaced completely.
- High-voltage cables must not be twisted or kinked. Crushed high-voltage cables must be replaced.
- After a bending operation, the resulting bend may only be returned to its original shape. To repeat bending at the same place is not permitted.
- When working in the vicinity of high-voltage components (identified accordingly with warning stickers and orange-colored coating), protect these components against damage.
- The specified work steps in the repair instructions must be adhered to exactly.
- High-voltage components and their holders must be screwed/bolted to the defined tightening torque. Tightening torques and tightening specifications must be observed.
- Connecting high-voltage components to body ground is crucial to safety for reasons of equipotential bonding. For this reason, it is prohibited to operate any high-voltage components without them being correctly connected to body ground. The measurement (insulation measurement) is performed by the vehicle automatically and therefore manual measurement is not required.

For a correct ground connection, the retaining elements of high-voltage components must not be painted. Follow further PAINTING NOTES .

- Removed high-voltage battery units must be stored in a manner that protects them from misuse and damage.

#### 6. *Potential compensation:*

Potential compensation wires, high-voltage cable, and the battery earth lead of the electrical machine electronics have a safety screw connection!

- Clean contact faces and have then checked by a second person.
- Tighten down screws/bolts to specified torque.
- Have tightening torque checked by a second person.
- Both persons must document that the work has been carried out correctly in the vehicle records.

### **64 00... INFORMATION ON USING CLEANING AGENT/PAINTS (PERSONAL PROTECTION EQUIPMENT)**

**WARNING:** Use of cleaning agents/paints not compliant with instructions can cause serious injuries or burns!  
 Handling cleaning agents/paints can trigger allergic skin and respiratory reactions!

#### **Observe following instructions:**

- IMPORTANT:
- Store cleaning agents/paints only in a secure cabinet.
  - Keep cleaning agents/paints away from naked flames and other sources of ignition.
  - Protect cleaning agents/paints from high temperatures and direct sunlight.
  - Always keep an eye douche on hand, change the water regularly (once a month).

#### **Observe following instructions before use:**

- IMPORTANT:
- Manufacturer's instructions (on container/packaging)
  - Hazard warnings (on container/packaging)
  - Manufacturer's instructions on package insert
  - Material safety data sheet of manufacturer
  - National market regulations

**Observe following instructions during use:**

- Do not eat, drink or smoke while working with these products.
  - Avoid direct contact with skin and eyes.
- IMPORTANT:
- Wear personal protective clothing/equipment.
  - Ensure that all enclosed areas are well ventilated or extract fumes directly.
  - Immediately change working clothes soiled with cleaning agent/paint.
  - After finishing work, wash your hands and apply protective skin cream.

IMPORTANT: Follow hazard warnings and wear personal protection equipment!

**First Aid:**

- If product comes in contact with eyes, immediately flush with running water for about 10 - 15 minutes. Seek the advice of eye specialist.
- In the event of skin contact and where applicable an allergic skin reaction, clean the affected areas immediately with soap and water and then apply silicone-free skin cream. Seek advice of physician.
- If an adhesive product is swallowed, rinse mouth/parts of mouth thoroughly with running water. Drink 1-2 glasses of water. Do not induce vomiting. Consult a doctor.
- After inhaling vapors ensure ample supply of fresh air. Keep calm, keep respiratory tracks clear and call doctor.

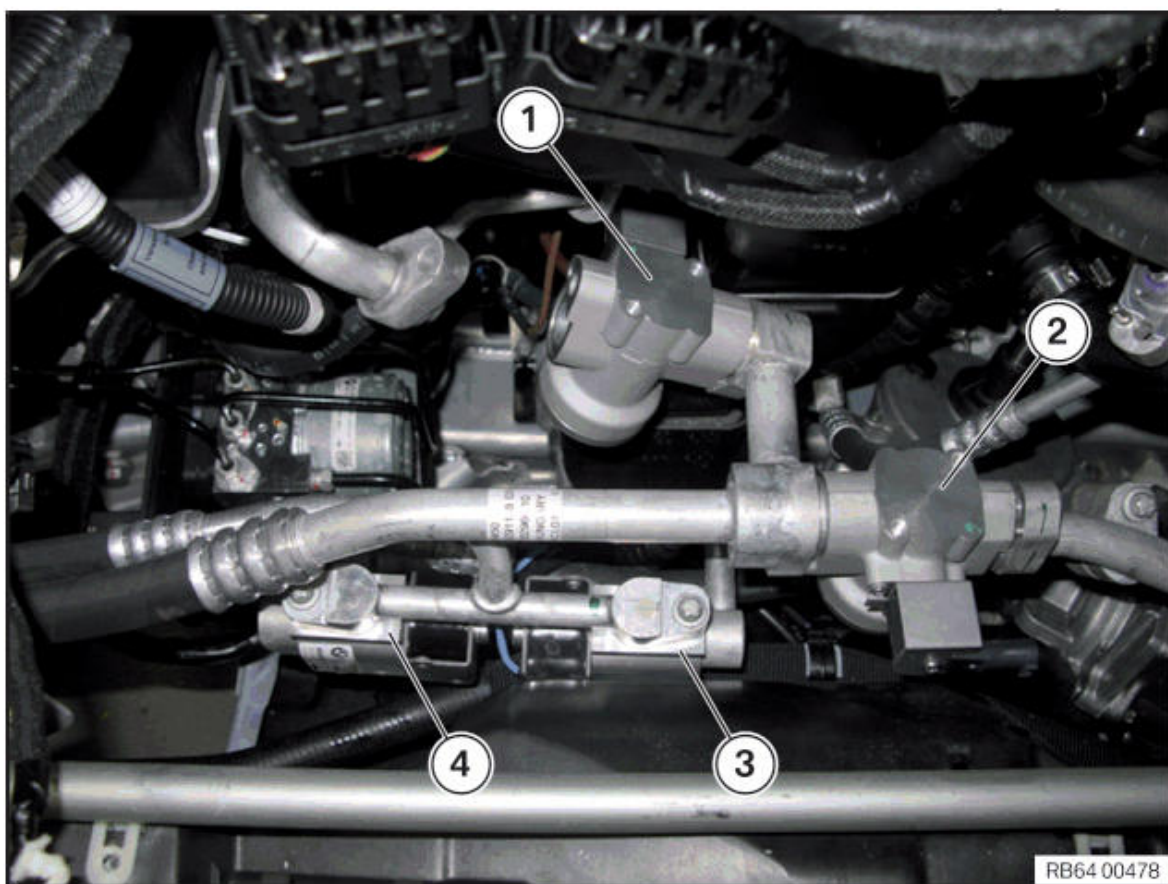
**Recycling:**

Dispose of cleaning agents/paints in a professional manner!

Observe national/country-specific disposal regulations.

**HVAC UNIT, CONTROL PANEL, BLOWERS, HVAC SENSORS, FLAPS AND ACTUATORS, ELECTRIC PUMP**

**64 11.. OVERVIEW OF SHUTOFF VALVES IN HEAT PUMP CIRCUIT**



- |   |  |   |  |
|---|--|---|--|
| 1 | <a href="#">Shutoff valve 3 (Y157)</a> | 3 | <a href="#">Shutoff valve 2 (Y156)</a> |
| 2 | <a href="#">Shutoff valve 4 (Y158)</a> | 4 | <a href="#">Shutoff valve 1 (Y155)</a> |

**Fig. 1: Overview Of Shutoff Valves In Heat Pump Circuit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **64 10 031 DRAIN AND TOP UP COOLANT, HEATER CIRCUIT**

**Special tools required:**

- 00 2 030

**WARNING:** High-voltage system - danger to life  
 Compliance with the following points is mandatory before beginning work:

- Follow all applicable **SAFETY INFORMATION**.

**WARNING:** Risk of scalding!  
 Only carry out repair work on the cooling system after the cooling system has cooled down!

**Lifetime coolant filling:**

Never reuse used coolant!

**IMPORTANT:** When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

### Installation note:

The cooling circuit of the heating may **ONLY** be filled with "**coolant concentrate i3**" (part number: 83 51 2 355 296).

"**Coolant concentrate i3**" must **NOT** be mistaken for **G48** or mixed with it.

In all equipment specifications, the heater circuit is filled with approx. 2 liters in a **mixture ratio** of **50/50** which provides freezing protection down to  $-40\text{ }^{\circ}\text{C}$ .

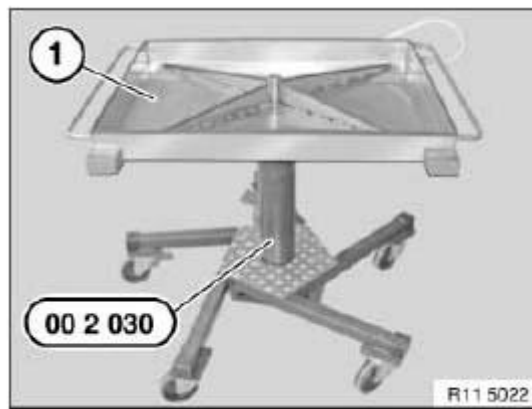
### Protective measures/rules of conduct:

- Wear protective goggles.
- Wear protective gloves.
- Note national regulations.

**IMPORTANT:** For dirt contamination of the cooling system (e.g. by engine oil), the cooling system must be rinsed with water until all dirt contamination is removed!

**IMPORTANT:** Risk of skidding due to coolant on the floor.  
**Danger of injury!**

Catch and dispose of drained coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).



**Fig. 2: Identifying Drip Tray And Special Tool (00 2 030).**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Recycling:

Observe country-specific waste disposal regulations.

### Necessary preliminary work:

- Remove **FRONT LUGGAGE COMPARTMENT WELL** .

### Draining coolant:

Open sealing cap (1) on coolant expansion tank.



**Fig. 3: Identifying Sealing Cap On Coolant Expansion Tank**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and remove coolant hose (1).

Drain, catch and dispose of coolant.



**Fig. 4: Identifying Coolant Hose**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Adding coolant:**

The cooling circuit of the heating may **ONLY** be filled with "coolant concentrate i3" .

"Coolant concentrate i3" must **NOT** be mistaken for G48 or mixed with it.

In all equipment specifications, the heater circuit is filled with approx. 2 liters in a **mixture ratio** of **50/50** which provides freezing protection down to -40 Å°C.

Fill and bleed **COOLING SYSTEM WITH VACUUM FILLING UNIT** .

**64 00... BLEEDING AND FILLING THE COOLING CIRCUIT FOR HEATING WITH THE VACUUM FILLING UNIT**

**Special tools required:**

- 00 2 030
- 17 0 100



Type	Model	Adapter Y from 17 0 100
I01	i3, i3 REX	17 0 109

**Lifetime coolant filling:**

Never reuse used coolant!

**IMPORTANT:** When replacing and removing components which rely on the corrosion protection effect of the coolant, it is essential to change the coolant. The cooling system must therefore be drained and refilled.

In the case of other removal work involving the draining of part quantities of coolant, replace these quantities which have been drained with new coolant.

**IMPORTANT:** You must protect the alternator against contamination by coolant when carrying out repair work on the cooling circuit.  
Cover alternator with suitable materials.  
Failure to comply with this procedure may result in an alternator malfunction.

Note on ordering:

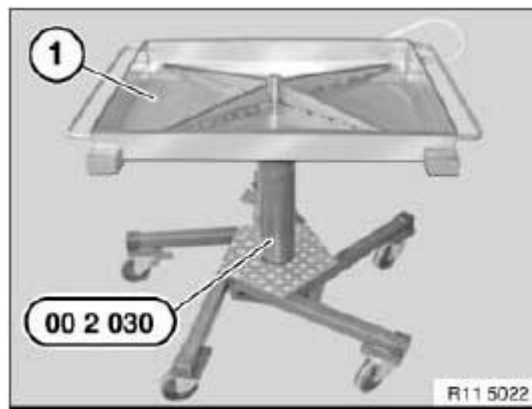
- Filler unit no. 81 39 2 152 473
- Collecting vessel no. 81 49 2 152 347
- Adapter: 17 0 100

**IMPORTANT:** Risk of slipping due to coolant on the floor.  
**Danger of injury!**

Catch and dispose of emerging coolant in drip tray (1) and if necessary special tool 00 2 030 (universal hydraulic lifting equipment).

**Recycling:**

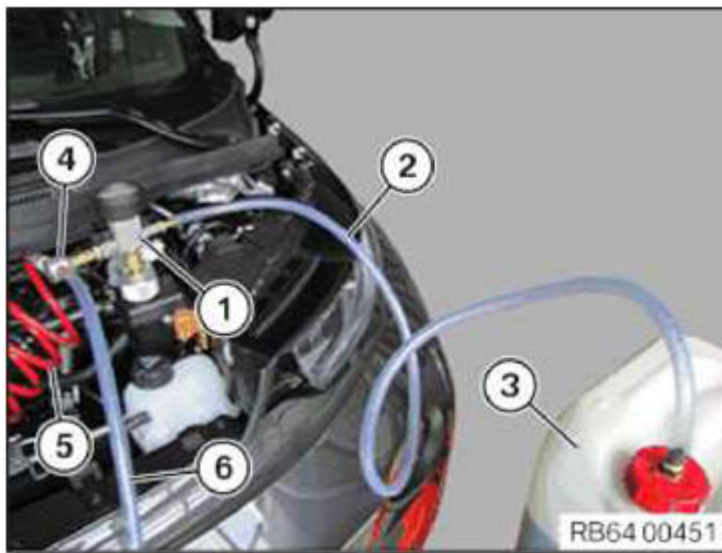
Observe country-specific waste disposal regulations.



**Fig. 5: Identifying Drip Tray And Special Tool (00 2 030).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Check all the coolant hoses before filling the cooling system with the vacuum filling unit.  
If necessary, replace damaged and porous coolant hoses.





**Fig. 6: Checking Coolant Hoses**

Courtesy of BMW OF NORTH AMERICA, INC.

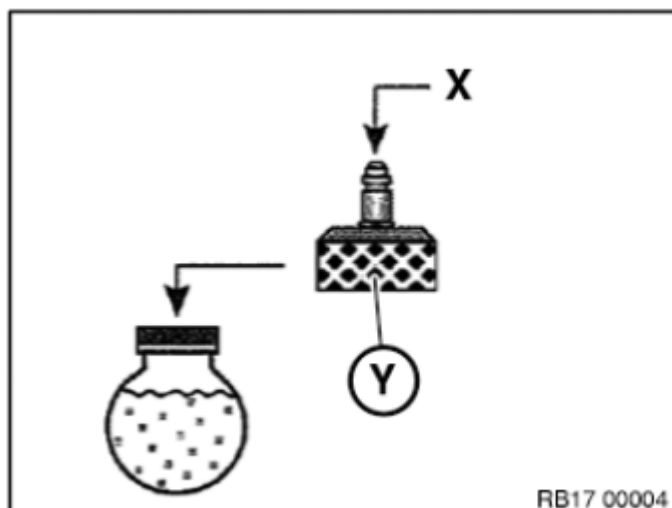
- 1) Filling unit with vacuum meter and shutoff valves
- 2) Filler hose
- 3) Coolant container
- 4) Venturi nozzle
- 5) Compressed air connection (max. 6 bar)
- 6) Outgoing-air hose (lead outgoing-air hose into a collecting container)

### Preconditions

- Cooling system expansion tank must be empty.
- There must be sufficiently premixed "**coolant concentrate i3**" (part number: 83 51 2 355 296) in the filling unit container, 1 - 2 liters more than the vehicle filling capacity.
  - Only use "**coolant concentrate i3**".
  - In all equipment versions, the heater circuit is filled with approx. 2 liters with a **mixing ratio of 50/50**, which provides freezing protection down to - 40 Å°C.
- Position the filling unit container at the same height as the coolant expansion tank.
- Compressed-air connection with 6 bar pressure present.
- Set vehicle heater to maximum temperature.

Select adapter (Y) according to table and connect to coolant expansion tank.

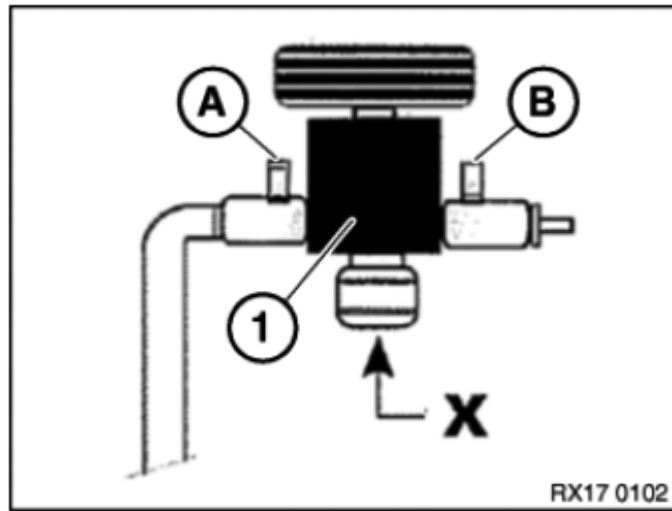
Connect filler unit to adapter connection (X).



**Fig. 7: Connecting Vacuum Filling Unit To Adapter Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Shutoff valves (A) and (B) of the filling unit (1) must be closed.

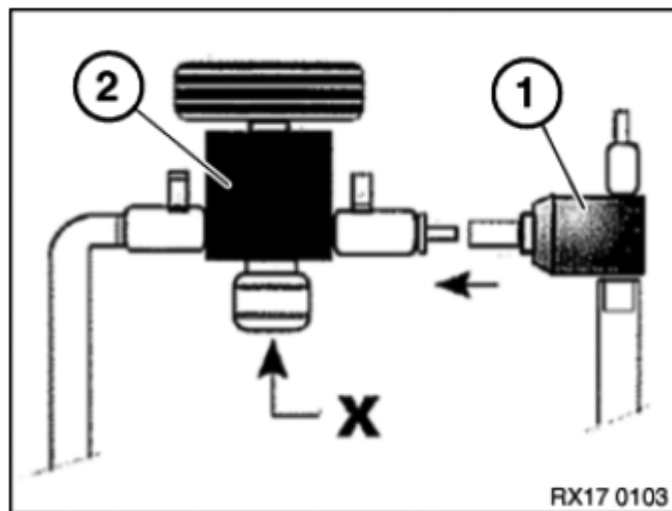
(X) Expansion tank connection



**Fig. 8: Closing Vacuum Filler Device Shut-Off Valves**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect venturi nozzle (1) to filling unit (2).

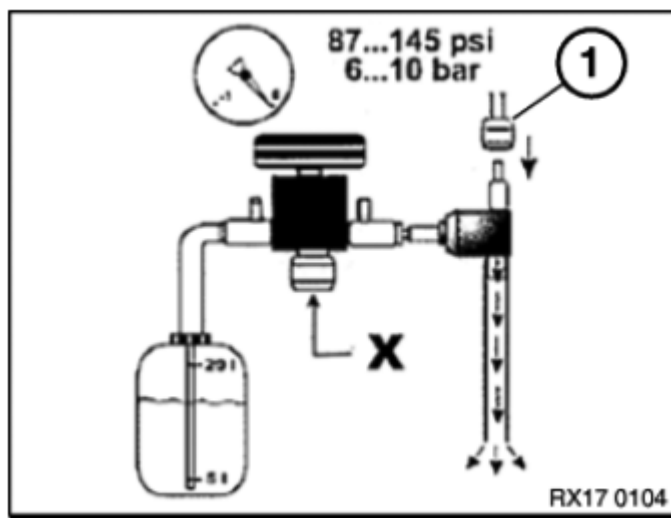
(X) Expansion tank connection



**Fig. 9: Connecting Venturi Nozzle To Filling Unit**  
Courtesy of BMW OF NORTH AMERICA, INC.

Connect compressed air (1).

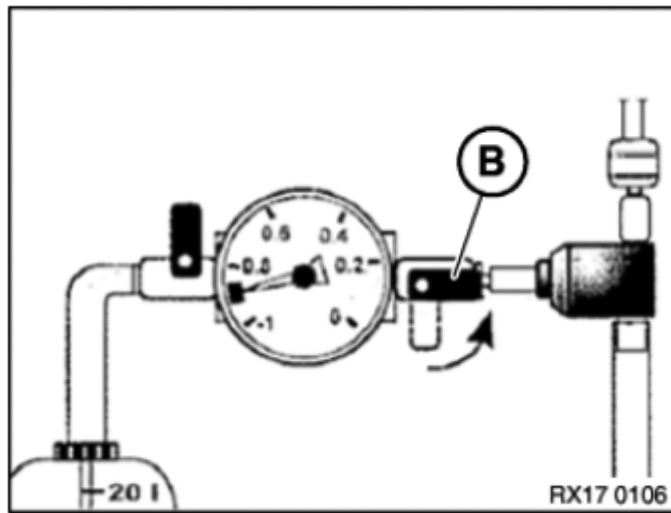
(X) Expansion tank connection



**Fig. 10: Connecting Compressed Air**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Open shutoff valve (B).

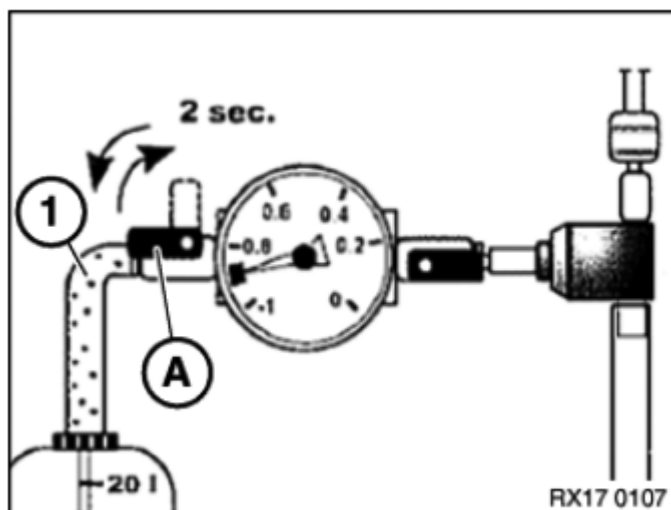
The venturi nozzle produces a flow noise.



**Fig. 11: Opening Shut-Off Valve**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Then open shutoff valve (A) until the filling hose (1) is free of bubbles.

Close shutoff valve (A) again. The filling hose (1) is vented in this way.



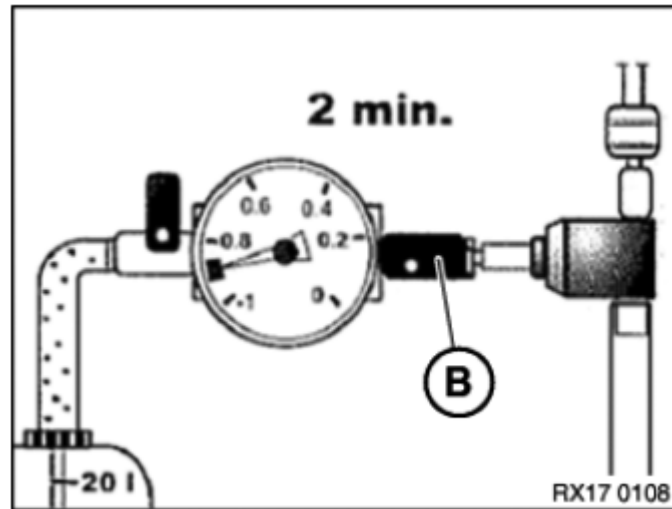
**Fig. 12: Closing Shut-Off Valve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Shutoff valve (B) will remain open.

Generate vacuum in coolant system for approx. 2 minutes. The end vacuum is reached at a vacuum of -0.7 to -0.95 bar. Green scale on the vacuum meter.

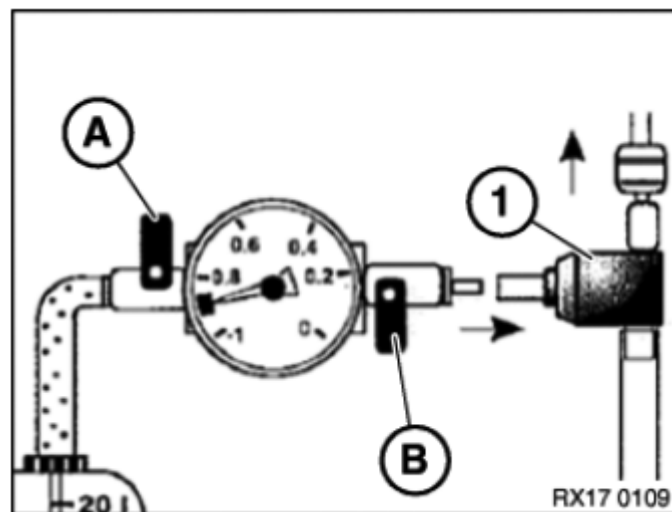
**NOTE:** The coolant hoses contract during vacuum build-up.

Then close shutoff valve (B) again.



**Fig. 13: Checking Shut-Off Valve**  
Courtesy of BMW OF NORTH AMERICA, INC.

Both shutoff valves (A) and (B) must be closed. Then seal Venturi nozzle (1).

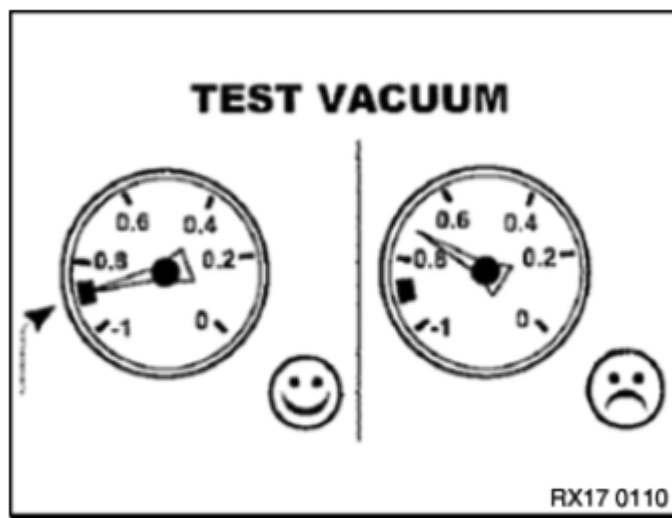


**Fig. 14: Closing Shut-Off Valve**  
Courtesy of BMW OF NORTH AMERICA, INC.

The cooling system must hold the vacuum for 30 s. If the needle in the vacuum meter falls, this indicates a leak in the cooling system.

If the vacuum remains constant, proceed with filling.

In event of leaks, check cooling system for leaks.



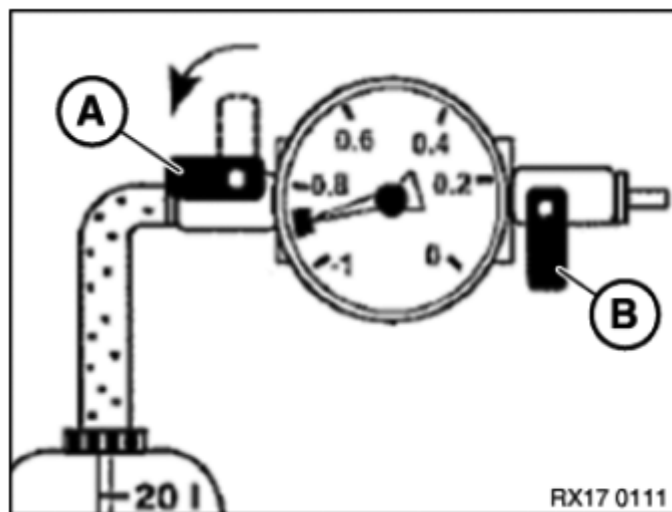
**Fig. 15: Identifying Vacuum Meters**

Courtesy of BMW OF NORTH AMERICA, INC.

There must be sufficiently premixed coolant in the filling unit container: 1 - 2 liters  
IMPORTANT: more than the vehicle filling capacity.

Position the filling unit container at the same height as the coolant expansion tank.

Shut-off valve (B) remains closed during the filling process.



**Fig. 16: Opening Shut-Off Valve**

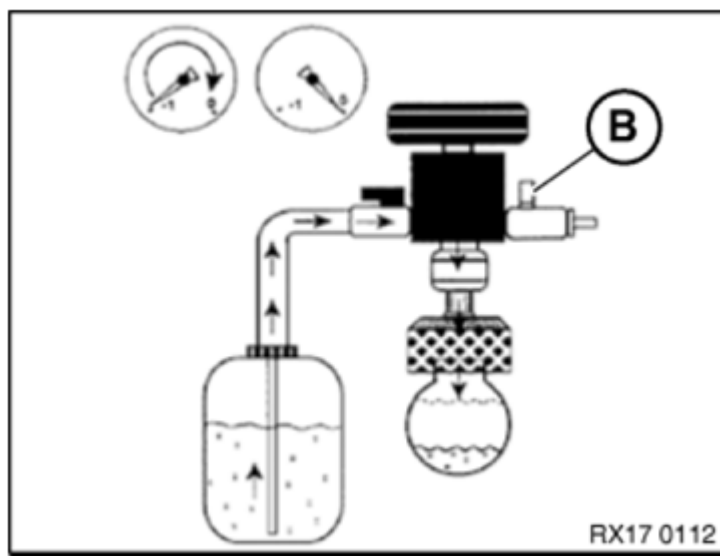
Courtesy of BMW OF NORTH AMERICA, INC.

To fill the cooling system, open shutoff valve (A) to filling unit container.

Coolant is now added.

The filling procedure is finished when the needle in the vacuum meter is at 0 bar or no longer falls.

If necessary, reduce remaining vacuum. Open shutoff valve (B) to do so.



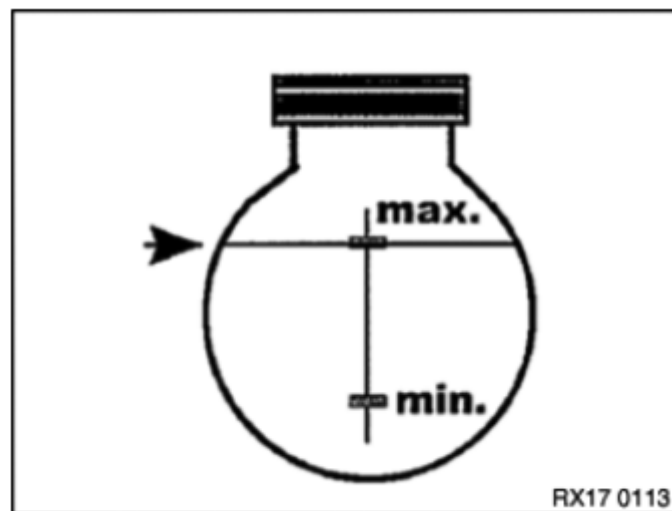
**Fig. 17: Opening Shutoff Valve**

Courtesy of BMW OF NORTH AMERICA, INC.

Remove filling unit with adapter from expansion tank.

Adjust coolant level to maximum.

Close coolant expansion tank.



**Fig. 18: Adjusting Coolant Level**

Courtesy of BMW OF NORTH AMERICA, INC.

Check function of cooling system.

Check cooling system for tightness.

## **64 11 380 REMOVING AND INSTALLING/REPLACING CONTROL UNIT FOR AIR CONDITIONING**

*Necessary preliminary tasks:*

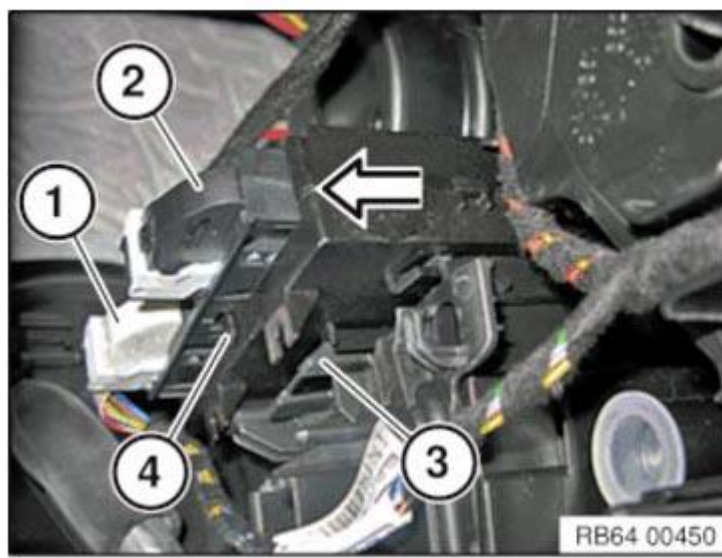
- Remove **TRIM PANEL FOR PEDAL MECHANISM**

Unlock and detach plug connections (1 and 2).

Unlock latch mechanism (3) downward.

Pull out control unit (4) in direction of arrow and remove.





**Fig. 19: Detaching Plug Connections**

Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Carry out VEHICLE PROGRAMMING/ENCODING.

**64 11 377 REMOVING AND INSTALLING CONTROL PANEL OF HEATER/AIR CONDITIONING SYSTEM**

**Necessary preliminary tasks:**

- Remove RADIO AND A/C CONTROL PANEL

**64 11 872 REMOVING AND INSTALLING/REPLACING ACTUATOR DRIVE FOR BLENDING FLAP (RIGHT)**

*Necessary preliminary tasks:*

- Remove CENTER DASHBOARD TRIM PANEL
- Remove PASSENGER'S SIDE FOOTWELL TRIM PANEL

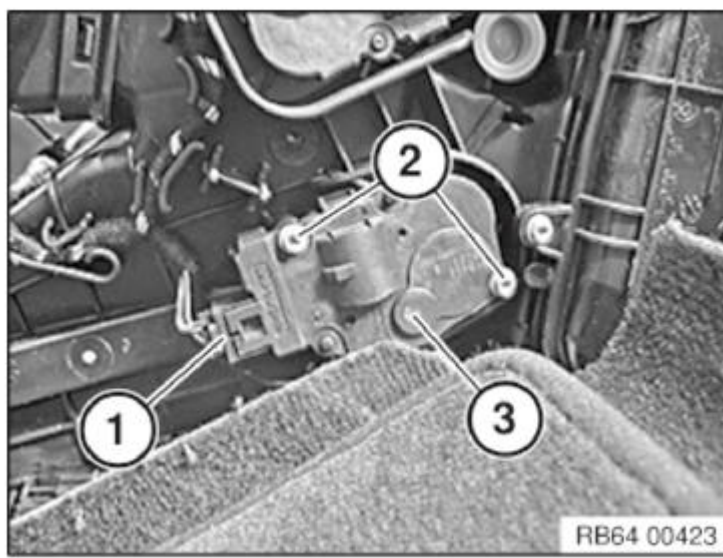
Unfasten plug connection (1) and disconnect.

Unfasten screws (2).

Remove actuator drive (3).

*Installation note:*

Make sure actuator drive (3) is correctly seated.



**Fig. 20: Identifying Actuator Drive, Plug Connection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Servomotors must be readdressed in the event of replacement!

Addressing can only be carried out with the BMW diagnosis system.

Service functions:

- Body
- Heating and air conditioning function
- Flap motors
- Readdress flap motors

### **64 11 868 REMOVING AND INSTALLING/REPLACING ACTUATOR DRIVE FOR DEFROSTING FLAP**

*Necessary preliminary tasks:*

- Remove **MIDDLE DASHBOARD COVER**
- Remove **PASSENGER'S SIDE FOOTWELL TRIM PANEL**

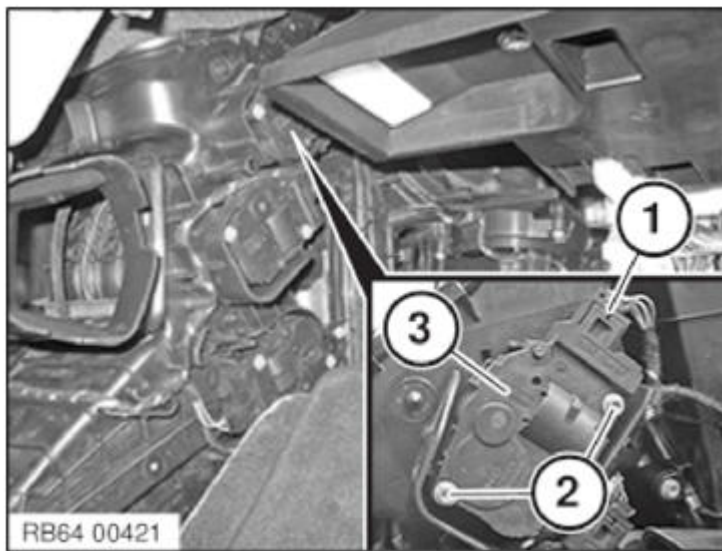
Unfasten plug connection (1) and disconnect.

Unfasten screws (2).

Remove actuator drive (3).

*Installation note:*

Make sure actuator drive (3) is correctly seated.



**Fig. 21: Identifying Actuator Drive, Plug Connection And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Servomotors must be readdressed in the event of replacement!

Addressing can only be carried out with the BMW diagnosis system.

Service functions:

- Body
- Heating and air conditioning function
- Flap motors
- Readdress flap motors

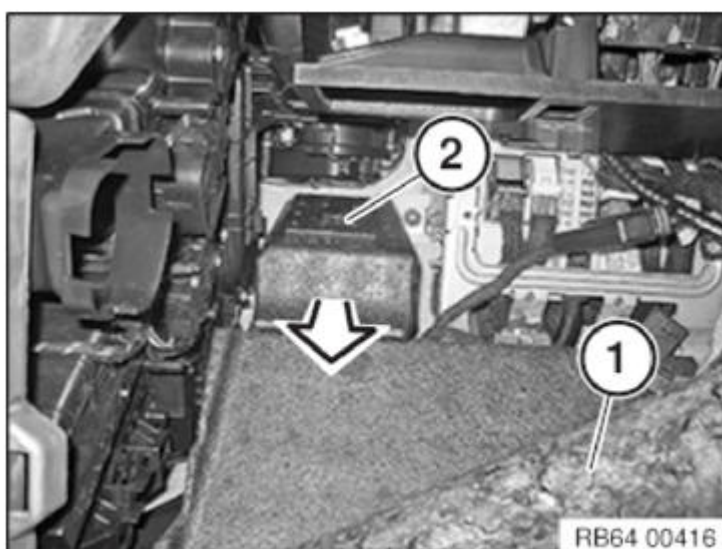
**64 11 806 REMOVING AND INSTALLING/REPLACING ACTUATOR DRIVE FOR FRESH/RECIRCULATED AIR FLAP**

*Necessary preliminary tasks:*

- Remove **BOTTOM FRONT FOOTWELL COVER**
- Remove **PASSENGER'S SIDE FOOTWELL TRIM PANEL**

Fold carpet (1) to side as shown.

Remove top footwell insert (2) in direction of arrow.

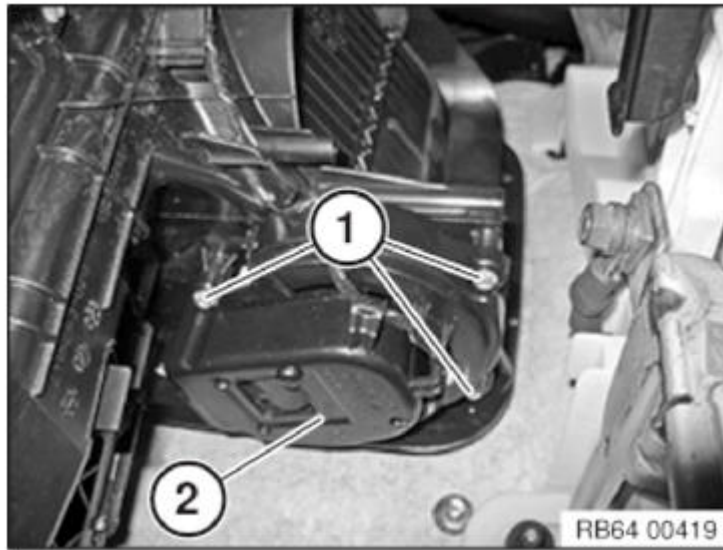


**Fig. 22: Removing Top Footwell Insert**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Unlock associated plug connection and disconnect.

Remove actuator drive with holder (2).



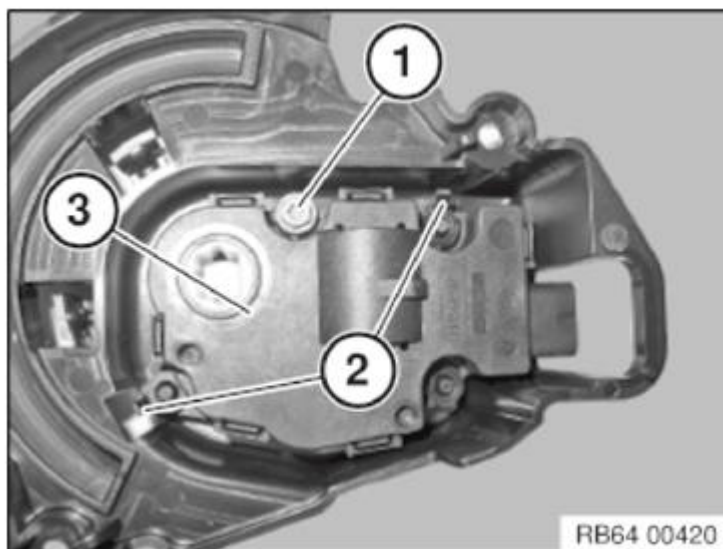
**Fig. 23: Identifying Actuator Drive With Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Release screw (1).

Unlock latch mechanisms (2).

Remove actuator drive (3).



**Fig. 24: Identifying Actuator Drive, Latch Mechanisms And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Servomotors must be readdressed in the event of replacement!  
Addressing can only be carried out with the BMW diagnosis system.  
Service functions:

- Body
- Heating and air conditioning function



- Flap motors
- Readdress flap motors

## 64 11 107 REMOVING AND INSTALLING/REPLACING ELECTRIC COOLANT PUMP (HEATER CIRCUIT)

### Necessary preliminary tasks:

- Remove LUGGAGE COMPARTMENT WELL

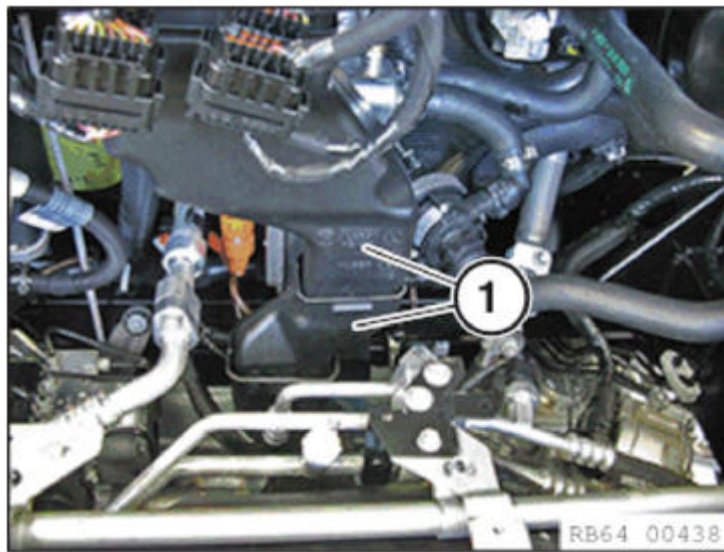
### Recycling

Coolant emerges when coolant lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping coolant.

Observe country-specific waste disposal regulations.

Remove air ducts (1).

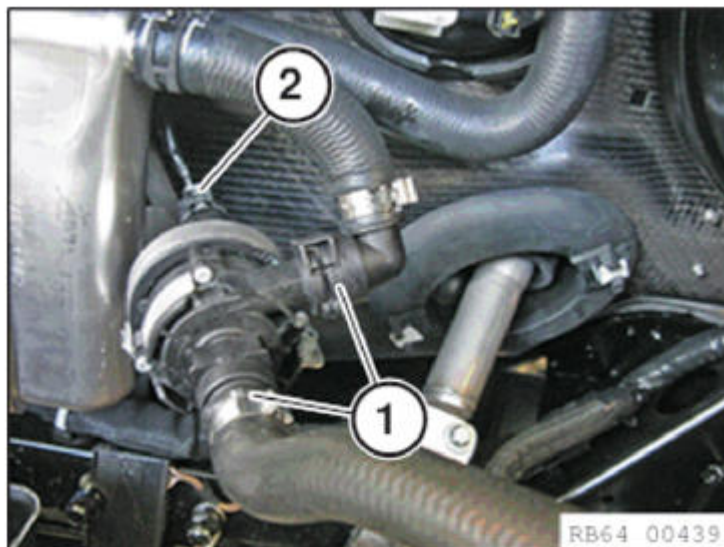


**Fig. 25: Identifying Air Ducts**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and remove coolant hoses (1).

Unfasten plug connection (2) and disconnect.

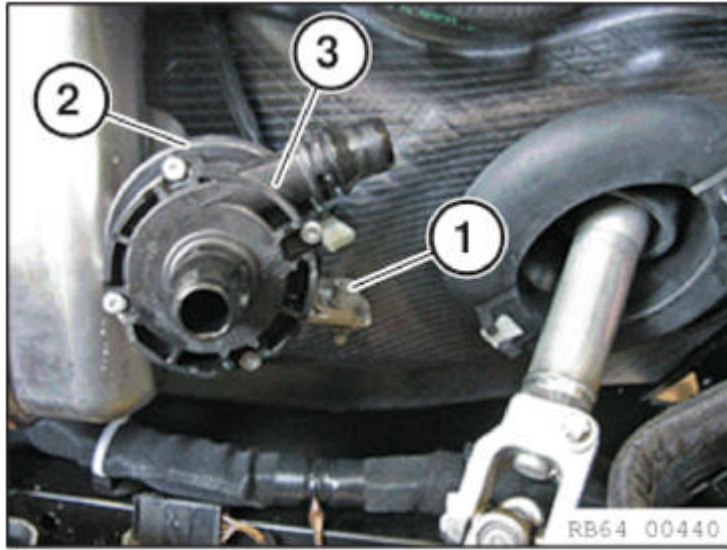


**Fig. 26: Identifying Coolant Hoses And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Remove retaining brackets (2).

Remove coolant pump (3).



**Fig. 27: Identifying Coolant Pump, Retaining Brackets And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- **BLEED AND FILL COOLING SYSTEM**

**ATTENTION!**

Filling and bleeding must not be performed in ECO-PRO MODE!

**64 11 908 REMOVING AND INSTALLING/REPLACING FOOTWELL TEMPERATURE SENSOR (LEFT)**

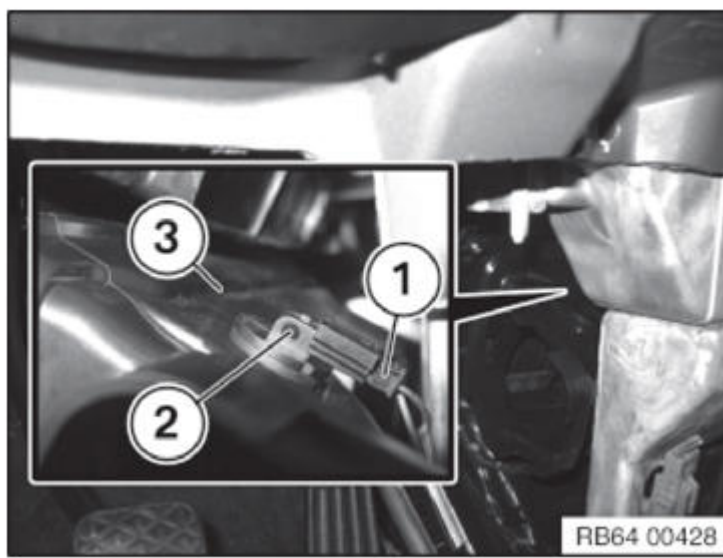
**Necessary preliminary tasks:**

- Remove **CENTER DASHBOARD TRIM**

Unfasten plug connection (1) and disconnect.

Twist temperature sensor (2) in an counter clockwise direction and pull out of heating and air-conditioning unit (3).





**Fig. 28: Identifying Air-Conditioning Unit And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

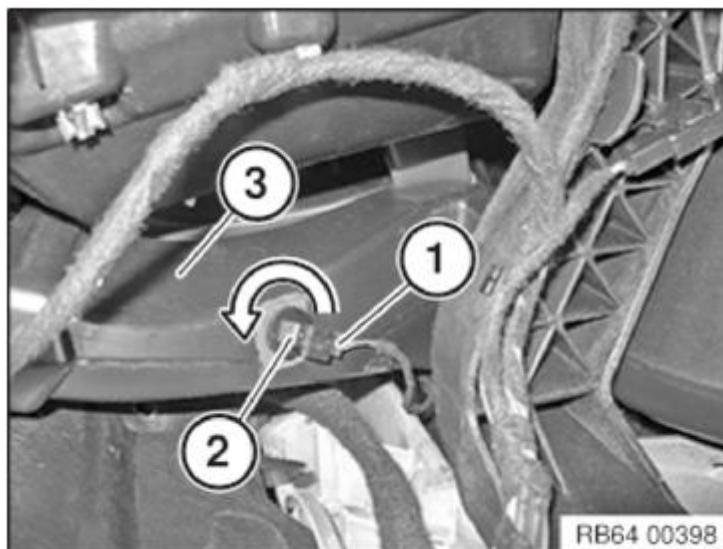
**64 11 908 REMOVING AND INSTALLING/REPLACING FOOTWELL TEMPERATURE SENSOR (RIGHT)**

Necessary preliminary tasks:

- Remove **GLOVE BOX**

Unfasten plug connection (1) and disconnect.

Turn temperature sensor (2) in direction of arrow and pull out of air duct (3).



**Fig. 29: Turning Temperature Sensor**

Courtesy of BMW OF NORTH AMERICA, INC.

**64 11 128 REMOVING AND INSTALLING/REPLACING HEAT PUMP CONTROLLER**

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work:  
 Disconnect **HIGH-VOLTAGE SYSTEM** from power.  
 Follow all applicable **SAFETY INFORMATION**.

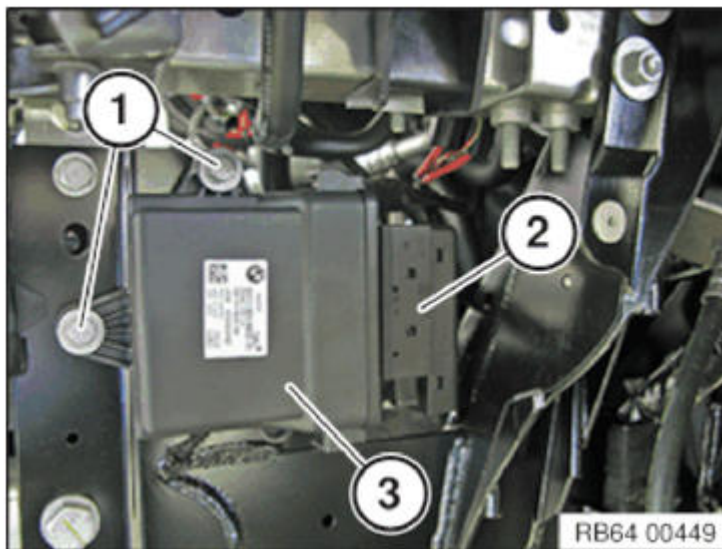
Necessary preliminary tasks:

- Clamp off **NEGATIVE BATTERY CABLE** .
- Remove **FRONT LEFT WHEEL ARCH COVER**

Release screws (1).

Unfasten plug connection (2) and disconnect.

Remove heat pump controller (3).



**Fig. 30: Identifying Heat Pump Controller, Plug Connection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

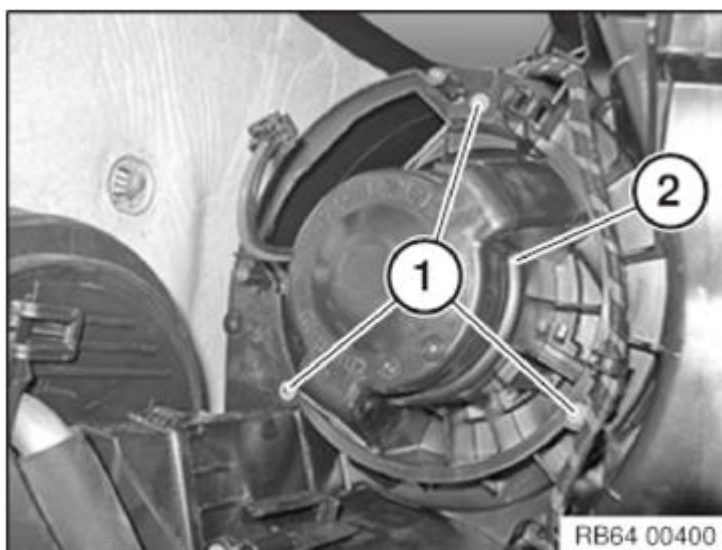
### **64 11 213 REMOVING AND INSTALLING/REPLACING HEATING AND AIR CONDITIONING BLOWER**

*Necessary preliminary tasks:*

- Remove **CONTROLLER FOR BLOWER**
- Remove **HEATING/AIR CONDITIONING CONTROL UNIT**

Release screws (1).

Remove blower (2).



**Fig. 31: Identifying Blower And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **64 11 206 REMOVING AND INSTALLING/REPLACING HEATING AND AIR-CONDITIONING UNIT**

**Special tools required:**

- [17 2 050](#)
- [32 1 270](#)

## Attention!

In **I01**, 2 different country-specific refrigerants and a new refrigerant oil are used.

**Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!**

Observe [NOTES](#) on refrigerant and refrigerant oil from 09/2013.

## Attention!

Risk of damage!

Restart engine only when air conditioning has been correctly filled.

Follow [NOTES](#) for opening and replacing parts in refrigerant circuit.

If air conditioning is opened for more than 24 h: Replace the [AIR CONDITIONING CONDENSER](#).

**Required preliminary work for the removal and installation of the heating and air-conditioning unit:**

- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Drain [COOLANT](#)
- Remove [SUPPORT FOR DASHBOARD](#)
- Remove [EXPANSION VALVE](#)

**Required preliminary work for the replacement of the heating and air-conditioning unit and the subsequent modification of the controller drives:**

- Remove [TRIM PANEL FOR PEDAL MECHANISM](#)
- Ignition ON
- Use the BMW diagnosis system to move the controller drives into the installation position as follows:
  - Service functions
  - Body
  - Heating and air conditioning functions
  - Flap motors
  - Installation position of flap motors
- [DISCONNECT ALL PLUG CONNECTIONS FROM THE CONTROL UNIT FOR THE HEATING AND AIR CONDITIONING SYSTEM](#)
- Ignition off
- Disconnect [NEGATIVE BATTERY LEAD](#)
- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Drain [COOLANT](#)
- Remove [SUPPORT FOR DASHBOARD](#)
- Remove [EXPANSION VALVE](#)

## Recycling

Coolant emerges when coolant lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping coolant.

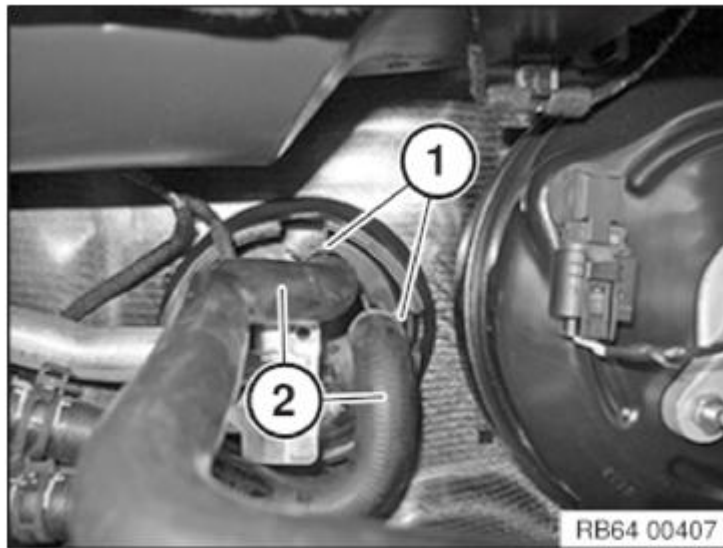
Observe country-specific waste disposal regulations.

**Attention!**

Connections must not be mixed up!

Mark connection sequence of water hoses prior to removal.

Release hose clamps (1) with special tool [17 2 050](#) and detach coolant hoses (2).



**Fig. 32: Identifying Coolant Hoses And Hose Clamps**

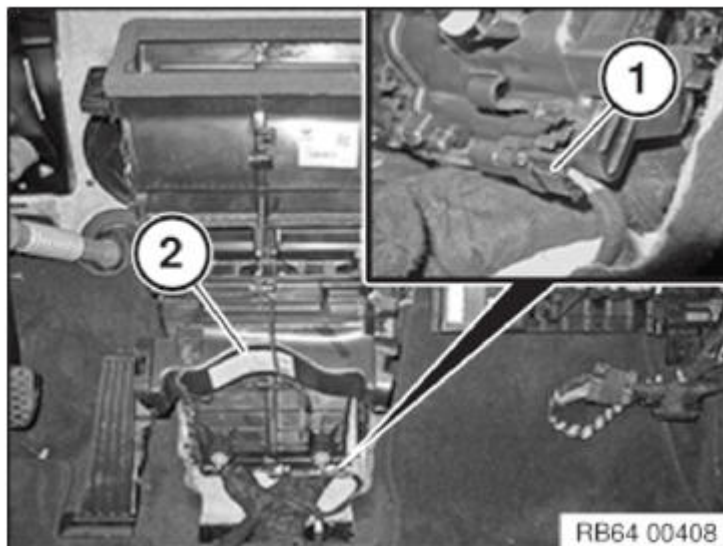
Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

Carefully blow out coolant connections on heat exchanger for heating system to remove remaining coolant.

Seal openings or lines on heat exchanger for heating system with special tool [32 1 270](#) to avoid escape of media and contamination.

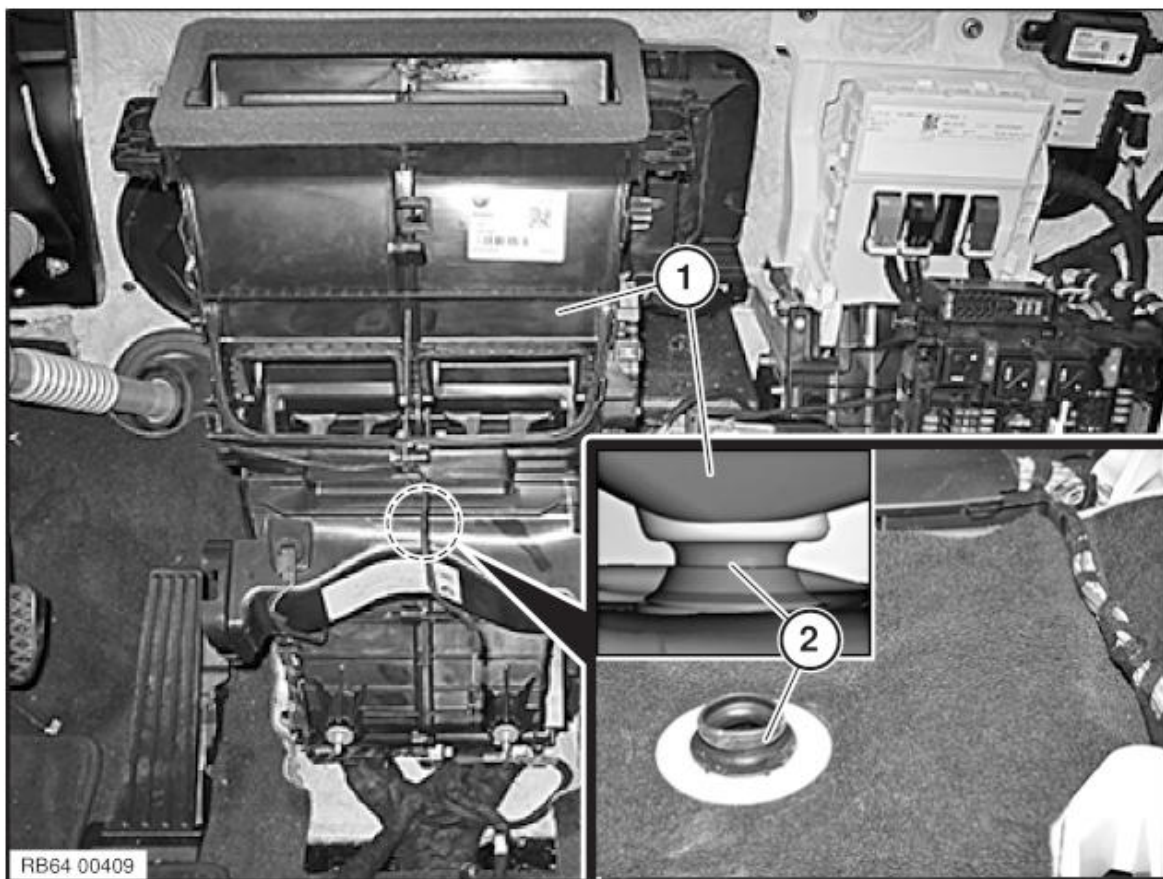
**WARNING:** Protect passenger compartment against emerging coolant.  
Unfasten plug connection (1) and disconnect.  
Remove heating and air-conditioning unit (2).



**Fig. 33: Identifying Air-Conditioning Unit And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.





**Fig. 34: Identifying Heating And Air-Conditioning Unit On Condensate Drain**

Courtesy of BMW OF NORTH AMERICA, INC.

**Attention!**

In the event of incorrect installation, there is a risk of water damage in the passenger compartment!

Installation note:

Coat the condensate drain (2) before installing the heating and air-conditioning unit (1) with **LUBRICANT G14** (sourcing reference from BMW Group Parts).

Heating and air-conditioning unit (1) must fit exactly on condensate drain (2).

Perform a visual inspection after installing the heating and air-conditioning unit (1).

**Replacement:**

Operation is described in: Replacing **EVAPORATOR**.

**After installation:**

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- **BLEED AND FILL COOLING SYSTEM**

**ATTENTION!**

Filling and bleeding must not be performed in ECO-PRO MODE!

**64 11 991 REMOVING AND INSTALLING/REPLACING SENSOR FOR AUTOMATIC RECIRCULATED AIR CONTROL (AUC)**

**Necessary preliminary tasks:**

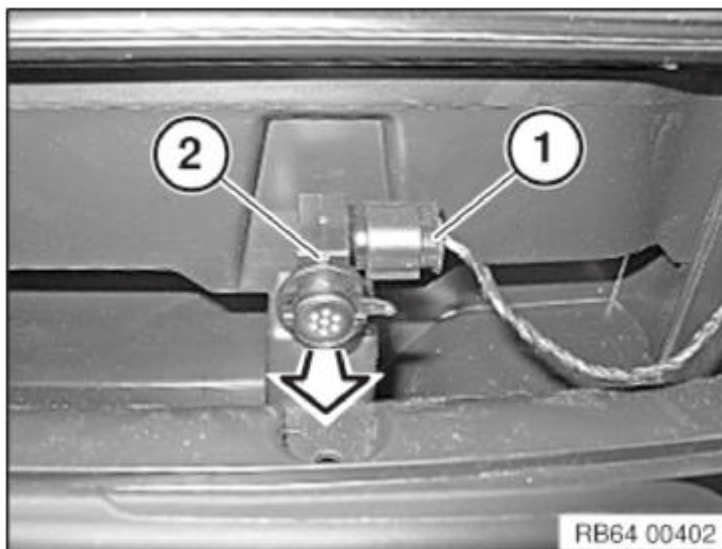
- Remove **COWL PANEL COVER**

Unfasten plug connection (1) and disconnect.

Remove automatic air recirculation control sensor (2) in direction of arrow.

*Installation note:*

Make sure automatic air recirculation control sensor (2) is correctly seated in trim panel.



**Fig. 35: Removing Automatic Air Recirculation Control Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **64 11 841 REPLACING ACTUATOR DRIVE FOR RIGHT FOOTWELL FLAP**

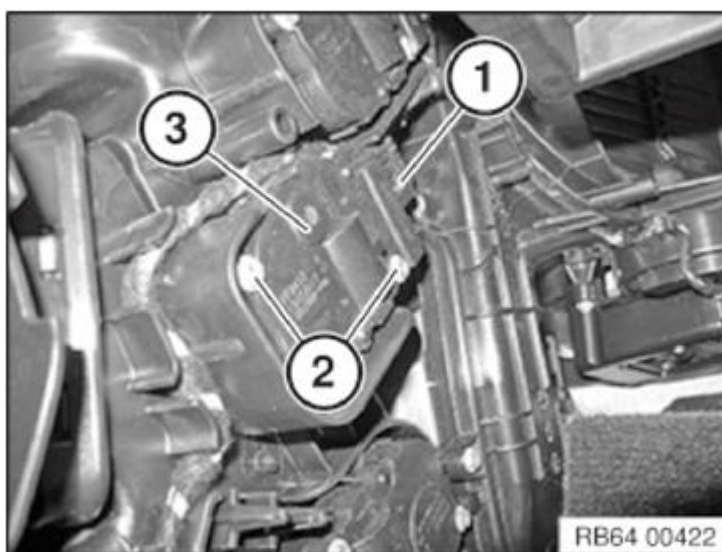
**Necessary preliminary tasks:**

- Remove **MIDDLE DASHBOARD COVER**
- Remove **PASSENGER'S SIDE FOOTWELL TRIM PANEL**

Unfasten plug connection (1) and disconnect.

Unfasten screws (2).

Remove actuator drive (3).



**Fig. 36: Identifying Actuator Drive And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**



Servomotors must be readdressed in the event of replacement!

Addressing can only be carried out with the BMW diagnosis system.

Service functions:

- Body
- Heating and air conditioning function
- Flap motors
- Readdress flap motors

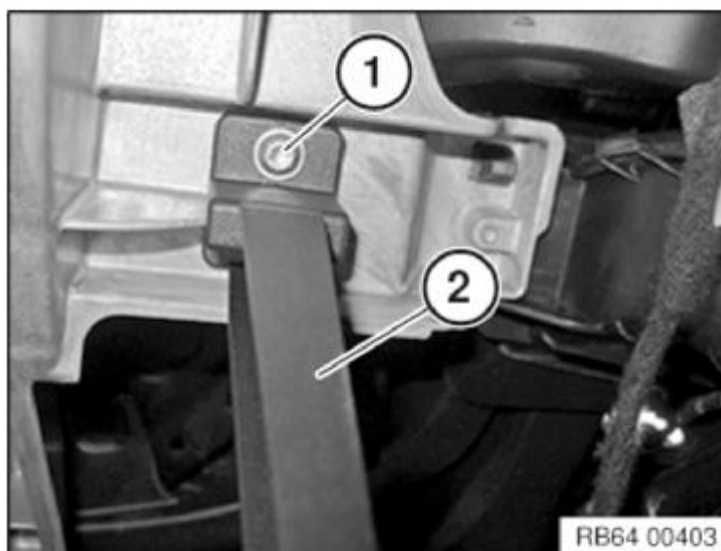
## **64 11 225 REPLACING CONTROLLER FOR HEATING AND AIR CONDITIONING SYSTEM BLOWER**

*Necessary preliminary tasks:*

- Remove **TRIM PANEL FOR PEDAL ASSEMBLY**

Release screw (1).

Take off holder (2).



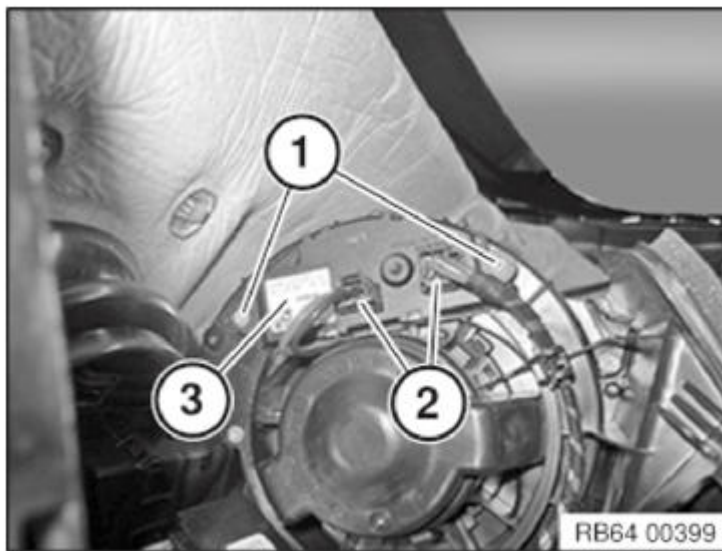
**Fig. 37: Identifying Holder And Screw**

**Courtesy of BMW OF NORTH AMERICA, INC.**

Release screws (1).

Unlock plug connections (2) and disconnect.

Remove controller (3).



**Fig. 38: Identifying Controller, Plug Connections And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **64 11 943 REPLACING EVAPORATOR TEMPERATURE SENSOR**

*Necessary preliminary tasks:*

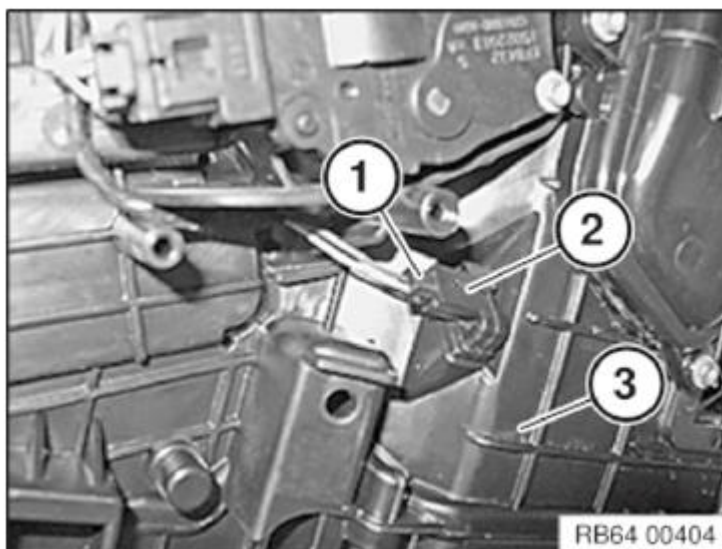
- Remove **BOTTOM FRONT FOOTWELL COVER**
- Remove **PASSENGER'S SIDE FOOTWELL TRIM PANEL**

Disconnect plug connection (1).

Pull evaporator temperature sensor (2) out of heater/air conditioner (3) and remove.

*Installation note:*

Ensure evaporator temperature sensor (2) is correctly seated.



**Fig. 39: Identifying Evaporator Temperature Sensor And Plug Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **64 11 606 REPLACING EXPANSION VALVE 3 OF HEAT PUMP CIRCUIT (Y154)**

Special tools required:

- **00 9 030**

**WARNING:**

High-voltage system - danger to life!

The following points must be strictly observed prior to starting work:

De-energize the **HIGH-VOLTAGE SYSTEM** .  
Follow all applicable **SAFETY INFORMATION**.

**Necessary preliminary tasks:**

- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Clamp off **BATTERY EARTH LEAD**

Release screw (1) and remove associated refrigerant line.

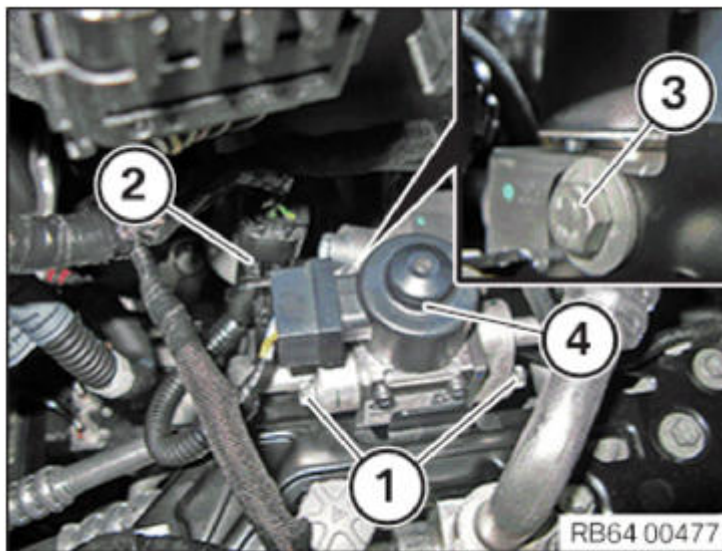
Tightening torque **64 53 11AZ** .

Unfasten plug connection (2) and disconnect.

Release screw (3).

Remove expansion valve (4).

*Installation note:*



**Fig. 40: Identifying Expansion Valve, Plug Connection And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Replace sealing rings.

Use special tool **00 9 030** to install sealing rings without damaging them.

**After installation:**

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

**64 11 208 REPLACING HEAT EXCHANGER**

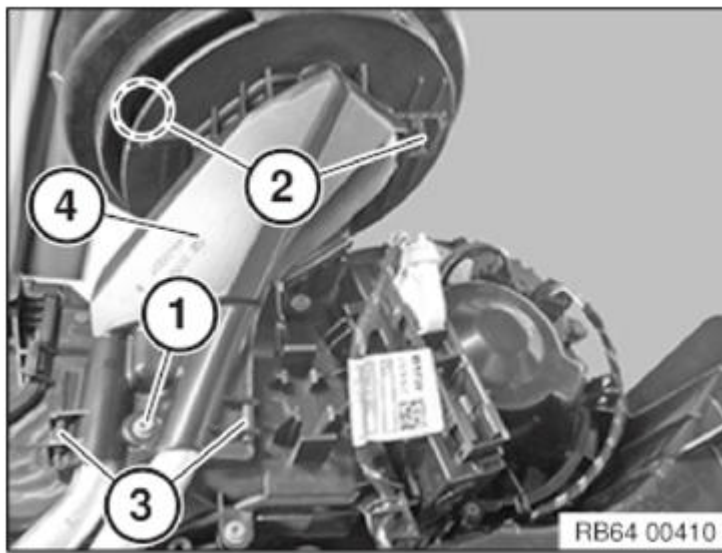
**Necessary preliminary tasks:**

- Remove **HEATER**

Release screw (1).

Unlock latch mechanisms (2 and 3).

Remove cover (4).

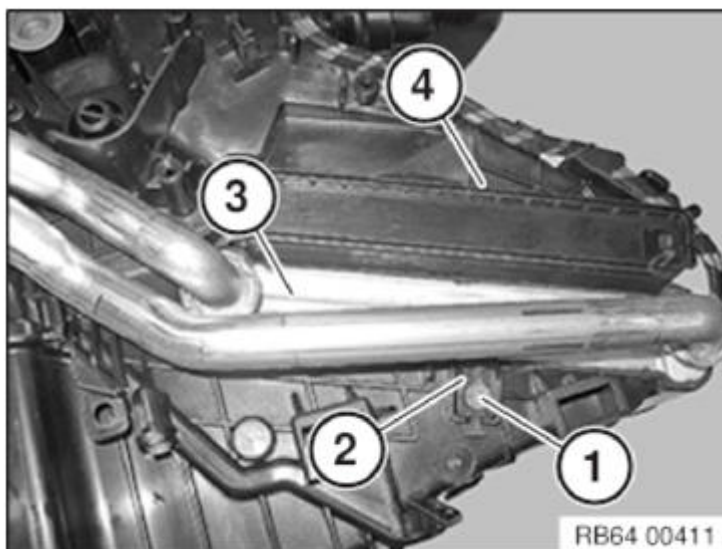


**Fig. 41: Identifying Cover, Latch Mechanisms And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Take off holder (2).

Pull heat exchanger (3) out of heating and air-conditioning unit (4).



**Fig. 42: Identifying Heat Exchanger, Holder And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**64 11 603 REPLACING SHUTOFF VALVE 2 OF HEAT PUMP CIRCUIT (Y156)**

Special tools required:

- [00 9 030](#)

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work:  
 De-energize the **HIGH-VOLTAGE SYSTEM** .  
 Follow all applicable **SAFETY INFORMATION**.

Necessary preliminary tasks:

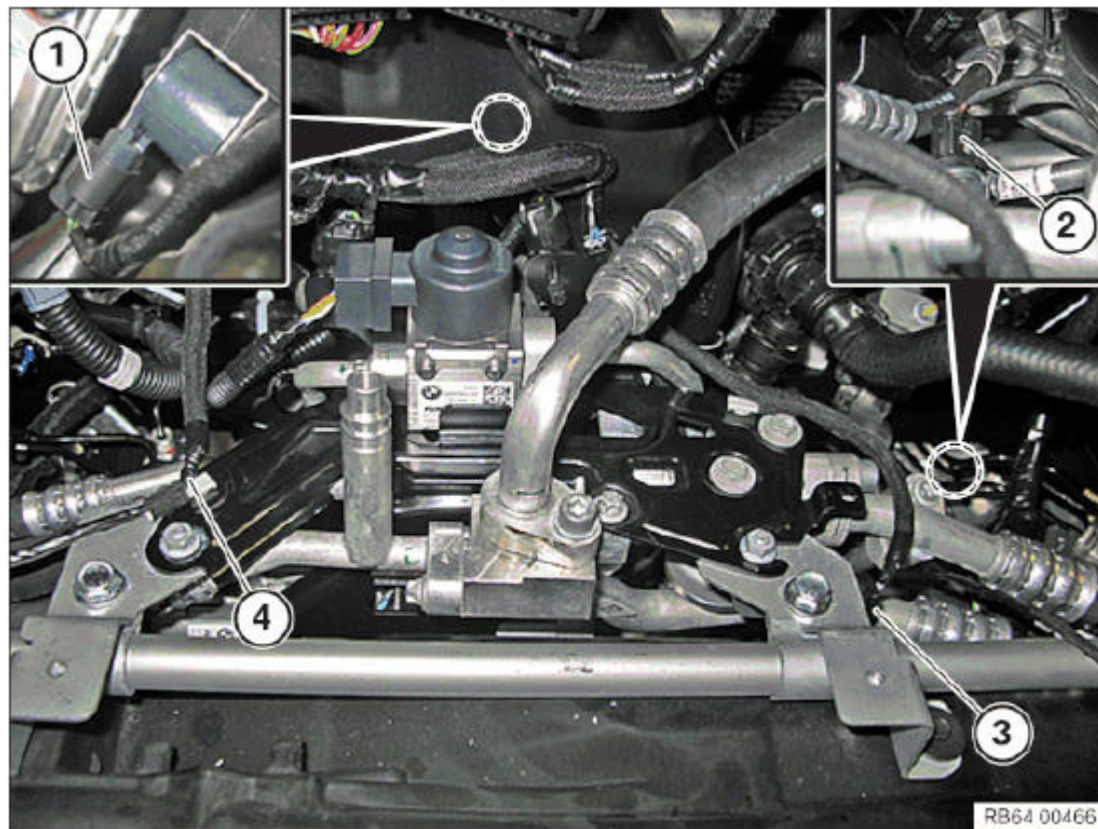
- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).



- Clamp off **BATTERY EARTH LEAD**

Unlock and disconnect plug connections (1, 2 and 3).

Unclip cable clip (4).

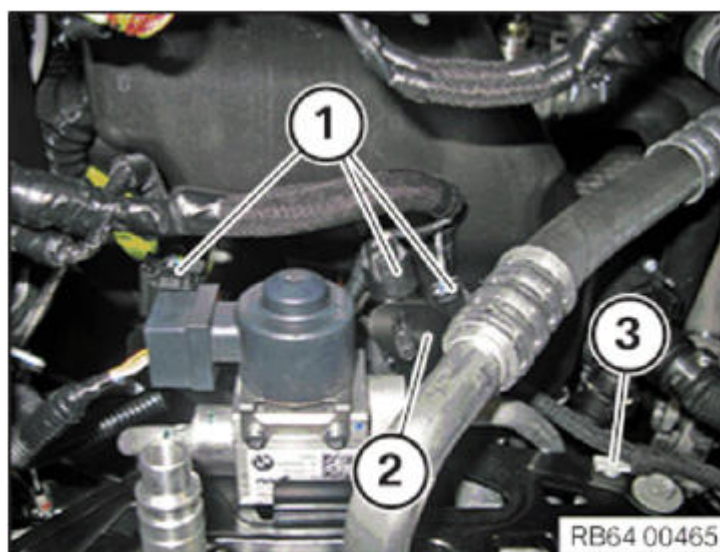


**Fig. 43: Identifying Plug Connections And Cable Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug connections (1) and disconnect.

Release associated connector housings from holder (2).

Unclip cable clip (3).



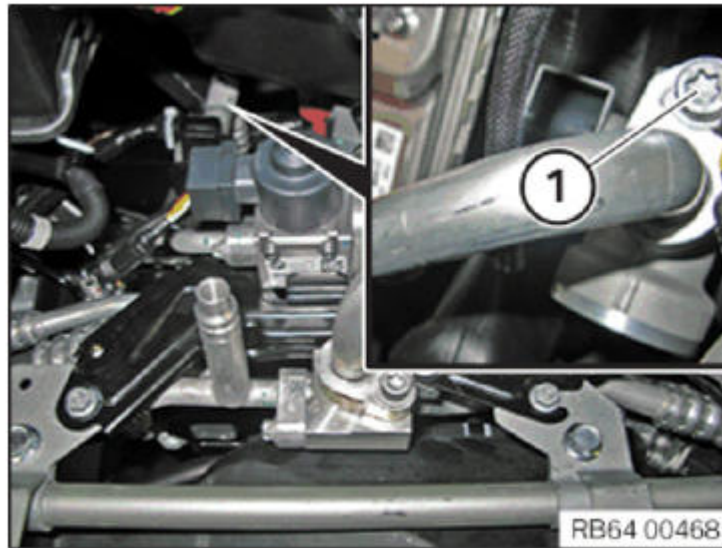
**Fig. 44: Identifying Plug Connections, Holder And Cable Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) and remove refrigerant line.

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to install sealing rings without damaging them.



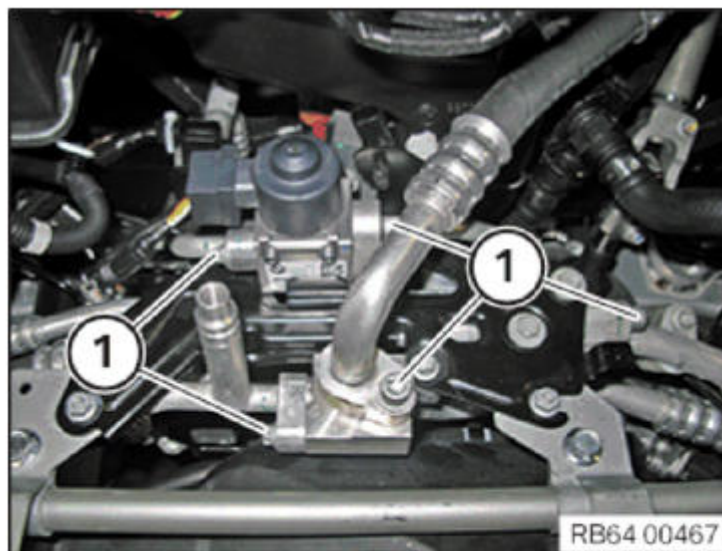
**Fig. 45: Identifying Refrigerant Line Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and remove associated refrigerant lines.

*Installation note:*

Replace sealing rings.

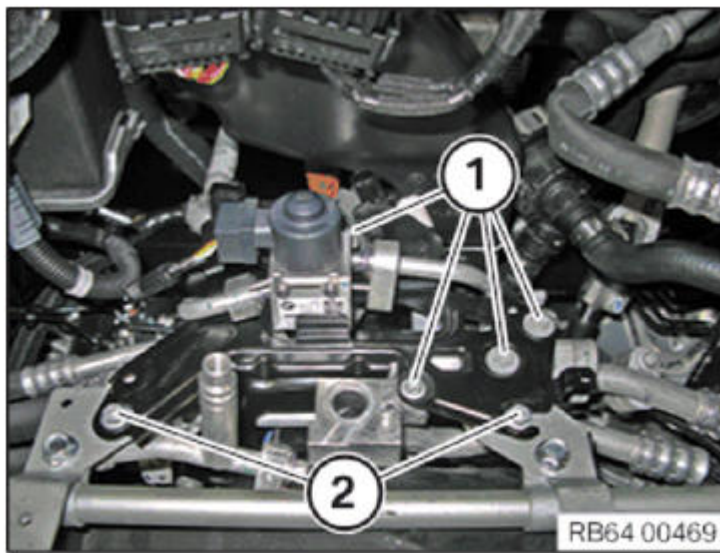
Use special tool [00 9 030](#) to mount sealing rings without damaging them.



**Fig. 46: Identifying Associated Refrigerant Lines Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten screws (1) and nuts (2).

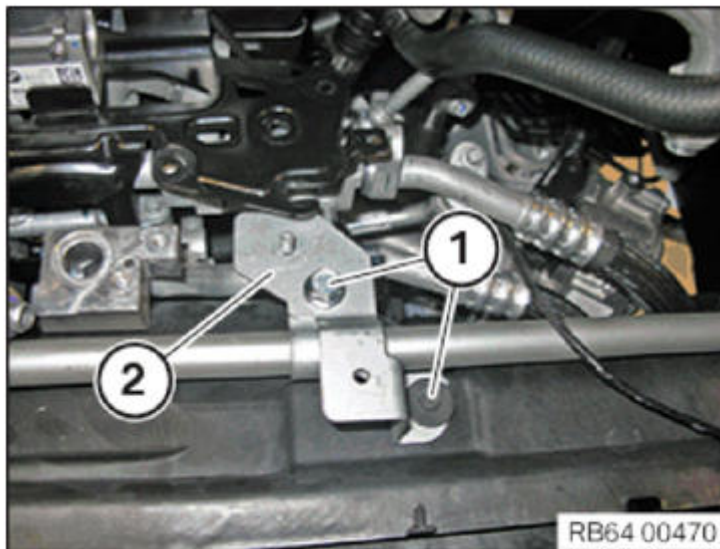




**Fig. 47: Identifying Screws And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

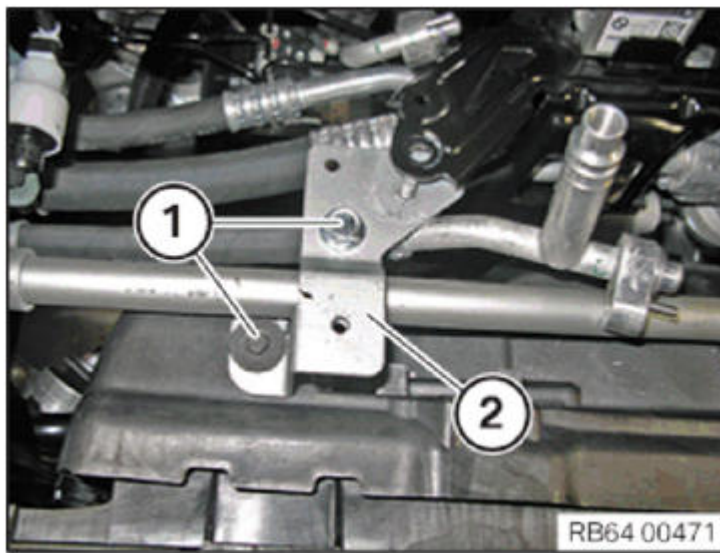
Take off holder (2).



**Fig. 48: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

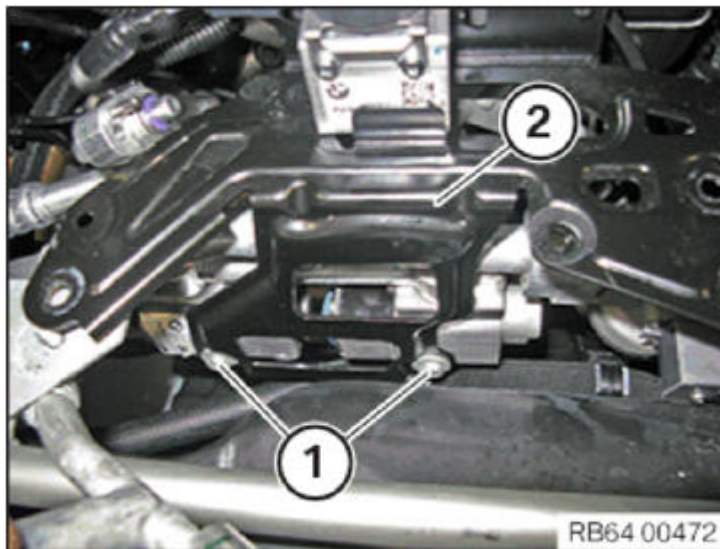
Take off holder (2).



**Fig. 49: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

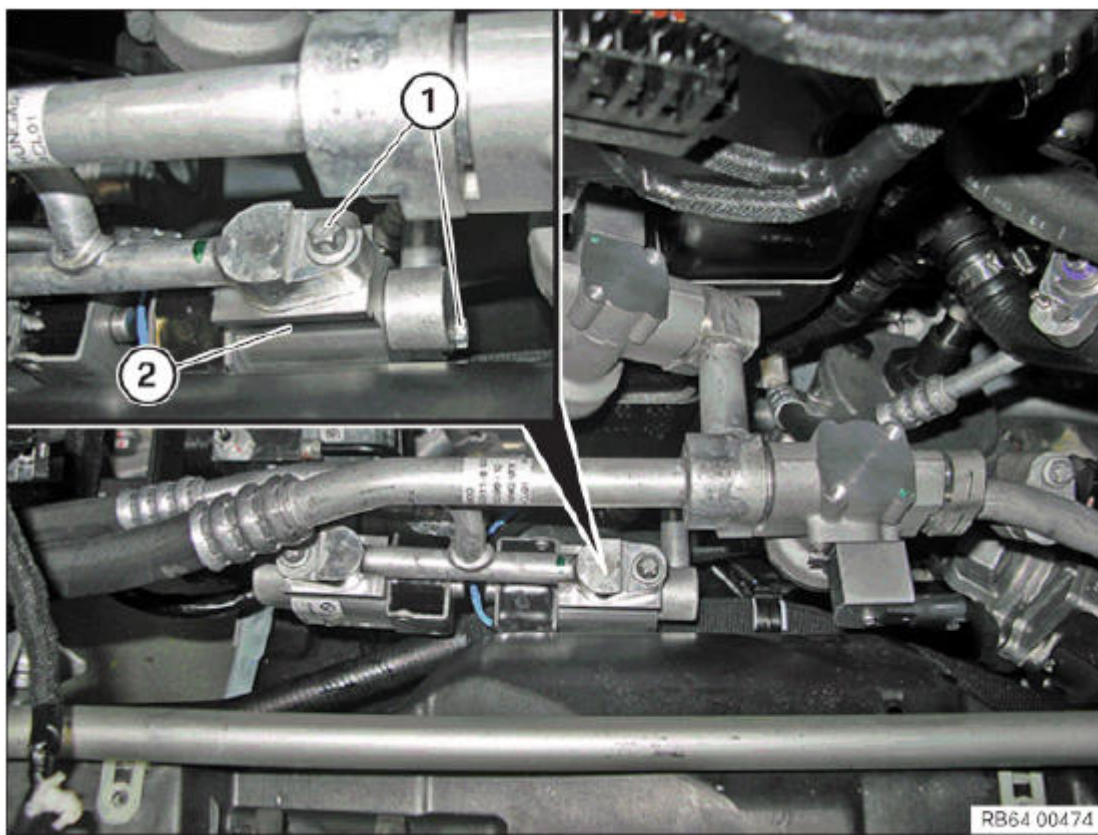
Take off holder (2).



**Fig. 50: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Take off shutoff valve (2).



**Fig. 51: Identifying Shutoff Valve And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

After installation:

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

### 64 11 632 REPLACING TEMPERATURE SENSOR 1 OF HEAT PUMP CIRCUIT (B396)

Special tools required:

- [00 9 030](#)

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work:  
 De-energize the [HIGH-VOLTAGE SYSTEM](#) .  
 Follow all applicable [SAFETY INFORMATION](#).

Necessary preliminary tasks:

- Drain off [AIR CONDITIONING SYSTEM](#)
- Clamp off [BATTERY EARTH LEAD](#)

Unfasten plug connection (1) and disconnect.

Release sensor (2).

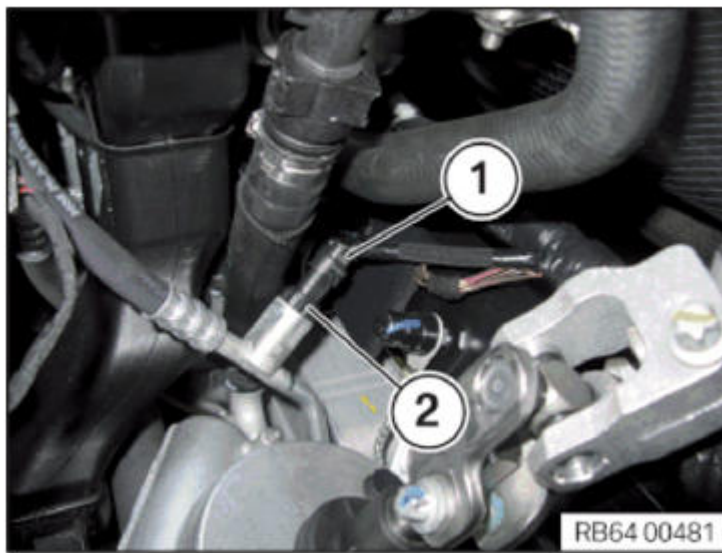
Tightening torque [64 53 10AZ](#) .

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to install sealing rings without damaging them.





**Fig. 52: Identifying Sensor And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

**64 11 633 REPLACING TEMPERATURE SENSOR 2 OF HEAT PUMP CIRCUIT (B397)**

**Special tools required:**

- **00 9 030**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the **HIGH-VOLTAGE SYSTEM** .  
Follow all applicable **SAFETY INFORMATION**.

**Necessary preliminary tasks:**

- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Clamp off **BATTERY EARTH LEAD**
- Remove **TRIM PANEL FOR COVER ON RIGHT SIDE MEMBER**

Unfasten plug connection (1) and disconnect.

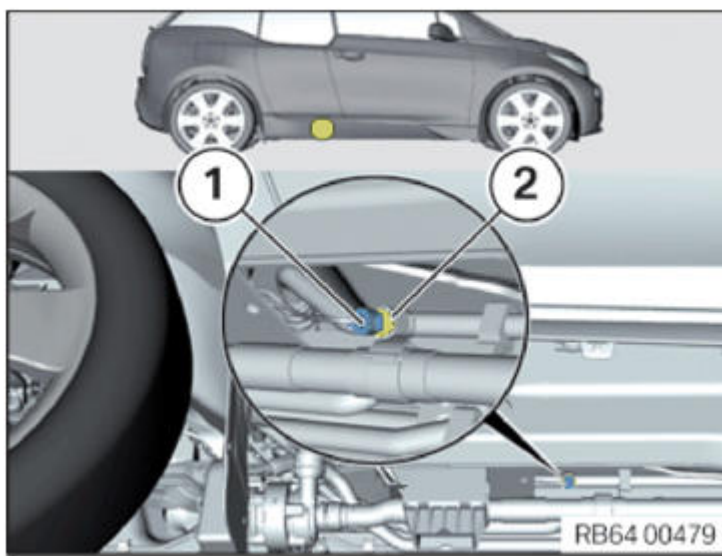
Release sensor (2).

Tightening torque **64 53 10AZ** .

*Installation note:*

Replace sealing rings.

Use special tool **00 9 030** to install sealing rings without damaging them.



**Fig. 53: Identifying Sensor And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

**64 11 634 REPLACING TEMPERATURE SENSOR 3 OF HEAT PUMP CIRCUIT (B398)**

**Special tools required:**

- **00 9 030**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the **HIGH-VOLTAGE SYSTEM** .  
Follow all applicable **SAFETY INFORMATION**.

**Necessary preliminary tasks:**

- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Clamp off **BATTERY EARTH LEAD**

Unfasten plug connection (1) and disconnect.

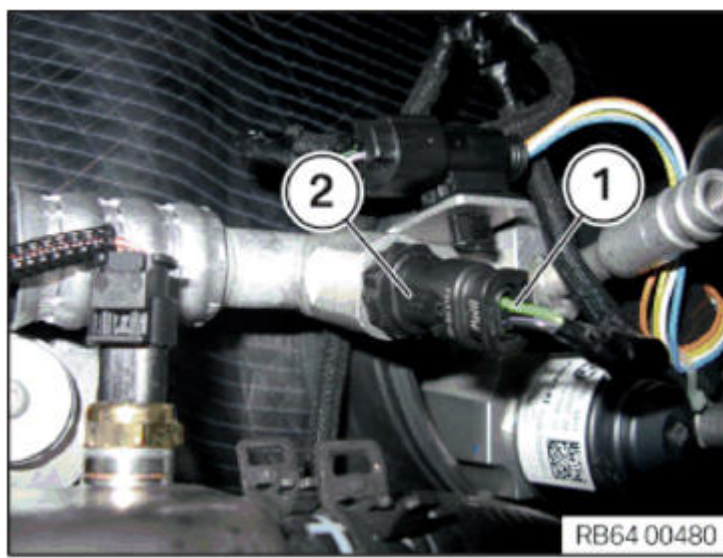
Release sensor (2).

Tightening torque **64 53 10AZ** .

*Installation note:*

Replace sealing rings.

Use special tool **00 9 030** to install sealing rings without damaging them.



**Fig. 54: Identifying Sensor And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

**64 11 602 REPLACING THE SHUTOFF VALVE 1 OF THE HEAT PUMP CIRCUIT (Y155)**

**Special tools required:**

- **00 9 030**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the **HIGH-VOLTAGE SYSTEM** .  
Follow all applicable **SAFETY INFORMATION**.

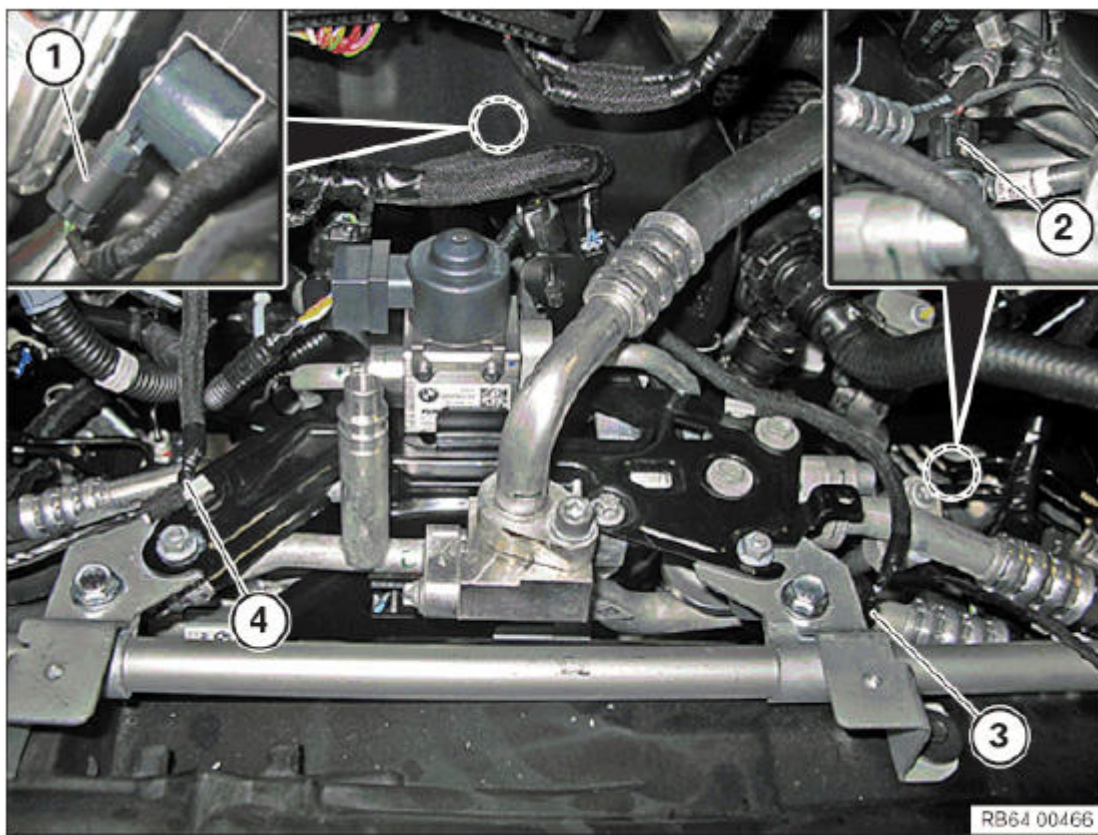
**Necessary preliminary tasks:**

- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Clamp off **BATTERY EARTH LEAD**

Unlock and disconnect plug connections (1, 2 and 3).

Unclip cable clip (4).



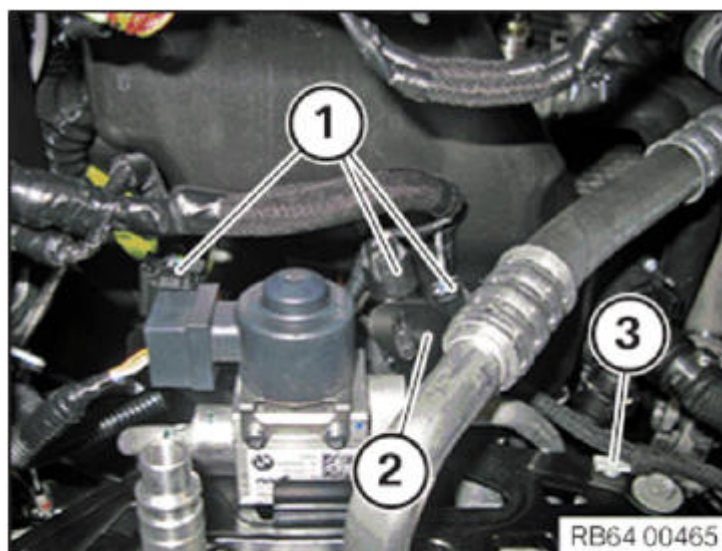


**Fig. 55: Identifying Plug Connections And Cable Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug connections (1) and disconnect.

Release associated connector housings from holder (2).

Unclip cable clip (3).



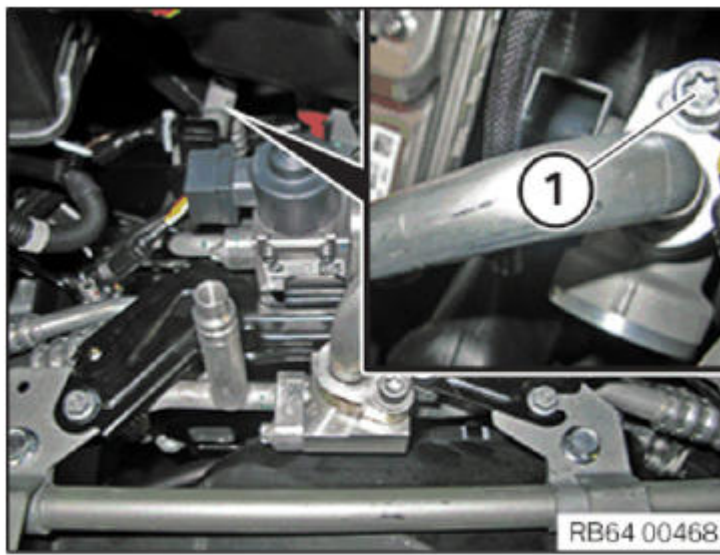
**Fig. 56: Identifying Plug Connections, Holder And Cable Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1) and remove refrigerant line.

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to install sealing rings without damaging them.



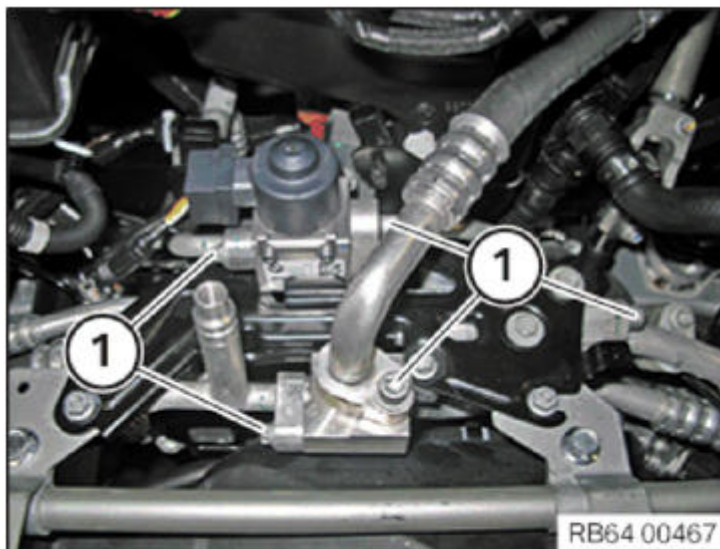
**Fig. 57: Identifying Refrigerant Line Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and remove associated refrigerant lines.

*Installation note:*

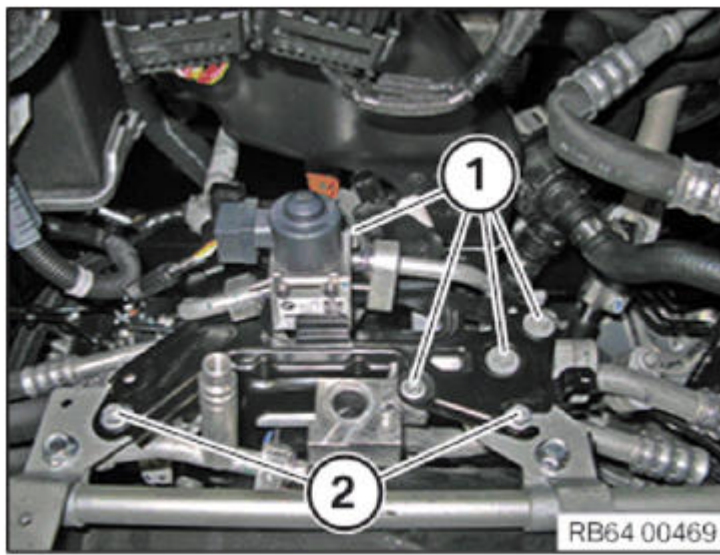
Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.



**Fig. 58: Identifying Associated Refrigerant Lines Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

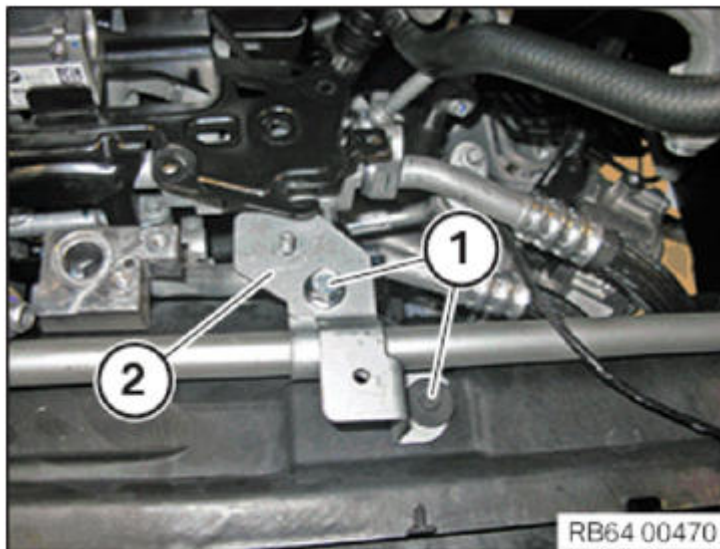
Unfasten screws (1) and nuts (2).



**Fig. 59: Identifying Screws And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Take off holder (2).

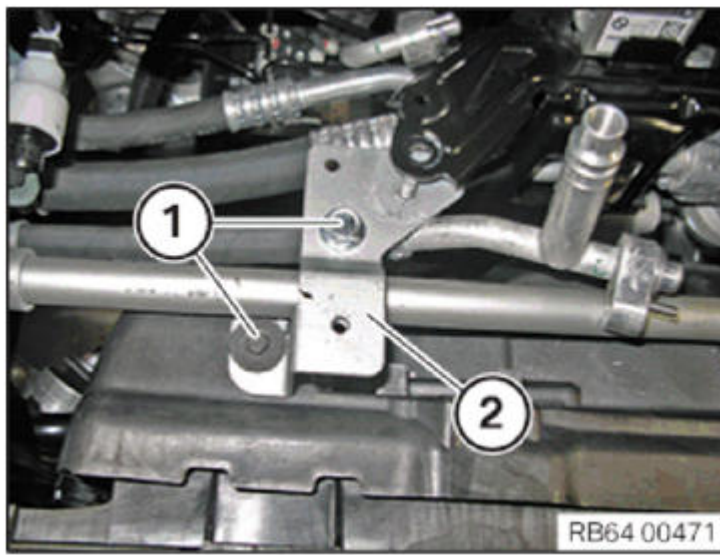


**Fig. 60: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Take off holder (2).

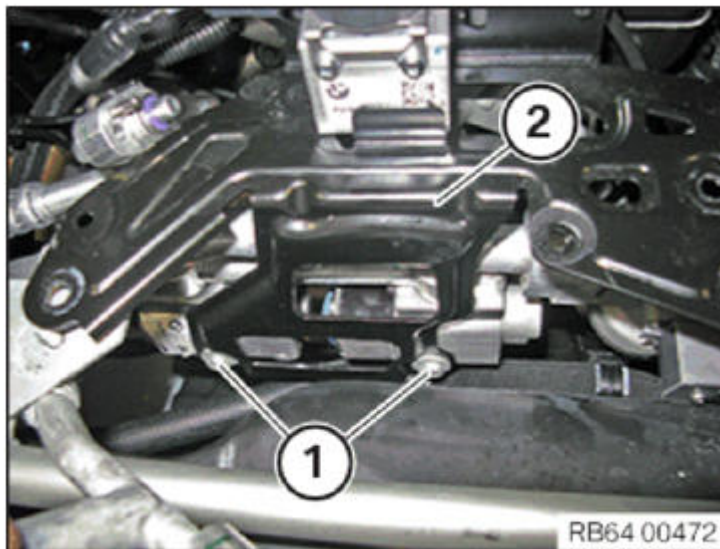




**Fig. 61: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

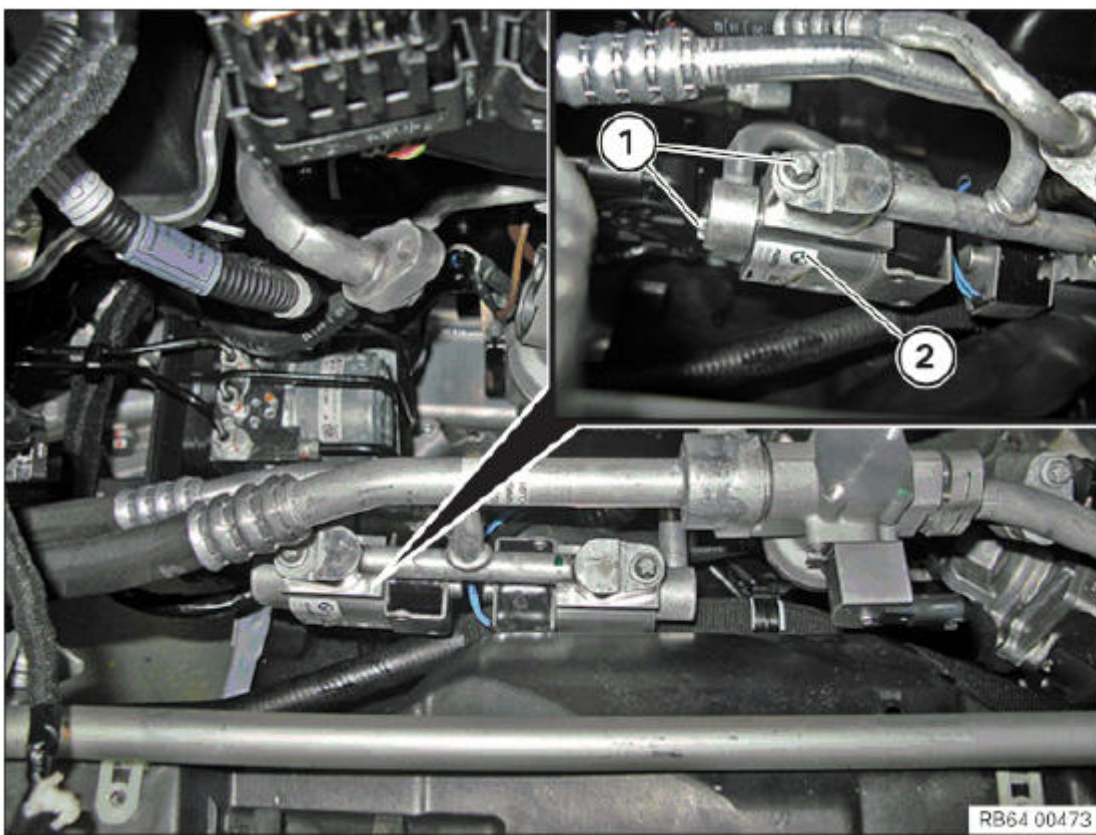
Take off holder (2).



**Fig. 62: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Take off shutoff valve (2).



**Fig. 63: Identifying Shutoff Valve And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

After installation:

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

#### **64 11 604 REPLACING THE SHUTOFF VALVE 3 OF THE HEAT PUMP CIRCUIT (Y157)**

Special tools required:

- [00 9 030](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the [HIGH-VOLTAGE SYSTEM](#) .  
Follow all applicable [SAFETY INFORMATION](#).

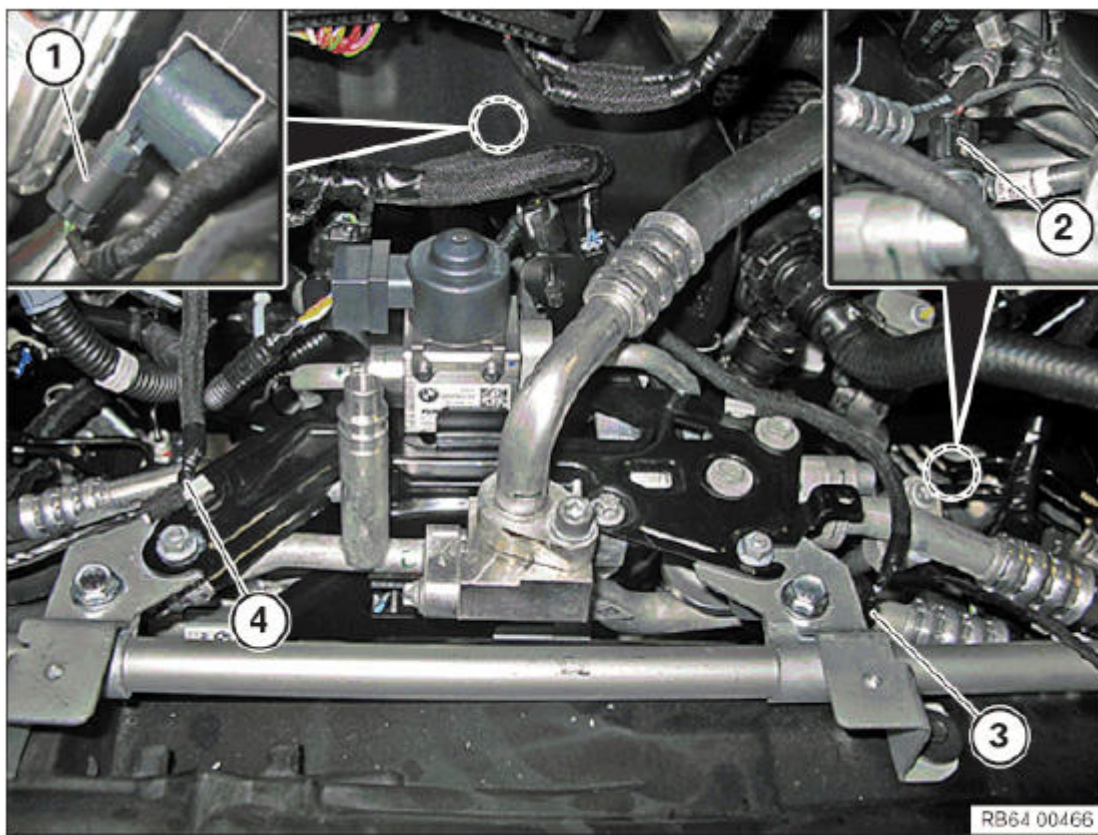
Necessary preliminary tasks:

- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Clamp off [BATTERY EARTH LEAD](#)

Unlock and disconnect plug connections (1, 2 and 3).

Unclip cable clip (4).



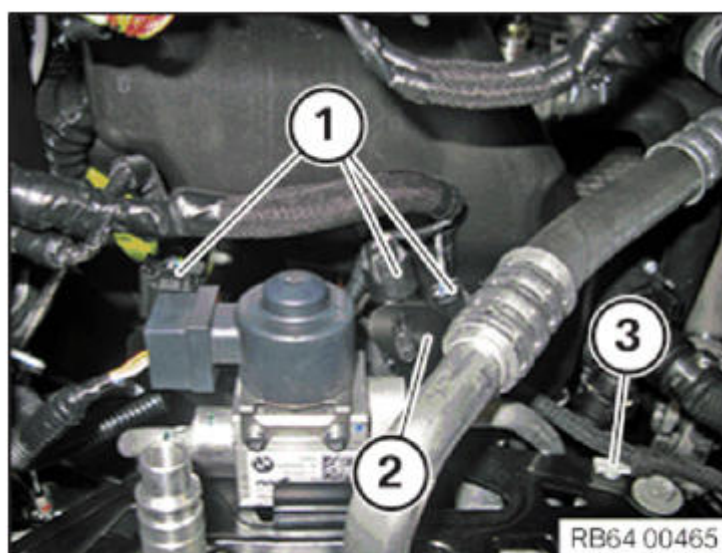


**Fig. 64: Identifying Plug Connections And Cable Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug connections (1) and disconnect.

Release associated connector housings from holder (2).

Unclip cable clip (3).



**Fig. 65: Identifying Plug Connections, Holder And Cable Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

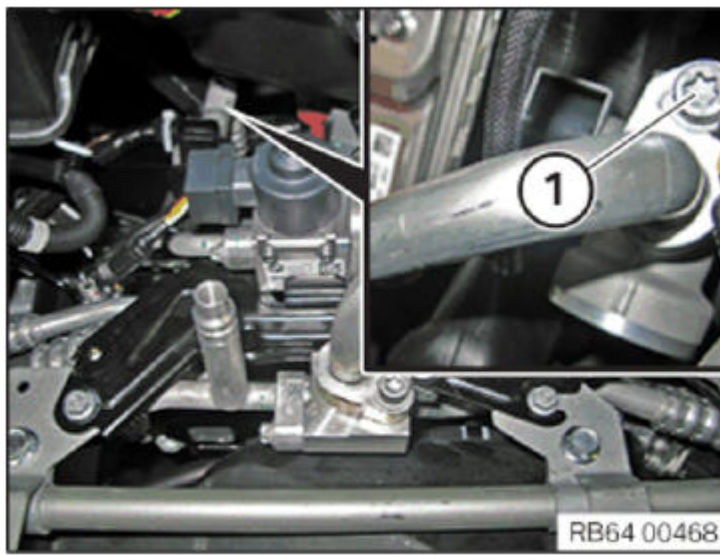
**Release screw (1) and remove refrigerant line.**

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to install sealing rings without damaging them.





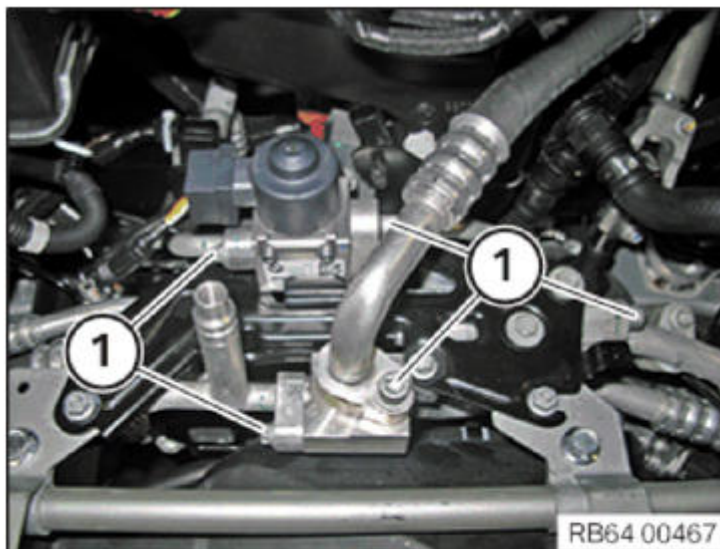
**Fig. 66: Identifying Refrigerant Line Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and remove associated refrigerant lines.

*Installation note:*

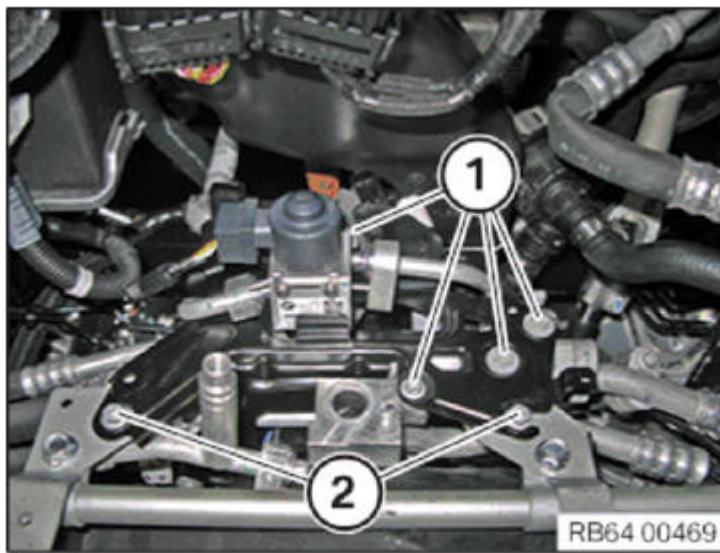
Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.



**Fig. 67: Identifying Associated Refrigerant Lines Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

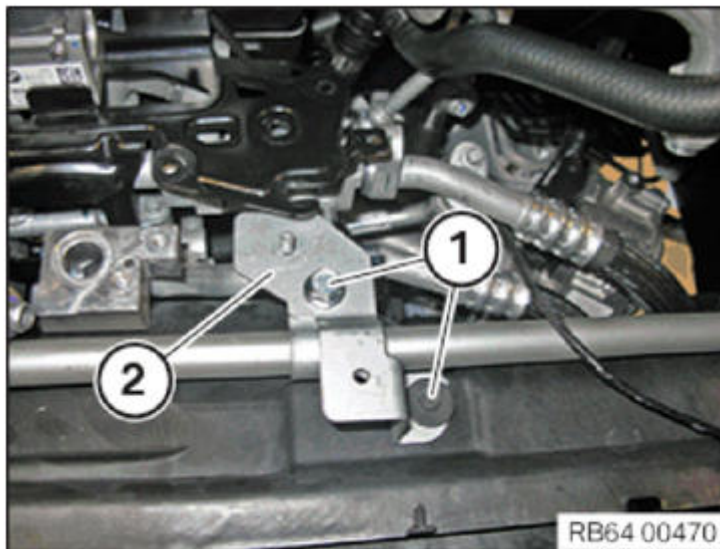
Unfasten screws (1) and nuts (2).



**Fig. 68: Identifying Screws And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

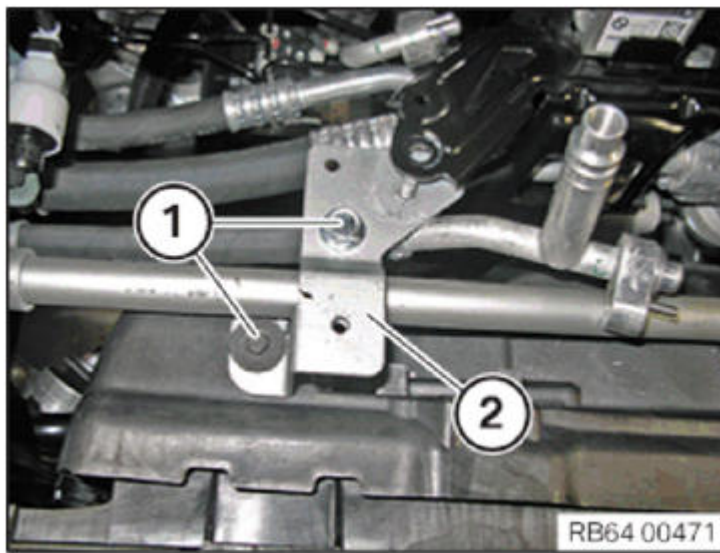
Take off holder (2).



**Fig. 69: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

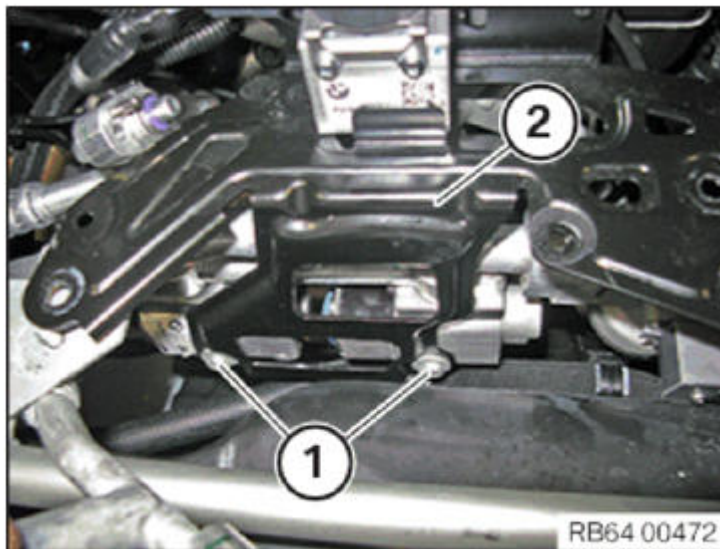
Take off holder (2).



**Fig. 70: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Take off holder (2).

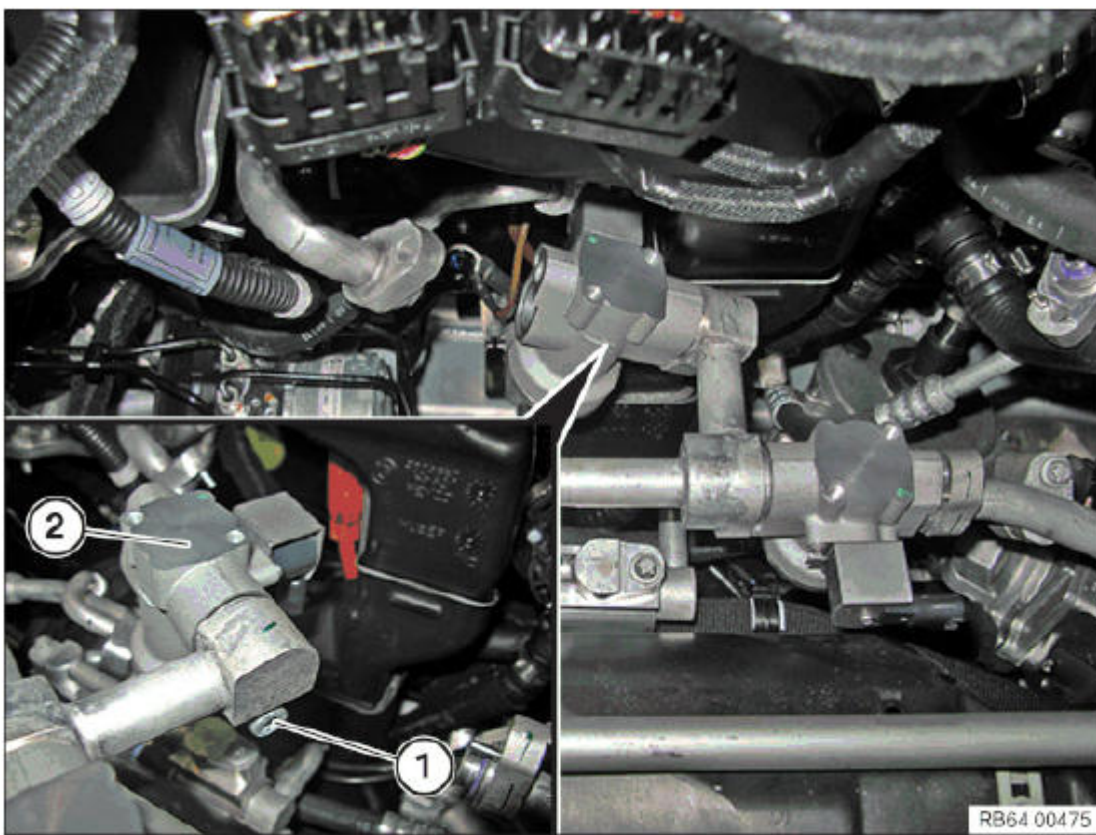


**Fig. 71: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Take off shutoff valve (2).





**Fig. 72: Identifying Shutoff Valve And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

After installation:

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

### **64 11 605 REPLACING THE SHUTOFF VALVE 4 OF THE HEAT PUMP CIRCUIT (Y158)**

Special tools required:

- [00 9 030](#)

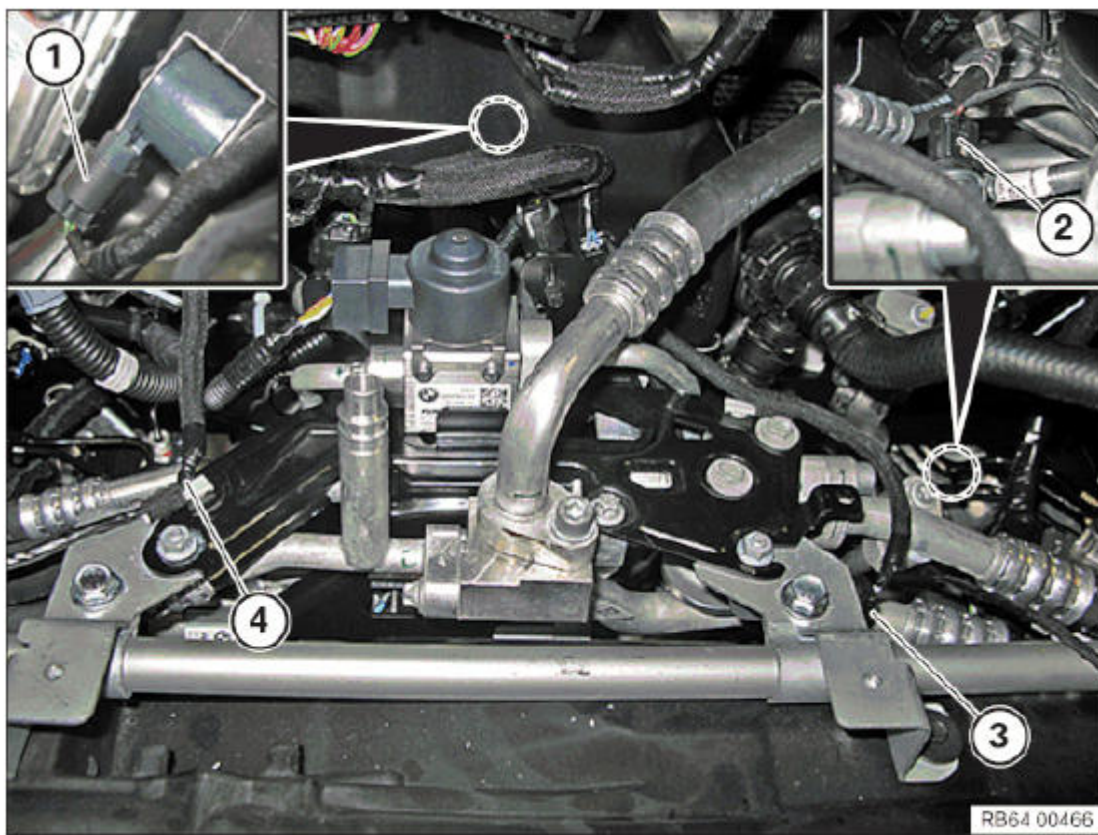
**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the [HIGH-VOLTAGE SYSTEM](#) .  
Follow all applicable [SAFETY INFORMATION](#).

Necessary preliminary tasks:

- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Clamp off [BATTERY EARTH LEAD](#)

Unlock and disconnect plug connections (1, 2 and 3).

Unclip cable clip (4).

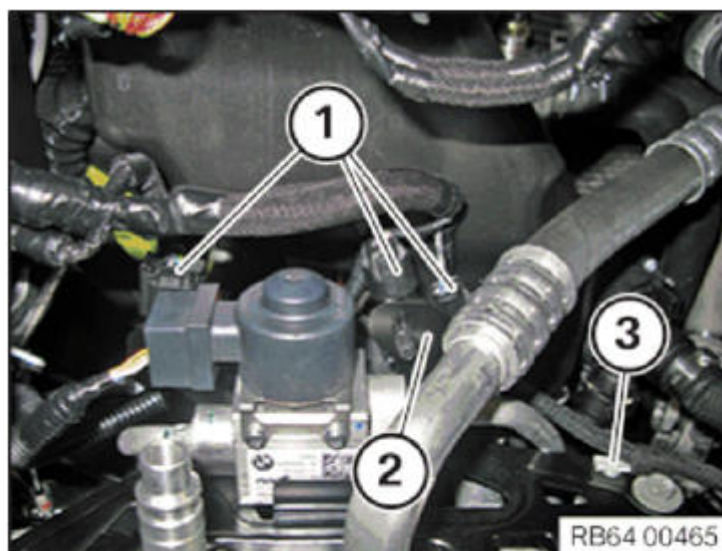


**Fig. 73: Identifying Plug Connections And Cable Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock plug connections (1) and disconnect.

Release associated connector housings from holder (2).

Unclip cable clip (3).



**Fig. 74: Identifying Plug Connections, Holder And Cable Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

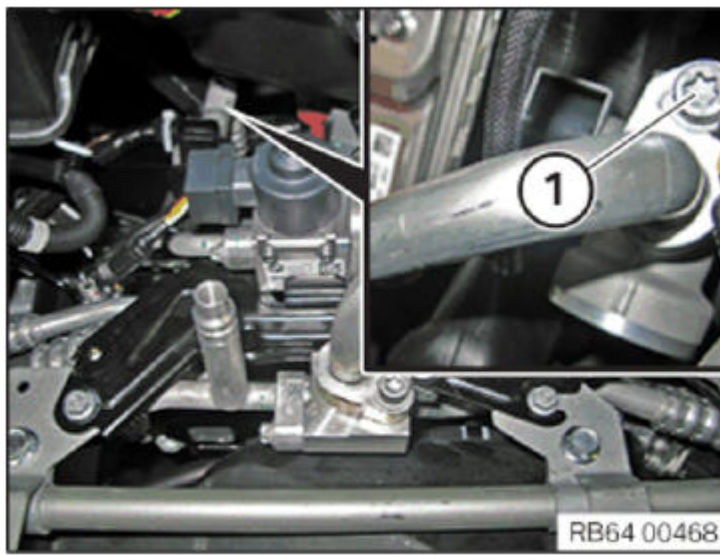
Release screw (1) and remove refrigerant line.

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to install sealing rings without damaging them.





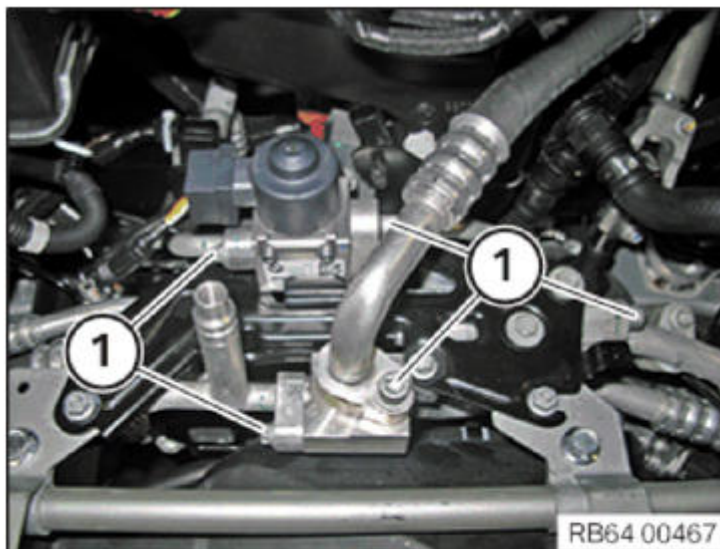
**Fig. 75: Identifying Refrigerant Line Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and remove associated refrigerant lines.

*Installation note:*

Replace sealing rings.

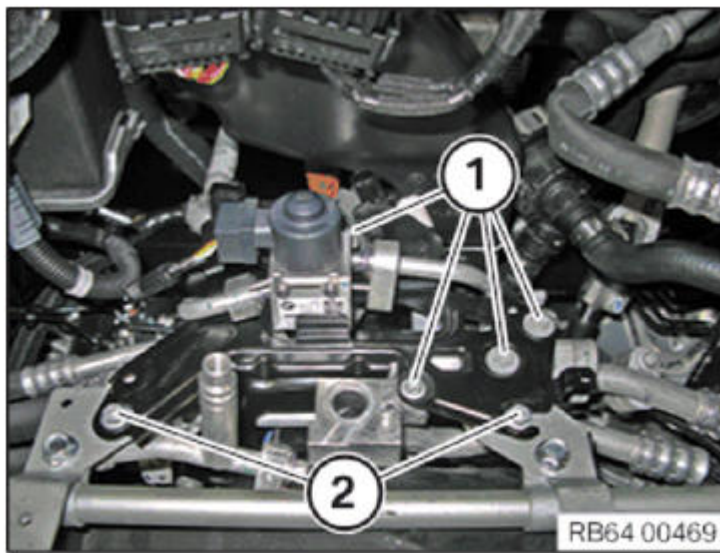
Use special tool [00 9 030](#) to mount sealing rings without damaging them.



**Fig. 76: Identifying Associated Refrigerant Lines Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten screws (1) and nuts (2).

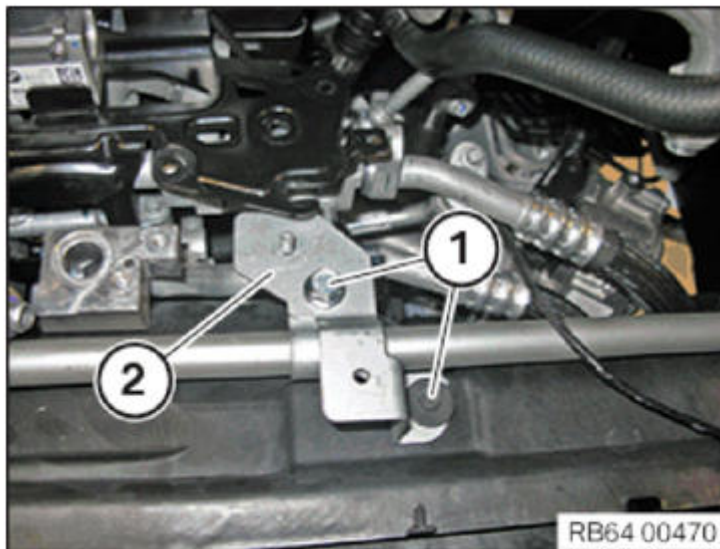




**Fig. 77: Identifying Screws And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

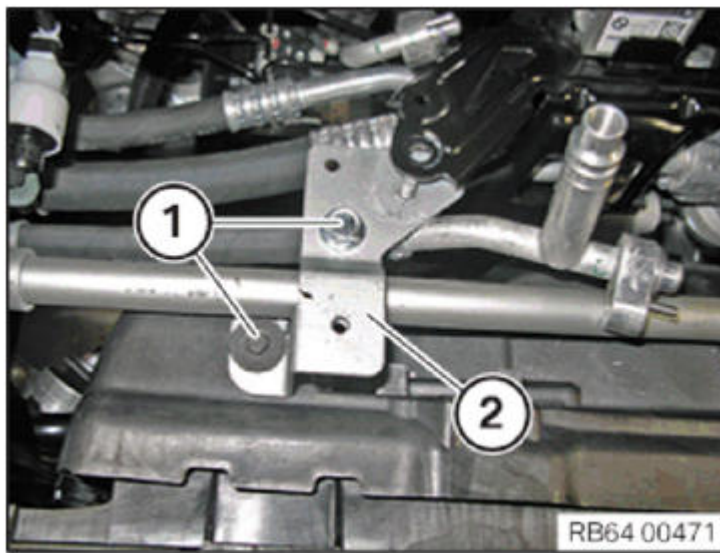
Take off holder (2).



**Fig. 78: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

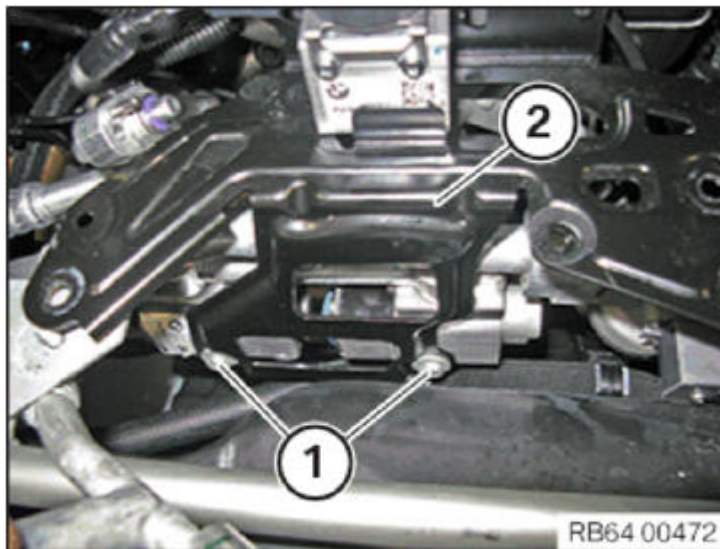
Take off holder (2).



**Fig. 79: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

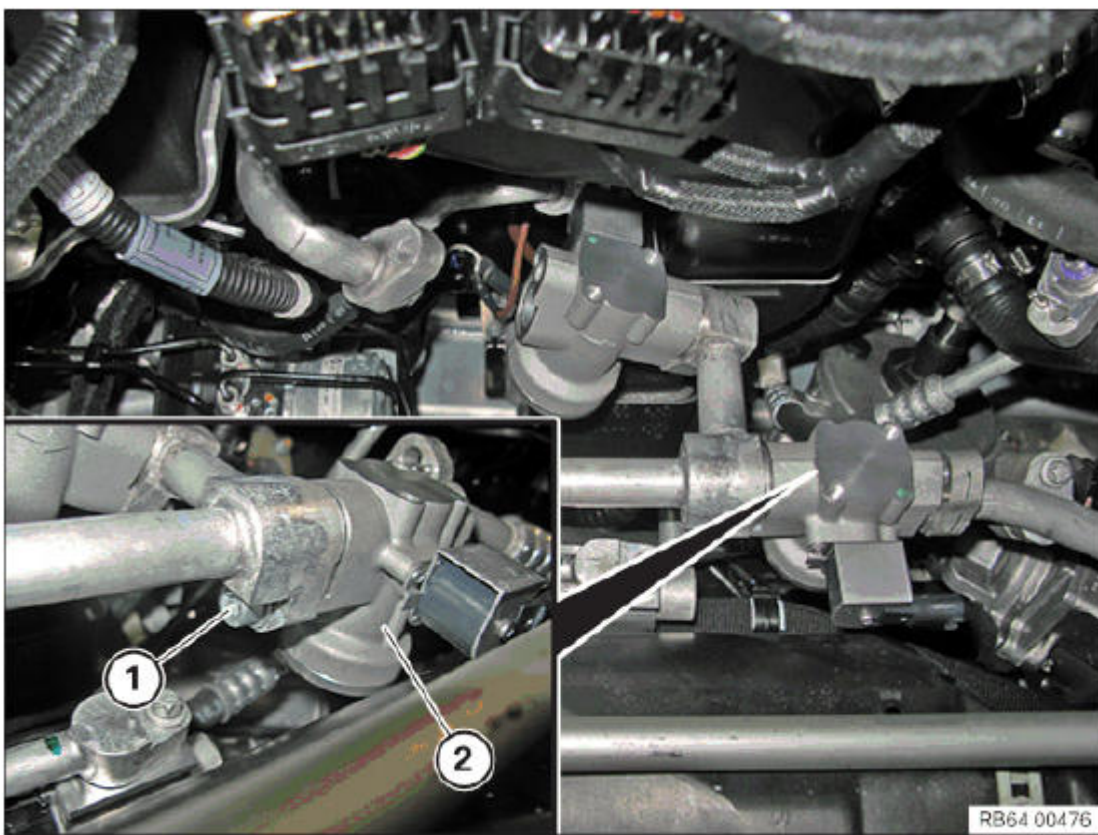
Take off holder (2).



**Fig. 80: Identifying Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Take off shutoff valve (2).



**Fig. 81: Identifying Shutoff Valve And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

After installation:

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

**(61 31 321 REMOVING AND INSTALLING RADIO AND A/C CONTROL PANEL)**

See [61 31 321 REMOVING AND INSTALLING RADIO AND A/C CONTROL PANEL](#) .

## **AUXILIARY HEATER AND CONTROL ELEMENTS**

### **64 12... INITIALIZING TELESTART HAND-HELD TRANSMITTER**

**NOTE:** The Telestart hand-held transmitter must be initialized when:

- Hand-held transmitter is replaced
- Car Access System control unit is replaced

The auxiliary heater is switched on with the hand-held transmitter and at a preselected switch-on time under an ambient temperature of approx. 15 Å°C.

Heating can be activated directly in the Central Information Display at any ambient temperature. To do so, go to the parking function menu under direct operation and mark the auxiliary heating box.

**NOTE:** Initialization can only be carried out with the BMW diagnosis system.

Follow instructions and specifications in procedure.

Service functions:

- Complete vehicle



- Body
- Air conditioning function
- Telearstart transmitter
- Initialization

## 64 12 320 REMOVING AND INSTALLING/REPLACING ELECTRICAL HEATING

### Special tools required:

- [17 2 050](#)
- [32 1 270](#)

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work:  
 De-energize the **HIGH-VOLTAGE SYSTEM** .  
 Follow all applicable **SAFETY INFORMATION**.

### Necessary preliminary tasks:

- Remove **LUGGAGE COMPARTMENT WELL**
- Clamp off **BATTERY EARTH LEAD**

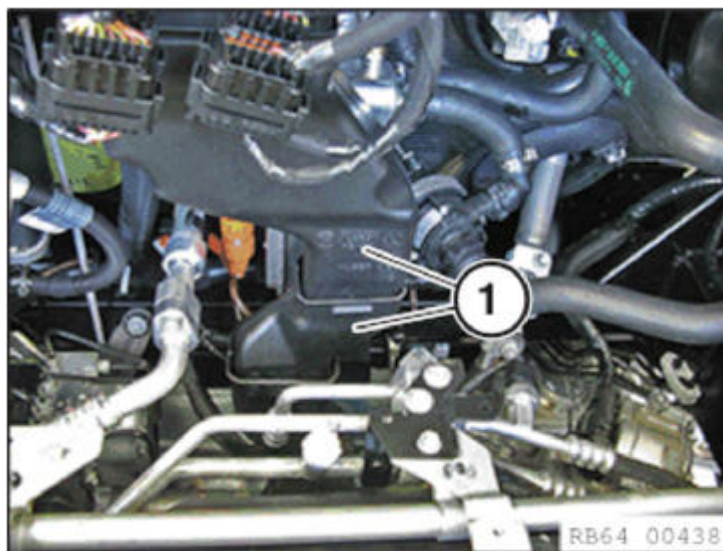
### Recycling

Coolant emerges when coolant lines are detached. Have a suitable collecting vessel ready.

Catch and dispose of escaping coolant.

Observe country-specific waste disposal regulations.

Remove air ducts (1).

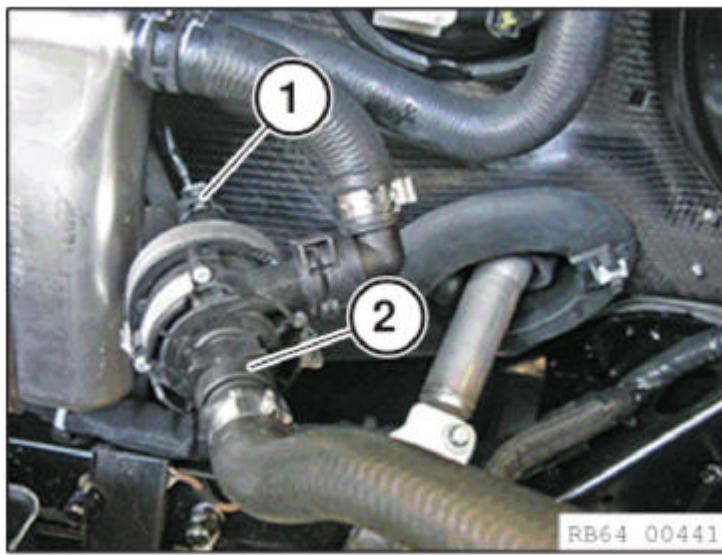


**Fig. 82: Identifying Air Ducts**

Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

Unlock and remove coolant line (2).



**Fig. 83: Identifying Coolant Line And Plug Connection**

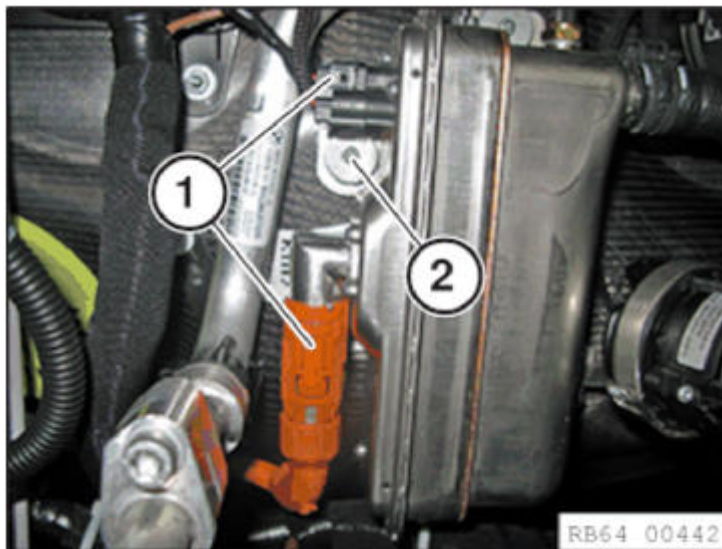
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Observe **NOTES ON UNLOCKING AND DISCONNECTING PLUG CONNECTIONS** on electric vehicles.

Unlock plug connections (1) and disconnect.

Release screw (2).

Tightening torque **64 52 5AZ** .



**Fig. 84: Identifying Plug Connections And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

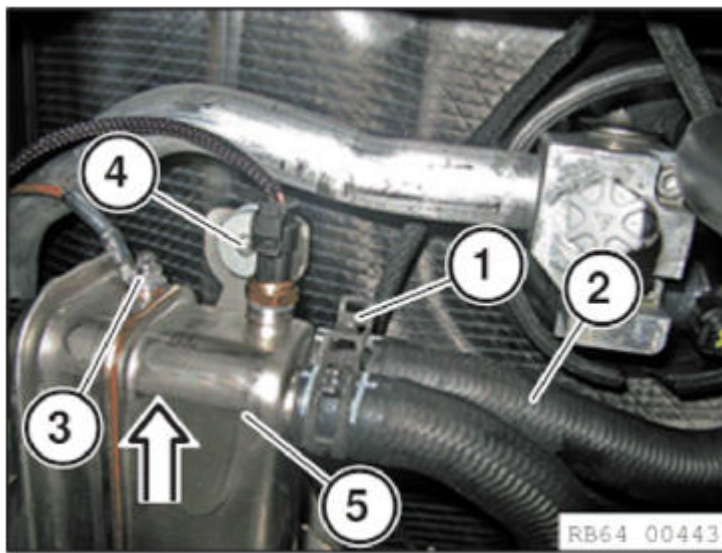
Release hose clamp (1) using special tool **17 2 050** and pull off coolant line (2).

Release nut (3) and remove equipotential bonding line.

Release screw (4).

Tightening torque **64 52 5AZ** .

Remove electrical heating (5) in direction of arrow.



**Fig. 85: Removing Electrical Heating**

Courtesy of BMW OF NORTH AMERICA, INC.

Observe **NOTES ON SCREW CONNECTIONS FOR EQUIPOTENTIAL**  
 IMPORTANT: **BONDING !**  
 Tightening torque **64 52 4AZ** .

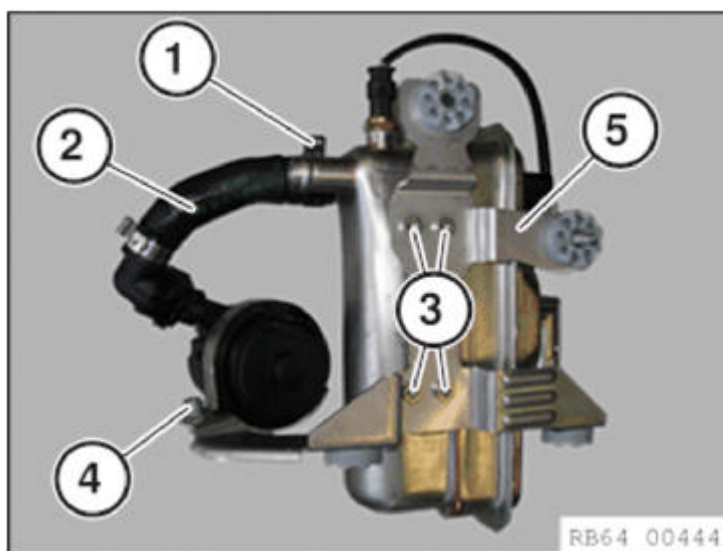
Carefully blow out electrical heating in order to remove remaining coolant.  
 IMPORTANT: Seal openings or pipes on electrical heating using special tool **32 1 270** in order to prevent escape of media and dirt contamination.

**Replacement:**

Release hose clamp (1) using special tool **17 2 050** and pull off coolant line (2).

Release screws (3 and 4).

Take off holder (5).



**Fig. 86: Identifying Coolant Line, Hose Clamp And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- **BLEED AND FILL COOLING SYSTEM**

**ATTENTION!**

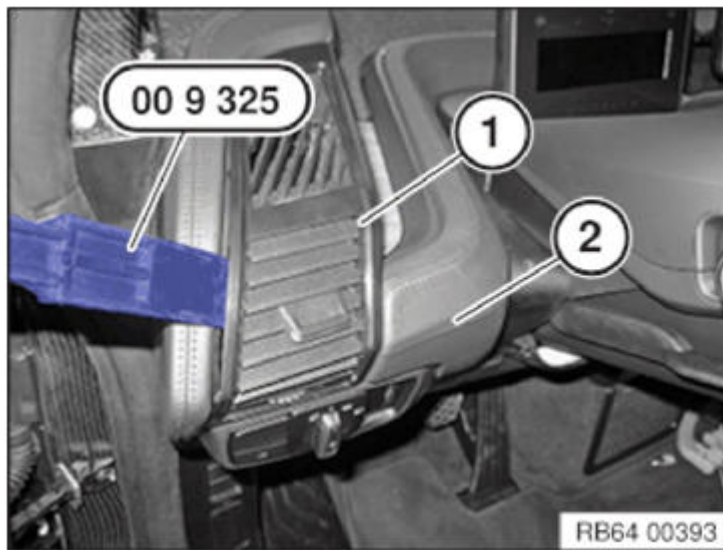


Filling and bleeding must not be performed in ECO-PRO MODE!

## NOZZLES AND OUTLETS

### 64 22 115 REMOVING AND INSTALLING (REPLACING) LEFT/RIGHT FRESH AIR GRILLE

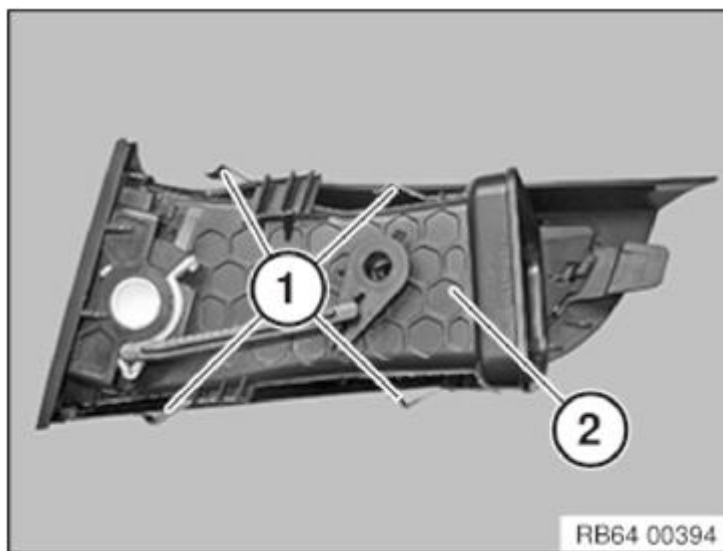
Lever out fresh air grille (1) from dashboard (2) using special tool 00 9 325.



**Fig. 87: Removing Fresh Air Grille From Dashboard Using Special Tool (00 9 325)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Latch mechanisms (1) on fresh air grille (2) must not be missing or bent.



**Fig. 88: Identifying Latch Mechanisms On Fresh Air Grille**  
Courtesy of BMW OF NORTH AMERICA, INC.

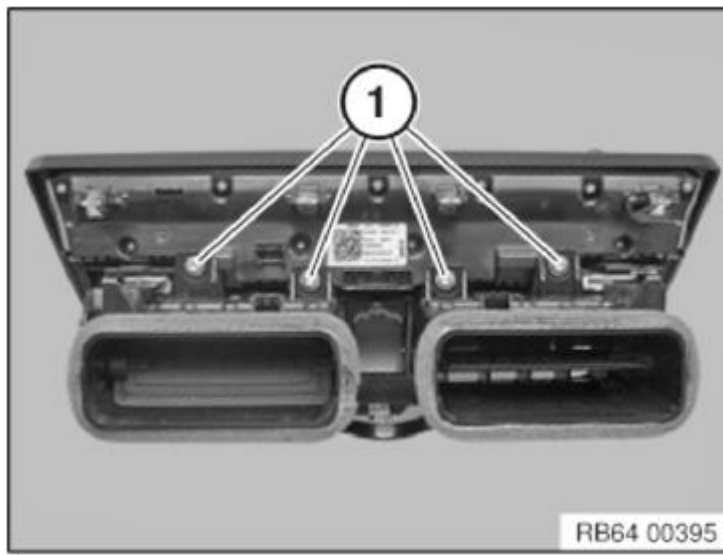
### 64 22 165 REMOVING AND INSTALLING/REPLACING CENTER FRESH AIR GRILLE

**Necessary preliminary tasks:**

- Remove **RADIO AND A/C CONTROL PANEL**

**Replacement:**

Release screws (1).



**Fig. 89: Identifying Screws**

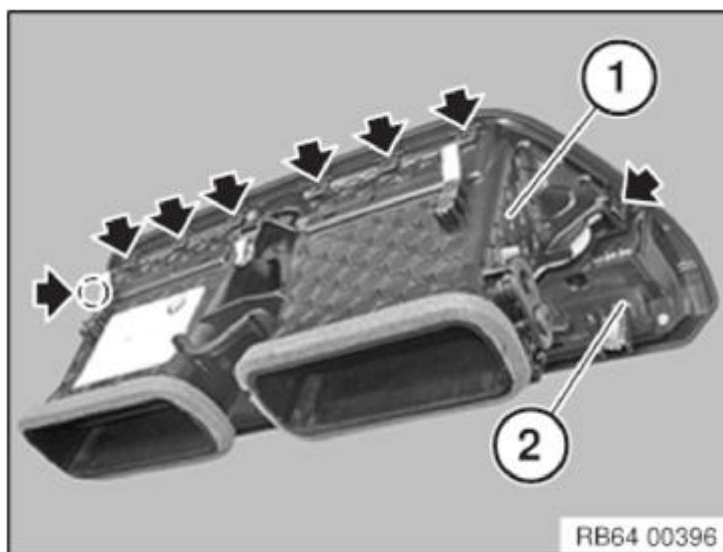
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock latches at marked points.

*Installation note:*

Latch mechanisms must not be damaged or missing.

Remove fresh air grille (1) from radio and A/C control panel (2).



**Fig. 90: Locating Fresh Air Grille Latch Mechanisms**

Courtesy of BMW OF NORTH AMERICA, INC.

## **HVAC SYSTEM CABIN FILTER**

### **64 31 010 REPLACING MICROFILTER FOR INTERIOR VENTILATION**

**Attention!**

Risk of damage!

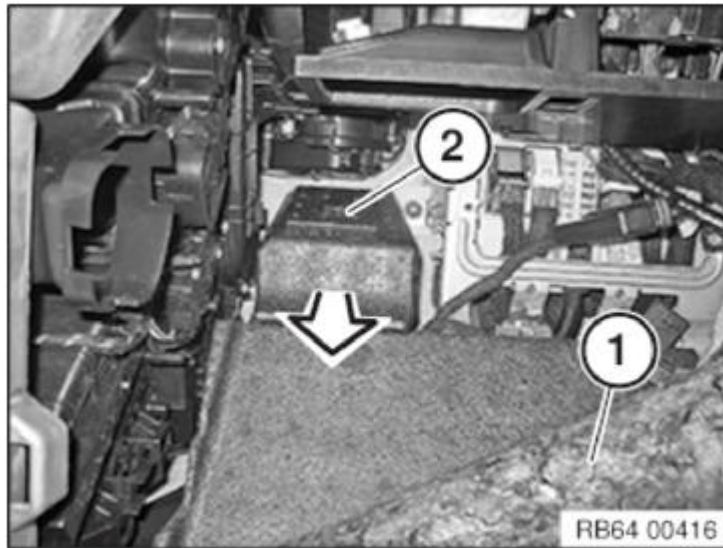
Air conditioning must not be operated without the prescribed filter element.

**Necessary preliminary tasks:**

- Remove **FOOTWELL TRIM ON PASSENGER'S SIDE**
- Remove **BOTTOM FRONT FOOTWELL COVER**

Fold carpet (1) to side as shown.

Remove top footwell insert (2) in direction of arrow.

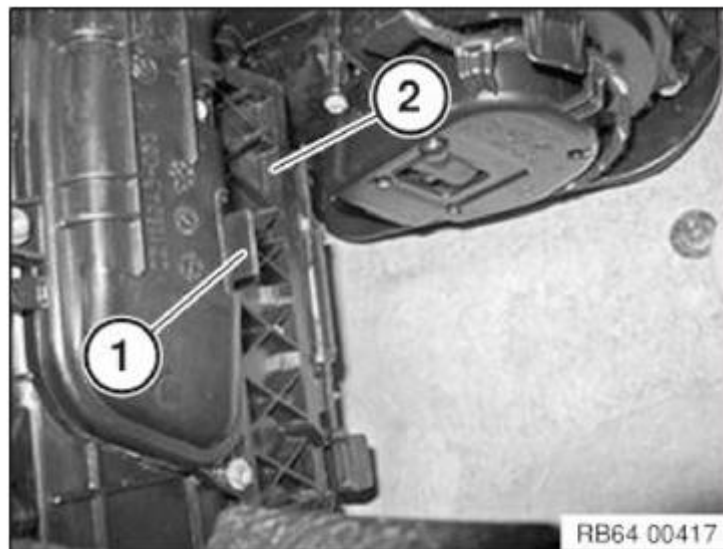


**Fig. 91: Removing Top Footwell Insert**

Courtesy of BMW OF NORTH AMERICA, INC.

Release lock (1).

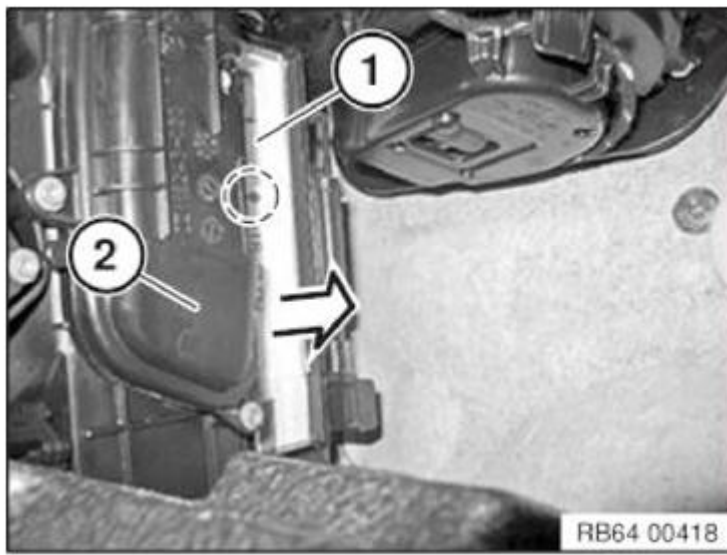
Open flap (2) and remove.



**Fig. 92: Identifying Lock And Flap**

Courtesy of BMW OF NORTH AMERICA, INC.

Pull the microfilter (1) out of the heating and air-conditioning unit (2) in the direction of the arrow.



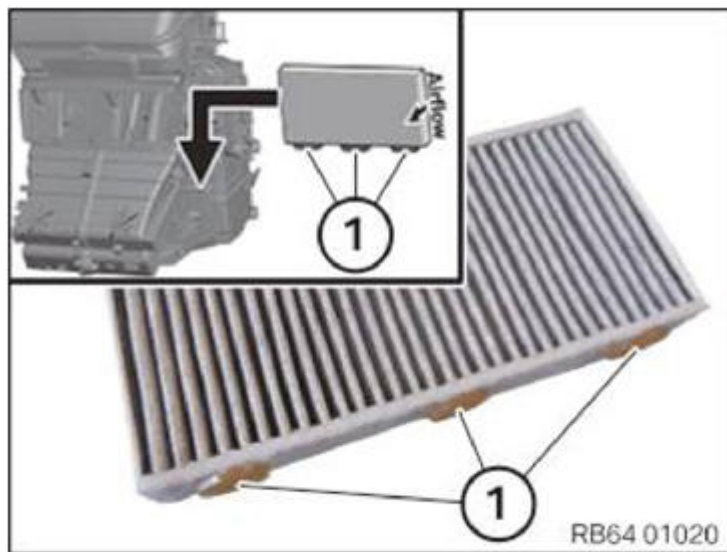
**Fig. 93: Removing Microfilter From Heating And Air-Conditioning Unit**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Bottom microfilter has three spacers (1).

The bottom spacers (1) need to be inside the heating and air-conditioning unit.

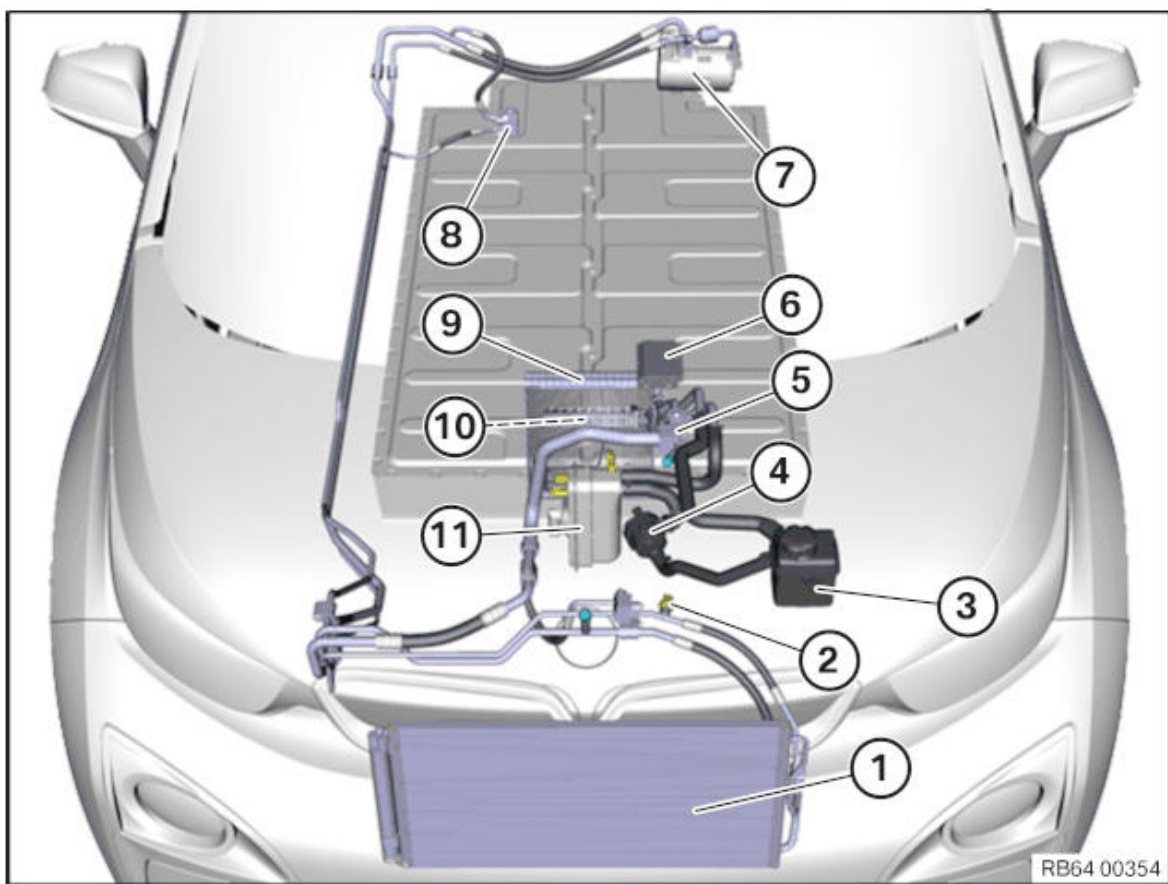
**NOTE:** As of version 2/2016, the spacers (1) are omitted.



**Fig. 94: Installing Microfilter**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **AIR CONDITIONING, LEAK DETECTION**

### **64 00... OVERVIEW COMPONENTS, REFRIGERANT CIRCUIT**

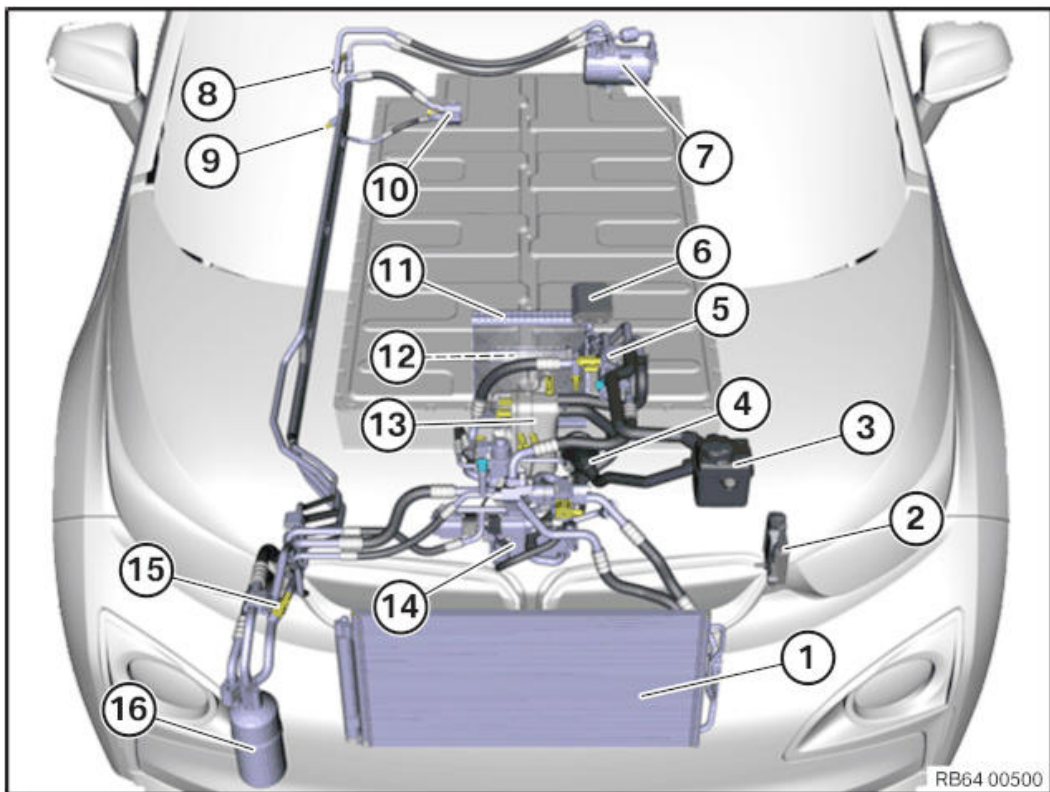


1. [Capacitor \(with desiccant insert\)](#)
2. [Safety pressure switch](#)
3. [Expansion tank](#)
4. [Electric coolant pump](#)
5. [Expansion valve 1](#)
6. [Control unit for Air conditioning](#)
7. Compressor for A/C system
8. [Expansion valve 2 for high-voltage battery unit](#)
9. [Evaporator](#)
10. [Radiator](#)
11. [Electrical heating](#)

**Fig. 95: Overview Of Refrigerant Circuit Components (Without Heat Pump)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Refrigerant circuit without heat pump (optional equipment 4T9):**





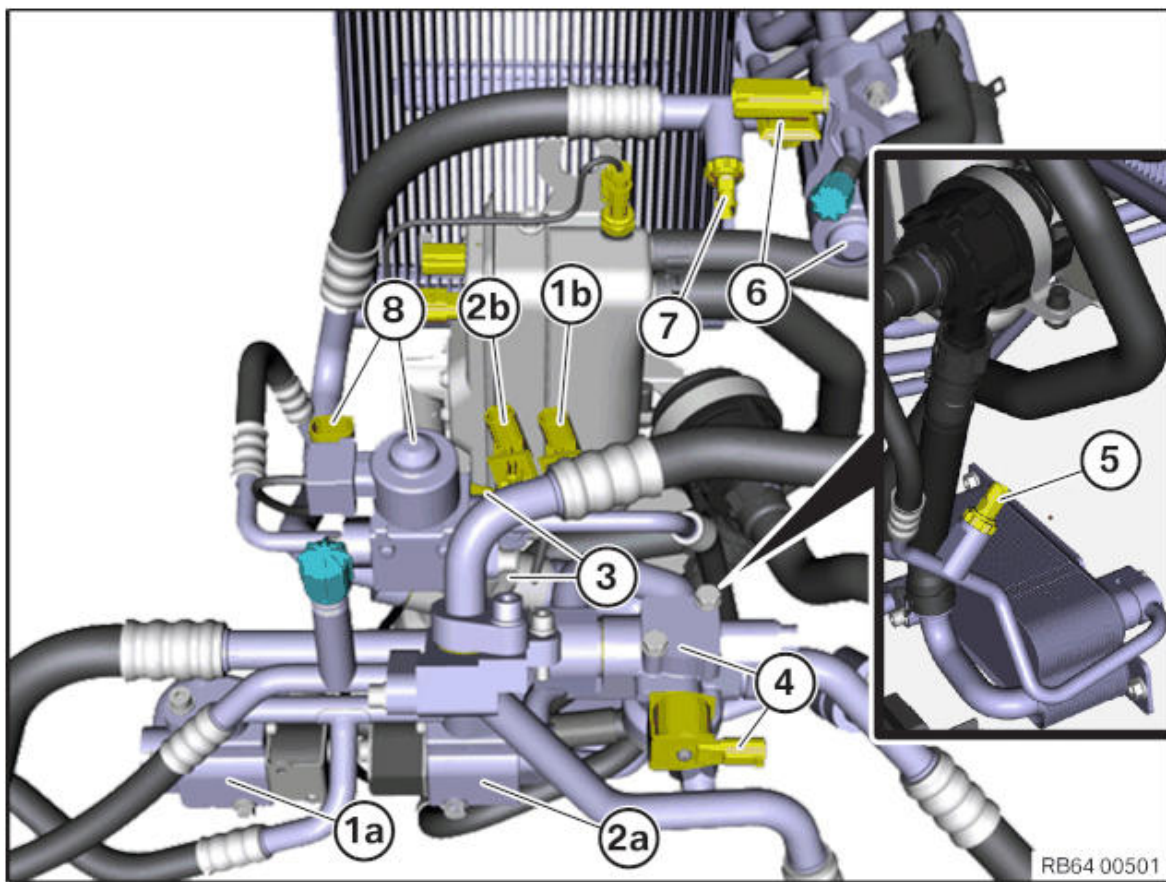
1. [Capacitor \(without desiccant insert\)](#)
2. [Heat pump controller](#)
3. [Expansion tank](#)
4. [Electric coolant pump](#)
5. [Expansion valve 1](#)
6. [Control unit for Air conditioning](#)
7. Compressor for A/C system
8. [Refrigerant pressure temperature sensor 2 \(B395\)](#)
9. [Temperature sensor 2 \(B397\)](#)
10. [Expansion valve 2 for high-voltage battery unit](#)
11. Evaporator
12. [Radiator](#)
13. [Electrical heating](#)
14. [Heat pump heat exchanger](#)
15. [Refrigerant pressure temperature sensor 1 \(B394\)](#)
16. [Dryer flask](#)

**Fig. 96: Overview Of Refrigerant Circuit Components (With Heat Pump)**

Courtesy of BMW OF NORTH AMERICA, INC.

**Refrigerant circuit with heat pump (optional equipment 4T9):**





1. a) [Shutoff valve 1 \(Y155\)](#)  
b) [Connector of shutoff valve 1 \(Y155\)](#)
2. a) [Shutoff valve 2 \(Y156\)](#)  
b) [Connector of shutoff valve 2 \(Y156\)](#)
3. [Shutoff valve 3 \(Y157\) with connector](#)
4. [Shutoff valve 4 \(Y158\) with connector](#)
5. [Temperature sensor 1 \(B396\)](#)
6. [Expansion valve 1 with connector](#)
7. [Temperature sensor 3 \(B398\)](#)
8. [Expansion valve 3 \(Y154\) with connector](#)

**Fig. 97: Overview Of Refrigerant Circuit Components (With Heat Pump)**

Courtesy of BMW OF NORTH AMERICA, INC.

**Refrigerant circuit with heat pump (optional equipment 4T9):**

### **64 50... A/C PERFORMANCE TEST**

**Observe the following conditions prior to the A/C performance test:**

1. Connect diagnosis system. Check of the fault memory (no faults in the fault memory).
2. Attach a thermometer with separate display element to the head restraint. Lay display element outwards out of passenger compartment.
3. Perform the test in a suitable workshop area with an ambient temperature above 18Â° C.
4. Vehicle temperature should be approximately the same as the ambient temperature in the workshop.
5. Engine must be at operating temperature (does not apply for electric vehicles).
6. ECO PRO mode must not be switched on.

**Heat passenger compartment:**

- "A/C button" is **not** activated during the heating process
- Close all side windows and doors
- Set air recirculation function.
- Select air distribution mode for footwell and defrosting.
- *On vehicles with CID* : In A/C menu (CID) in Air distribution index tab: select 100 % footwell for driver and front passenger and 100 % defrosting for driver (this applies here to driver and front passenger)
- Maximum temperature setting
- Maximum blower speed
- Start engine (does not apply for electric vehicles)

### Cool down passenger compartment:

Switch on air conditioning compressor with "A/C button" at a vehicle interior temperature of 45 Å°C (measured at the head restraint).

*On vehicles with MAX-AC button:*

- Activation of MAX-AC (= maximum cooling power)

*On vehicles without MAX-AC button:*

- Set maximum cooling power by means of following steps:
  - Setting minimum temperature
  - Blower setting maximum
  - Stratification maximum cold (4 blue bars)
  - Only ventilation open
  - Close remaining flaps (air outlet **only** from center fresh air grille, left and right)

After 5 min, measure both ventilation temperatures with a thermometer at the same time (center, left and right fresh air grille). The measured temperature must be  $\leq 16$  Å°C and the difference between right and left may not be greater than 2 Å°C.

If one or both temperature specifications is not reached, drain off heating and air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#). Measure the amount of refrigerant drawn off and compare with the nominal fill amount. See [AIR CONDITIONING, REFRIGERANT AMOUNTS](#) .

Check whether refrigerant loss is present:

- If there is a **permissible** loss of refrigerant: fill the refrigerant circuit with the nominal fill amount. See [FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#). See also [AIR CONDITIONING, REFRIGERANT AMOUNTS](#) .
- If there is an **impermissible** loss of refrigerant: after rectifying the leak, fill the refrigerant circuit with the nominal fill amount. See [FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#). See also [AIR CONDITIONING, REFRIGERANT AMOUNTS](#) .
- If there is no refrigerant loss, continue troubleshooting using the pressure measurement (only possible for vehicles with unregulated air conditioning compressor up to series E46/E53).

### 64 50 010 DRAWING OFF, EVACUATING AND FILLING HEATING AND AIR CONDITIONING SYSTEM (R1234YF)

#### **WARNING:**

**Only persons in possession of a professional certificate of competence for the maintenance and repair of heating and air conditioning systems are authorized to carry out repair work on the refrigerant circuit. It must be available no later than 04 July 2010 (applies only to EU countries;**

follow country-specific regulations in non-EU countries).  
Refrigerant circuit is under high pressure!

- If the protective caps on the filling valves are difficult to open, there is a danger of injury from leaking valve inserts.

**Repair work may only be carried out on a depressurized refrigerant circuit!**

- Before conducting repairs, check the actual pressure drop on the pressure gauge of the A/C service station
- Follow all applicable **SAFETY INFORMATION**.

**Attention!**

**Risk of damage!**

Only R1234yf refrigerant may be used.

Restart engine only when air conditioning has been correctly filled.

**Vehicle-specific notes:**

**Only I01:**

Equipment specification **with and without** heat pump:

To access the connections for the refrigerant lines, **REMOVE FRONT LUGGAGE COMPARTMENT WELL**.



**Fig. 98: Identifying Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

Equipment specification **with** heat pump:

**Before the drawing off, evacuation or filling procedure, carry out the following steps:**

1. **Switch on terminal 15:** To do this, operate the start/stop button **without operating the brake pedal**.
2. **Switch off blower at IHKA controls** (so that compressor cannot start up).
3. **Switch on low-beam headlight** (so that terminal 15 can switch off automatically after a certain period).

If nec., charge the high-voltage battery (12 V battery is charged via the high-voltage battery).

#### 4. Pull off connector (1).

**This state must be retained for the duration of the entire drawing off, evacuation and filling procedure.**

**After filling the refrigerant circuit, reconnect connector (1)!**

Equipment specification **with and without** heat pump:

**After filling the refrigerant circuit, delete fault memory!**

**Only I12:**

**Attention!**

**Risk of damage!**

**Risk of paint damage and scratches!**

Open engine compartment lid to access the connections of the refrigerant lines!

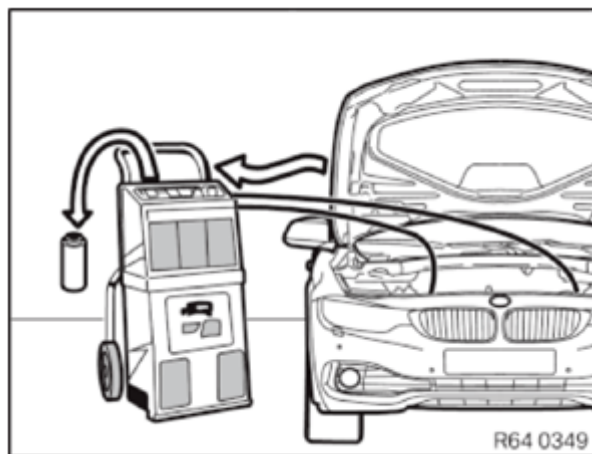
**Open and close the engine compartment lid as specified in the instructions without exception!**

**Attention!**

**For R1234yf, an A/C service station especially suited for this refrigerant must be used!**

**A/C service station for R134a must not be used!**

**COMPLY WITH THE NOTES ON REFRIGERANT (R134A, R1234YF) AND REFRIGERANT OIL (SANDEN SP-A2).**



**Fig. 99: Draining Air Conditioning System Refrigerant Oil**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Risk of damage!

Carefully move the climate service station!

Comply with the operating instructions and service interval for the A/C service station!

Make sure that the hoses of the A/C service station are drained after the drawing off or filling procedure!

The climate service station contains highly sensitive components, such as scales.

These components will be damaged due to improper handling, such as fast driving over a bump. This will result in a significant reduction of the measuring accuracy when drawing off and filling.

## **Attention!**

The vehicle must be parked on the floor during all drawing off, evacuation and filling procedures!

Filling a raised vehicle will result in insufficient filling levels.

### **NOTE: In the event of complaints, perform A/C performance test!**

If the system fails the test, draw off, evacuate and fill the air conditioning in accordance with the operating instructions of the relevant service station.

#### *Instructions for drawing off air conditioning:*

Before evacuation, the A/C service station will investigate the refrigerant.

If the refrigerant is consistent with the requirements, evacuation is continued.

If the refrigerant is not consistent with the requirements, it must be evacuated into an external container by a special extractor unit and disposed of.

### **In order to enhance the separation of refrigerant and refrigerant oil, allow the Air conditioning to run for a few minutes before drawing off.**

This limits the entrainment of refrigerant oil while it is drawn off.

Drawn-off refrigerant oil must be changed and reintroduced via the A/C service station.

During drawing off, set the blower of the heating and air-conditioning unit to the middle blower speed. This ensures that drawing off is more effective since the pressure on the low pressure side increases.

#### *Recycling:*

Dispose of drawn-off refrigerant oil as hazardous waste.

Observe country-specific waste disposal regulations.

#### *Note in case of contaminated refrigerant R1234yf:*

If the A/C service station for R1234yf identifies a contaminated refrigerant in the refrigerant circuit of the vehicle before evacuation, then a special procedure to draw off and dispose of this refrigerant must be followed. Contact BMW for further information.

#### *Instructions for evacuating off air conditioning:*

Before each filling, evacuate the refrigerant circuit.

Observe an evacuation time of **at least 30 minutes** .

The evacuation procedure removes all traces of ambient air, water vapor and any other gases present from the heating and air conditioning system. This enables subsequent system filling with refrigerant.

If the vacuum does not remain stable when the system is off, run the procedure for leaks in the refrigerant circuit.

During evacuation, set the blower of the heating and air-conditioning unit to the middle blower speed. This ensures that evacuation is more effective since the pressure on the low pressure side increases.

#### *Notes for filling heating and air conditioning system:*

### **IN CERTAIN CASES, SANDEN SP-A2 REFRIGERANT OIL MUST BE INJECTED INTO THE REFRIGERANT CIRCUIT.**

Before filling with refrigerant, replace the refrigerant oil entrained during drawing off.

Also top up any lost fluid as indicated in the table:



## Loss of R1234yf refrigerant

**Table 1** indicates the permitted loss of refrigerant after a specific period of time. There is no leak. refrigerant oil may not be topped up.

**Table 2** indicates the amount of refrigerant oil must be topped up with an unapproved loss of refrigerant due to a leak after a specific period of time.

### Different cases:

- a. Loss of refrigerant per **Table 1** is not exceeded
  - Top up lost R1234yf refrigerant
  - It is **not permitted** to top up the refrigerant oil
- b. Loss of refrigerant per **Table 1** is exceeded
  - Top up lost R1234yf refrigerant
  - refrigerant oil must be topped up **additionally** per **Table 2**

### REFRIGERANT OIL SPECIFICATION

Number of years since last filling	0 - 1	1 - 2	2 - 3	3 - 4	4 - 5
Permissible loss [g] --> Do not top up refrigerant oil	≤ 30	≤ 60	≤ 90	≤ 120	≤ 150

### REFRIGERANT OIL SPECIFICATION

Number of years since last filling	Loss of R1234yf refrigerant [g]	Top up quantity refrigerant oil
0-1	< 120	0
	120 - 150	10
	> 150	20
1 - 2	< 180	0
	180 - 210	10
	> 210	20
2 - 3	< 240	0
	240 - 270	10
	> 270	20
3 - 4	< 300	0
	300 - 330	10
	> 330	20
4 - 5	< 360	10
	> 360	20

Follow **NOTES FOR OPENING AND REPLACING PARTS** in refrigerant circuit.

Depending on the type of component replaced on the heating and air conditioning system, it may be necessary to top up the refrigerant oil, even if no measurable losses have occurred during drawing off. Follow the notes provided by the air conditioning manufacturer, taking account of the tolerances (and inaccuracies) indicated in the operating instructions of the relevant service station.

Information on the required refrigerant capacity for the entire air conditioning is contained on the type plate (1) in the engine compartment.





**Fig. 100: Identifying Refrigerant Capacity Type Plate**  
Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, refer to [CAPACITY](#) .

**Installation note:**

Reseal refrigerant filler necks on vehicle with sealing caps.

**64 50 010 DRAWING OFF, EVACUATING AND FILLING HEATING AND AIR  
CONDITIONING SYSTEM (R134A)**

**WARNING:** Only persons in possession of a professional certificate of competence for the maintenance and repair of heating and air conditioning systems are authorized to carry out repair work on the refrigerant circuit. It must be available no later than 04 July 2010 (applies only to EU countries; follow country-specific regulations in non-EU countries).  
Refrigerant circuit is under high pressure!

- If the protective caps on the filling valves are difficult to open, there is a danger of injury from leaking valve inserts.

Repair work may only be carried out on a depressurized refrigerant circuit!

- Before conducting repairs, check the actual pressure drop on the pressure gauge of the A/C service station.
- Follow all applicable [SAFETY INFORMATION](#).

**Attention!**

Risk of damage!

Only R134a refrigerant may be used.

Restart engine only when air conditioning has been correctly filled.

**Vehicle-specific notes:**

**Only I12:**

**Attention!**

**Risk of damage!**

## **Risk of paint damage and scratches!**

To gain access to the refrigerant line connections, open the engine compartment lid.

**Open and close the engine compartment lid as specified in the instructions without exception!**

**Vehicle-specific notes:**

### **BMW I01:**

Equipment specification **with and without** heat pump:

To access the connections for the refrigerant lines, **REMOVE FRONT LUGGAGE COMPARTMENT WELL**.

Equipment specification **with** heat pump:

**Before the drawing off, evacuation or filling procedure, carry out the following steps:**



**Fig. 101: Identifying Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

1. **Switch on terminal 15:** To do so, press the Start/Stop button **without operating the brake pedal**.
2. **Switch off blower at IHKA controls** (so that compressor cannot start up).
3. **Switch on low-beam headlight** (so that terminal 15 can switch off automatically after a certain period).

If nec., charge the high-voltage battery (12 V battery is charged via the high-voltage battery).

4. **Pull off connector (1).**

**This state must be retained for the duration of the entire drawing off, evacuation and filling procedure.**

**After filling the refrigerant circuit, reconnect connector (1)!**

Equipment specification **with and without** heat pump:

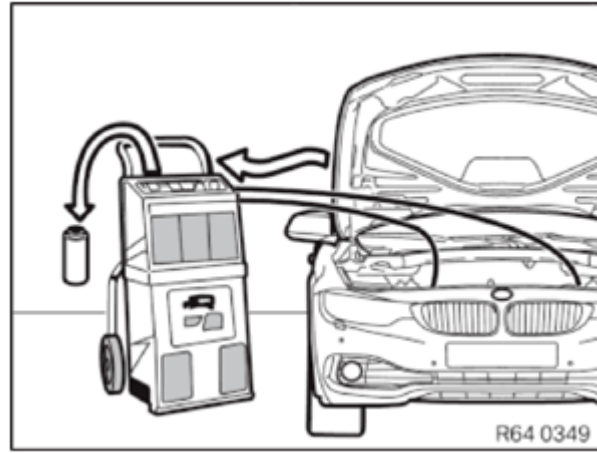
**After filling the refrigerant circuit, delete fault memory!**

**IMPORTANT:** Risk of damage!

Carefully move the climate service station!

Comply with the operating instructions and service interval for the A/C service station!

Make sure that the hoses of the A/C service station are drained after the drawing off or filling procedure!



**Fig. 102: Draining Air Conditioning System Refrigerant Oil**  
Courtesy of BMW OF NORTH AMERICA, INC.

The climate service station contains highly sensitive components, such as scales.

These components will be damaged due to improper handling, such as fast driving over a bump. This will result in a significant reduction of the measuring accuracy when drawing off and filling.

IMPORTANT: The vehicle must be parked on the floor during all drawing off, evacuation and filling procedures!

Filling a raised vehicle will result in insufficient filling levels.

**NOTE:** **READ AND COMPLY WITH NOTES ON REFRIGERANT (R134A, R1234YF) AND REFRIGERANT OIL (SANDEN SPA2) .**

**NOTE:** **In the event of complaints, perform A/C performance test!**

If the system fails the test, draw off, evacuate and fill the air conditioning in accordance with the operating instructions of the relevant service station.

*Instructions for drawing off air conditioning:*

To help separation of refrigerant and refrigerant oil, run engine at low speed (800-1200 RPM) and with air conditioning turned on for a few minutes.

This limits the entrainment of refrigerant oil while it is drawn off.

Drawn-off refrigerant oil must be changed and reintroduced via the A/C service station.

During drawing off, set the blower of the heating and air-conditioning unit to the middle blower speed. This ensures that drawing off is more effective since the pressure on the low pressure side increases.

Recycling:

Dispose of drawn-off refrigerant oil as hazardous waste.

Observe country-specific waste disposal regulations.

*Instructions for evacuating off air conditioning:*

Before each filling, evacuate the refrigerant system.

Observe an evacuation time of **at least 30 minutes** .

The evacuation procedure removes all traces of ambient air, water vapor and any other gases present from the heating and air conditioning system. This enables subsequent system filling with refrigerant.

If the vacuum does not remain stable when the system is off, run the procedure for leaks in the refrigerant circuit.

During evacuation, set the blower of the heating and air-conditioning unit to the middle blower speed. This ensures that evacuation is more effective since the pressure on the low pressure side increases.

*Notes for filling heating and air conditioning system:*

**IN CERTAIN CASES, THE REFRIGERANT OIL SANDEN SP-A2 CAN BE FILLED INTO THE REFRIGERANT CIRCUIT BY INJECTION.**

Before filling with refrigerant, replace the refrigerant oil entrained during drawing off.

Also top up any lost fluid as indicated in the table:

**Loss of R134a refrigerant**

**Table 1** indicates the permitted loss of refrigerant after a specific period of time. There is no leak. refrigerant oil may not be topped up.

**Table 2** indicates the amount of refrigerant oil must be topped up with an unapproved loss of refrigerant due to a leak after a specific period of time.

**Different cases:**

- a. Loss of refrigerant per **Table 1** is not exceeded
  - Top up lost R134a refrigerant
  - It is **not permitted** to top up the refrigerant oil
- b. Loss of refrigerant per **Table 1** is exceeded
  - Top up lost R134a refrigerant
  - refrigerant oil must be topped up **additionally** per **Table 2**

**REFRIGERANT OIL SPECIFICATION**

Number of years since last filling	0 - 1	1 - 2	2 - 3	3 - 4	4 - 5
Permissible loss [g] --> Do not top up refrigerant oil	≤ 30	≤ 60	≤ 90	≤ 120	≤ 150

**REFRIGERANT OIL SPECIFICATION**

Number of years since last filling	R134a loss of coolant [g]	Top up quantity refrigerant oil
0-1	< 120	0
	120 - 150	10
	> 150	20
1 - 2	< 180	0
	180 - 210	10
	> 210	20
2 - 3	< 240	0
	240 - 270	10
	> 270	20
3 - 4	< 300	0
	300 - 330	10
	> 330	20
4 - 5	< 360	10
	> 360	20

Follow **NOTES FOR OPENING AND REPLACING PARTS** in refrigerant circuit.

Depending on the type of component replaced on the heating and air conditioning system, it may be necessary to top up the refrigerant oil, even if no measurable losses have occurred during drawing off. Follow the notes provided by the air conditioning manufacturer, taking account of the tolerances (and inaccuracies) indicated in the operating instructions of the relevant service station.



**Fig. 103: Identifying Refrigerant Capacity Type Plate**  
Courtesy of BMW OF NORTH AMERICA, INC.

Information on the required refrigerant capacity of the air conditioning is found on the type plate (1).

If necessary, refer to [CAPACITY](#).

**Installation note:**

Reseal refrigerant filler necks on vehicle with sealing caps.

**Attention!**

**I01, I12:**

**In national-market versions with R134a with production date up to 08/2014 the type plate shows incorrect refrigerant oil.**

**Always use Sanden SP-A2**

(Part number Sanden SPA2: 2 339 920)

**64 50... FILLING REFRIGERANT OIL BY MEANS OF INJECTION**

**Special tools required:**

- [2 286 910](#)

**Attention!**

**This procedure is only applicable to:**

1. Countries, in which BMW i vehicles or hybrid vehicles are delivered with R134a refrigerant.
2. Workshops in these countries that do not have a separate A/C service station for BMW i vehicles or hybrid vehicles.
3. If a BMW i vehicle or hybrid vehicle (R134a refrigerant, Sanden SP-A2 refrigerant oil) must be filled with an A/C service station for R134a and the vehicle's expansion tank is filled with ND-8 refrigerant oil.

**OBSERVE NOTES ON REFRIGERANT AND REFRIGERANT OIL FROM 09/2013 !**

**Necessary preliminary tasks:**

- [EVACUATE REFRIGERANT CIRCUIT AND FILL WITH REFRIGERANT.](#)

Vehicle with heat pump: The connector pulled off in the previously mentioned procedure remains disconnected until completion of refrigerant oil filling process.

**(Do not fill in refrigerant oil )**

- Disconnect refrigerant lines of A/C service station from high pressure and low pressure connection on the vehicle.

**(A/C service station no longer needed )**

- Define amount of refrigerant oil to be filled in:

**Parts of refrigerant circuit were not replaced:**

**Amount of refrigerant oil to be filled in =**

amount of refrigerant oil drawn off by means of A/C service station +

4 milliliter extra amount (for volume of hose)

**Parts of refrigerant circuit were replaced (air conditioning compressor excluded):**

**Amount of refrigerant oil to be filled in =**

amount of refrigerant oil drawn off by means of A/C service station +

**EXTRA AMOUNT FOR NEW PART** +

4 milliliter extra amount (for volume of hose)

**When replacing A/C compressor:**

**Amount of refrigerant oil to be filled in =**

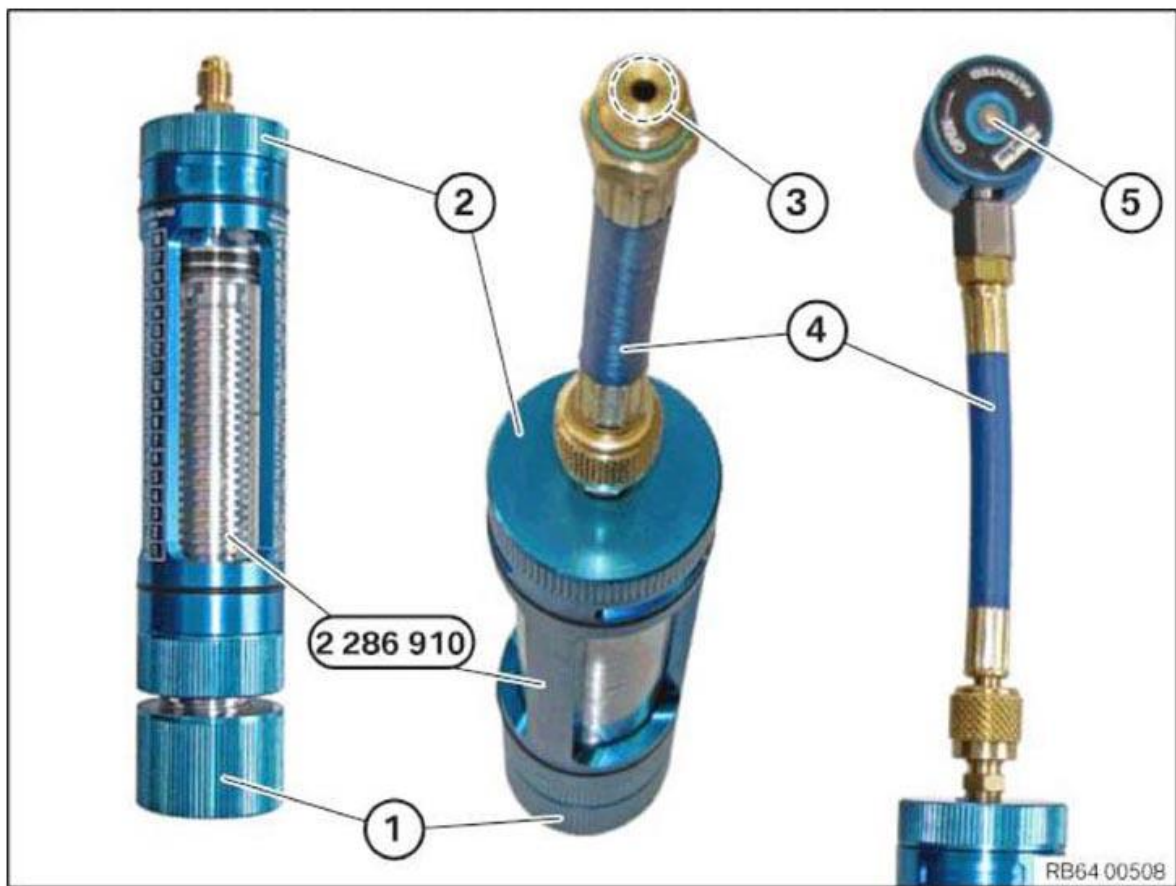
amount of refrigerant oil drawn off by means of A/C service station +

**AMOUNT OF REFRIGERANT OIL DEFINED OF PREVIOUS AIR CONDITIONING COMPRESSOR** +

4 milliliter extra amount (for volume of hose)

- Fill in amount of refrigerant oil to be filled in into a **clean** measuring cup.





**Fig. 104: Identifying Knurled Screw And Special Tool (2 286 910)**

**Courtesy of BMW OF NORTH AMERICA, INC.**

1. Screw out knurled screw (1) in such a way to make room for the amount of refrigerant oil to be filled into the special tool **2 286 910** , if necessary.
2. Unscrew lid (2).
3. Fill in refrigerant oil from measuring cup into special tool **2 286 910** via opening of lid (2).
4. Screw hose (4) on lid (2) until hand-tight.
5. Screw lid (2) with hose (4) on special tool **2 286 910** .
6. Rotate knurled screw (1) until refrigerant oil slightly emerges from opening (3).
7. Screw low pressure quick-release coupling (5) on hose (4).

Tightening torque: 10 Nm

8. If necessary, turn the screw (1) on the low-pressure quick-release coupling (2) anti-clockwise.
9. Connect low pressure quick-release coupling (2) with low pressure connection on vehicle and tighten screw (1) in clockwise direction.
10. Screw in knurled screw (3) completely until reaching limit position.
11. Release screw (1) in counterclockwise direction and remove low pressure quick-release coupling (2) from low pressure connection on vehicle.
12. BMW I01 with heat pump: **PLUG IN THE CONNECTOR PULLED OFF BEFORE FILLING PROCEDURE.**
13. Delete the fault memory.



**Fig. 105: Identifying Low Pressure Quick-Release Coupling And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**64 50 770 FLUSHING REFRIGERANT CIRCUIT (WITHOUT HEAT PUMP)**

**Special tools required:**

- [2 286 732](#)
- [2 286 730](#)
- [2 286 727](#)
- [2 286 729](#)
- [2 285 575](#)
- [2 286 734](#)
- [2 286 735](#)

**Attention!**

**It is only necessary to flush refrigerant circuit in the following case:**

- For a **mechanical fault in the air conditioning compressor** and the resulting **debris intrusion in the refrigerant circuit.**

**Refrigerant circuit can be flushed in the following cases as needed:**

- If the refrigerant circuit was open for more than 24 h (e.g. after an accident).
- If there are doubts about the correct amount of refrigerant oil in the refrigerant circuit.
- If the refrigerant circuit is contaminated.

**Attention!**

In I01, **2 different country-specific refrigerants** and one **refrigerant oil Sanden SP-A2** are used.

**Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!**

**OBSERVE NOTES ON REFRIGERANT AND REFRIGERANT OIL FROM 09/2013 !**

**Refrigerant circuit is always flushed with R134a, regardless of the refrigerant used in the vehicle!**

**Refrigerant circuit is flushed in the direction of flow.**

**Observe operating instructions of the A/C service station!**

Overview A/C service stations (does not apply for USA and Japan)

## **Attention!**

Risk of damage!

Only switch on air conditioning again once refrigerant circuit has been properly filled.

### **READ AND COMPLY WITH NOTES ON COMPRESSOR REPLACEMENT.**

### **FOLLOW INSTRUCTIONS FOR OPENING AND REPLACING PARTS IN REFRIGERANT CIRCUIT .**

#### **Procedure and preliminary work in the case of a faulty air conditioning compressor:**

1. Drain and clean A/C service station oil reservoir before drawing off oil.
2. Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
3. Remove air conditioning compressor for heating and air conditioning system
4. Drain refrigerant oil from the faulty air conditioning compressor into a **clean** bucket via the oil drain plug.
5. Complete visual inspection of the drained refrigerant oil from the faulty air conditioning compressor:
  - **no debris in refrigerant oil = do not flush refrigerant circuit**
  - **debris in refrigerant oil = flush refrigerant circuit**

#### **If no refrigerant oil leaks out of the faulty air conditioning compressor:**

6. Visual inspection of the drained refrigerant oil in the A/C service station oil reservoir:
  - **dark/brown coloring of refrigerant oil = do not flush refrigerant circuit**
  - **black coloring of refrigerant oil = flush refrigerant circuit**

**NOTE:** Refrigerant oil in an intact refrigerant circuit can change color over time. Dark/brown coloring of the refrigerant oil does not automatically indicate an impermissible contamination of the refrigerant circuit.

#### **If refrigerant circuit does not need to be flushed:**

7. Install new air conditioning compressor for heating and air conditioning system
8. Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
9. Delete fault memory

#### **If refrigerant circuit does need to be flushed:**

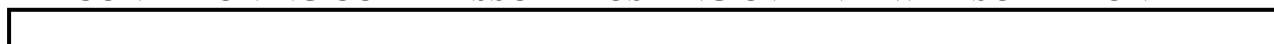
7. **REMOVE AIR CONDITIONING CONDENSER (WITH DESICCANT INSERT)**
8. **REMOVE EXPANSION VALVE 2 FOR HIGH-VOLTAGE BATTERY UNIT**

#### **The following parts must be replaced by new parts:**

- **AIR CONDITIONING COMPRESSOR**
- **AIR CONDITIONING CONDENSER (WITH DRYER FLASK)**
- **EXPANSION VALVE 1**
- **EXPANSION VALVE 2 FOR HIGH-VOLTAGE BATTERY UNIT**

#### **Flushing overview**

#### **AIR CONDITIONING COMPRESSOR FLUSHING OVERVIEW DESCRIPTION**



Flushing	Air conditioning compressor	Refrigerant lines Air conditioning compressor	Air conditioning condenser (with desiccant insert)	Refrigerant lines Air conditioning condenser	expansion valve 1	expansion valve 2 High-voltage battery unit	Flushing
1	removed	with A/C service station Connected High-pressure pipe <a href="#">2 286 732</a>	removed	together Connected Thinner line <a href="#">2 286 727</a>	fitted (used part)	removed, replaced by <a href="#">2 286 734</a>	1
2		low pressure line <a href="#">2 286 730</a>		Thicker line <a href="#">2 286 729</a> Hose <a href="#">2 285 575</a>	removed, replaced by <a href="#">2 286 735</a>	fitted (new part)	2

### Prepare Flushing 1:

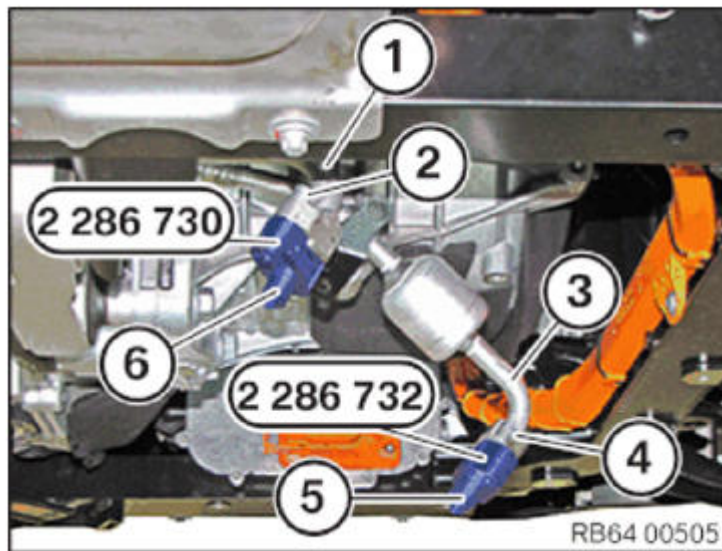
Mount special tool [2 286 732](#) on high pressure line (3) of air conditioning compressor (thinner line) and secure with screw (4) on vehicle side.

Mount special tool [2 286 730](#) on low pressure line (1) of air conditioning compressor (thicker line) and secure with screw (2) on vehicle side.

Tightening torque [64 52 1AZ](#) .

### Connection to the A/C service station:

Connect high pressure line of the A/C service station to the high-pressure connection (5) of the special tool [2 286 732](#) .



**Fig. 106: Connecting High Pressure Line Of A/C Service Station To High-Pressure Connection Of Special Tool (2 286 732)**

Courtesy of BMW OF NORTH AMERICA, INC.

Connect low pressure line of the A/C service station to the low-pressure connection (6) of the special tool [2 286 730](#) .

### Prepare Flushing 1:

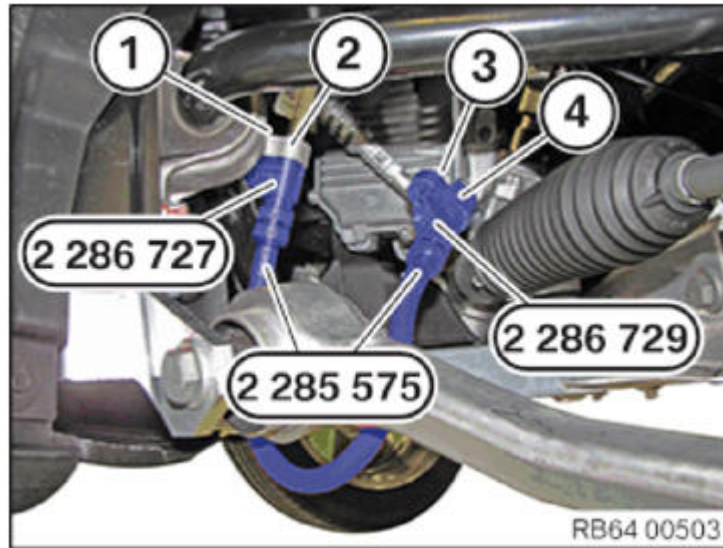
Mount special tool [2 286 727](#) on a thinner line (2) of the air conditioning condenser and secure with the screw (1) on the vehicle.

Mount special tool [2 286 729](#) on a thicker line (4) of the air conditioning condenser and secure with the screw (3) on the vehicle.



Tightening torque [64 53 3AZ](#) .

Connect special tools [2 286 727](#) and [2 286 729](#) using special tool [2 285 575](#) .



**Fig. 107: Identifying Special Tools (2 286 727 And 2 286 729)**

Courtesy of BMW OF NORTH AMERICA, INC.

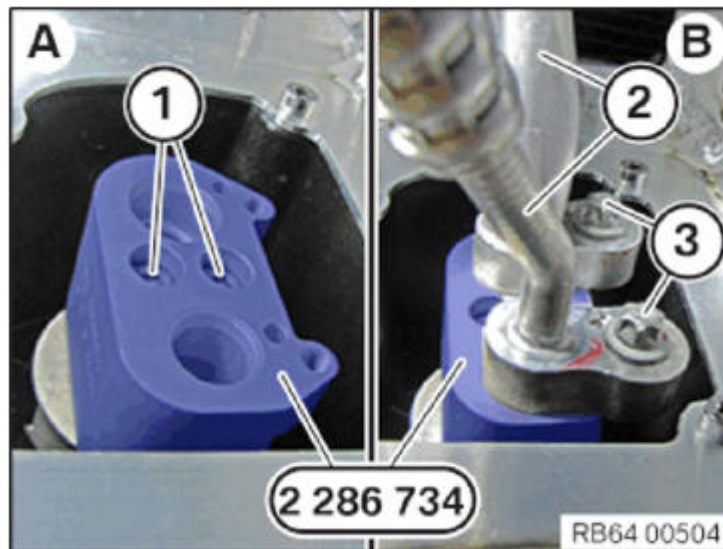
### Prepare Flushing 1:

- A. In place of expansion valve 2, mount special tool [2 286 734](#) as illustrated and secure with screws (1) from expansion valve 2.

Tightening torque [64 53 7AZ](#) .

- B. Mount refrigerant line (2) and secure with (3) screws.

Tightening torque [64 53 6AZ](#) .



**Fig. 108: Identifying Special Tool (2 286 734)**

Courtesy of BMW OF NORTH AMERICA, INC.

### Perform Flushing 1:

1. Call up procedure:
  - 03 Body
  - Heating and air conditioning functions
  - Flushing refrigerant circuit
2. Start "Flushing 1" test module.

3. Start flushing at the A/C service station.
4. Perform Flushing 1 for at least 30 min.
5. Once Flushing 1 is complete, check whether refrigerant in sight glass on the A/C service station is clean:
  - Refrigerant in sight glass is clean: Change to Flushing 2.
  - Refrigerant in sight glass is not yet clean: Fully repeat Flushing 1.

### Prepare Flushing 2:

*Necessary preliminary tasks:*

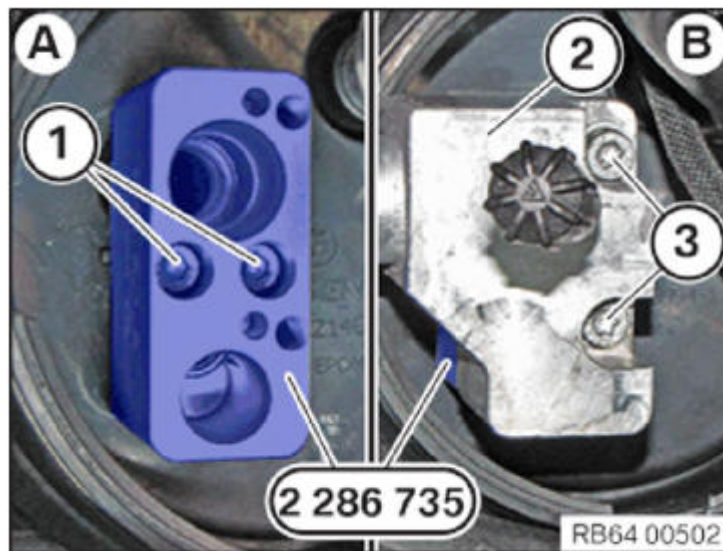
- Remove **EXPANSION VALVE 1**

- A. In place of expansion valve 1, mount special tool **2 286 735** as illustrated and secure with screws (1) from removed expansion valve 1 on vehicle side.

Tightening torque **64 53 2AZ** .

- B. Mount refrigerant line (2) on special tool **2 286 735** and secure with bolts (3).

Tightening torque **64 53 1AZ** .



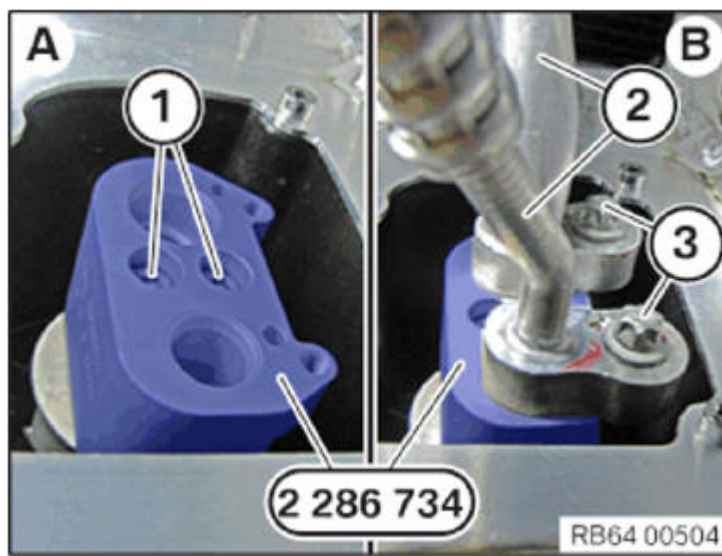
**Fig. 109: Identifying Special Tool (2 286 735)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Prepare Flushing 2:

- B. Release bolts (3). Remove refrigerant lines (2).
- A. Release (1) screws. Remove special tool **2 286 734** .

**INSTALL NEW EXPANSION VALVE 2 FOR HIGH-VOLTAGE BATTERY UNIT.**





**Fig. 110: Identifying Special Tool (2 286 734)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Perform Flushing 2:**

1. Start "Flushing 2" test module.
2. Start flushing at the A/C service station.
3. Carry out flushing 2 for at least 30 min.
4. Once Flushing 2 is complete, check whether refrigerant in sight glass on the A/C service station is clean:
  - Refrigerant in sight glass is clean: Both flushings are complete.
  - Refrigerant in sight glass is not yet clean: Fully repeat Flushing 2.

**After completing both flushings, proceed as follows:**

- Remove all special tools.
- Install new air conditioning compressor for heating and air conditioning system

(If the refrigerant circuit has been flushed, the full amount of refrigerant oil is required when a new air conditioning compressor is installed!)

- **INSTALL A NEW AIR CONDITIONING CONDENSER (INCLUDING DESICCANT INSERT)**
- **INSTALL NEW EXPANSION VALVE 1**
- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Delete fault memory

**64 50... INSTRUCTIONS FOR HANDLING R1234YF REFRIGERANT**

**Work on the refrigerant circuit may only be carried out by experts!**

Avoid all contact with liquid or gaseous R1234yf. Wear safety goggles and gloves when working on the refrigerant circuit.

- Follow all applicable **SAFETY INFORMATION**.

**WARNING:** Although R1234yf at normal temperature is non-toxic, non-flammable and not explosive in air in any mixture ratio, it is still essential to follow various safety precautions. At higher temperatures, R1234yf is inflammable.

As a gas, R1234yf is colorless, odorless and heavier than air. If it enters the atmosphere, this may result in an imperceptible danger of asphyxiation or in cardiac palpitations, especially in workshop pits. Ventilate rooms adequately; if necessary, turn on installed extractor systems.

Store charged refrigerant pressure flasks in a place where they are not exposed to direct sunlight or any other heat source (max. 45 °C). Also avoid exposing them to mechanical stress (e.g. by dropping).

Do not weld or solder on to filled air conditioning systems or in rooms into which R1234yf may have leaked. Exposure to flames or high temperatures ( $\geq 50$  °C) may give rise to toxic products of decomposition (hydrofluoric acid). For this reason, do not smoke either.

In the event of fire, carbon dioxide (CO<sub>2</sub>), extinguishing powder and a sprayed water jet are deemed to be suitable extinguishant. Cool reservoirs at risk with a sprayed water jet (risk of bursting!).

If the protective caps on the filling valves are difficult to open, there is a risk of injury from leaking valve inserts (high pressure).

The filled refrigerant circuit of the A/C system is subject to excess pressure. Before carrying out repairs on the A/C system, it is absolutely essential to draw off the refrigerant.

- Before conducting repairs, check the actual pressure drop on the pressure gauge of the A/C service station.

R1234yf must be drawn off, cleaned and returned to the A/C system using an A/C service station following the relevant operating instructions.

For a properly functioning A/C system, it is essential to have the greatest possible levels of cleanliness when working on the A/C system and the longest possible evacuation (at least 30 minutes dehumidification from refrigerant circuit) before each filling of the A/C system.

R1234yf easily absorbs moisture. Therefore, seal off opened pipes, condenser, evaporator, compressor and dryer flask immediately with plugs.

- If an A/C system has been completely drained by leakage, accident or repair, the desiccant insert must be replaced as excessive moisture may have entered the system. See [REMOVE/INSTALL/REPLACE CAPACITOR \(WITH DESICCANT INSERT, FOR VEHICLES WITHOUT HEAT PUMP\)](#) or [REMOVING/INSTALLING/REPLACING DRYER FLASK FOR AIR CONDITIONING \(VEHICLES EQUIPPED WITH HEAT PUMP\)](#).

With exchange parts, the plugs may only be removed immediately before the lines are connected. In the event of warranty claims, the used parts must be provided with plugs to be able to determine the cause of the damage.

#### **Installation note:**

After each refill of an A/C system, check that the protective caps of the filler valves are hand-tight. They serve as additional seals.

### **64 50... LEAK DETECTION WITH FORMING GAS**

**NOTE:** Leak detection with forming gas replaces the leak detection that is restricted in EU countries using UV.  
**Observe national regulations in all other countries!**

Compliance with the manufacturer's operating instructions provided in the equipment case is absolutely mandatory!

**IMPORTANT:** Read and comply with the manufacturer's operating instructions provided with the special tool particularly with regard to accident prevention, health protection and environmental protection.  
**Only the basic procedure is described in the following!**

**IMPORTANT:** Wear personal protective clothing/equipment!

**NOTE:**

Determine the customer's use behavior prior to leak detection! Certain user behaviors can lead to a loss of refrigerant from the refrigerant circuit even if there is no leak. This may occur if the customer has not used the air conditioning for a period of more than six months. This may cause O-rings to harden and refrigerant may escape. In this case, it will be sufficient to fill the refrigerant circuit again and switch on the heating and air conditioning system for approximately 10 minutes while the engine is running.

**Necessary preliminary work:**

- If components of the refrigerant circuit are contaminated, clean the engine compartment. Otherwise, the sensor head of the leak detector will become contaminated.

**COMPLY WITH NOTES AND INSTRUCTIONS ON HANDLING HIGH PRESSURE CLEANER .**

- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Fill the air conditioning system with forming gas
- Set pressure to 5 bar

To reach the components of the refrigerant circuit with leak detector, specific parts must be removed depending on the vehicle.

**Remove the following parts first immediately before the check of the respective components**

- Drive belt from air conditioning compressor
- Center fresh air grille
- Covers
- Trim panels
- Air duct
- Intake silencer
- Bulkheads
- Parts of the interior equipment (automatic rear air-conditioning system)

With some vehicles, the air flaps of the automatic air flap control (LKS) must be opened.

Vehicles **with and without** heat pump:

To access the connections for the refrigerant lines, **REMOVE FRONT LUGGAGE COMPARTMENT WELL .**

Vehicles **with** heat pump:

**Carry out the following steps before filling the refrigerant circuit with forming gas:**



**Fig. 111: Identifying Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

1. **Switch on terminal 15:** To do so, press the Start/Stop button **without operating the brake pedal**.
2. **Switch off blower at IHKA controls** (so that air conditioning compressor cannot start up).
3. **Switch on low-beam headlight** (so that terminal 15 can switch off automatically after a certain period).

If nec., charge the high-voltage battery (12 V battery is charged via the high-voltage battery).

4. **Pull off connector (1).**

**This state must last for the duration of the entire leak detection process!**

Equipment specification **with and without** heat pump:

**After filling the refrigerant circuit with refrigerant, delete fault memory!**

Always perform the leak detection with a pressure of **5 bar at first!**

**IMPORTANT:** This is absolutely necessary to find certain leaks, such as in the area of the O-rings. If no leak is detected, repeat the leak detection with **10 bar**.

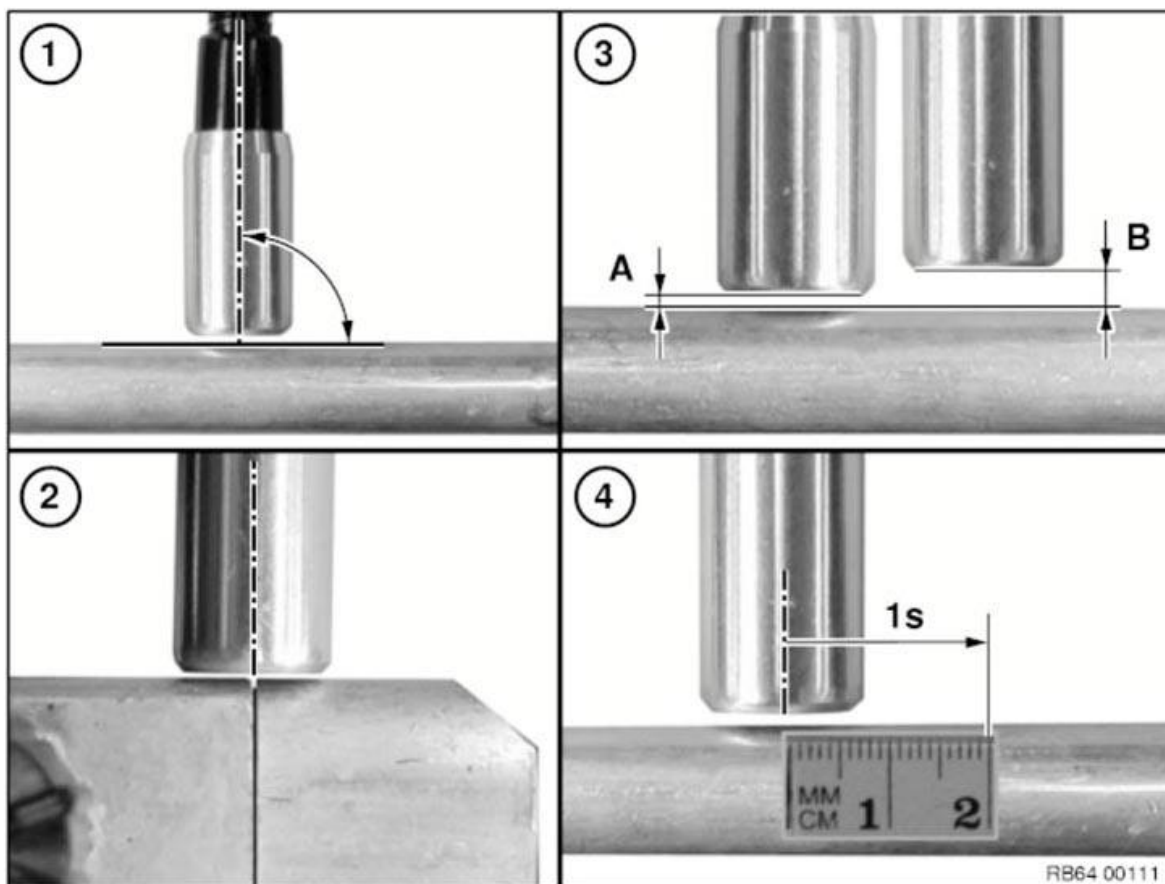
The leak detection may not be performed **more than 3 h** after filling the refrigerant circuit with forming gas!

**IMPORTANT:** Forming gas consists of 95% nitrogen and 5% hydrogen. The leak detector will detect hydrogen. If this is leaking from the refrigerant circuit even though the pressure remains, the leak detection bears no results.

**Risk of damage!**

**IMPORTANT:** Maximum approved pressure: **10 bar**

**Do not start** the engine during the entire procedure!



**Fig. 112: Checking Distance Between Sensor Head And Surface**

Courtesy of BMW OF NORTH AMERICA, INC.

Notes for handling the leak detector:

1. Sensor head should always stand vertical to the surface to be checked.
2. Sensor head must always be aligned to the center of the point to be checked. Slowly guide the sensor head around the point (e.g. connection point, sealing surface, etc.).
3. The optimal distance (A) between sensor head and surface to be checked should permanently be approximately 1 mm.

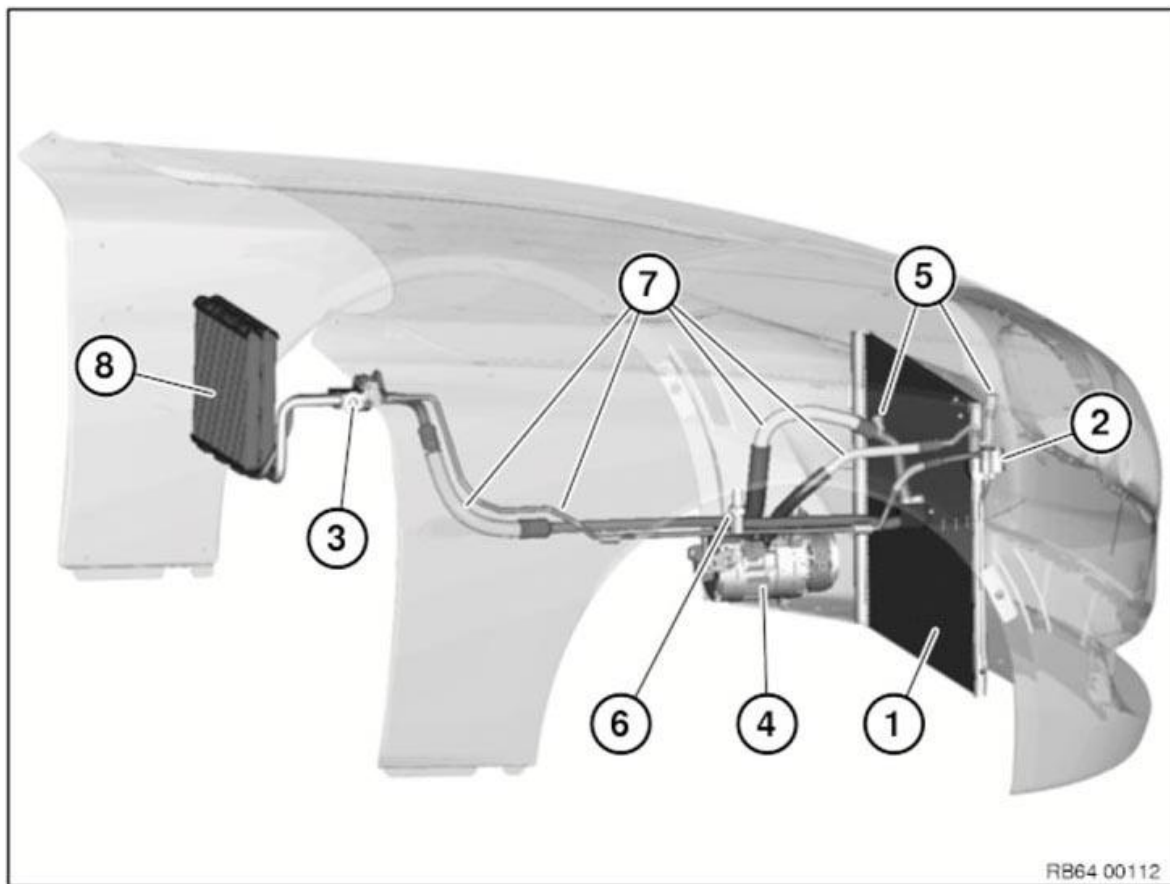
Maximum distance (B) at points that are difficult to access approximately 5 mm.

4. Checking speed may not be more than maximum 2 cm per s.

**NOTE:** If the leak detector displays a leak, remove the sensor head from the leak for approximately 10 s. Then check if the leak is still displayed at the same point. Repeat the process up to three times, to ensure that a leak is actually present at this point.

**NOTE:** Replace the leaking component. Relieve the pressure from the refrigerant circuit prior to replacement.

**IMPORTANT:** Compliance with the instructions above is absolutely mandatory!  
Non-compliance will significantly reduce the efficiency of leak detection!



**Fig. 113: Overview Of Air Conditioning Compressor System Components**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** The graphic shows the example of the refrigerant circuit on the F02 with the automatic rear air-conditioning system optional equipment. Refrigerant circuits on other vehicles may differ from the graphic. Refrigerant circuits of BMW i vehicles differ a lot from the figure [OVERVIEW COMPONENTS REFRIGERANT CIRCUIT01](#) Overview components refrigerant circuit12 Pay attention to leak detection in these vehicles

**Overview of positions to be checked:**

1. Air conditioning condenser
2. Connection point between air conditioning condenser and refrigerant line
3.
  - a. Expansion valve, front (vehicles with and without automatic rear air-conditioning system)
  - b. Expansion valve, rear (vehicles with automatic rear air-conditioning system)
4. Air conditioning compressor
5. Filler neck high pressure and low pressure
6. Refrigerant pressure sensor
7.
  - a. Refrigerant line, front (vehicles with and without automatic rear air-conditioning system)
  - b. Refrigerant line, rear (vehicles with automatic rear air-conditioning system)
8.
  1. Evaporator, front (vehicles with and without automatic rear air-conditioning system)
  2. Evaporator, rear (vehicles with automatic rear air-conditioning system)

**NOTE:** Refrigerant line connection points are identified by arrows.

**Checking sequence:**



1. Check of components 1, 2, 3a, 4, 5, 6, 7a and 8a of the automatic front air-conditioning system.

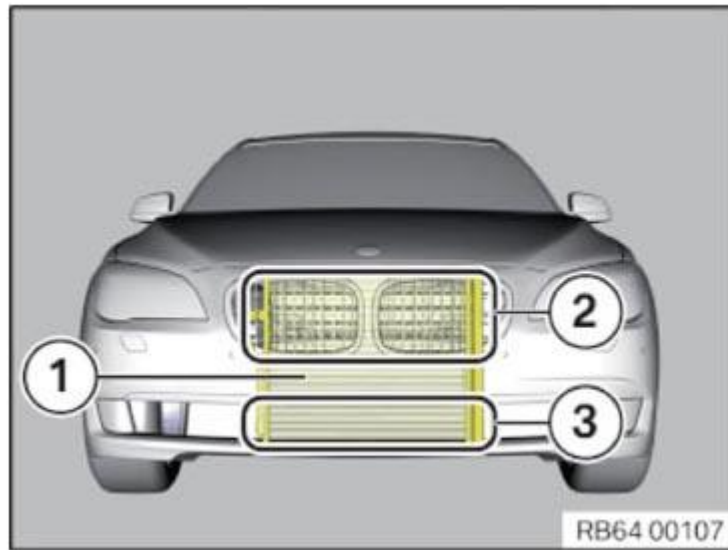
**If no fault found:**

2. Check of components 3b, 7b, 8b and connection points of the automatic rear air-conditioning system.

**1. Air conditioning condenser:**

Damage caused by stone chipping, etc. is the most frequent cause of air conditioning condenser leaks (1):

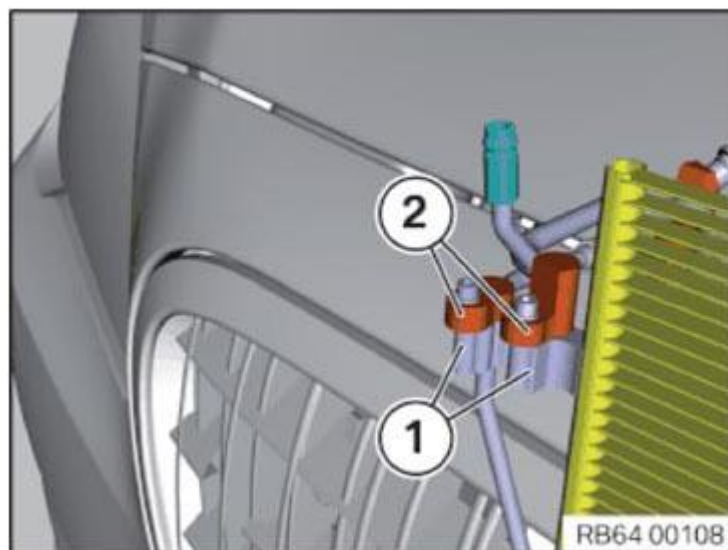
1. Visual inspection in the area of the radiator grille (2) and air inlet grille, center (3).
2. Check damaged points first.
3. Check the remainder of the air conditioning condenser.



**Fig. 114: Identifying Ornamental Grille And Capacitor Leaks**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2. Connection point capacitor - refrigerant line**

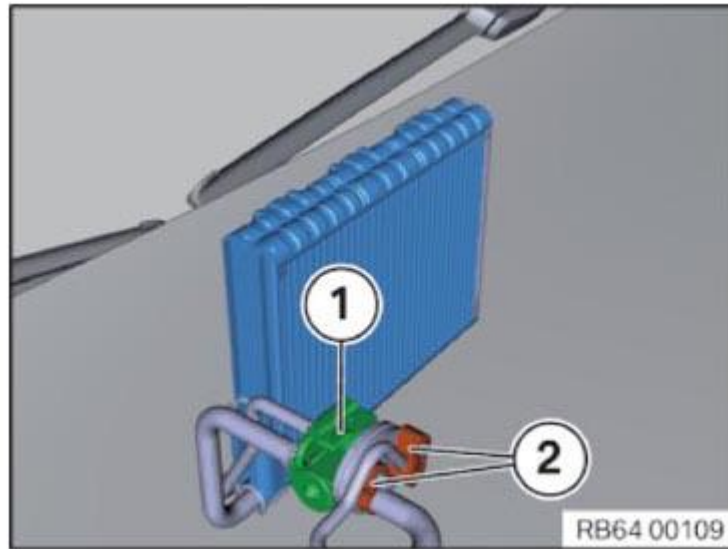
Check the connection point between the connection at the air conditioning condenser (1) and refrigerant lines (2).



**Fig. 115: Identifying Air Conditioning Condenser And Refrigerant Lines**  
Courtesy of BMW OF NORTH AMERICA, INC.

**3. Expansion valve:**

Check the connection point between the expansion valve (1) and refrigerant lines (2).



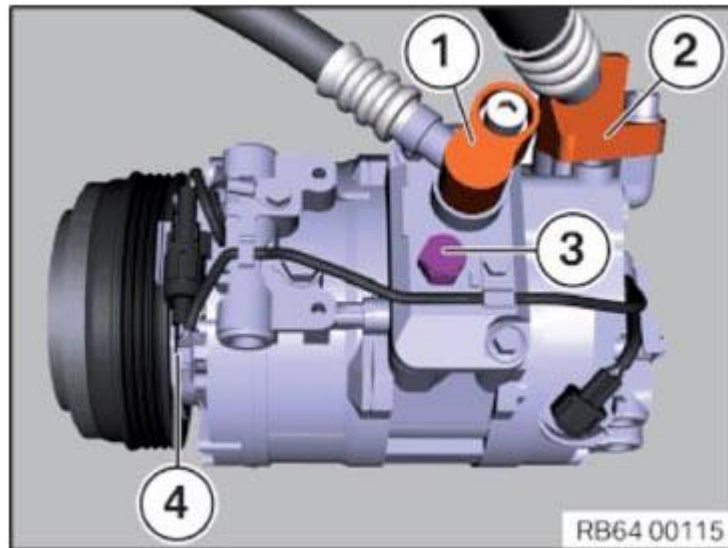
**Fig. 116: Identifying Expansion Valve And Refrigerant Lines**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### 4. A/C compressor:

Remove drive belt from air conditioning compressor.

Check the following components on the air conditioning compressor:

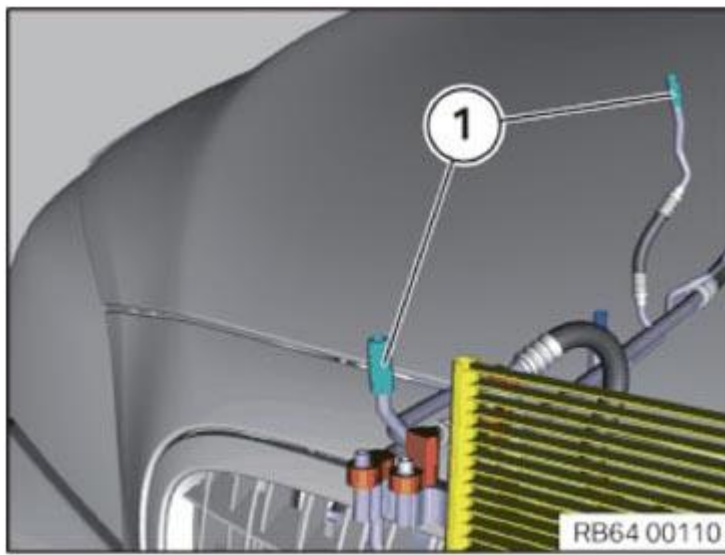
1. High-pressure connection
2. Low pressure connection
3. Pressure relief valve
4. Radial shaft seal of the magnetic coupling: Turn the magnetic coupling several times by hand during the leak detection.



**Fig. 117: Identifying A/C Compressor**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### 5. Filler neck

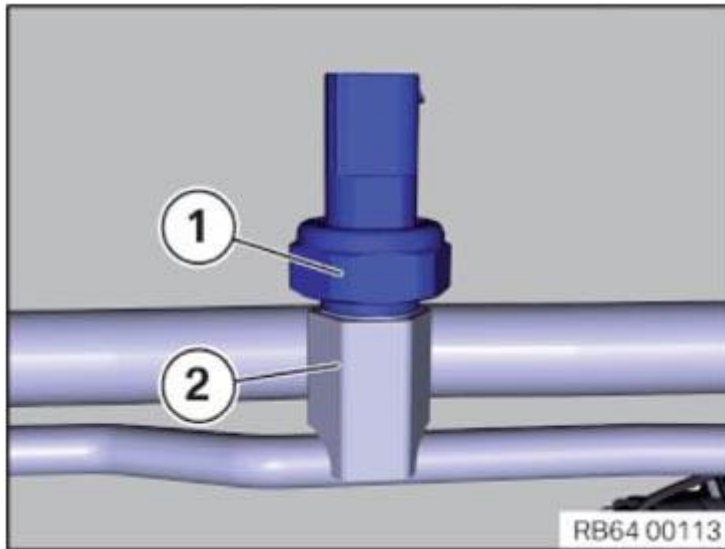
Blow out the fuel filler neck (1) prior to checking.



**Fig. 118: Identifying Fuel Filler Neck**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### 6. Refrigerant pressure sensor

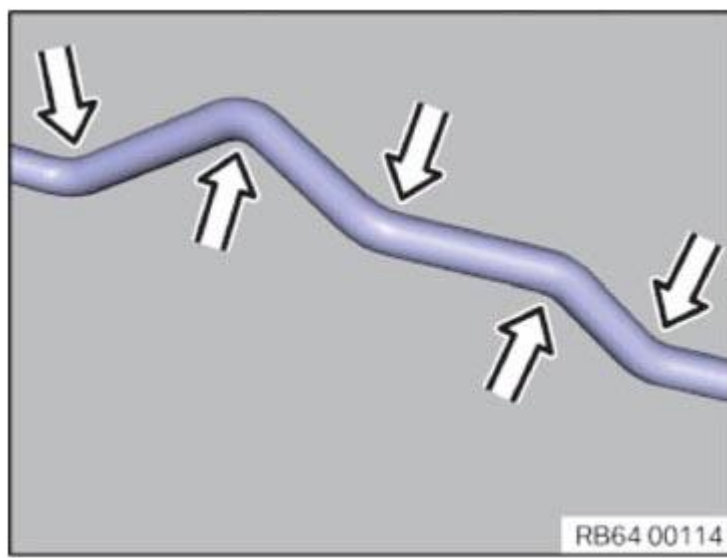
Check the sealing surface between the refrigerant pressure sensor (1) and the refrigerant line (2).



**Fig. 119: Identifying Refrigerant Pressure Sensor And Refrigerant Line**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### 7. Refrigerant lines:

1. Perform visual inspection
2. Check damaged points first.
3. Check bending points at points marked with an arrow. Leaks occur especially frequently at these points.
4. Check the remainder of the refrigerant line.



**Fig. 120: Locating Refrigerant Lines**  
 Courtesy of BMW OF NORTH AMERICA, INC.

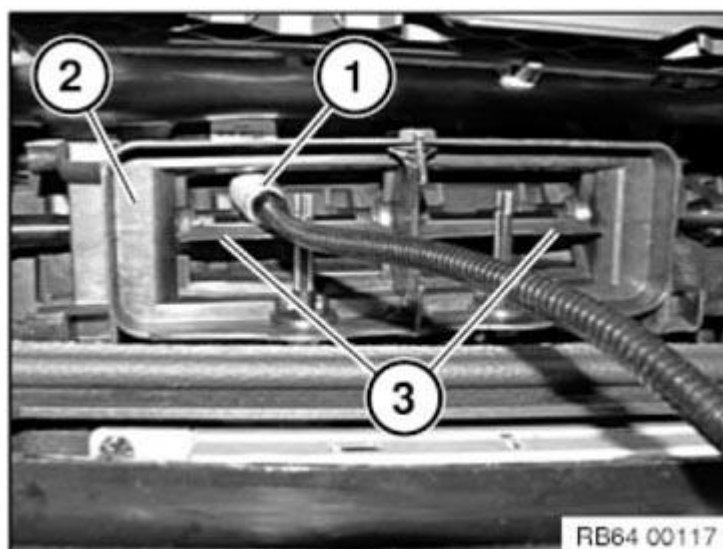
### 8. Evaporator:

Remove the center fresh air grille.

Compliance with the following settings is **absolutely** required:

- Air recirculation function On
- Lowest blower speed
- Lowest temperature
- Set the air distribution to ventilation (air may only flow out of the **center** fresh air grille)

Position sensor head (1) in air duct of middle fresh air grille (2) as illustrated and move slowly from inside to outside above and below air flap (3). Carry out this operation on the left and right fresh air grilles.



**Fig. 121: Identifying Sensor Head And Middle Fresh Air Grille**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Some vehicles have an expansion valve directly next to the fresh air intake for the  
 IMPORTANT: passenger compartment.  
 In this case the expansion valve must be covered!

Following the completed leak detection:

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

**64 50... NOTES REGARDING REFRIGERANT (R134A, R1234YF) AND REFRIGERANT OIL (SANDEN SP-A2)**

**Attention!**

**2 different refrigerants and the refrigerant oil Sanden SP A2 specific to the country are used.**

**Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!**

This information can be found on the **type plate** on the bonnet.

**R1234yf refrigerant is used in the following countries:**

**OBSERVE NOTES ON HANDLING R1234YF REFRIGERANT !**

Europe				Asia	America
Belgium	Great Britain	Malta	Sweden	Israel	USA
Bosnia and Herzegovina	Ireland	Macedonia	Switzerland	Â	Canada
Bulgaria	Iceland	The Netherlands	Slovakia	Â	Â
Denmark	Italy	Norway	Slovenia	Â	Â
Germany	Croatia	Austria	Spain	Â	Â
Estonia	Latvia	Poland	Czech Republic	Â	Â
Finland	Liechtenstein	Portugal	Hungary	Â	Â
France	Lithuania	Romania	Cyprus	Â	Â
Greece	Luxembourg	Serbia	Â	Â	Â

**Introduction of R1234yf refrigerant:**

European countries listed in the table and Israel:

- BMW i as of 09/2013
- All other vehicles as of 07/2016

USA and Canada:

- All vehicles as of 07/2016

The introduction date may vary slightly according to the specific country and model.

**The refrigerant R134a will continue to be used in all other countries.**

Observe notes on handling R134a refrigerant!

**Refrigerant oil Sanden SP-A2 is used for both, R1234yf and R134a .**

**OBSERVE NOTES ON HANDLING REFRIGERANT OIL !**

**Attention!**

**I01, I12 with production date up to 08/2014:**

**In the national-market version with R134a a wrong refrigerant oil is present on the type plate**

**Always use Sanden SP-A2**

(Part number Sanden SP-A2: 2 339 920)

## Attention!

Only vehicles with a production date from 09/2013 and **R1234yf** refrigerant/Sanden **SP-A2** refrigerant oil can be filled using the A/C service station for **R1234yf** .

In addition to vehicles with a production date from 09/2013, also all previous vehicles **without the electric A/C compressor** with **R134a** refrigerant and both **ND-8** and Sanden **SP-A2** refrigerant oil can be filled using the A/C service station for **R134a** .

## Exception:

BMW i and hybrid vehicles (with an electric A/C compressor) that are filled with **R134a** refrigerant/Sanden **SP-A2** refrigerant oil. These vehicles must be **INJECTED** with Sanden **SP-A2** refrigerant oil.

**When filling the refrigerant circuit with R134a, always ensure you use the correct, vehicle-specific refrigerant oil type!**

**The previous ND-8 refrigerant oil must not be mixed with Sanden SPA2 refrigerant oil!**

Sanden **SP-A2** refrigerant oil may be mixed with **ND-8** refrigerant oil in vehicles without an electric A/C compressor.

**To prevent inadmissibly mixing the different refrigerant oil types, rinse the A/C service station hoses after each drawing off/filling procedure!**

## **64 50 612 REMOVING AND INSTALLING/REPLACING HEAT PUMP HEAT EXCHANGER**

### Special tools required:

- [17 2 050](#)
- [32 1 270](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the **HIGH-VOLTAGE SYSTEM** .  
Follow all applicable **SAFETY INFORMATION**.

### Necessary preliminary tasks:

- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Drain [COOLANT](#)
- Clamp off [BATTERY EARTH LEAD](#)

### Recycling

Coolant emerges when coolant lines are detached. Have a suitable collecting vessel ready.

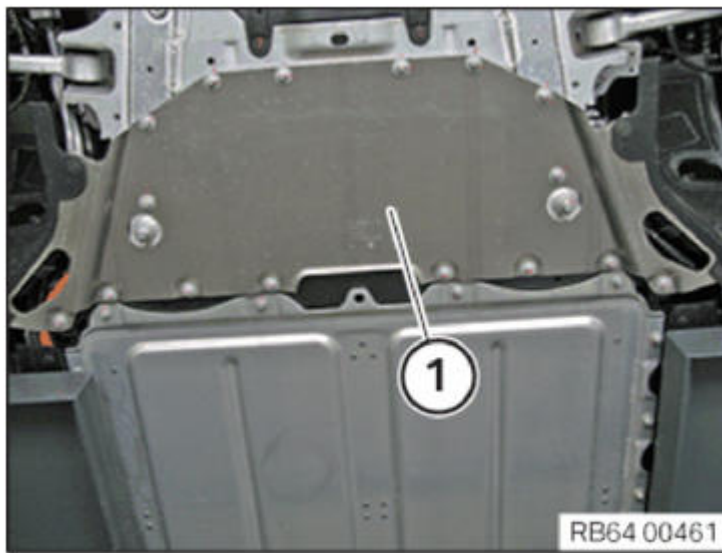
Catch and dispose of escaping coolant.

Observe country-specific waste disposal regulations.

Release all screws on stiffening plate (1).

Remove thrust panel (reinforcement plate) (1).



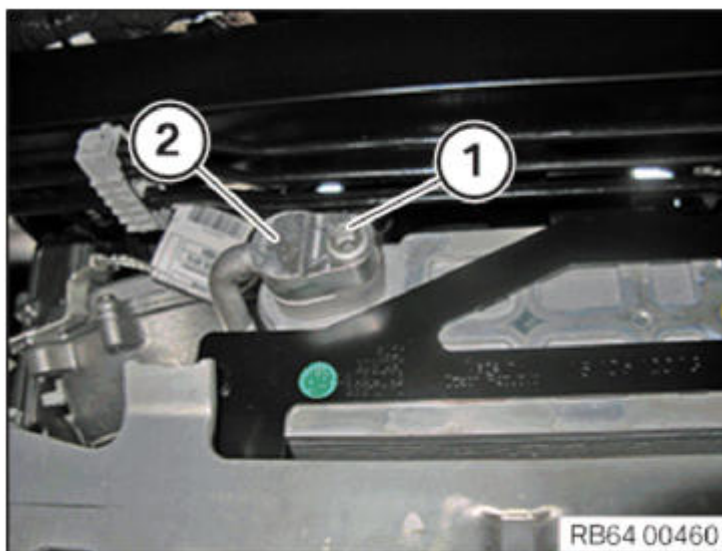


**Fig. 122: Identifying Screws On Stiffening Plate**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque [64 53 9AZ](#) .

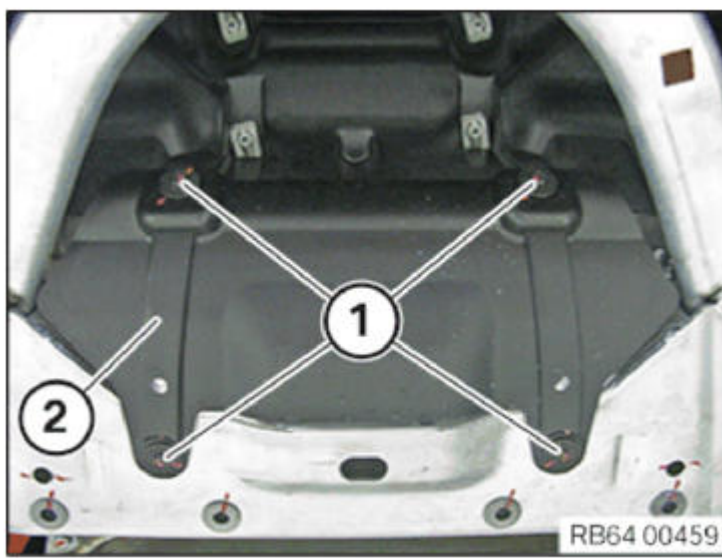
Remove refrigerant line (2).



**Fig. 123: Identifying Refrigerant Line And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Remove cover (2).



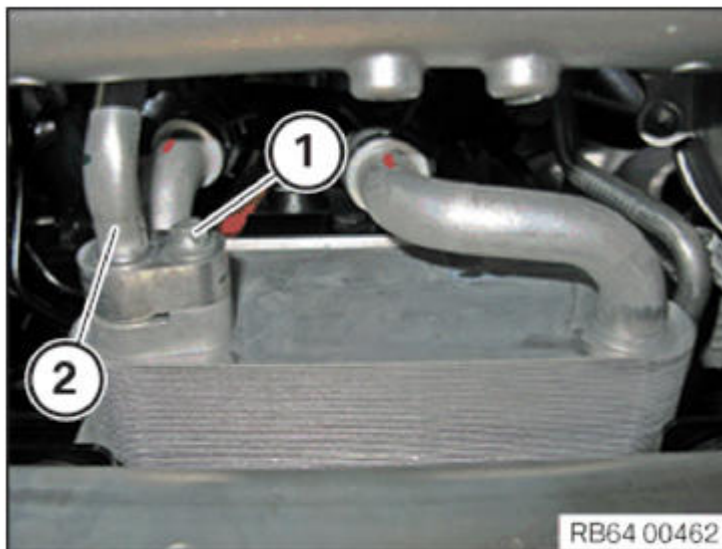
**Fig. 124: Identifying Cover Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque [64 53 9AZ](#) .

Remove refrigerant line (2).

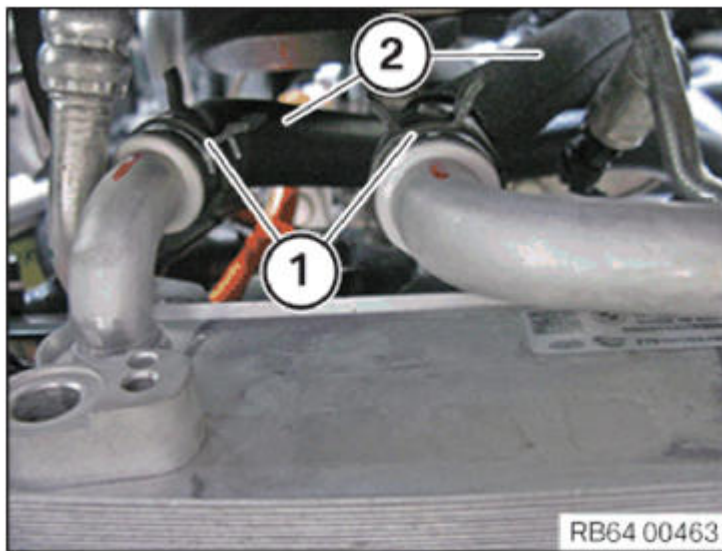


**Fig. 125: Identifying Refrigerant Line And Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

Release hose clamps (1) with special tool [17 2 050](#) .

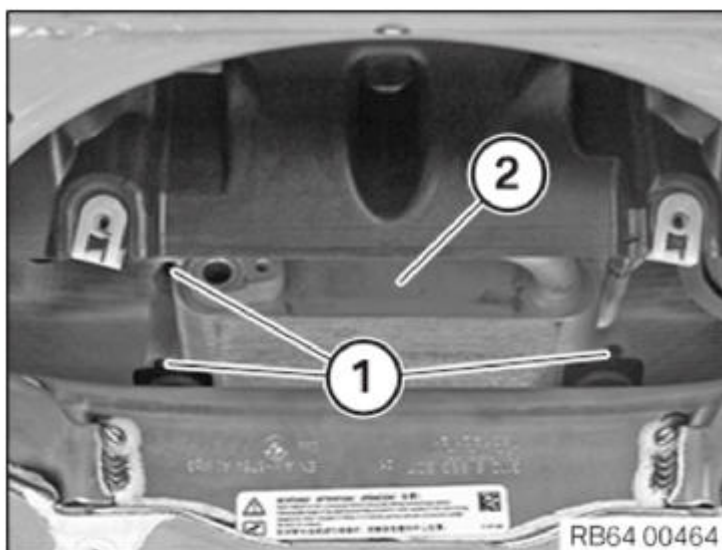
Detach coolant lines (2).



**Fig. 126: Identifying Coolant Lines And Hose Clamps**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unscrew nuts (1).

Take off heat pump heat exchanger (2).



**Fig. 127: Identifying Heat Pump Heat Exchanger And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Bleed and fill [COOLING SYSTEM](#)

IMPORTANT: Filling and bleeding must not be performed in ECO-PRO MODE!

**64 50 771 RINSE THE REFRIGERANT CIRCUIT WITH THE HEAT PUMP**

**Special tools required:**

- [2 286 732](#)
- [2 286 730](#)
- [2 285 575](#)
- [2 286 736](#)

- [2 286 734](#)

**Attention!**

**It is only necessary to flush refrigerant circuit in the following case:**

- For a **mechanical fault in the air conditioning compressor** and the resulting **debris intrusion in the refrigerant circuit**.

**Refrigerant circuit can be flushed in the following cases as needed:**

- If the refrigerant circuit was open for more than 24 h (e.g. after an accident).
- If there are doubts about the correct amount of refrigerant oil in the refrigerant circuit.
- If the refrigerant circuit is contaminated.

**Attention!**

In **I01**, **2 different country-specific refrigerants** and the **refrigerant oil Sanden SP-A2** are used.

**Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!**

**OBSERVE NOTES ON REFRIGERANT AND REFRIGERANT OIL FROM 09/2013 !**

**Refrigerant circuit is always flushed with R134a, regardless of the refrigerant used in the vehicle!**

**Observe operating instructions of the A/C service station!**

Overview A/C service stations (does not apply for USA and Japan)

**Attention!**

Risk of damage!

Only switch on air conditioning again once refrigerant circuit has been properly filled.

**READ AND COMPLY WITH NOTES ON COMPRESSOR REPLACEMENT.**

**FOLLOW INSTRUCTIONS FOR OPENING AND REPLACING PARTS IN REFRIGERANT CIRCUIT .**

**Procedure and preliminary work in the case of a faulty air conditioning compressor:**

1. Drain and clean A/C service station oil reservoir before drawing off oil.
2. Draw off A/C system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
3. Remove air conditioning compressor for Air conditioning
4. Drain refrigerant oil from the faulty air conditioning compressor into a **clean** bucket via the oil drain plug.
5. Complete visual inspection of the drained refrigerant oil from the faulty air conditioning compressor:
  - **no debris in refrigerant oil = do not flush refrigerant circuit**
  - **debris in refrigerant oil = flush refrigerant circuit**

**If no refrigerant oil leaks out of the faulty air conditioning compressor:**

6. Visual inspection of the drained refrigerant oil in the A/C service station oil reservoir:
  - **dark/brown coloring of refrigerant oil = do not flush refrigerant circuit**
  - **black coloring of refrigerant oil = flush refrigerant circuit**

**NOTE:** Refrigerant oil in an intact refrigerant circuit can change color over time. Dark/brown coloring of the refrigerant oil does not automatically indicate an impermissible contamination of the refrigerant circuit.

**If refrigerant circuit does not need to be flushed:**

7. install new air conditioning compressor for Air conditioning
8. Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
9. Delete fault memory

**If refrigerant circuit does need to be flushed:**

7. [REMOVE DRYER FLASK](#)
8. [REMOVE EXPANSION VALVE 3](#)
9. [CONNECTOR OF TEMPERATURE SENSOR 3 \(B398\) NEEDS TO BE PLUGGED IN.](#)

The following parts must be replaced by new parts:

- [AIR CONDITIONING COMPRESSOR](#)
- [DRYER FLASK](#)
- [EXPANSION VALVE 1](#)
- [EXPANSION VALVE 2](#)
- [EXPANSION VALVE 3 FOR HIGH-VOLTAGE BATTERY UNIT](#)

Flushing overview

**AIR CONDITIONING COMPRESSOR FLUSHING OVERVIEW DESCRIPTION**

Flushing	Air conditioning compressor	Refrigerant lines Air conditioning compressor	Dryer flask	Refrigerant lines Dryer flask	expansion valve 1	expansion valve 2 High-voltage battery unit	Expansion valve 3	Flushing
1	removed	with A/C service station Connected High-pressure pipe <a href="#">2 286 732</a> low pressure line <a href="#">2 286 730</a>	removed	together Connected Refrigerant lines 2 x <a href="#">2 286 730</a> Hose <a href="#">2 285 575</a>	fitted (used part)	fitted (used part)	removed, replaced by <a href="#">2 286 736</a>	1
2								2
3								3
4								4
5								5
6								6

**NOTE:** Conversions are required between the following flushing processes:

1. Between flushing 2 and 3
2. Between flushing 4 and 5

No conversions are required between the following flushing processes:

1. Between flushing 1 and 2
2. Between flushing 3 and 4
3. Between flushing 5 and 6

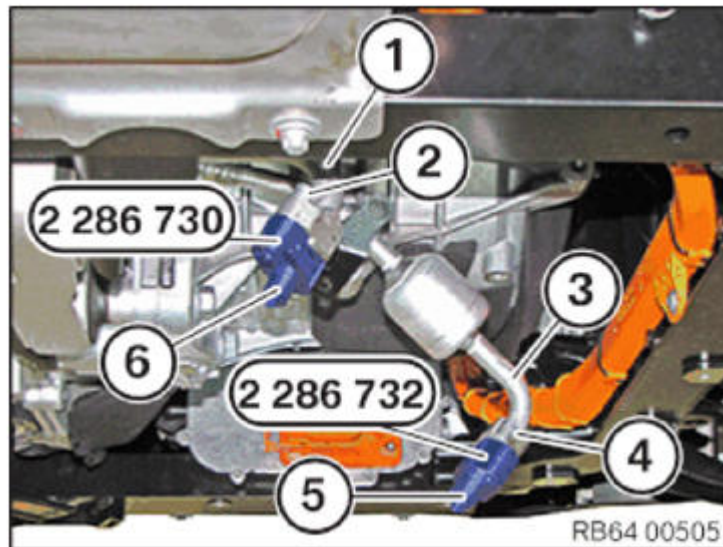


### **Prepare Flushing 1:**

Mount special tool [2 286 732](#) on high pressure line (3) of air conditioning compressor (thinner line) and secure by means of screw (4) located on vehicle.

Mount special tool [2 286 730](#) on low pressure line (1) of air conditioning compressor (thicker line) and secure by means of screw (2) located on vehicle.

Tightening torque [64 52 1AZ](#) .



**Fig. 128: Connecting High Pressure Line Of A/C Service Station To High-Pressure Connection Of Special Tool (2 286 732)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **Connection to the A/C service station:**

Connect high pressure line of A/C service station to high-pressure connection (5) of special tool [2 286 732](#) .

Connect low pressure line of A/C service station to low-pressure connection (6) of special tool [2 286 730](#) .

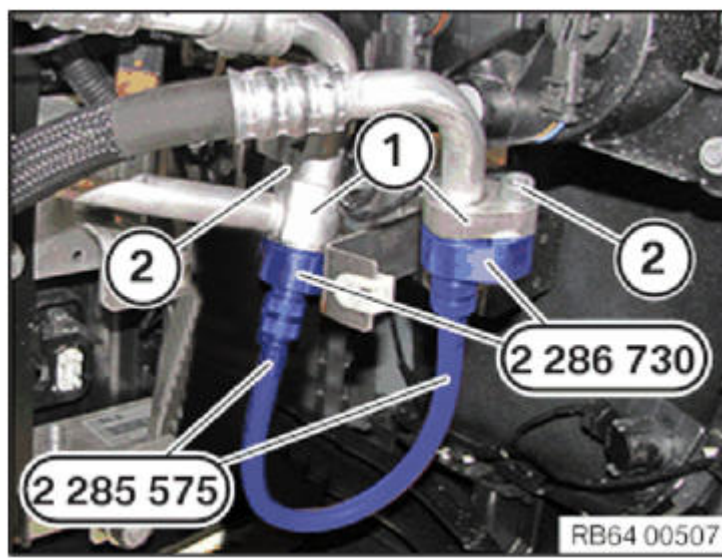
### **Prepare Flushing 1:**

Mount special tool [2 286 730](#) on both refrigerant lines (1) of dryer flask and secure by means of screws (2).

Tightening torque [64 53 8AZ](#) .

Connect special tools [2 286 730](#) by means of special tool [2 285 575](#) .



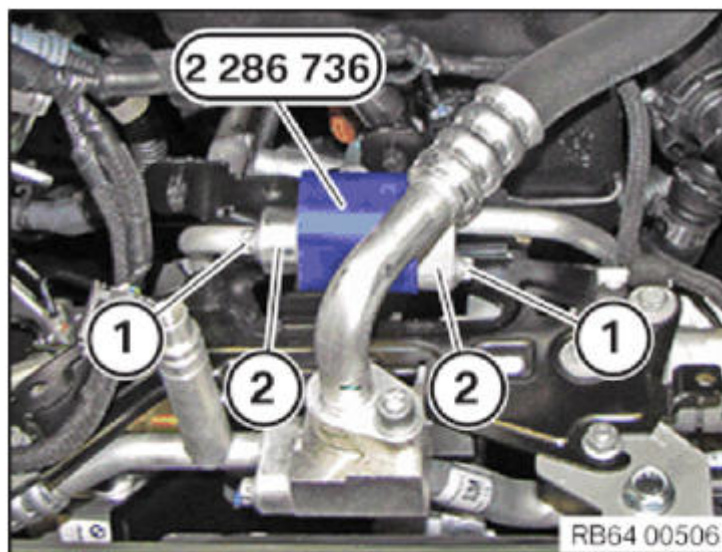


**Fig. 129: Mounting Special Tool (2 286 730) On Both Refrigerant Lines Of Dryer Flask**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Prepare Flushing 1:**

Mount refrigerant lines (2) of expansion valve 3 on special tool [2 286 736](#) and secure by means of screws (1).

Tightening torque [64 53 11AZ](#) .



**Fig. 130: Mounting Refrigerant Lines Of Expansion Valve 3 On Special Tool (2 286 736)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Perform Flushing 1:**

1. Call up procedure:
  - 03 Body
  - Heating and air conditioning functions
  - Flushing refrigerant circuit
2. Start "Flushing 1" test module.
3. Start flushing at the A/C service station.
4. Perform Flushing 1 for at least 30 min.
5. Once Flushing 1 is complete, check whether refrigerant in sight glass on the A/C service station is clean:
  - Refrigerant in sight glass is clean: Change to Flushing 2.
  - Refrigerant in sight glass is not yet clean: Fully repeat Flushing 1.

## Perform Flushing 2:

1. Start "Flushing 2" test module.
2. Start flushing at the A/C service station.
3. Carry out flushing 2 for at least 30 min.
4. Once Flushing 2 is complete, check whether refrigerant in sight glass on the A/C service station is clean:
  - Refrigerant in sight glass is clean: Change to Flushing 3.
  - Refrigerant in sight glass is not yet clean: Fully repeat Flushing 2.

## Prepare flushing 3:

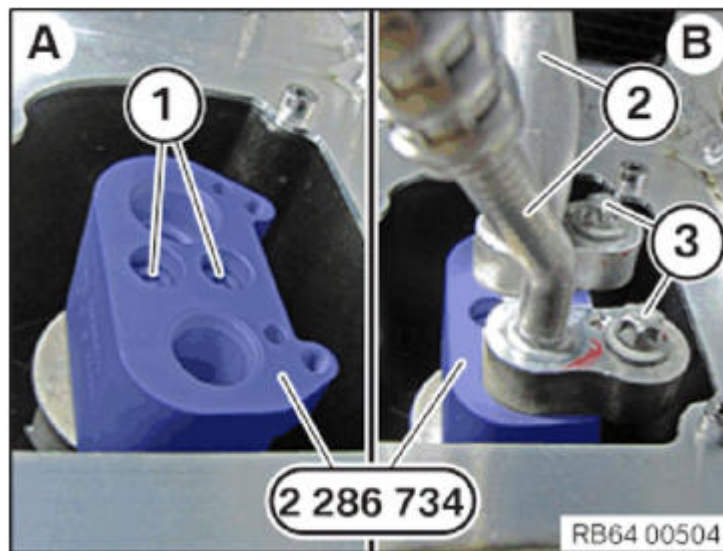
*Necessary preliminary tasks:*

- Remove **EXPANSION VALVE 2 FOR HIGH-VOLTAGE BATTERY UNIT**
- A. Mount special tool **2 286 734** instead of expansion valve 2 as indicated and secure by means of screws (1) of expansion valve 2.

Tightening torque **64 53 7AZ** .

- B. Mount refrigerant line (2) and secure with (3) screws.

Tightening torque **64 53 6AZ** .



**Fig. 131: Identifying Special Tool (2 286 734)**  
Courtesy of BMW OF NORTH AMERICA, INC.

## Carry out flushing 3:

1. Start test module "flushing 3".
2. Start flushing at the A/C service station.
3. Carry out flushing 3 for at least 30 min.
4. Check whether refrigerant in sight glass of A/C service station is clean after flushing 3:
  - Refrigerant in sight glass is clean: Change to Flushing 4.
  - Refrigerant in sight glass is not yet clean: repeat flushing 3 completely.

## Carry out flushing 4:

1. Start test module "flushing 4".
2. Start flushing at the A/C service station.
3. Carry out flushing 4 for at least 30 min.
4. Check whether refrigerant in sight glass of A/C service station is clean after flushing 4:

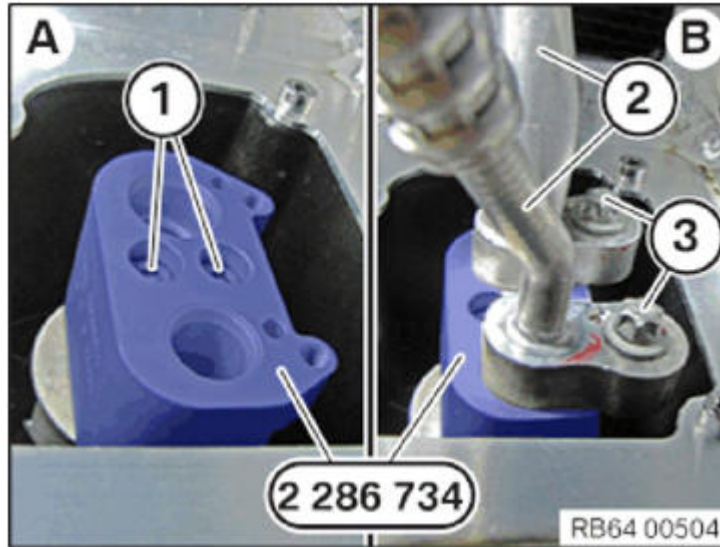
- Refrigerant in sight glass is clean: Change to Flushing 5.
- Refrigerant in sight glass is not yet clean: repeat flushing 4 completely.

### Prepare flushing 5:

B. Release bolts (3). Remove refrigerant lines (2).

A. Release (1) screws. Remove special tool **2 286 734** .

### **INSTALL A NEW EXPANSION VALVE 2 FOR THE HIGH-VOLTAGE BATTERY UNIT.**



**Fig. 132: Identifying Special Tool (2 286 734)**

Courtesy of BMW OF NORTH AMERICA, INC.

### Carry out flushing 5:

1. Start test module "flushing 5".
2. Start flushing at the A/C service station.
3. Carry out flushing 5 for at least 30 min.
4. Check whether refrigerant in sight glass of A/C service station is clean after flushing 5:
  - Refrigerant in sight glass is clean: Change to flushing 6.
  - Refrigerant in sight glass is not yet clean: repeat flushing 5 completely.

### Carry out flushing 6:

1. Start test module "flushing 6".
2. Start flushing at the A/C service station.
3. Carry out flushing 6 for at least 30 min.
4. Check whether refrigerant in sight glass of A/C service station is clean after flushing 6:
  - Refrigerant in sight glass is clean: all flushings are completed.
  - Refrigerant in sight glass is not yet clean: repeat flushing 6 completely.

### Proceed as follows after completion of all flushings:

- Remove all special tools.
- Install new air conditioning compressor for Air conditioning

(If the refrigerant circuit has been flushed, the full amount of refrigerant oil is required when a new air conditioning compressor is installed!)

- Install **NEW DRYER FLASK**

(If refrigerant circuit has been flushed, the full amount of refrigerant oil is required when a new dryer flask is installed!)

- Install **NEW EXPANSION VALVE 1**
- Install **NEW EXPANSION VALVE 3**
- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Delete fault memory

## **AC HOUSING/EVAPORATOR, SWITCHING ELEMENTS**

### **64 51 001 CLEANING EVAPORATOR**

#### **Special tools required:**

- **2 413 653**

**WARNING:** When handling cleaning agent, observe following protective measures:  
Wear protective rubber gloves and protective goggles.  
If cleaning agent comes into contact with eyes or skin, wash immediately with lots of water.  
**OBSERVE NOTES FOR HANDLING CLEANING AGENTS .**

#### **Recycling:**

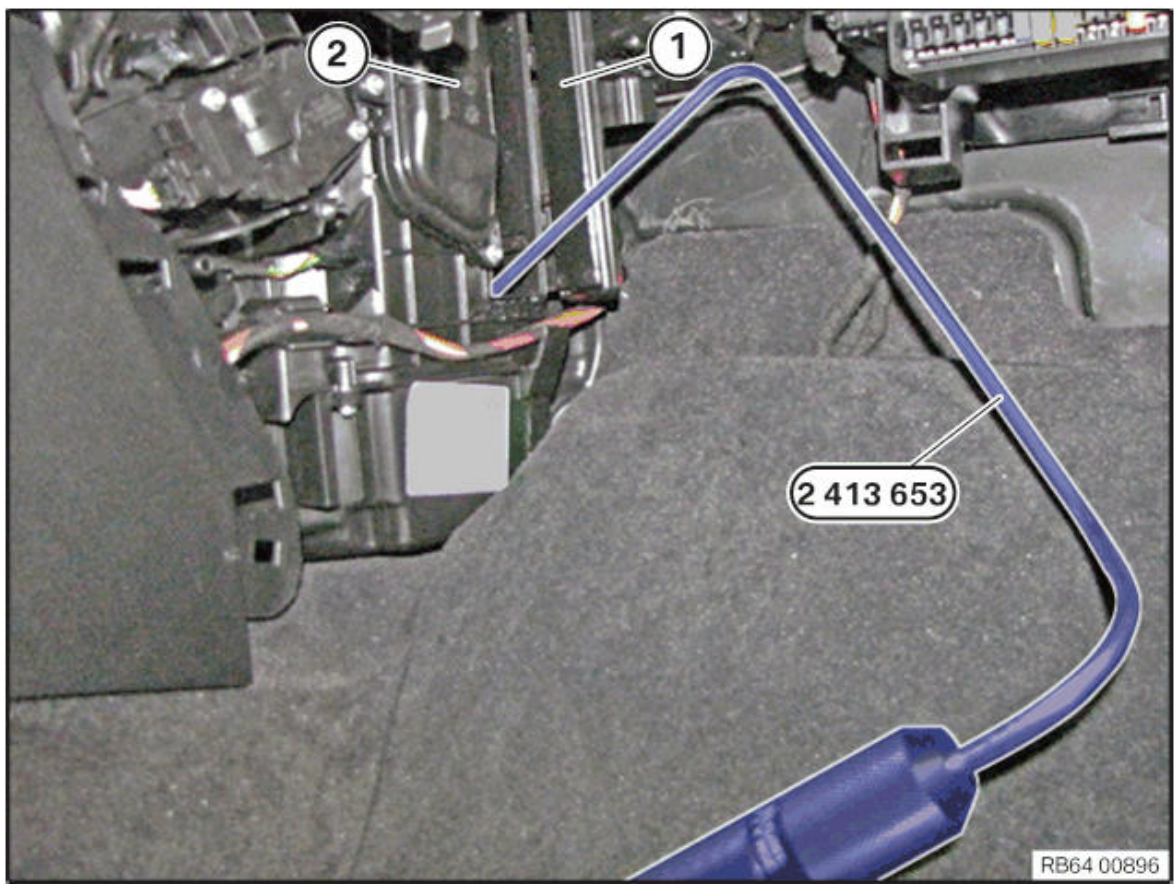
Carry out the cleaning operation in a suitable washing bay as the emerging cleaning agent escapes through the drain openings in the transmission tunnel.

#### **Necessary preliminary tasks:**

#### **To avoid dirtying vehicle interior:**

- Close all the ventilation outlets
- Set air conditioning to air recirculation function
- Cover carpet in work area
- Remove **STIFFENING PLATE**
- Remove **MICROFILTER** for passenger compartment ventilation

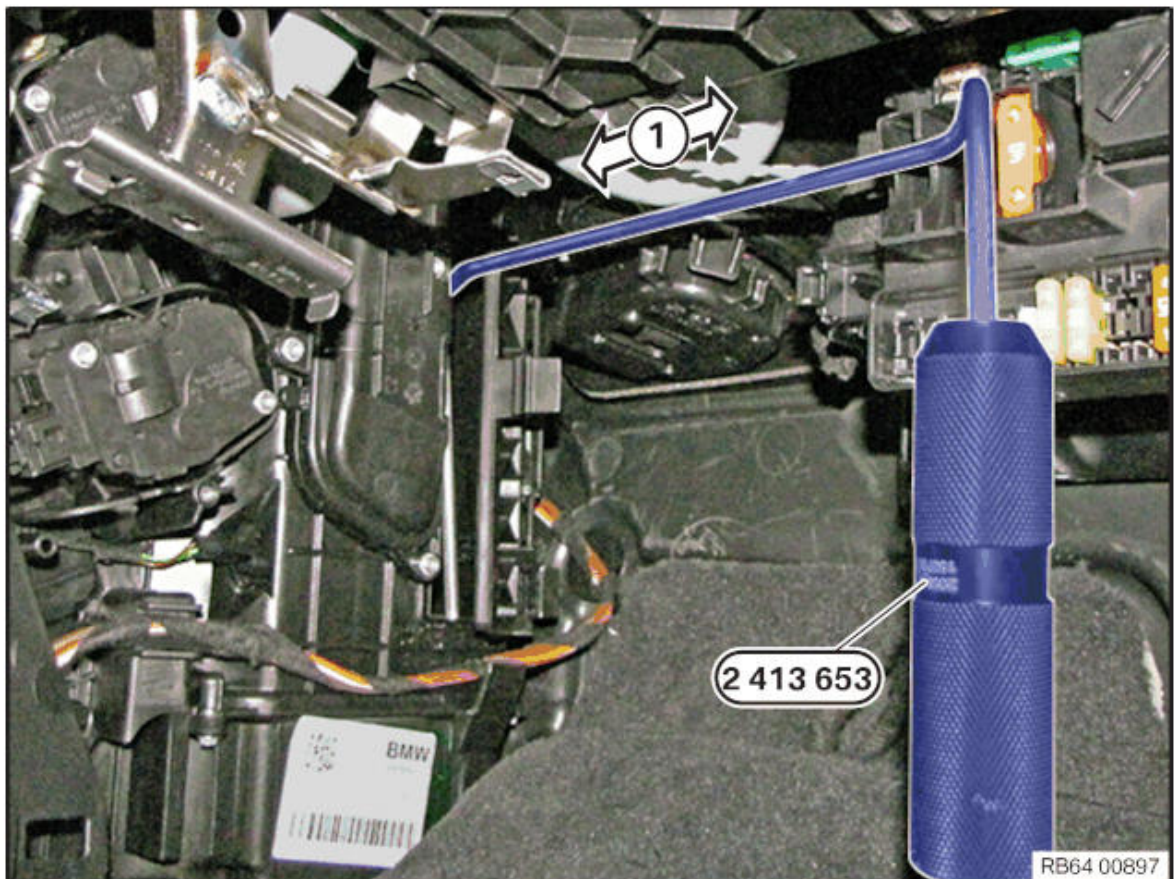




**Fig. 133: Inserting Special Tool (2 413 653) Into Microfilter Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Open flap (1).

Insert special tool [2 413 653](#) into the microfilter housing (2) as shown.



**Fig. 134: Moving Special Tool (2 413 653)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position special tool [2 413 653](#) up against the top right limit position as shown.

Move special tool [2 413 653](#) from right to left (1) to limit position.

Move special tool [2 413 653](#) back and forth until the A/C system cleaner has been completely sprayed.

#### **After termination of the cleaning operation:**

1. Let the vehicle drip off for about 5 minutes.
2. All vehicles: Install microfilter for the interior ventilation.
3. Set air conditioning to footwell ventilation and fresh air mode. Open side windows/doors.
4. Start the vehicle and let the air conditioning run for approx. 5 minutes at maximum blower output.
5. F4x, F5x: Install the rear underbody protection.

Install I01: [STIFFENING PLATE](#) .

6. In order to eliminate last remnants of cleaning agent, repeat steps 3 and 4 before handover to the customer.

### **64 51... PERFORM LEAKAGE TEST FOR EVAPORATOR**

#### **Special tools required:**

- [00 9 030](#)
- 64 5 121
- 64 5 126
- [2 414 889](#)
- 0 496 223

**WARNING:** Comply with the standard national safety regulations on handling nitrogen.  
Ensure that employees are advised of how to handle pressurized vessels and nitrogen gas correctly (danger of asphyxiation). For this purpose, follow the notes and instructions in the technical safety specifications available from the gas supplier.

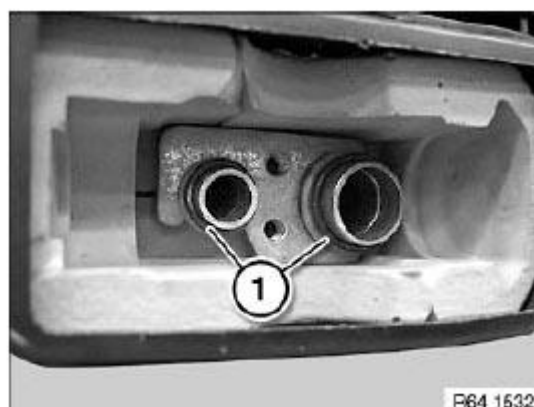
*Necessary preliminary tasks:*

- Remove [EXPANSION VALVE](#)

**NOTE:** Graphic similar.

Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.



**Fig. 135: Identifying Sealing Rings**

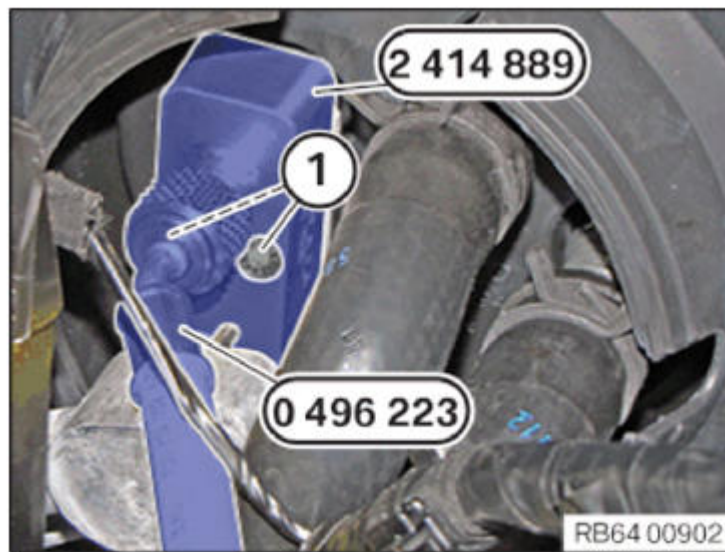
Courtesy of BMW OF NORTH AMERICA, INC.



Use vehicle screws (1) to screw the special tool [2 414 889](#) to the retaining clip of the removed expansion valve.

Tightening torque [64 53 9AZ](#) .

Screw special tool 0 496 223 together with special tool [2 414 889](#) .



**Fig. 136: Screwing Special Tool (0 496 223) With Special Tool (2 414 889)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Risk of damage: Use only nitrogen pressure bottles with pressure reducers for leak-testing.  
**IMPORTANT:** Pressurize evaporator to 10 bar **slowly** only. Excessively fast pressurization and pressures in excess of 20 bar may cause damage to the evaporator.

Connect nitrogen pressure bottle with pressure reducer to pressure gauge and then connect to special tool 0 496 223 (connecting hose).

**NOTE:**

- **Testing device must be leakproof.**
- **Ambient temperature and temperature of vehicle must not change during the test procedure**
- **Do not move the vehicle during this period**

Apply test pressure of **10 bar slowly** and close nitrogen pressure bottle.

Check leak-tightness of testing device and of connection to refrigerant line.

The test pressure is set to 10 bar and must not drop by more than 1.5 bar to 8.5 bar over a test period of 2 hours.

If the pressure loss is greater than 1.5 bar, this indicates that there is a leak in the evaporator unit.

**WARNING:** After the leakage test, **unscrew special tool 0 496 223 slowly from special tool [2 414 889](#) to reduce pressure.**

**After the leakage test:**

- Replace sealing rings. Use special tool [00 9 030](#) to mount sealing rings without damaging them.
- Install [EXPANSION VALVE](#)
- Evacuate and fill air conditioning

**64 51 520 REMOVING AND INSTALLING OR REPLACING EXPANSION VALVE**

**Special tools required:**

- [00 9 030](#)

**IMPORTANT:** In I01, 2 different country-specific refrigerants and a new refrigerant oil are used. Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!  
Always observe the [NOTES](#) on refrigerant and refrigerant oil from 09/2013!

Risk of damage!  
**IMPORTANT:** Only switch on air conditioning again once refrigerant circuit has been properly filled. Follow [NOTES](#) for opening and replacing parts in refrigerant circuit.

**NOTE:** If air conditioning is opened for more than 24 hours:

- Replace [CONDENSER ASSEMBLY](#).

**Necessary preliminary tasks:**

- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Remove [FRONT LUGGAGE COMPARTMENT WELL](#)

Release screws (1).

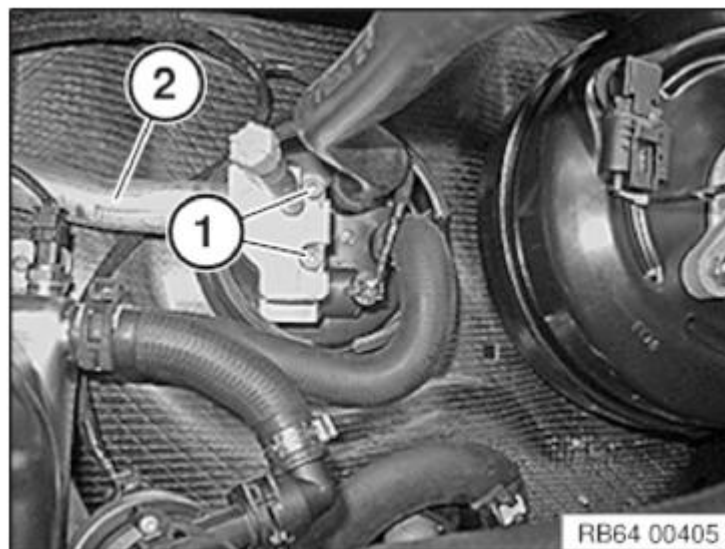
Tightening torque [64 53 1AZ](#) .

Remove refrigerant line (2) and place to one side.

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to install sealing rings without damaging them.



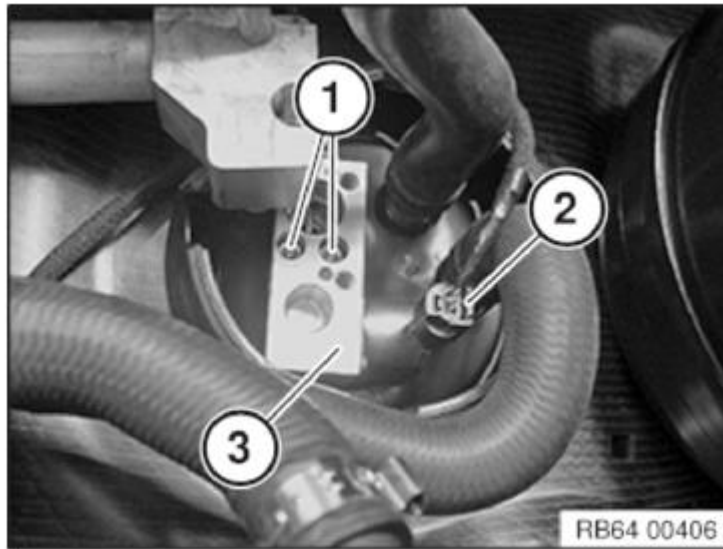
**[Fig. 137: Identifying Refrigerant Line And Screws](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [64 53 2AZ](#) .

Unfasten plug connection (2) and disconnect.

Remove expansion valve (3).

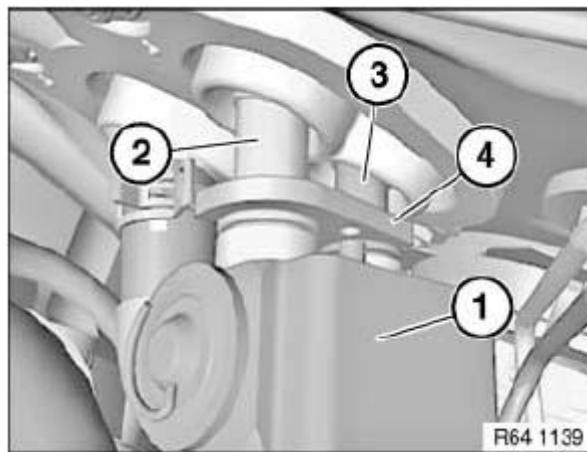


**Fig. 138: Identifying Expansion Valve, Plug Connection And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Place expansion valve (1) exactly on refrigerant lines (2) and (3).

Fit screws of expansion valve (1) and make sure retaining clip (4) is correctly positioned.



**Fig. 139: Identifying Expansion Valve On Refrigerant Lines**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

**64 51 534 REMOVING AND INSTALLING/REPLACING EXPANSION VALVE FOR HEATING AND AIR-CONDITIONING UNIT WITH HEAT PUMP**

**Special tools required:**

- [00 9 030](#)

**IMPORTANT:** In I01, 2 different country-specific refrigerants and a new refrigerant oil are used. Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!  
Always observe the **NOTES** on refrigerant and refrigerant oil from 09/2013!

Risk of damage!

**IMPORTANT:** Only switch on air conditioning again once refrigerant circuit has been properly filled.  
Follow **NOTES** for opening and replacing parts in refrigerant circuit.

**NOTE:** If air conditioning is opened for more than 24 hours:

- Replace **CONDENSER ASSEMBLY**.

**Necessary preliminary tasks:**

- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Remove **FRONT LUGGAGE COMPARTMENT WELL**

Unlock plug connections (1) and disconnect.

Unclip connector (2).

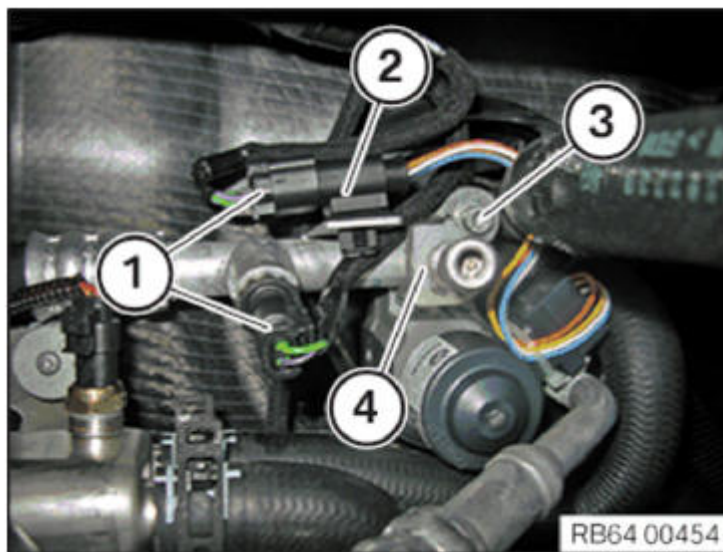
Release screw (3).

Tightening torque **64 53 1AZ** .

Remove refrigerant line (4) and place to one side.

*Installation note:*

Replace sealing rings.



**Fig. 140: Identifying Refrigerant Line, Plug Connections And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Use special tool **00 9 030** to install sealing rings without damaging them.

Release screw (1).

Tightening torque **64 53 1AZ** .

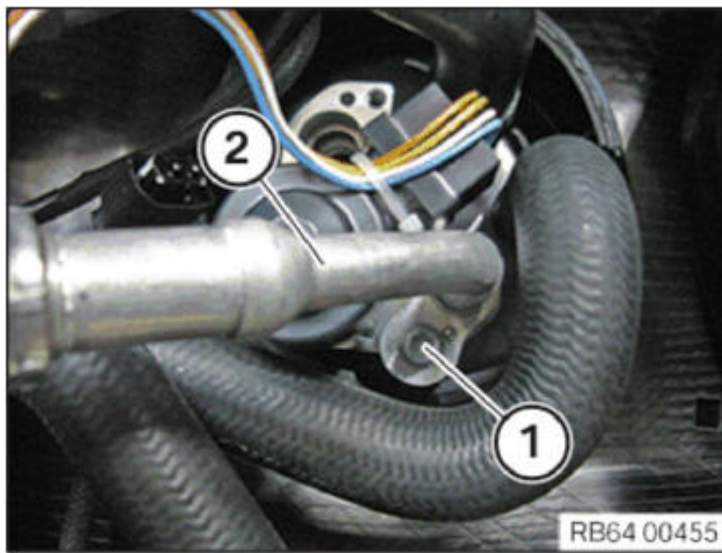
Remove refrigerant line (2) and place to one side.

*Installation note:*

Replace sealing rings.

Use special tool **00 9 030** to mount sealing rings without damaging them.



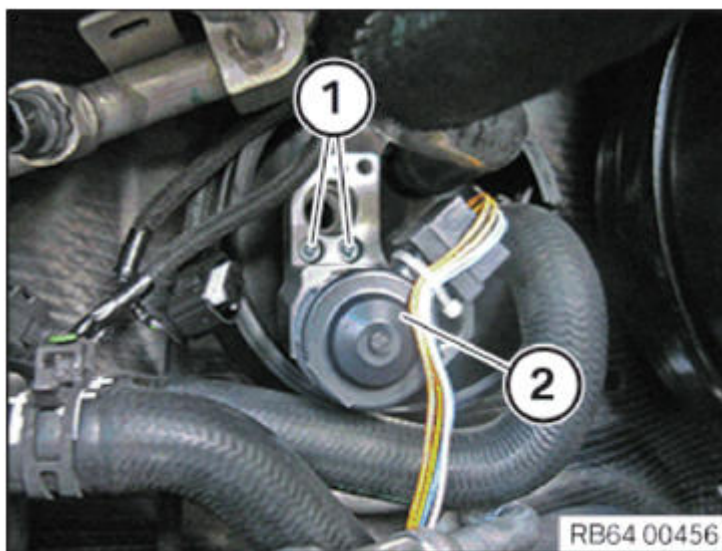


**Fig. 141: Identifying Refrigerant Line And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [64 53 2AZ](#) .

Remove expansion valve (2).

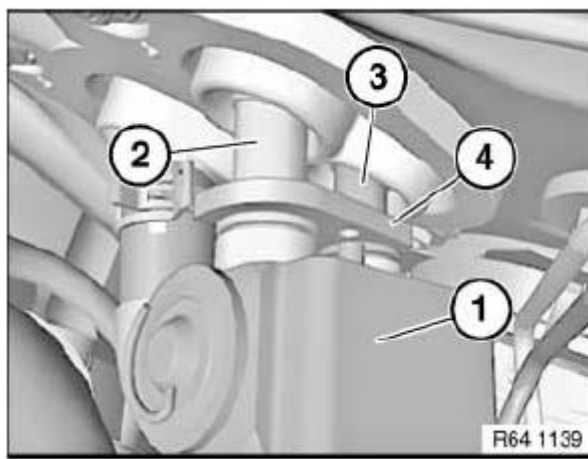


**Fig. 142: Identifying Expansion Valve And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Place expansion valve (1) exactly on refrigerant lines (2) and (3).

Fit screws of expansion valve (1) and make sure retaining clip (4) is correctly positioned.



**Fig. 143: Identifying Expansion Valve On Refrigerant Lines**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

**64 51 533 REMOVING AND INSTALLING/REPLACING EXPANSION VALVE FOR HIGH-VOLTAGE BATTERY UNIT**

**Special tools required:**

- [00 9 030](#)
- [2 298 505](#)

**IMPORTANT:** In I01, 2 different country-specific refrigerants and a new refrigerant oil are used. **Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!**  
 Always observe the [NOTES](#) on refrigerant and refrigerant oil from 09/2013!

**IMPORTANT:** **Risk of damage!** Only switch on heating and air conditioning system again once refrigerant circuit has been properly filled.  
 Follow [NOTES](#) for opening and replacing parts in refrigerant circuit.

**NOTE:** If air conditioning system is opened for more than 24 hours:

- Replace [CONDENSER ASSEMBLY](#).

**Necessary preliminary tasks:**

- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

Versions with and without heat pump are described separately.

**Version without heat pump:**

Unlock and detach plug connections (1 and 3).

Unfasten screws (2).

Tightening torque [64 53 6AZ](#) .

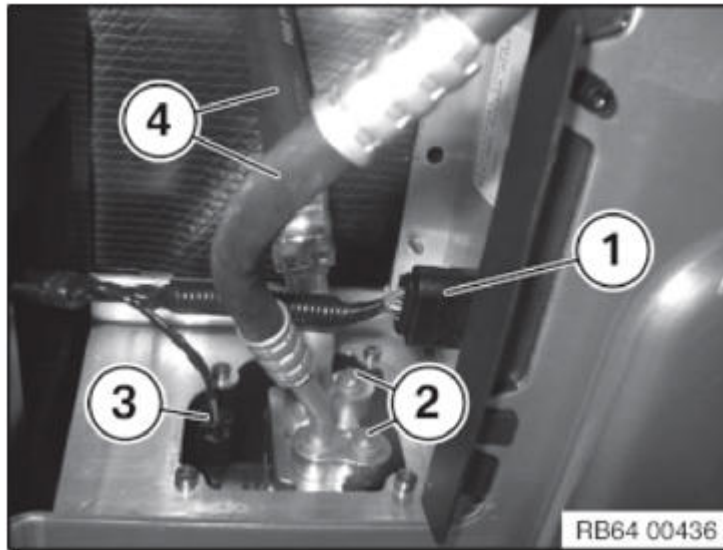


Remove refrigerant lines (4).

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to install sealing rings without damaging them.



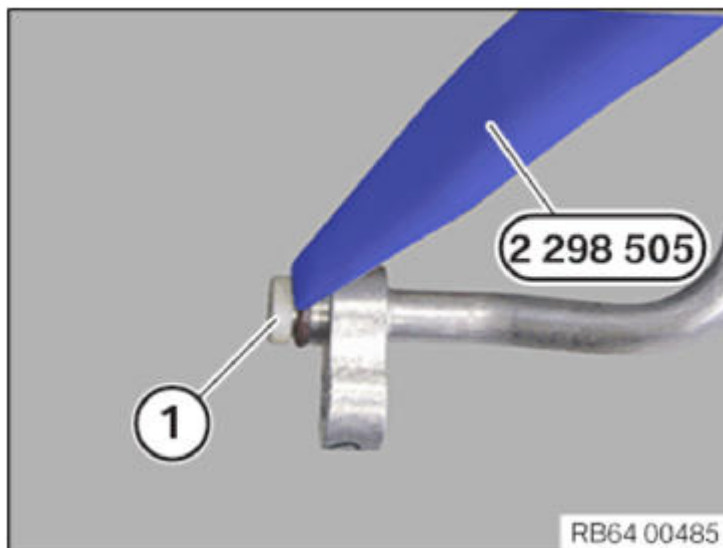
**Fig. 144: Identifying Refrigerant Lines, Plug Connections And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with guide sleeve:**

*Installation note:*

Replace guide sleeve.

Take off guide sleeve (1) with special tool [2 298 505](#) .



**Fig. 145: Identifying Guide Sleeve With Special Tool (2 298 505)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

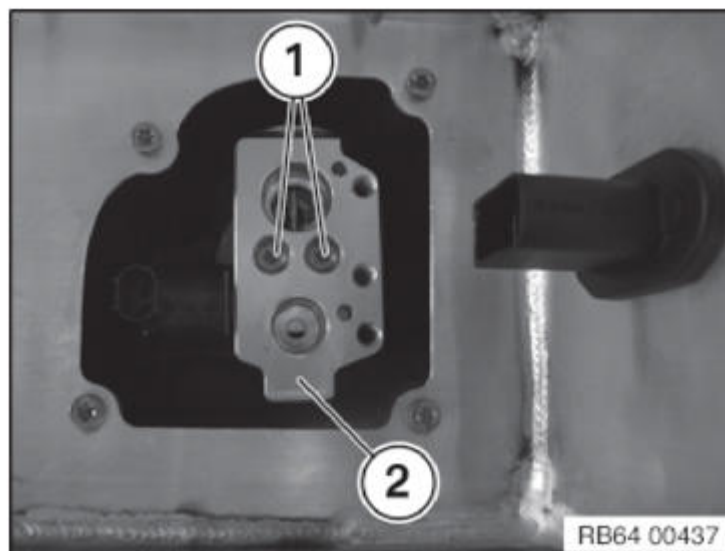
Tightening torque [64 53 7AZ](#) .

Remove expansion valve (2) towards front.

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.



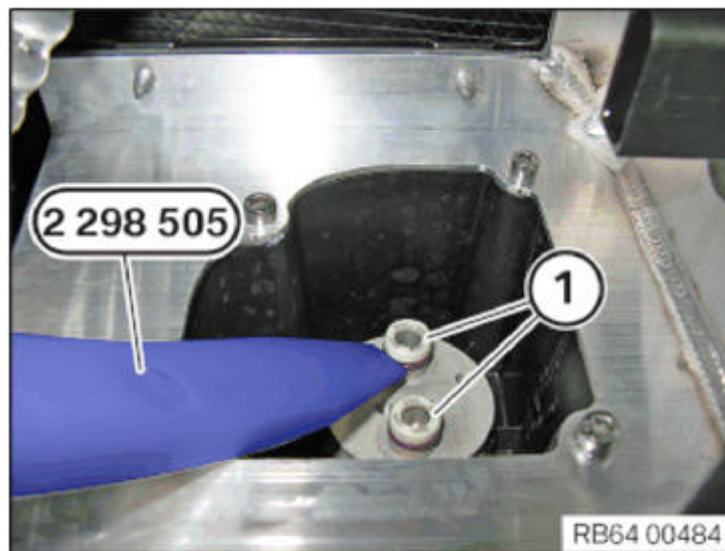
**Fig. 146: Identifying Expansion Valve And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with guide sleeve:**

*Installation note:*

Replace guide sleeves.

Take off guide sleeves (1) with special tool [2 298 505](#).



**Fig. 147: Identifying Guide Sleeves With Special Tool (2 298 505)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with heat pump:**

Unlock and detach plug connections (1 and 3).

Unfasten screws (2).

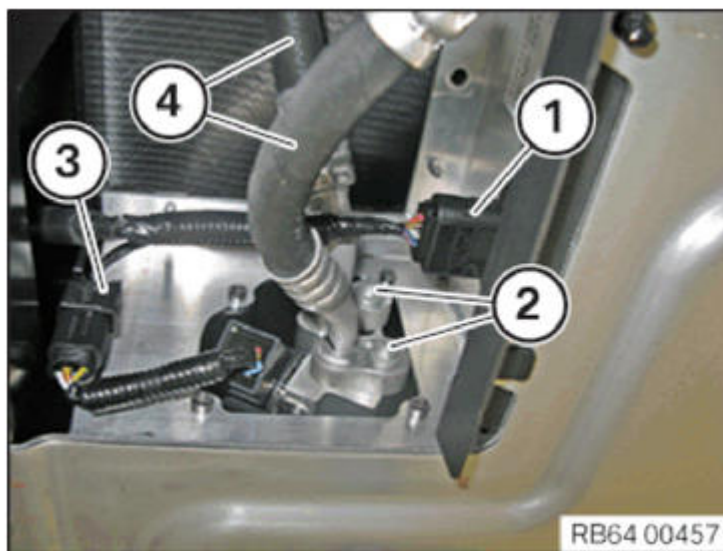
Tightening torque [64 53 6AZ](#).

Remove refrigerant lines (4).

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.



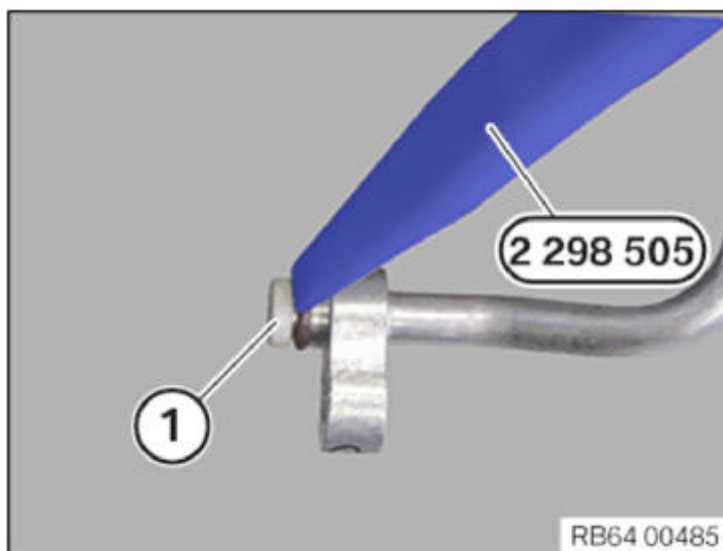
**Fig. 148: Identifying Refrigerant Lines, Plug Connections And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version with guide sleeve:**

*Installation note:*

Replace guide sleeve.

Take off guide sleeve (1) with special tool [2 298 505](#) .



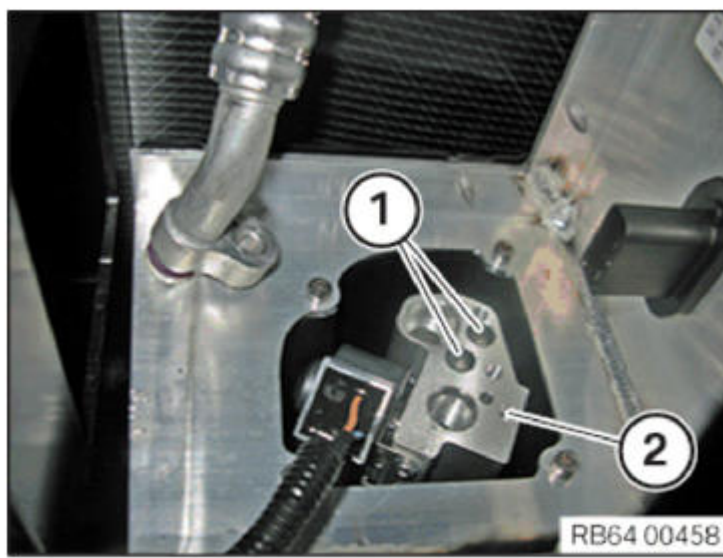
**Fig. 149: Identifying Guide Sleeve With Special Tool (2 298 505)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [64 53 7AZ](#) .

Remove expansion valve (2) towards front.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.



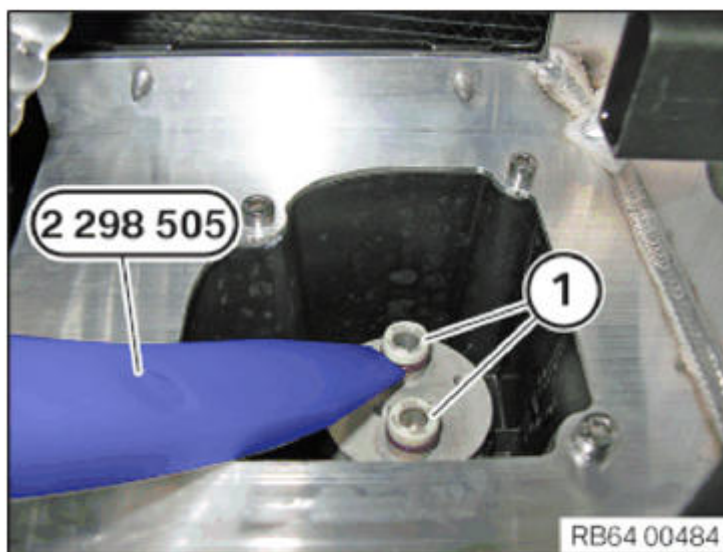
**Fig. 150: Identifying Expansion Valve And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Version with guide sleeve:**

*Installation note:*

Replace guide sleeves.

Take off guide sleeves (1) with special tool [2 298 505](#).



**Fig. 151: Identifying Guide Sleeves With Special Tool (2 298 505)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

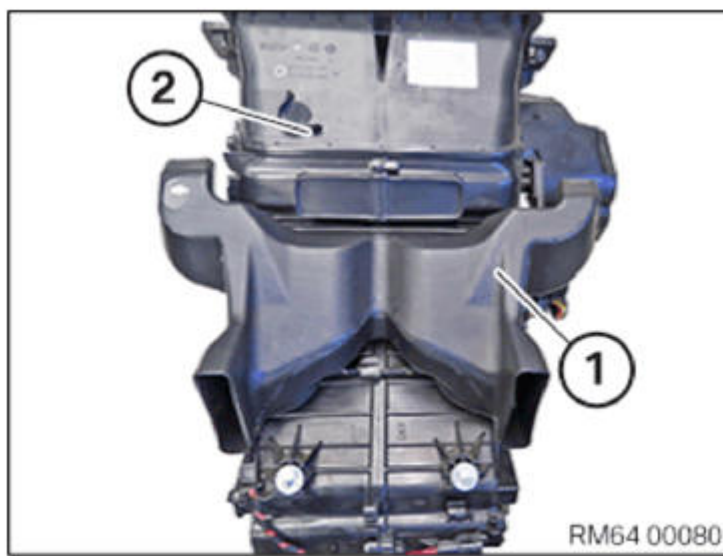
### **64 51 598 REPLACING EVAPORATOR**

**Necessary preliminary tasks:**

- Remove [HEATER/AIR CONDITIONER](#)

**REMOVAL:**

Disengage and remove air duct (1) from heating and air-conditioning unit (2).

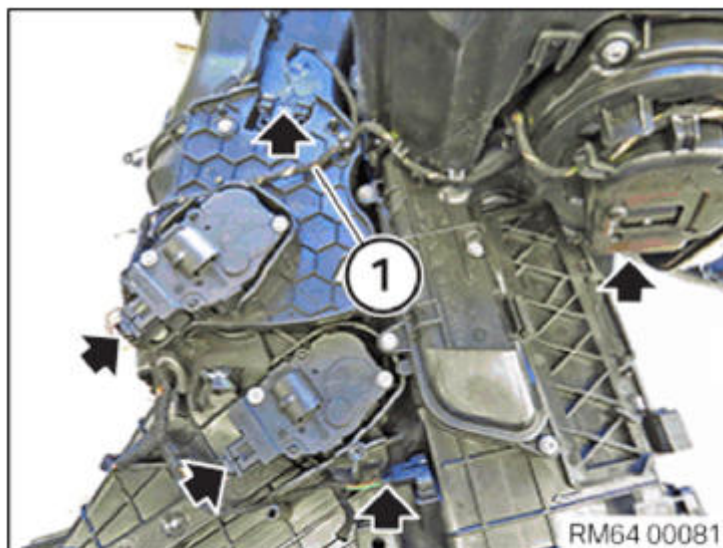


**Fig. 152: Identifying Air Duct**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect connector at marked points.

Feed out wiring harness (1).



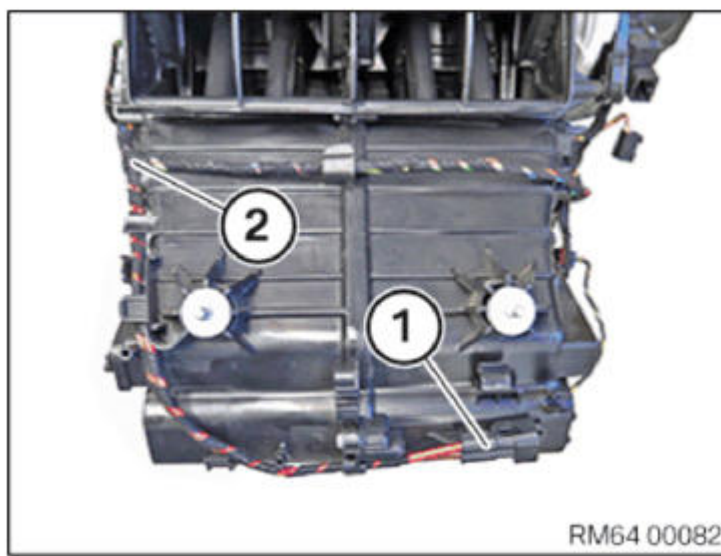
**Fig. 153: Locating Wiring Harness Connector Marked Points**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and remove connector housing (1).

Feed out wiring harness (2).

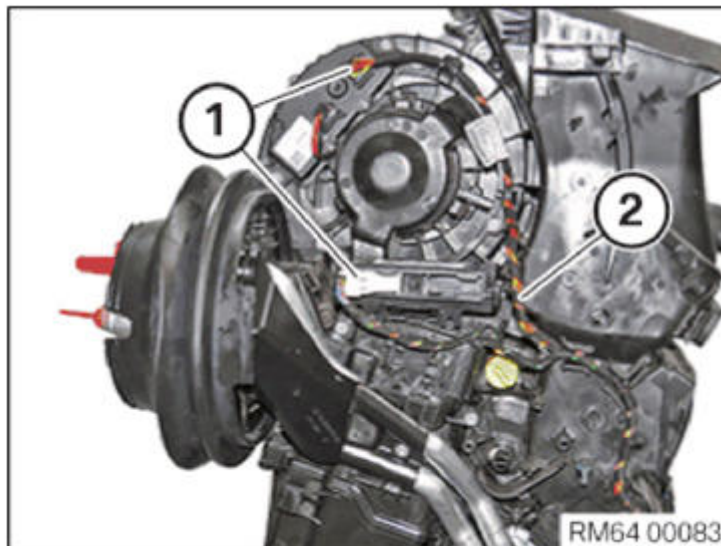




**Fig. 154: Identifying Wiring Harness And Connector Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect the connector (1).

Feed out and remove wiring harness (2).



**Fig. 155: Identifying Wiring Harness And Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

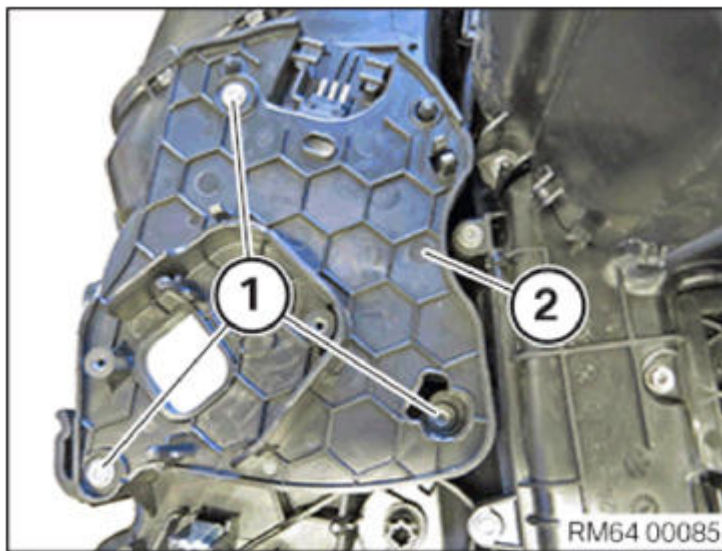
**On version with central kinematics:**

Remove **CONTROLLER DRIVE FOR FOOTWELL FLAP, RIGHT.**

Release screws (1).

Remove central kinematics (2).

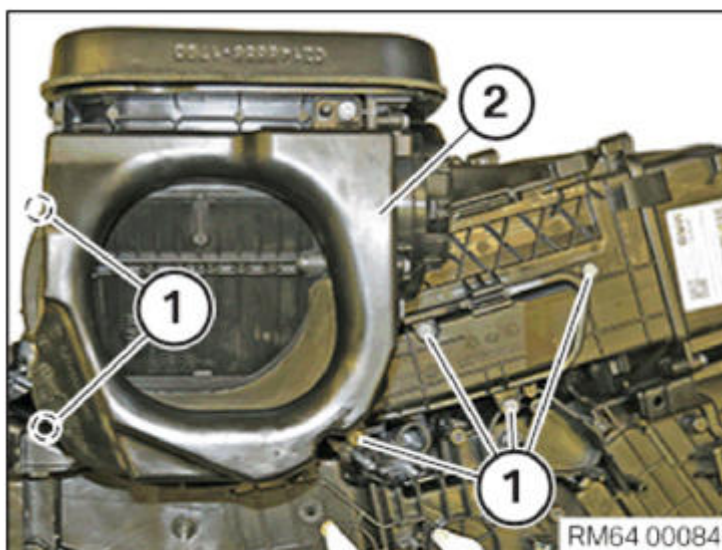




**Fig. 156: Identifying Central Kinematics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Remove housing fresh air/air recirculation (2).

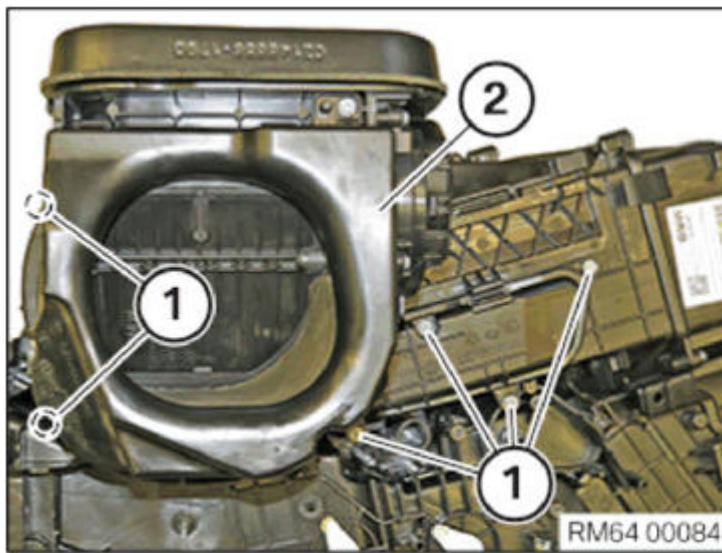


**Fig. 157: Identifying Housing Fresh Air/Air Recirculation And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**INSTALLATION:**

Properly position housing fresh air/air recirculation (2).

Tighten down screws (1).



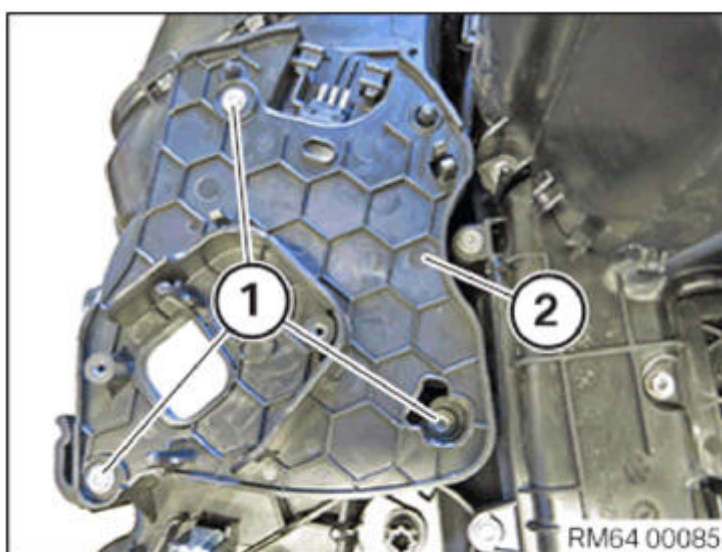
**Fig. 158: Identifying Housing Fresh Air/Air Recirculation And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**On version with central kinematics:**

Remove **CONTROLLER DRIVE FOR FOOTWELL FLAP, RIGHT.**

Position central kinematics (2).

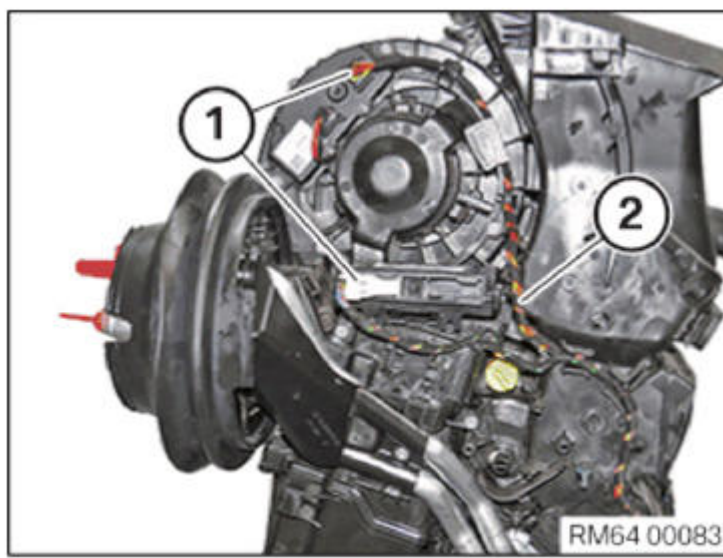
Tighten down screws (1).



**Fig. 159: Identifying Central Kinematics And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Feed in wiring harness (2) properly.

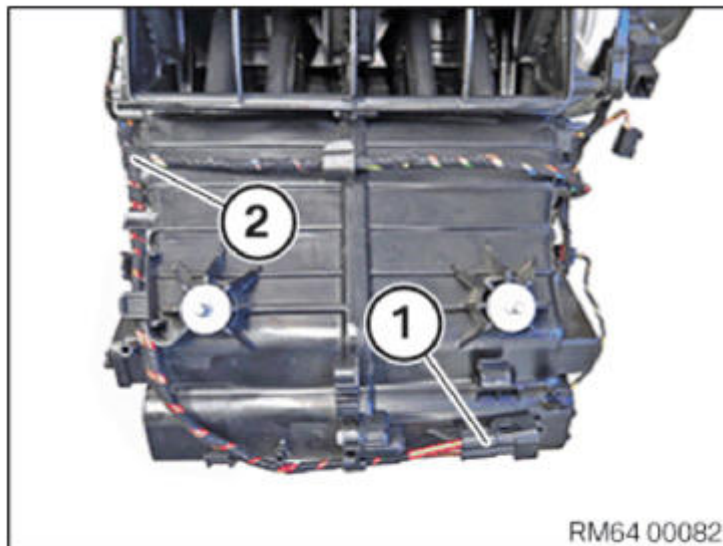
Connect and lock the connector (1).



**Fig. 160: Identifying Wiring Harness And Connector**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position and feed in the wiring harness (2) properly.

Position and lock plug connection (1) properly.

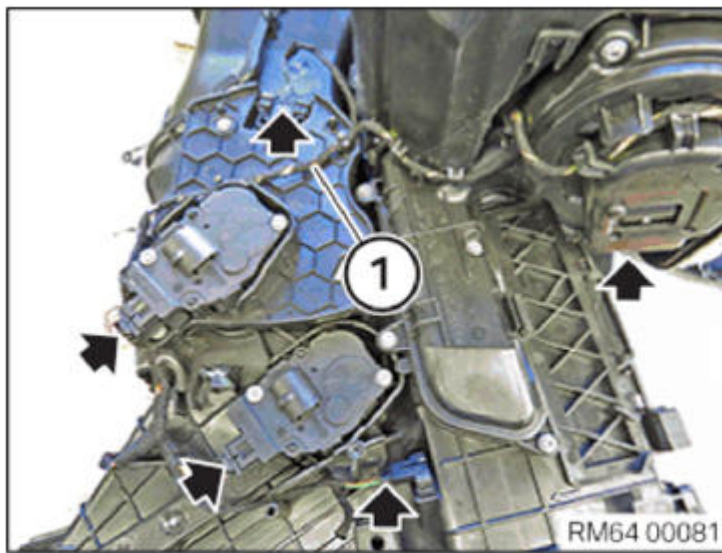


**Fig. 161: Identifying Wiring Harness And Connector Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

Position and feed in the wiring harness (1) properly.

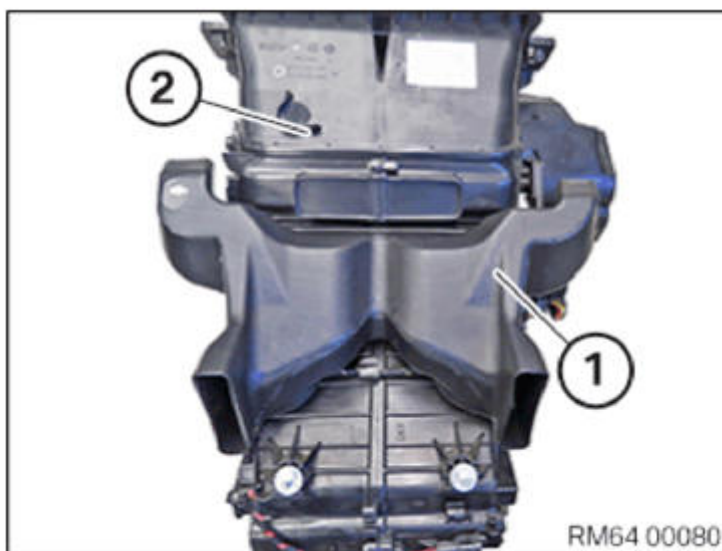
Connect connector at the marked points.





**Fig. 162: Locating Wiring Harness Connector Marked Points**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Position and engage air duct (1) properly at heating and air-conditioning unit (2).



**Fig. 163: Identifying Air Duct**  
 Courtesy of BMW OF NORTH AMERICA, INC.

The following components need to be remounted:

- **RADIATOR**
- **BLOWER**
- **MICROFILTER**
- **HEATING AND AIR CONDITIONING SYSTEM CONTROL UNIT**
- All controller drives
- **EVAPORATOR TEMPERATURE SENSOR**

**Required reworking:**

- Install **HEATING AND AIR-CONDITIONING UNIT**

## **COMPRESSOR**

**61 25 900 DISCONNECT HIGH-VOLTAGE SYSTEM FROM POWER**

**WARNING:** High-voltage system - danger to life!

**WARNING:** The following points must be strictly observed prior to starting work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

Stick to the procedure absolutely.

- IMPORTANT:
1. Disconnect any connected high-voltage charging cable.
  2. Open engine compartment lid
  3. Switch off ignition
  4. Before disconnecting the high-voltage safety connector, ensure that the vehicle is in "sleep" state.

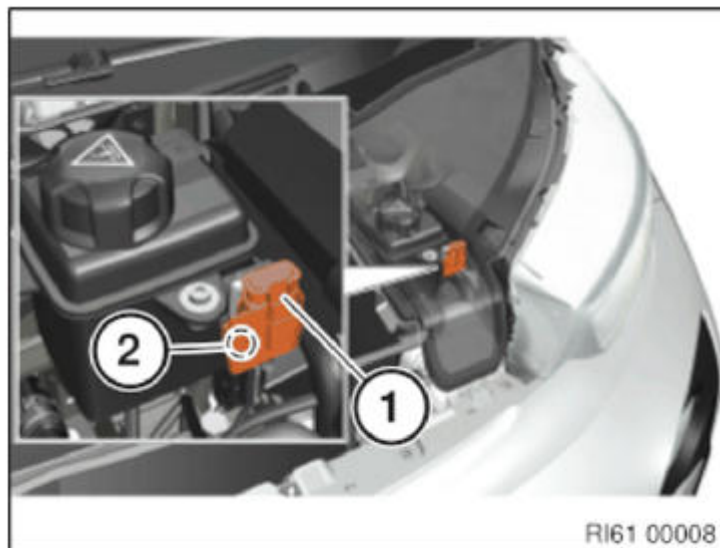
Comply with procedure for return to service!

- IMPORTANT:
1. If connected, disconnect 12V charger
  2. Remove shackle lock
  3. Connect high-voltage safety connector
  4. Perform double terminal change (operate START-STOP button 4 times with a 1-second between each operation)

### **Disconnect high-voltage system from power:**

IMPORTANT: The high-voltage safety connector cannot be fully disconnected.

Unlock high-voltage safety connector (1) and pull out until bore holes (2) on connector and bushing are fully exposed. The labelling "OFF" is visible on the high-voltage safety connector.



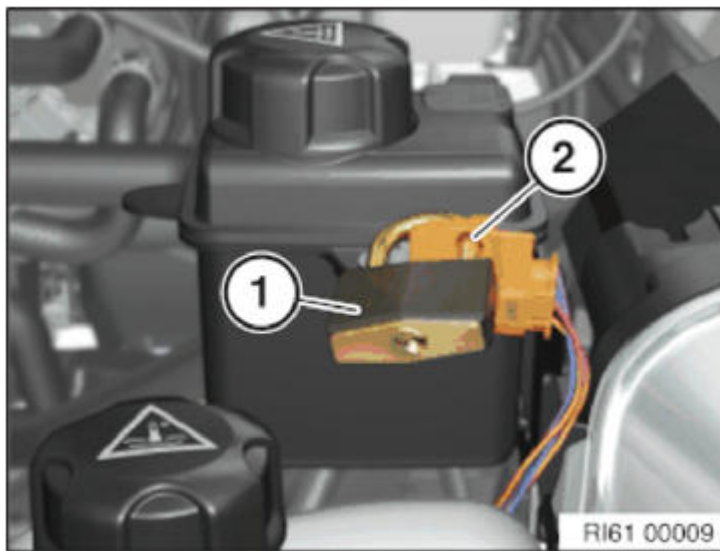
**Fig. 164: Identifying High-Voltage Safety Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

### **Secure high-voltage system against being switched back on:**

Insert and lock shackle lock (1) in exposed bore hole (2) of high-voltage safety connector (2).

IMPORTANT: Store shackle lock key in a safe place.



**Fig. 165: Identifying Shackle Lock And High-Voltage Safety Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

Determine voltage free status:

**WARNING:** Mandatory steps prior to carrying out further repair work:

- Activate ignition and check that there is zero voltage in the instrument cluster. Check Control message "High-voltage system deactivated" must be displayed.
- Pay attention to active high-voltage warnings (indicator light, check control, etc.), determine cause and correct problem.
- The **12V BATTERY MAY BE DISCONNECTED** only when Check Control Message "high-voltage system switched off" is displayed in the instrument cluster.



**Fig. 166: Screen Display - Check Control Message High-Voltage System Deactivated**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** With the ignition off and the high-voltage safety connector disconnected, the Check Control message "Hybrid system faulty" is displayed as standard. Zero voltage (high-voltage system switched-off) is only displayed with the ignition on.

**WARNING:** Danger to life!  
If it cannot be established beyond doubt that the instrument cluster is de-



energized, work is not permitted to begin. **Danger to life!**  
Before work begins, a qualified, certified electrician must verify that the system has been disconnected from the power supply (1000 V DC) using appropriate measuring devices and measuring procedures.  
=> In this case, Technical Support must be contacted! Furthermore, the vehicle must be made inaccessible and blocked off with barrier tapes!

## 64 52... INSTRUCTIONS FOR OPENING AND PART REPLACEMENT IN REFRIGERANT CIRCUIT

Special tools required:

- [00 9 030](#)
- [32 1 270](#)

### **WARNING:**

- Follow all applicable [SAFETY INFORMATION](#).

### Attention!

- Always use new O-rings each time A/C connections are opened

They must **not** be coated.

Use special tool [00 9 030](#) to install sealing rings without damaging them.

- Open the refrigerant circuit for as short of a period as possible.
- Close all components and lines in the refrigerant circuit and return parts **immediately** following the removals at openings with special tool [32 1 270](#) to prevent penetration of moisture or foreign objects.
- If the refrigerant circuit was closed at the openings with special tool [32 1 270](#) but it remains open for more than 24 h, the dryer insert for the air conditioning must be replaced.

### I. Part replacement as preliminary work for further repair work and part replacement based on gradual leakage.

(minor leak, e.g. hairline crack)

*Procedure:*

- Draw off [HEATING AND AIR CONDITIONING SYSTEM](#), then determine drawn-off amount of refrigerant oil
- Carry out part replacement
- Replace removed refrigerant oil and additionally top up with new refrigerant oil according to components replaced:
  - Compressor: refer to [NOTES ON COMPRESSOR REPLACEMENT](#)
  - Evaporator: 10 ml
  - Capacitor: 20 ml
  - Desiccant insert/dryer flask: 20 ml
  - Each replaced refrigerant line: 10 ml
  - Condenser with integrated dryer flask: 40 ml
  - Safety pressure switch and gasket: no additional refrigerant oil
  - Only I01: Radiator, high-voltage battery unit: 20 ml
- [EVACUATE AND FILL AIR CONDITIONING SYSTEM](#)

### II. Part replacement due to sudden leakage

(major leak, e.g. pipe break due to accident)

*Procedure:*

- Draw off **HEATING AND AIR CONDITIONING SYSTEM**, then determine drawn-off amount of refrigerant oil
- Carry out part replacement
- Replace removed refrigerant oil and additionally top up with new refrigerant oil according to components replaced:
  - Compressor: refer to **NOTES ON COMPRESSOR REPLACEMENT**
  - Evaporator: 35 ml
  - Capacitor: 35 ml
  - Desiccant insert/dryer flask: 55 ml
  - Each replaced refrigerant line: 35 ml
  - Condenser with integrated dryer flask: 55 ml
  - Safety pressure switch and gasket: no additional refrigerant oil
  - Only I01: Radiator, high-voltage battery unit: 35 ml
- **EVACUATE AND FILL A/C SYSTEM**

**64 52... NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR (AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR KNOWN)**

**Special tools required:**

- **00 9 030**

**NOTE:** This procedure only applies if the new air conditioning compressor has a label with the amount of refrigerant oil. A **DIFFERENT PROCEDURE** applies for air conditioning compressors without a label indicating the amount of refrigerant oil.

**Risk of damage!**

**Remove the air conditioning compressor without damaging and without the use of force!**

**Air conditioning compressors with plastic belt pulleys:**

**IMPORTANT:**

- Avoid impacts/knocks to plastic belt pulley (caused by tools, contact with base).
- Return faulty air conditioning compressors in their original packaging only and with sealed connected branches.

**When starting up a new air conditioning compressor for the first time, it is absolutely essential to carry out the following breaking-in procedure:**

- Switch on Air conditioning system
- Set all air vents in the dashboard to "OPEN"

**IMPORTANT:**

- Start engine and let it stabilize at idle speed
- Set blower output to min. 75% of max. blower output
- Switch on air conditioning and run for at least 2 minutes at **idle speed**

**Risk of damage at increased engine speed!**

**IMPORTANT:** In the event of a mechanical air conditioning compressor failure and the resulting ingress of chips into the refrigerant circuit, replace the following parts:  
**All vehicles except I01:**

- air conditioning compressor
- Replace desiccant insert

- Line to the capacitor
- Refrigerant oil

**Only I01:**

- air conditioning compressor
- Capacitor with desiccant insert/dryer flask. See REMOVE/INSTALL/REPLACE CAPACITOR (WITH DESICCANT INSERT, FOR VEHICLES WITHOUT HEAT PUMP) or REMOVING/INSTALLING/REPLACING DRYER FLASK FOR AIR CONDITIONING (VEHICLES EQUIPPED WITH HEAT PUMP).
- All expansion valves. Rinse the refrigerant circuit. See FLUSHING REFRIGERANT CIRCUIT (WITHOUT HEAT PUMP) or RINSE THE REFRIGERANT CIRCUIT WITH THE HEAT PUMP.

**All vehicles without I01 with heat pump:**

The new air conditioning compressor is filled at the factory with refrigerant oil.

The amount of refrigerant oil in the new air conditioning compressor corresponds to the amount of refrigerant oil for the **entire new and unfilled** refrigerant circuit.

**Only I01 with heat pump:**

**The new air conditioning compressor and new dryer flask** are filled at the factory with refrigerant oil.

The amount of refrigerant oil in the new air conditioning compressor and in the new dryer flask corresponds to the amount of refrigerant oil for the **entire new and unfilled** refrigerant circuit.

**When replacing the air conditioning compressor it is absolutely essential to adapt the amount of refrigerant oil in accordance with the instructions below!**

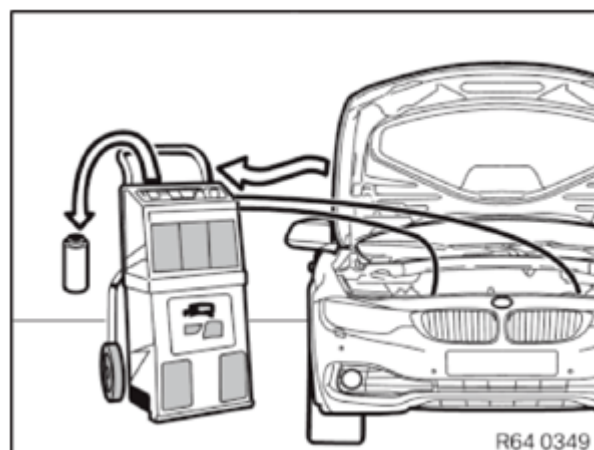
**AN ADAPTATION IS ALSO REQUIRED FOR THE REPLACEMENT OF THE DRYER FLASK.**

**An adaptation of the amount of refrigerant oil is not required in the following cases:**

- Replacement of the **complete** refrigerant circuit.
- If the refrigerant circuit was rinsed (**only I01**).

When evacuating the air conditioning refrigerant oil is also extracted and collected in the oil separator of the A/C service station.

This amount of refrigerant oil is displayed after the extraction of the air conditioning on the display of the A/C service station.



**Fig. 167: Draining Air Conditioning System Refrigerant Oil**  
Courtesy of BMW OF NORTH AMERICA, INC.

Note down the amount of refrigerant oil shown on the A/C service station display.

**Determination of the amount of refrigerant oil to be filled in the new air conditioning compressor:**

Transfer the refrigerant oil remaining in the **previous air conditioning compressor** via the oil filler plug completely into a measuring cup.

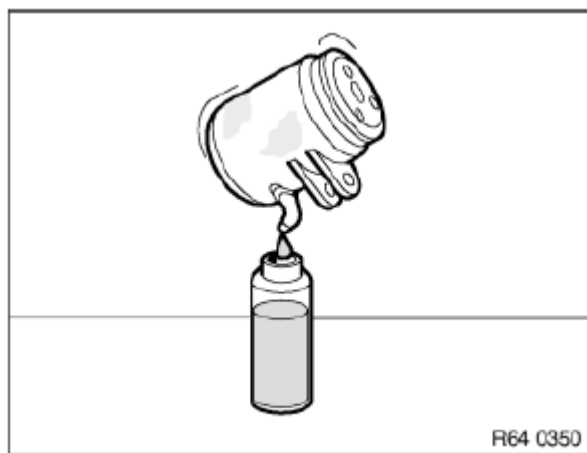
Read the amount of refrigerant oil at the measuring cup. Add **10 ml extra** to the amount of refrigerant oil recorded as a precaution, but record **at least a total of 50 ml**.

**Example:**

20 ml read at measuring cup:

20 ml + 10 ml extra = 30 ml < 50 ml

Amount of refrigerant oil to be filled in the new air conditioning compressor = **50 ml**



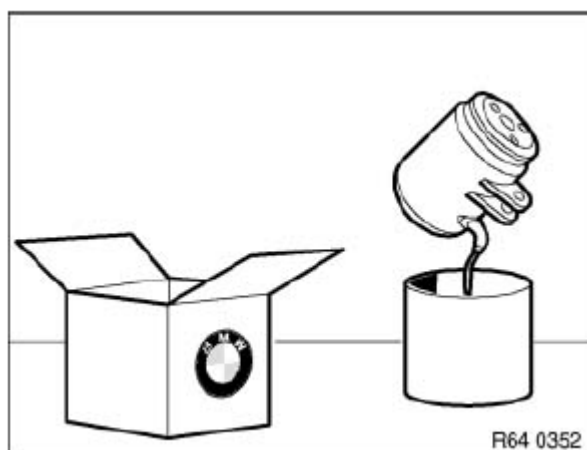
**Fig. 168: Draining Refrigerant Oil Into Container**  
Courtesy of BMW OF NORTH AMERICA, INC.

Turn the belt pulley during the filling process.

This allows more refrigerant oil to flow out of the previous air conditioning compressor.

Open oil filler plug. Drain the following amount of refrigerant oil from the **new air conditioning compressor** into a clean measuring cup:

Amount of refrigerant oil to be drained from the new air conditioning compressor = amount of refrigerant oil on the label for the new air conditioning compressor - amount of refrigerant oil to be filled in the new air conditioning compressor



**Fig. 169: Filling Air Conditioning Compressor Oil Into Collecting Vessel**  
Courtesy of BMW OF NORTH AMERICA, INC.

Example:

Amount of refrigerant oil stated on the label of the new air conditioning compressor: 150 ml

Amount of refrigerant oil to be drained = 150 ml - 50 ml = **100 ml**

100 ml must be drained from the **new air conditioning compressor** .

*Installation note:*

Replace sealing rings.

Use special tool **00 9 030** to mount sealing rings without damaging them.

Tightening torque **64 52 2AZ** .

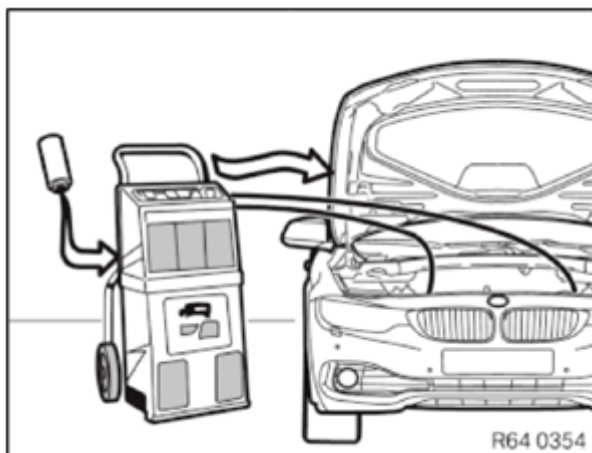
The drained new refrigerant oil can be filled into the expansion tank of the A/C service station after draining.

**On account of its hygroscopic properties, refrigerant oil must not be stored in open collecting vessels.**

If the new, drained refrigerant oil is not filled straight away into the expansion tank of the A/C service station, it must be disposed of properly.

After installing the new air conditioning compressor, it is essential that the air conditioning system is filled with the same amount of refrigerant oil as initially drawn off and noted before the system is filled with refrigerant.

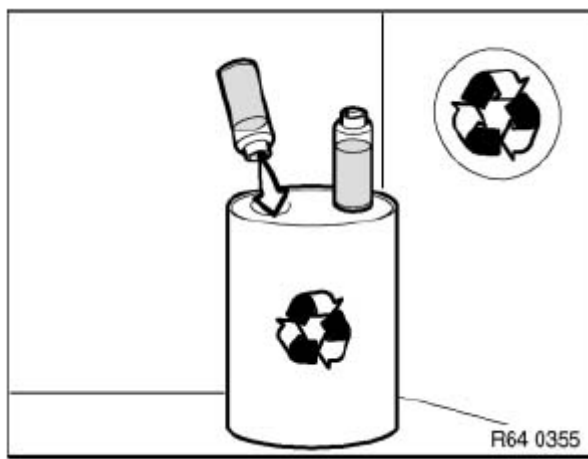
- See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.



**Fig. 170: Pouring Refrigerant Oil Into Air Conditioning System**  
Courtesy of BMW OF NORTH AMERICA, INC.

The refrigerant oil drawn off from the oil separator of the A/C service station and from the previous air conditioning compressor **must not be reused and must be correctly disposed of.**

Observe country-specific waste disposal regulations.



**Fig. 171: Disposing Refrigerant Fluid**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

If the refrigerant circuit is open for longer than 24 hours:

- Replace desiccant insert

**64 52... NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR (AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR NOT KNOWN)**

**Special tools required:**

- [00 9 030](#)

**NOTE:** This procedure only applies if the new air conditioning compressor does not have a label with the amount of refrigerant oil. A **DIFFERENT PROCEDURE** applies for air conditioning compressors with a label indicating the amount of refrigerant oil.

**Risk of damage!**

**Remove the air conditioning compressor without damaging and without the use of force!**

**IMPORTANT:** Air conditioning compressors with plastic belt pulleys:

- Avoid impacts/knocks to plastic belt pulley (caused by tools, contact with base).
- Return faulty air conditioning compressors in their original packaging only.

**When starting up a new air conditioning compressor for the first time, it is absolutely essential to carry out the following breaking-in procedure:**

- IMPORTANT:**
- Switch on Air conditioning system
  - Set all air vents in the dashboard to "OPEN"
  - Start engine and let it stabilize at idle speed
  - Set blower output to min. 75% of max. blower output
  - Switch on air conditioning and run for at least 2 minutes at **idle speed**

**Risk of damage at increased engine speed!**

**IMPORTANT:** In the event of a mechanical air conditioning compressor failure and the resulting ingress of chips into the refrigerant circuit, replace the following parts:  
**All vehicles except I01:**

- **AIR CONDITIONING COMPRESSOR**



- Replace desiccant insert. See **REMOVE/INSTALL/REPLACE CAPACITOR (WITH DESICCANT INSERT, FOR VEHICLES WITHOUT HEAT PUMP)** or **REMOVING/INSTALLING/REPLACING DRYER FLASK FOR AIR CONDITIONING (VEHICLES EQUIPPED WITH HEAT PUMP)**.
- Line to the capacitor
- Refrigerant oil

**Only I01:**

- air conditioning compressor
- **CAPACITOR WITH DESICCANT INSERT/DRYER FLASK**
- All expansion valves. Rinse the refrigerant circuit. See **FLUSHING REFRIGERANT CIRCUIT (WITHOUT HEAT PUMP)** or **RINSE THE REFRIGERANT CIRCUIT WITH THE HEAT PUMP**.

**All vehicles without I01 with heat pump:**

The new air conditioning compressor is filled at the factory with refrigerant oil.

The amount of refrigerant oil in the new air conditioning compressor corresponds to the amount of refrigerant oil for the **entire new and unfilled** refrigerant circuit.

**Only I01 with heat pump:**

**The new air conditioning compressor and new dryer flask** are filled at the factory with refrigerant oil.

The amount of refrigerant oil in the new air conditioning compressor and in the new dryer flask corresponds to the amount of refrigerant oil for the **entire new and unfilled** refrigerant circuit.

**When replacing the air conditioning compressor it is absolutely essential to adapt the amount of refrigerant oil in accordance with the instructions below!**

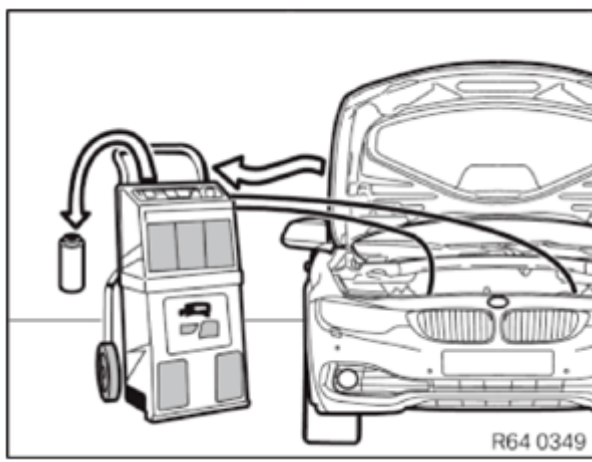
**AN ADAPTATION IS ALSO REQUIRED FOR THE REPLACEMENT OF THE DRYER FLASK.**

**An adaptation of the amount of refrigerant oil is not required in the following cases:**

- Replacement of the **complete** refrigerant circuit.
- If the refrigerant circuit was rinsed (**only I01**).

When evacuating the air conditioning system, refrigerant oil is also extracted and collected in the oil separator of the A/C service station.

After evacuation, the refrigerant must be filtered in the A/C service station as the oil separator could still contain a liquid refrigerant/oil mixture. The refrigerant completely gasifies through the cleaning operation. Only the prior bound refrigerant oil remains in the oil separator. Measure and note down this quantity of refrigerant oil.



**Fig. 172: Draining Air Conditioning System Refrigerant Oil**  
Courtesy of BMW OF NORTH AMERICA, INC.

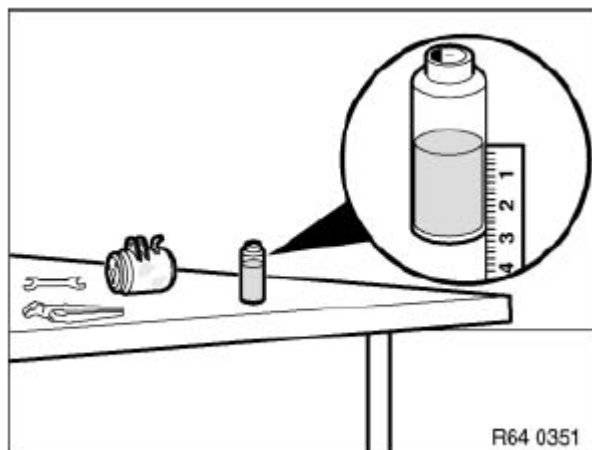
- See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

Transfer the refrigerant oil remaining in the previous air conditioning compressor via the oil filler plug completely into a measuring cup.



**Fig. 173: Draining Refrigerant Oil Into Container**  
Courtesy of BMW OF NORTH AMERICA, INC.

Measure the amount of refrigerant oil collected from the previous air conditioning compressor.



**Fig. 174: Measuring Amount Of Refrigerant Oil Collected From Compressor**  
Courtesy of BMW OF NORTH AMERICA, INC.

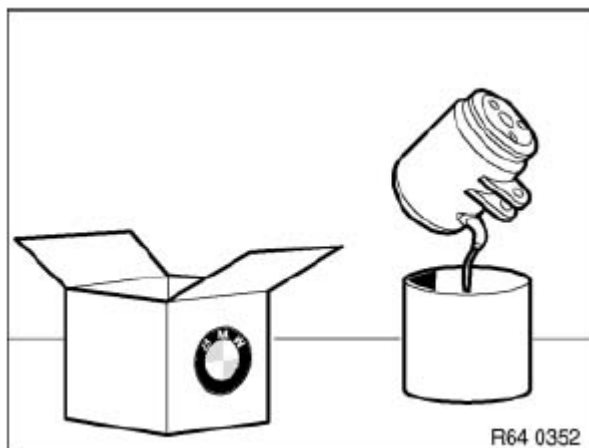
Open oil filler plug and pour entire contents of air conditioning compressor into a clean collecting vessel.

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.

Tightening torque [64 52 2AZ](#) .

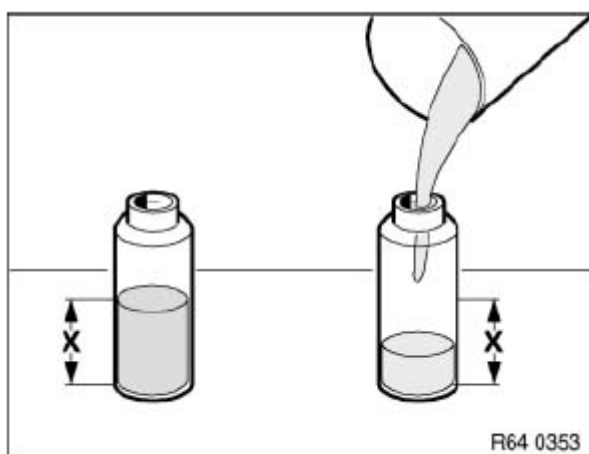


**Fig. 175: Filling Air Conditioning Compressor Oil Into Collecting Vessel**  
Courtesy of BMW OF NORTH AMERICA, INC.

From the new air conditioning compressor, pour the same amount of refrigerant oil (as drained from the previous air conditioning compressor) + **10 ml extra** into a clean measuring cup and pour again into the new air conditioning compressor. **At least but a total of 50 g.**

Remaining refrigerant oil can be poured into A/C service station tank.

- See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).



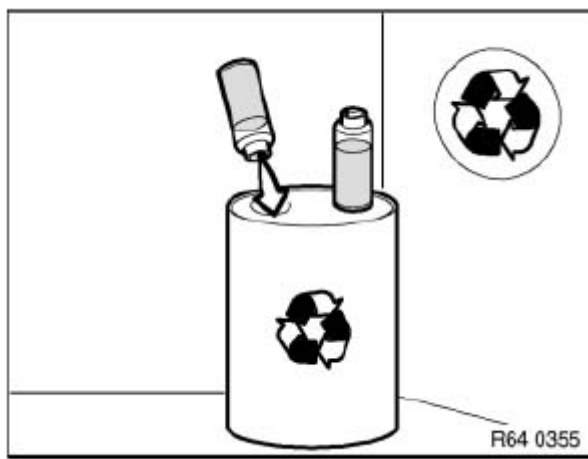
**Fig. 176: Draining Refrigerant Oil Into A/C Service Station Tank**  
Courtesy of BMW OF NORTH AMERICA, INC.

Otherwise the excess refrigerant oil must be disposed of correctly.

On account of its hygroscopic properties, refrigerant oil must not be stored in open containers.

The refrigerant oil drawn off from the oil separator of the A/C service station and from the previous air conditioning compressor must not be reused and must be correctly disposed of.

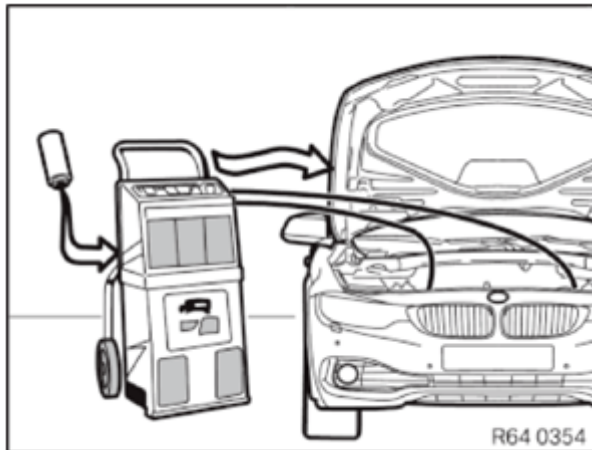
Observe country-specific waste disposal regulations.



**Fig. 177: Disposing Refrigerant Fluid**  
Courtesy of BMW OF NORTH AMERICA, INC.

After installing the new air conditioning compressor, it is essential before filling the air conditioning to pour the same amount of the previously drawn off refrigerant oil into the system again.

- See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.



**Fig. 178: Pouring Refrigerant Oil Into Air Conditioning System**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

If the refrigerant circuit is open for longer than 24 hours:

- Replace desiccant insert. See **REMOVE/INSTALL/REPLACE CAPACITOR (WITH DESICCANT INSERT, FOR VEHICLES WITHOUT HEAT PUMP)** or **REMOVING/INSTALLING/REPLACING DRYER FLASK FOR AIR CONDITIONING (VEHICLES EQUIPPED WITH HEAT PUMP)**.

## **64 52 530 REMOVING AND INSTALLING/REPLACING ELECTRIC A/C COMPRESSOR I01**

**Special tools required:**

- **00 9 030**
- **32 1 270**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the **HIGH-VOLTAGE SYSTEM** .  
Follow all applicable **SAFETY INFORMATION**.

- **HANDLING REFRIGERANT**

- **HANDLING REFRIGERANT OIL**

In I01, 2 different country-specific refrigerants and a new refrigerant oil are used.

**IMPORTANT:** Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!

**OBSERVE NOTES ON REFRIGERANT AND REFRIGERANT OIL FROM 09/2013 !**

**Risk of damage!**

Only switch on heating and air conditioning system again once refrigerant circuit has been properly filled.

Read and comply with notes on compressor replacement. See **NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR (AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR NOT KNOWN)** or **NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR (AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR KNOWN)**.

**IMPORTANT:** **FOLLOW NOTES FOR OPENING AND REPLACING PARTS IN REFRIGERANT CIRCUIT .**

If Air conditioning is opened for more than 24 h:

**REPLACE CONDENSER FOR AIR CONDITIONING.**

*Necessary preliminary tasks:*

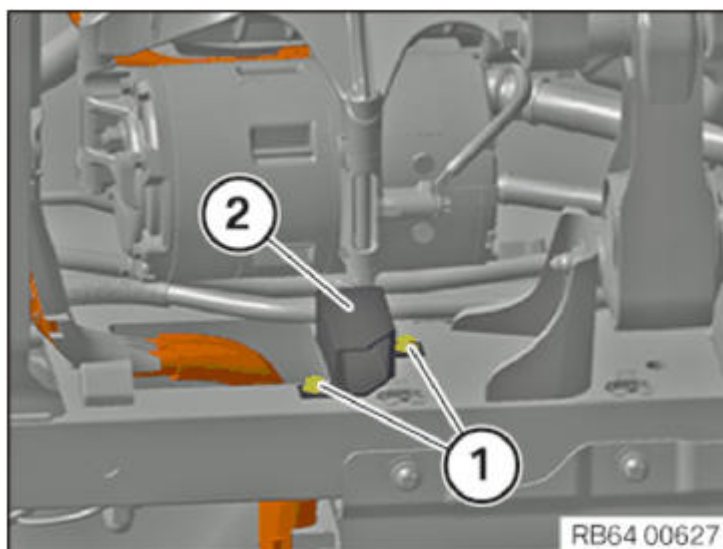
- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Remove LEFT HORIZONTAL STRUT

**IMPORTANT:** Seal openings or lines on compressor with special tool **32 1 270** to prevent escape of media and dirt contamination.

**Build date after 07/2014:**

Release screws (1).

Remove stop pad (2).

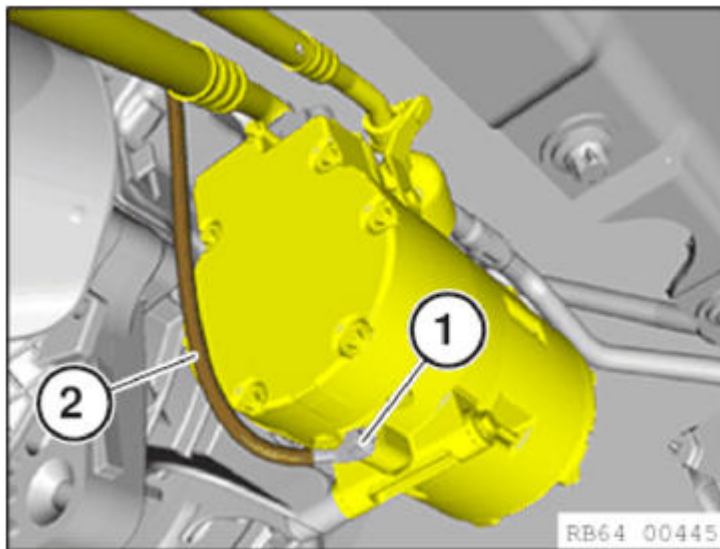


**Fig. 179: Identifying Stop Pad And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Remove equipotential bonding line (2).

Tightening torque **64 52 3AZ** .



**Fig. 180: Identifying Equipotential Bonding Line And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) on compressor (2).

Tightening torque **64 52 2AZ** .

*Installation note:*

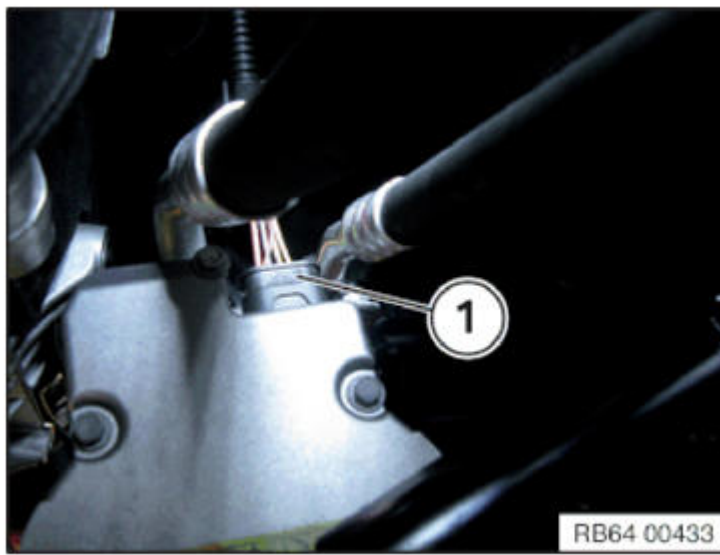
Remember isolating rings.



**Fig. 181: Identifying Screws On Compressor**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.





**Fig. 182: Identifying Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: **OBSERVE NOTES ON UNLOCKING AND DISCONNECTING DIFFERENT PLUG CONNECTIONS ON ELECTRIC VEHICLES .**

Unfasten plug connection (1) and disconnect.



**Fig. 183: Identifying Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

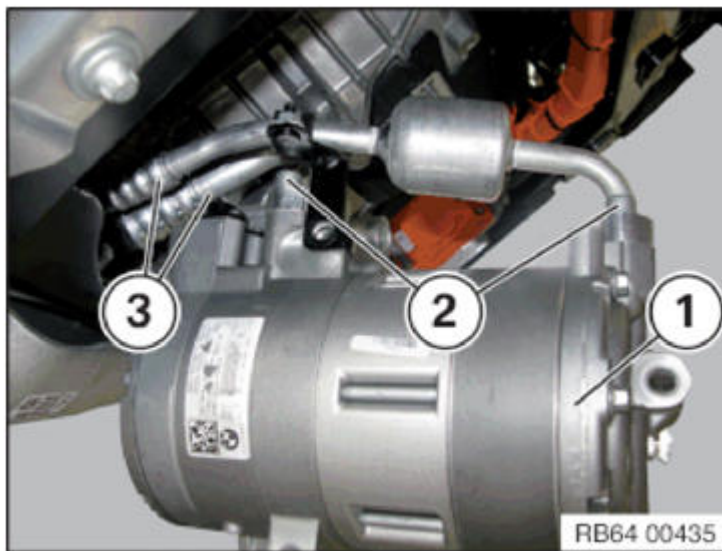
**NOTE:** Secure compressor (1) against falling out.

Unfasten screws (2).

Tightening torque **64 52 1AZ** .

Remove refrigerant lines (3).

*Installation note:*



**Fig. 184: Identifying Compressor, Refrigerant Lines And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.

**Replacement:**

- Adjust the amount of refrigerant oil in the new compressor. See [NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR \(AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR NOT KNOWN\)](#) or [NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR \(AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR KNOWN\)](#).

Danger of compressor damage!

**Danger of customer complaints due to reduced cooling power of the Air conditioning!**

**Before the installation of the new compressor, it is absolutely necessary to adjust the amount of refrigerant oil in the new compressor!**

IMPORTANT: Follow all applicable [SAFETY INFORMATION](#).

See [NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR \(AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR NOT KNOWN\)](#) or [NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR \(AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR KNOWN\)](#).

**After installation:**

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

**CONDENSER AND DRYER WITH LINES**

**64 53... INSTRUCTIONS FOR DESICCANT INSERT REPLACEMENT**

**Special tools required:**

- [32 1 270](#)

A desiccant insert that is in a correctly functioning, sealed heating and air conditioning system does not have to be changed at regular service-inspection intervals.

**However, the dryer flask or desiccant insert must absolutely be replaced in the event of:**

- contamination of the refrigerant with debris (e.g. when the compressor is clamped).
- With depressurized and/or completely drained refrigerant circuit.
- With a refrigerant circuit, which was closed using special tool [32 1 270](#) but remains open for more than 24 hours.

The desiccant insert cannot be replaced in the following vehicles:

- 1-Series E8x, 3-Series E9x from 12/2008
- E84, E89
- 1-Series F2x, 3-Series F3x
- BMW i01 i3 WITHOUT heat pump

In these vehicles, the condenser for the heating and air conditioning system must be replaced.

- BMW i01 i3 WITH heat pump

On this vehicle the low pressure battery must be replaced.

### 64 53... INSTRUCTIONS FOR REPLACEMENT OF AIR CONDITIONING CAPACITORS AND RADIATOR/COOLERS

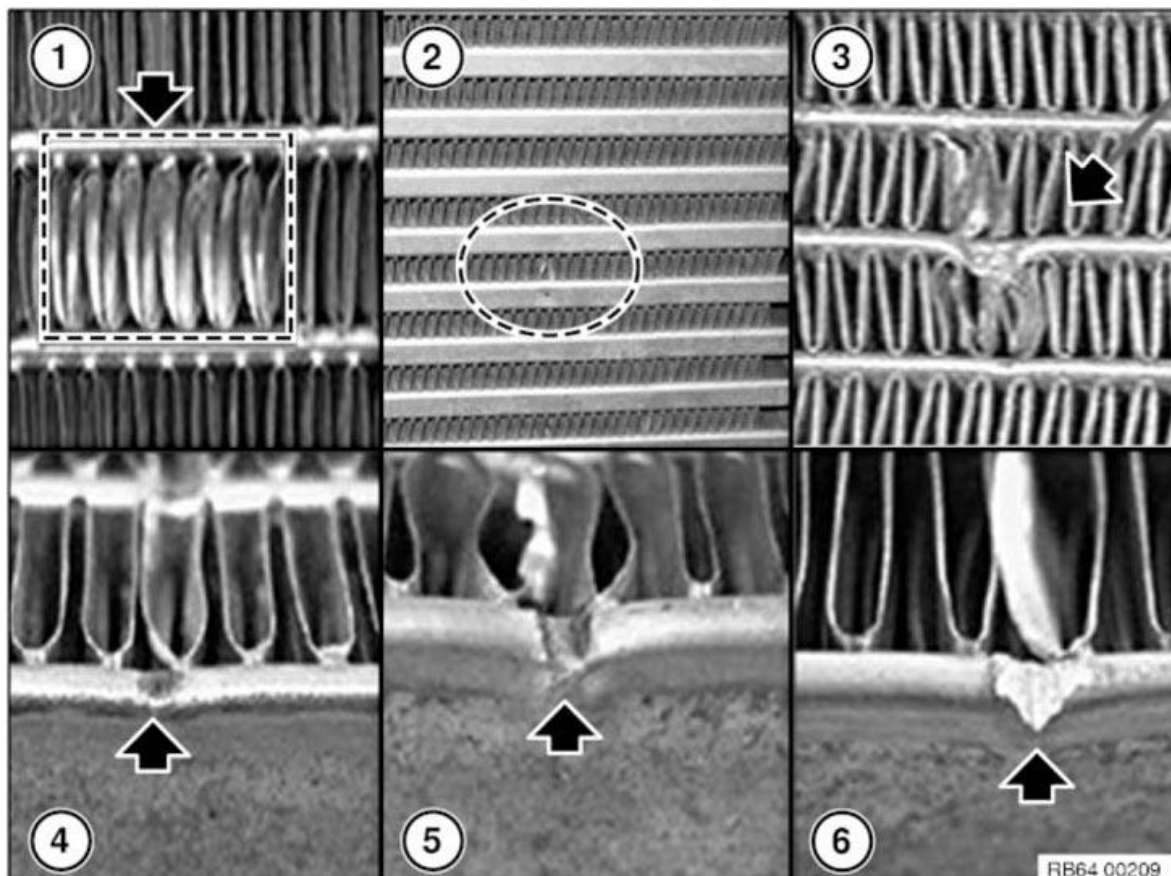
Even when they are correctly installed or due to normal driving, radiators (oil cooler, radiator, charge air cooler) or air conditioning condensers may show slight impressions or deformations on their discs (1).

**IMPORTANT:** A slight sag with a large radius for the air conditioning condenser is also permissible. As long as tightness/function are not degraded and an adequate distance of a few mm between the radiator and air conditioning condenser remains in place, **this is not damage in either case.**

**Radiators or air conditioning condensers are not to be replaced in these cases!**

**NOTE:** The deformations shown in Fig. (1) can be bent back with a standard fin comb.

Damage to lines carrying media or on the flat pipe require exchange of the radiator or air conditioning condenser (2-6).



Dryer flask (integrated in the air conditioning condenser):

Round dents/depressions are permitted.

**The air conditioning condenser is not to be replaced in this case.**

**64 53 551 REMOVE AND INSTALL/REPLACE CAPACITOR (WITH DESICCANT INSERT FOR VERSION WITHOUT HEAT PUMP) FOR HEATING AND AIR CONDITIONING SYSTEM**

**Special tools required:**

- **00 9 030**

IMPORTANT: In I01, 2 different country-specific refrigerants and a new refrigerant oil are used.  
**Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!**  
Always observe the **NOTES** on refrigerant and refrigerant oil from 09/2013!

IMPORTANT: Risk of damage!  
Only switch on air conditioning again once refrigerant circuit has been properly filled.  
**FOLLOW INSTRUCTIONS FOR OPENING AND REPLACING PARTS IN REFRIGERANT CIRCUIT !**

**NOTE:** Equipment specification without heat pump:  
Desiccant insert is located in the capacitor. Desiccant insert cannot be replaced separately.

**Equipment specification with heat pump:**

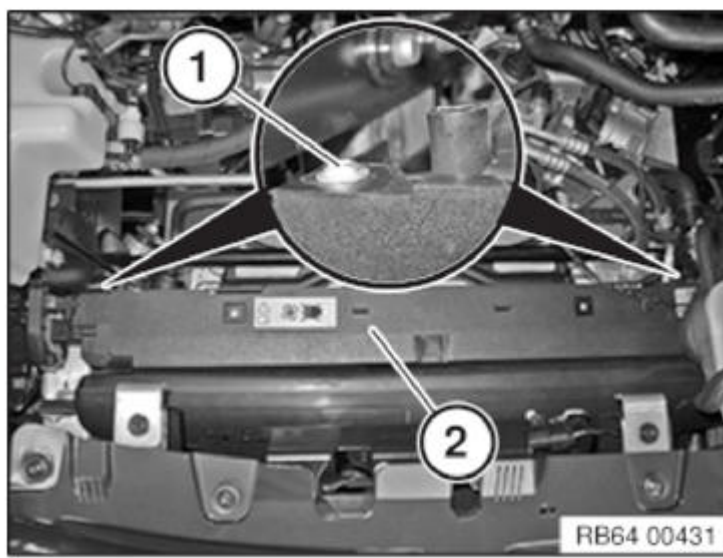
Desiccant insert is not located in the capacitor. **DESICCANT INSERT CANNOT BE REPLACED SEPARATELY.**

*Necessary preliminary tasks:*

- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Remove **FAN COWL**

Release screws (1).

Remove cover (2).

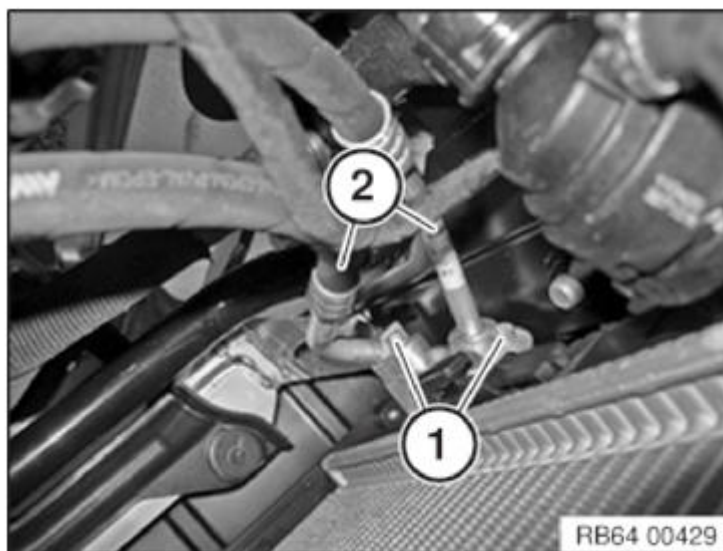


**Fig. 186: Identifying Cover And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Disconnect refrigerant lines (2) and lay to one side.

Tightening torque [64 53 3AZ](#) .



**Fig. 187: Identifying Refrigerant Lines And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out capacitor (1).

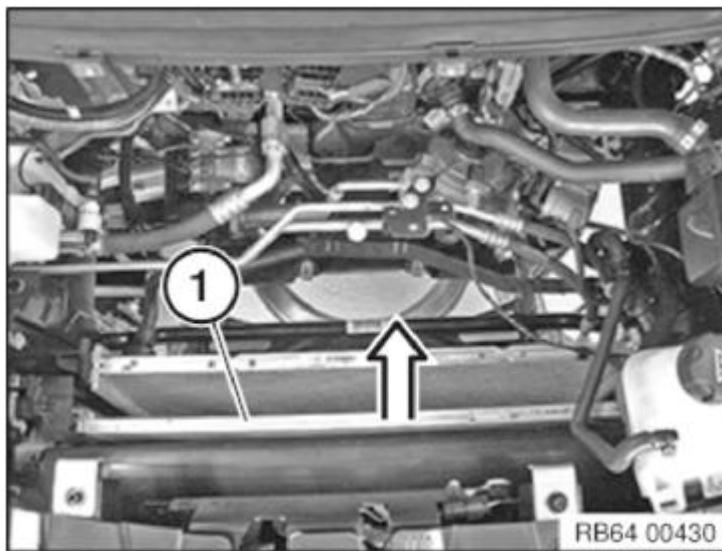
*Installation note:*

The fins on the radiator and condenser should not be damaged.

Replace sealing rings.

Use special tool [00 9 030](#) to install sealing rings without damaging them.





**Fig. 188: Pulling Out Capacitor**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

**64 53... REMOVING AND INSTALLING (REPLACING) INTAKE PIPE AND PRESSURE LINE FOR ELECTRIC A/C COMPRESSOR**

**Special tools required:**

- [32 1 270](#)
- [00 9 030](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
De-energize the [HIGH-VOLTAGE SYSTEM](#) .  
Follow all applicable [SAFETY INFORMATION](#).

**WARNING:** Danger of injury!  
Refrigerant circuit is under high pressure!

**IMPORTANT:** In I01, 2 different country-specific refrigerants and a new refrigerant oil are used.  
Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!  
[OBSERVE NOTES ON REFRIGERANT AND REFRIGERANT OIL FROM 09/2013 !](#)

**IMPORTANT:** **Risk of damage!**  
Only switch on air conditioning again once refrigerant circuit has been properly filled.  
Read and comply with notes on compressor replacement! See [NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR \(AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR NOT KNOWN\)](#) or [NOTES FOR CHANGING THE AIR CONDITIONING COMPRESSOR \(AMOUNT OF REFRIGERANT OIL OF NEW AIR CONDITIONING COMPRESSOR KNOWN\)](#).

[FOLLOW NOTES FOR OPENING AND REPLACING PARTS IN REFRIGERANT CIRCUIT .](#)

If Air conditioning is opened for more than 24 h:

[REPLACE CONDENSER FOR AIR CONDITIONING.](#)



*Necessary preliminary tasks:*

- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Remove [ELECTRIC A/C COMPRESSOR](#)
- Partly remove [TRIM PANEL FOR COVER ON SIDE MEMBER, RIGHT](#)

**IMPORTANT:** Seal openings or lines on compressor with special tool [32 1 270](#) to prevent escape of media and dirt contamination.

Release screw (1).

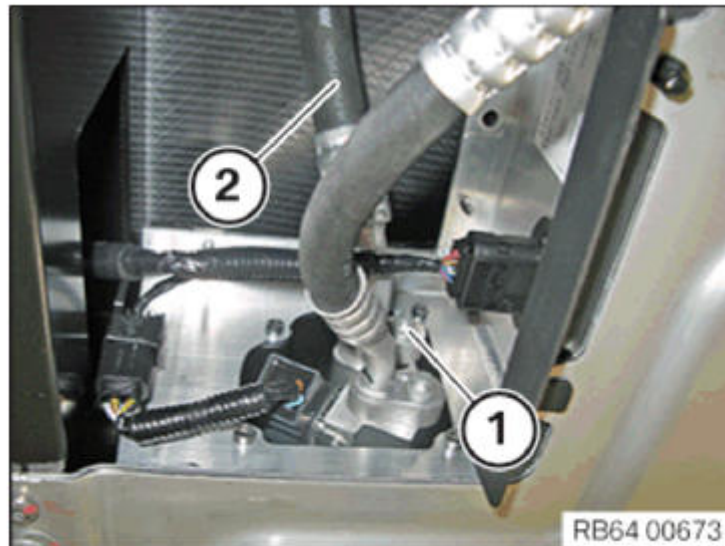
Tightening torque [64 53 6AZ](#) .

Remove refrigerant line (2).

*Installation note:*

Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.



**Fig. 189: Identifying Refrigerant Line And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque [64 53 12AZ](#) .

Release screw (2).

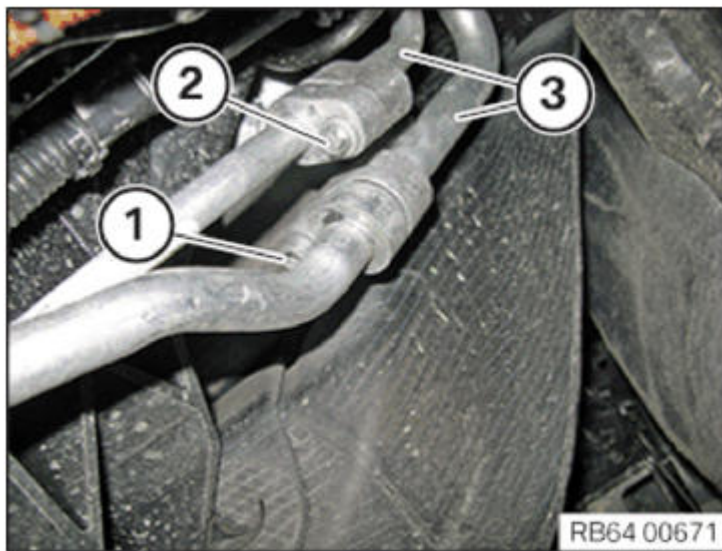
Tightening torque [64 53 13AZ](#) .

Remove refrigerant lines (3).

*Installation note:*

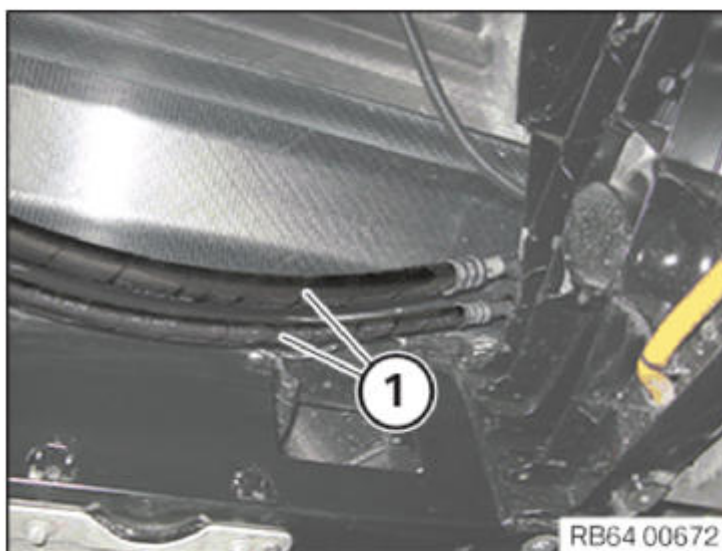
Replace sealing rings.

Use special tool [00 9 030](#) to mount sealing rings without damaging them.



**Fig. 190: Identifying Refrigerant Lines And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Feed out refrigerant lines (1).



**Fig. 191: Identifying Refrigerant Lines**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

**64 53 510 REMOVING AND INSTALLING/REPLACING DRYER FLASK FOR AIR CONDITIONING (EQUIPMENT SPECIFICATION WITH HEAT PUMP)**

**Special tools required:**

- **00 9 030**

**IMPORTANT:** In I01, 2 different country-specific refrigerants and a new refrigerant oil are used. **Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!**  
 Observe **NOTES** on refrigerant and refrigerant oil from 09/2013.

**IMPORTANT:** Risk of damage!  
 Restart engine only when A/C system has been correctly filled.

Follow **INSTRUCTIONS** for opening and replacing parts in refrigerant circuit.  
If Air conditioning is opened for more than 24 h: **REPLACE CONDENSER FOR AIR CONDITIONING.**

### Necessary preliminary tasks:

- Draw off/evacuate the A/C system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Remove **FRONT WHEEL ARCH COVER**

**NOTE:** Oil bumper removed for purposes of clarity.

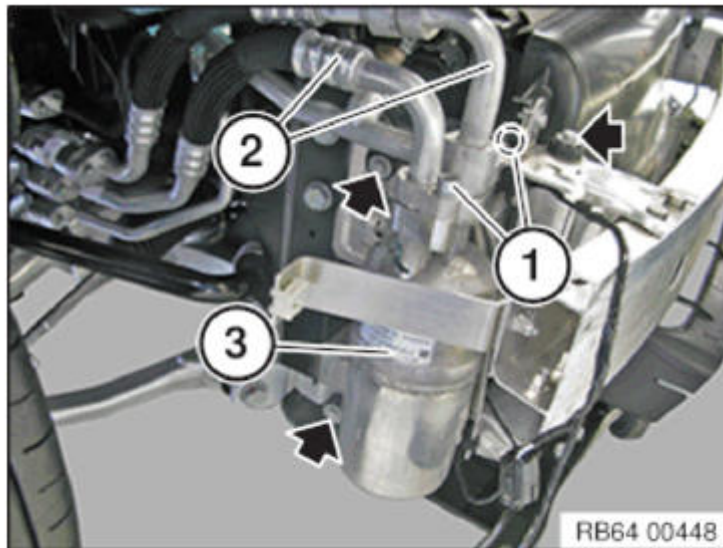
Release screws (1).

Tightening torque **64 53 8AZ** .

Remove refrigerant lines (2).

Release screws at marked points.

Take off dryer flask (3).



**Fig. 192: Locating Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace sealing rings.

Use special tool **00 9 030** to mount sealing rings without damaging them.

### Observe the following when replacing the dryer flask:

IMPORTANT:

- In case the refrigerant circuit was **not rinsed** , the **amount of refrigerant oil of the new dryer flask needs to be adjusted** before installation!
- The new dryer flask is filled at the factory with refrigerant oil.
- The amount of refrigerant oil of the new dryer flask is higher than in the one removed.
- **Before the installation, the new dryer flask has to contain the same amount of refrigerant oil as the one removed!**

**Adjusting the amount of refrigerant oil of the new dryer flask is not required in the following cases only:**

- When exchanging the **entire** refrigerant circuit.
- In case the refrigerant circuit was rinsed.

### Adjusting the amount of refrigerant oil of the new dryer flask:

1. Clean dryer flask, if necessary.
2. Define and note down weight of new dryer flask.

Example: 785 g

3. Define and note down weight of removed dryer flask.

Example: 750 g

4. Drain the following amount of refrigerant oil from the new dryer flask in a **clean** measuring cup:

Amount of refrigerant oil to be drained in ml (g approx. equals ml) =

Weight new dryer flask in g - Weight removed dryer flask in g

Example:

Amount of refrigerant oil to be drained in ml = 785 g - 750 g = **35 g** approx. equals **35 ml**

35 ml of refrigerant oil need to be drained from the new dryer flask.

The drained new refrigerant oil can be filled into the expansion tank of the A/C service station after draining.

**On account of its hygroscopic properties, refrigerant oil must not be stored in open containers.**

If the new, drained refrigerant oil is not filled straight away into the expansion tank of the A/C service station, it must be disposed of properly.

### After installation:

- Evacuate and fill air conditioning. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).

### 64 53 770 REPLACING COOLANT PRESSURE TEMPERATURE SENSOR 1 (B394) (WITH HEAT PUMP)

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work:  
 De-energize the [HIGH-VOLTAGE SYSTEM](#) .  
 Follow all applicable [SAFETY INFORMATION](#).

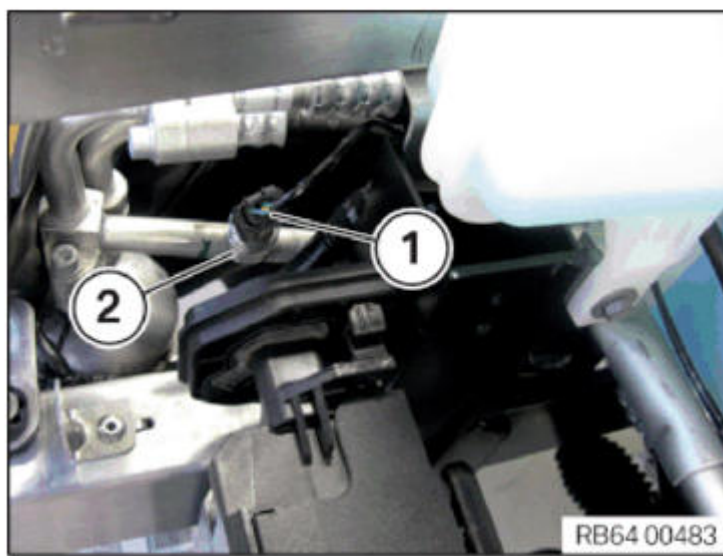
### Necessary preliminary tasks:

- Drain off air conditioning system. See [DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
- Clamp off [BATTERY EARTH LEAD](#)

Unfasten plug connection (1) and disconnect.

Release sensor (2).

Tightening torque [64 53 5AZ](#) .



**Fig. 193: Identifying Sensor And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

**64 53 771 REPLACING COOLANT PRESSURE TEMPERATURE SENSOR 2 (B395) (WITH HEAT PUMP)**

**WARNING:**

**High-voltage system - danger to life!**

**The following points must be strictly observed prior to starting work:**

**De-energize the HIGH-VOLTAGE SYSTEM .**

**Follow all applicable SAFETY INFORMATION.**

**Necessary preliminary tasks:**

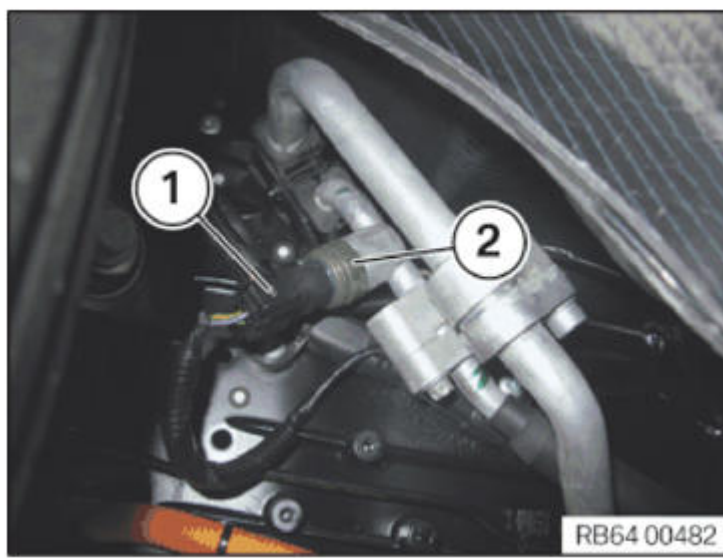
- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Clamp off **BATTERY EARTH LEAD**
- Remove **WHEEL ARCH COVER AT REAR RIGHT**

Unfasten plug connection (1) and disconnect.

Release sensor (2).

Tightening torque **64 53 5AZ** .





**Fig. 194: Identifying Sensor And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill air conditioning. See **DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.

**64 53 520 REPLACING SAFETY PRESSURE SWITCH**

IMPORTANT: In I01, 2 different country-specific refrigerants and a new refrigerant oil are used. **Before carrying out repair work on refrigerant circuit, always determine which refrigerant is used in the vehicle!**  
Observe **NOTES** on refrigerant and refrigerant oil from 09/2013.

Risk of damage!  
Restart engine only when air conditioning system has been correctly filled.  
IMPORTANT: Follow **INSTRUCTIONS** for opening and replacing parts in refrigerant circuit.  
If air conditioning system is opened for more than 24 hours: **REPLACING CAPACITOR FOR HEATING AND AIR CONDITIONING SYSTEM**

**Necessary preliminary tasks:**

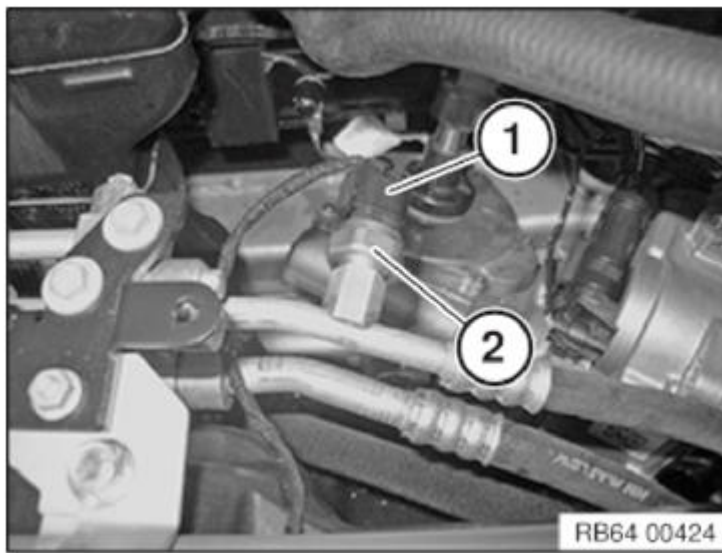
- Drain off air conditioning system. See **DRAWING OFF/EVACUATING HEATING AND AIR CONDITIONING SYSTEM (R134A)** or **DRAWING OFF HEATING/AIR CONDITIONING SYSTEM (R1234YF)**.
- Remove **FRONT LUGGAGE COMPARTMENT WELL**

Unfasten plug connection (1) and disconnect.

Release safety switch (2) and remove.

Tightening torque **64 53 5AZ** .





**Fig. 195: Identifying Safety Switch And Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Evacuate and fill A/C system. See [DRAWING OFF/EVACUATING/FILLING HEATING AND AIR CONDITIONING SYSTEM \(R134A\)](#) or [DRAWING OFF/FILLING HEATING/AIR CONDITIONING SYSTEM \(R1234YF\)](#).
-

## HVAC

### Heating And Air Conditioning - Special Tools - All I3 Models - i3

## HEATING AND AIR CONDITIONING

### 0301361 ACCESSORIES MECHANICAL TOOL

**NOTE:** For detecting leaks in the refrigerant circuit



**Fig. 1: Identifying Accessories (0301361)**

Courtesy of BMW OF NORTH AMERICA, INC.

### 2286910 ACCESSORIES AM

**NOTE:** Mechanical oil syringe for supplying the refrigerant oil BMWi and Hybrid. Refrigerant oil for electrically driven air conditioning compressors BMWi.

SI number

08 04 14 (079)



**Fig. 2: Identifying Accessories (2286910)**

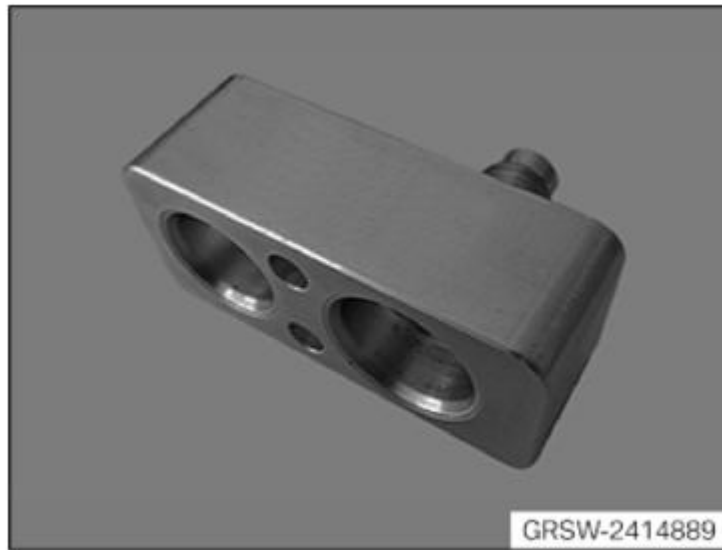
Courtesy of BMW OF NORTH AMERICA, INC.

**2414889 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Pressure test adapter for evaporator test MINI/2 Series Active Tourer/X1

SI number

01 57 15 (353)



**Fig. 3: Identifying Adapter (2414889).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2286734 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Adapter replaces expansion valve in HV battery unit Contained in set 83 30 2 358 482

SI number

08 07 14 (082)



**Fig. 4: Identifying Adapter (2286734).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2286727 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** For rinsing refrigerant circuit in the vehicle after compressor damage. For connection to the low pressure side of the air conditioning condenser. Contained in set 83 30 2 358 482

SI number

08 07 14 (082)



**Fig. 5: Identifying Adapter (2286727).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2286730 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Adapter on low-pressure connection compressor For SA495 (heat pump) required 3 times Contained in set 83 30 2 358 482

SI number

08 07 14 (082)



**Fig. 6: Identifying Adapter (2286730).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2286736 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Adapter expansion valve on evaporator (above the front axle for SA495). Contained in block 83 30 2 358 482.

SI number

08 07 14 (082)



**Fig. 7: Identifying Adapter (2286736).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2286732 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Adapter on compressor high-pressure connection Contained in set 83 30 2 358 482

SI number

08 07 14 (082)



**Fig. 8: Identifying Adapter (2286732).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2286729 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Adapter on high-pressure connection of air conditioning condenser  
Contained in set 83 30 2 358 482

SI number

08 07 14 (082)



**Fig. 9: Identifying Adapter (2286729).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2407656 ADAPTER AM**

**NOTE:** Adapter kit for "Loktrace KA1000" (81342210336) for the leakage test for 1234yf air conditioning systems.

SI number

08 02 15 (249)



**Fig. 10: Identifying Adapter (2407656).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2286735 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Adapter replaces expansion valve on evaporator (bulkhead) Contained in set 83 30 2 358 482

SI number

08 07 14 (082)





**Fig. 11: Identifying Adapter (2286735)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2362832 CLEANING AGENT AM**

**NOTE:** For cleaning the evaporator and blower shafts in the vehicle ventilation system

**Storage Location**

Individual



**Fig. 12: Identifying Cleaning Agent (2362832)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**641020 HOOK MINIMUM SET: MECHANICAL TOOLS AM**

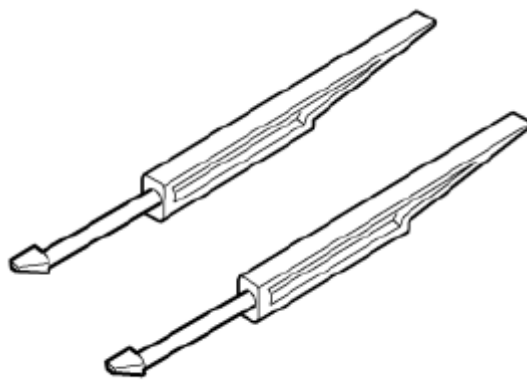
**NOTE:** (release hook) For releasing and removing fresh air grille. For removing various covers.

**Storage Location**

C2

**SI number**

01 15 99 (483)



W64 1 020

**Fig. 13: Identifying Hook (641020)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2285575 HOSE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Short circuit hose for bridging adapter of air conditioning condenser (2 286727 and 2286729) For SA459 (heat pump), contained 2 times in set 83 30 2 358 482

SI number

08 07 14 (082)



**Fig. 14: Identifying Hose (2285575)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2413653 SPRAY LANCE AM**

**NOTE:** The spray lance for cleaning the evaporator UKL1 and UKL2 is to be used likewise for left- and right-hand drive vehicles.

SI number

01 41 15 (315)



**Fig. 15: Identifying Spray Lance (2413653)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**9429217 SPRAYER AM**

**NOTE:** For cleaning the air conditioning condensers in conjunction with spray lances.

**Storage Location**

Individual

**SI number**

08 05 12 (812)



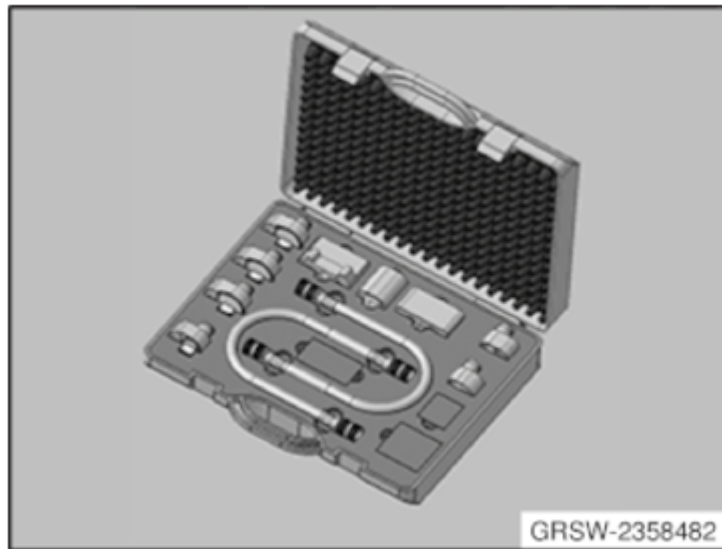
**Fig. 16: Identifying Sprayer (9429217)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2358482 TOOL SET AM**

**NOTE:** Storage case incl. rinsing adapter set BMW i -> created under new part number 2 413 236 from the end of 2015 onwards. Set consists of: 83 30 2 286 730 (3x) 83 30 2 286 732 83 30 2 286 734 83 30 2 286 735 83 30 2 286 736 83 30 2 286 727 83 30 2 286 729 83 30 2 285 575 (2x)

**Storage Location**

Individual



**Fig. 17: Identifying Tool Set (2358482)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**0427679 WRENCH MECHANICAL TOOL**

**NOTE:** For opening the service coupling valves for R134a air conditioning lines



**Fig. 18: Identifying Wrench (0427679)**  
Courtesy of BMW OF NORTH AMERICA, INC.

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## HVAC

### Heating And Air Conditioning - Technical Data - All I3 Models - i3

## AIR CONDITIONING, REFRIGERANT AMOUNTS

### 64 50 AIR CONDITIONING, REFRIGERANT AMOUNTS I01, I12

#### AIR CONDITIONING AND REFRIGERANT AMOUNTS I01, I12 SPECIFICATION

I01 Refrigerant capacity R134a/R1234yf without heat pump (The data on the type plate in the engine compartment is definitive)	g	750 $\hat{\pm}$ 10
I01 Refrigerant capacity R134a/R1234yf with heat pump (The data on the type plate in the engine compartment is definitive)	g	970 $\hat{\pm}$ 10
I12 Refrigerant capacity R134a/R1234yf (The data on the type plate in the engine compartment is definitive)	g	630 $\hat{\pm}$ 10

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## HVAC

### Heating And Air Conditioning - Tightening Torques - All I3 Models - i3

## HVAC COMPRESSOR

### 64 52 HVAC COMPRESSOR

#### TIGHTENING TORQUE SPECIFICATION - COMPRESSOR

Â	Type	Thread	Tightening specifications	Dimension
1AZ Refrigerant lines to compressor	I01	M8	Replace screws.	19 Nm
	I12	M8	Â	18 Nm
2AZ Compressor to electric machine housing	I01	M6	Replace screws.	7.6 Nm
3AZ Equipotential bonding line to compressor	I01/I12	M6	Â	19 Nm
4AZ Potential equalization to electrical heating	I01/I12	M6	Replace nut!	4 Nm
5AZ Electrical heater to body	I01	M6	Replace screws.	2.6 Nm
	I12	M6	Â	8 Nm
6AZ Electrical heater to holder	I01/I12	M6	Â	8 Nm
7AZ Changeover valve to holder	I12	Â	Â	2 Nm
8AZ Compressor to bracket	I12	M6	Replace screws.	7.0 Nm
9AZ Compressor to bracket	I12	M8	Replace screws.	30 Nm
10AZ Holder to electrical machine housing	I12	M8	Â	30 Nm

## REFRIGERANT LINES AND EXPANSION VALVE

### 64 53 REFRIGERANT LINES AND EXPANSION VALVE

#### TIGHTENING TORQUE SPECIFICATION - REFRIGERANT LINES AND EXPANSION VALVE

Â	Type	Thread	Tightening specifications	Dimension
1AZ Refrigerant lines to flange (expansion valve)	I01	M6	Â	8 Nm
	I12	M6	Â	11.8 Nm
2AZ Expansion valve to heater - A/C	I01	M6	Â	5.5 Nm
	I12	M6	Â	4.5 Nm
3AZ Refrigerant lines to capacitor	I01	M6	Â	8 Nm
	I12	M6	Â	11.8 Nm
4AZ Refrigerant lines to air-conditioning compressor	I01	M8	Â	19 Nm
	I12	M8	Â	18 Nm
5AZ Safety pressure switch	I01/I12	Â	Â	10 Nm
6AZ Refrigerant lines to expansion valve (high-voltage battery)	I01	M6	Â	13 Nm
	I12	M6	Â	11.8 Nm
7AZ Expansion valve to high-voltage battery	I01/I12	M6	Â	4.5 Nm
8AZ Refrigerant lines to dryer flask	I01	M8	Â	19 Nm
9AZ Refrigerant lines to heat pump heat exchanger	I01	M6	Â	8 Nm
10AZ Refrigerant temperature sensor	I01	Â	Â	1.5 Nm
11AZ Refrigerant lines to expansion valve 3 (Y154)	I01	M6	Â	8 Nm



Â	Type	Thread	Tightening specifications	Dimension
12AZ Intake pipe connection	I01	M8	Â	19 Nm
13AZ Pressure line connection	I01	M6	Â	13 Nm

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## MAINTENANCE

### Maintenance and General Information Operating Fluids

#### 1.0 INTRODUCTION

These operating fluids specifications describe the standards which are necessary for approval and application for BMW automobiles. Operating fluids are arranged in vehicle group category and are approved for all assemblies. Any reference to a particular fluid contained in an active Service Information Bulletin since January 1987 will be listed next to the fluid's part number. Before applying operating fluids, it is important to make sure that the specifications and manufacturing codes on the container conform with those on the enclosed specification list.

Prior to their approval, all operating fluids are tested in detail on test stands, in laboratories, and in cars during field tests. As new information is received, the Operating Fluids Manual will be updated. Some lubricants or fluids may be listed in more than one specific group. For example, Part No. 81 22 1 468 879 (Pentosin CHF7.1 Fluid) is listed under Group 32 (Steering) as well as in Group 37 (Integrated Suspension Systems). BMW Car Care products are listed in Group 99.

BMW of North America has also approved various fluids for use which are not available through the Parts Department, but may be obtained locally. A list of these approved fluids is found on sections 4.0 and 5.0.

Some fluids have been phased out of PDC inventory. Such fluids will be marked by an asterisk (\*) after the part number along with the name(s) of alternate supplier(s) and the product name/part number.

#### 2.0 CORROSION PROTECTION FOR VEHICLE IN LONG-TERM STORAGE

Location - inside of a building whenever possible or covered parking lot (especially convertibles).

Replace engine oil and filter after engine reaches operating temperature. Run engine several minutes after replacing oil. Engine oil must be replaced every 12 months. Factory engine oil (in new cars) can remain in the engine up to 12 months.

Check/correct electrolyte level in battery cells.

Disconnect battery ground lead to avoid discharging battery through current draw of electrical equipment. Or, switch off battery main disconnect switch (if equipped).

Inspect undercoating for damage and repair as necessary.

Inspect wax coating in engine compartment, on engine, underbody and axles. Repair as necessary.

Operate air conditioner monthly for 10 minutes in order to lubricate the seals and the expansion valve.

**NOTE:** The air conditioner will only work at temperatures above 37°F/3°C.

#### PRE-DELIVERY CARS

Replace brake fluid if car has been parked outdoors longer than six (6) months.

Fill the vehicle fuel tank with fresh fuel in order to prevent condensation inside the tank (applies only to metal fuel tanks).

Check, and if needed, correct the coolant level and concentration of long-term antifreeze and corrosion inhibitor.

Apply brakes to dry the brake discs of any moisture and spray them with a corrosion inhibitor. Spray the complete brake assemblies after parking the car at its final storage location.

Do not apply the parking brake. Brake linings could seize when the parking brake is applied for an extended period of time. Rather, engage first gear (manual transmissions) or "park" position (automatic transmissions) to hold vehicle stationary.

Increase inflation pressure on all road tires to 50 psi.

Thoroughly clean the entire car, including underside, engine and engine compartment.

### **EXTERIOR FINISH**

Repair any damage to the paint finish. Wash entire vehicle exterior with BMW Car Wash Shampoo (Part No. 82 14 9 400 129) or equivalent. Polish painted and chrome finishes with Car Polish Cream - 3M Part No. 6055 (former BMW Part No. 82 14 9 400 131) or equivalent.

Polishing the vehicle with abrasive cleaners and/or cleaner waxes may have a detrimental effect on the appearance of the paint. Waxing of Paint Sealer treated vehicles may still be done, but only if non-abrasive cleaners or non-abrasive cleaner-waxes are used.

Wax painted and chrome finishes with BMW Car Wax (Part No. 83 12 9 408 527) or equivalent. Wax painted and chrome plated parts if storage period is 12 months or longer. Dewax and re wax cars every six (6) months if stored outside.

Check convertible top for damage.

## **3.0 CONVERSION TABLE**

### **CONVERSION CHART**

<b>Liters</b>	<b>US Gallons</b>	<b>US Pints</b>	<b>Liters</b>	<b>US Gallons</b>	<b>US Pints</b>
0.5	0.132	1.055	8.0	2.112	16.904
1.0	0.264	2.113	9.0	2.376	19.017
2.0	0.538	4.226	10.0	2.640	21.130
3.0	0.792	6.339	11.0	2.904	23.243
4.0	1.056	8.452	12.0	3.168	25.356
5.0	1.320	10.565	13.0	3.432	27.469
6.0	1.584	12.678	14.0	3.696	29.582
7.0	1.848	14.791	15.0	3.960	31.695
<b>Conversion Factors:</b>					
Liters in US Gallons x 0.264					
US Gallons in Liters x 3.785					
Liters in US Pints x 2.113					
US Pints in Liters x 0.473					

## **4.0 ALTERNATE UNIVERSAL LUBRICANTS AND WORKSHOP SUPPLIES**

### **ALTERNATE UNIVERSAL LUBRICANTS AND WORKSHOP SUPPLIES REFERENCE CHART**

<b>BMW P/N</b>	<b>Description/Application</b>	<b>3M P/N</b>	<b>Wurth P/N</b>	<b>Loctite P/N</b>

BMW P/N	Description/Application	3M P/N	Würth P/N	Loctite P/N
81 22 9 400 208 (1)	<b>Lubricant/Contact Cleaner Spray</b> Stops electrical and mechanical faults due to water, moisture, rust, dirt and friction. Colorless, neutral, free of grease and silicone, suitable for all applications. Examples: Stops moisture on distributor, generator, ignition coil, starter, spark plugs, coils, relays, contacts, etc. Prevents metal parts from corroding. Stops rubber and plastic parts from aging prematurely. Applications: from -50°C to +150°C.	Â	89360/1	24379
81 22 9 400 229 (1)	<b>Hand Cleaner</b> Removes stubborn stains and grit without attacking skin. Contains special skin protectant. Does not clog pipes.	Â	893900	25108
81 22 9 400 720 (1)	<b>Molybdenum Disulfide (MOS<sup>2</sup>) Spray</b> Loosens rust, eliminates squeaking and similar noises, prevent rust seizure. Displaces water on ignition components to allow quick starting. Insulates electrical systems against moisture and stops corrosion.	8876	Â	24378
81 22 9 407 138 (1)	<b>Stain Remover</b> Removes tar, oil and grease stains from seat covers, leather upholstery and painted plastic components.	Â	89024	Â
81 22 9 407 174 (1)	<b>Bearing Grease</b> A water repellent high-pressure grease for lubricating flywheel gear rings, starter motor pinions, etc., and also as an acid-proof grease for battery terminal posts.	Â	893530	Â
81 22 9 407 301 (1)	<b>Loctite 574</b> Anaerobic, silicone sealant for aluminum flange surfaces. Provides instant sealing when flanges are assembled.	Â	893574	24018

BMW P/N	Description/Application	3M P/N	Wurth P/N	Loctite P/N
81 22 9 407 388 (1)	<b>Adhesive Remover</b> Removes all residual or excess adhesive, sealing and coating compounds, wax, grease or oil films from painted and plastic surfaces, i. e. before installing front or rear spoilers and decor strips.	8984	Â	Â
81 22 9 407 394 (1)	<b>Loctite 380</b> Black cyanacrylate adhesive for joining metals, rubber, PVC.	8155	893 4103	38050
81 22 9 407 524 (1)	Â	1357HP	Â	Â
81 22 9 407 629 (1)	<b>High-Adhesion Lubricant</b> Long-life high-adhesion lubricant for clutch and brake linkages, spring struts, stabilizers, idler levers and pivots.	8878	Â	20029
81 22 9 407 711 (1)	<b>Universal Lube Spray</b> Colorless lubricant with high lubricant content. Eliminates squeaks and grating noises from spring seat bases. Lubricates door stops and locks, seat adjustment mechanism, etc. Resistant to temperatures between -50Â°C and 120Â°C.	8878	893106	20029

(1) These items are no longer available through BMW NA Parts Department.

## 5.0 APPROVED OPERATING FLUIDS SOURCES

### APPROVED OPERATING FLUIDS SOURCES REFERENCE CHART

Group	Description, S. I. Bulletin	Product Name, Source	Telephone
11	Engine Oil, SAE 5W-50	"Syntec FSX" Castrol Inc., Piscataway, NJ	732-980-9100
11	Oxygen Sensor Lubricant	Bostik "Never-Seez" NSBT-16 Bostik Findley, Middleton, MA	888-603-8558
11	Intake& Vacuum System Leak Detector S. I. Bulletin B 11 03 92 (3500)	"LiquiMoly (Lubro Moly) Motor Lecksucher" 2021 W. A. W. D.	800-477-9293
11	Cold Weld Epoxy	"J-B Weld" J-B Weld Company, Sulphur Springs, TX	903-885-7696

	<b>Description, S. I.</b>		
<b>Group</b>	<b>Bulletin</b>	<b>Product Name, Source</b>	<b>Telephone</b>
13	Loctite 290 Throttle Housing Fasteners S. I. Bulletin B 13 06 91 (3440)	"Loctite 290" Kem Krest, Inc., Elkhart, IN	800-285-5917
18	Copper Paste Exhaust System Joints S. I. Bulletin B 18 03 89 (1954)	"8945" 3M Automotive Trades Division, Livonia, MI	800-521-8180
23	Synthetic Transmission Fluid	"Mobil SHC 630" Mobil Oil Corporation	800-582-3645
34	Brake Component Lubricant S. I. Bulletins B 34 02 94&B 34 05 98	Bostik "Never-Seez" NSBT-16 Bostik Findley, Middleton, MA	888-603-8558
36	Loctite 638 (green) Affix wheel hub covers	"Loctite 680" Kem Krest, Inc., Elkhart, IN	800-285-5917
36	Loctite Cleaner 755 Loctite 242 M5 Wheel Covers S. I. Bulletin B 36 03 90 (3182)	"Loctite Cleaning Solvent 755" "Loctite 242" Kem Krest, Inc., Elkhart, IN	800-285-5917
41	Structural Adhesive S. I. Bulletin B 41 01 95 (4150)	"DP420 Epoxy Adhesive with 3M EPX Applicator" 3M Industrial Tapes and Specialties Division, Livonia, MI	800-521-8180
54	Renax GL1	"Poliplex #1" Fuchs Lubricants Corp., Harvey, IL	800-323-7755
61	Rubberized Super Glue	"893 4103" Würth USA, Inc., Ramsey, NJ	800-526-5228
62	Contact Cleaner Spray IC Acoustic Transmitter S. I. Bulletin B 62 04 92 (3539)	"CRC QD Contact Cleaner Spray 5101" CRC Industries, Warminster, PA	800-272-8963
63	Silicone Gasket Material Turn Signals S. I. Bulletin B 63 05 91 (3313)	"Permatex Form-A- Gasket 6B-80627" Kem Krest, Inc., Elkhart, IN	800-285-5917
64	AC System Disinfectant S. I. Bulletin B 64 08 91 (3373)	"Airguard" J. J. Products, Inc., East Orange, NJ	800-654-2356
Â	Â	"Airsept" The Auto Doctor, Tucker, GA	404-662-6778
64	AC System Treatment	"893540-U" Würth USA, Inc., Ramsey, NJ	800-526-5228

#### APPROVED OPERATING FLUIDS SOURCES REFERENCE CHART

<b>Group</b>	<b>Description, S. I.</b>	<b>Product Name, Source</b>	<b>Telephone</b>



Group	Description, S. I.	Product Name, Source	Telephone
97	Brushable Seam Sealer Seals spot-welded, riveted, or bolted seams and joints. Brushable consistency remains flexible. Retains brush marks appearance.	"8901021" Wurth USA, Inc., Ramsey, NJ	800-526-5228
97	Body Seal, Beige Underbody Seal, Black Permanent, flexible protection against stone chipping damage. Fast drying and paintable.	"0892091 U" "0893075 U" Wurth USA, Inc., Ramsey, NJ	800-526-5228
97	Seam Sealer, Grey Fast drying, paintable, silicone-free sealant for special spray gun application.	"0893228 U" Wurth USA, Inc., Ramsey, NJ	800-526-5228
99	Paint Cleaner	"Machine Cleaner 1" and "Hi-Tech Cleaner 2" Meguiar's Inc., Irvine, CA	800-854-8073
99	Machine Glaze	"Mirror Glaze 3" Meguiar's Inc., Irvine, CA	800-854-8073
99	Paint Sealer	"Sealer and Reseal Glaze 7" Meguiar's Inc., Irvine, CA	800-854-8073
99	Paint Swirl Remover	"Hi-Tech Swirl Remover 9" Meguiar's Inc., Irvine, CA	800-854-8073
99	Paint Carnauba Paste Wax	"Hi-Tech Yellow Wax 26" Meguiar's Inc., Irvine, CA	800-854-8073

## 6.0 OPERATING FLUIDS - ADDITIVES

Today's modern oils and fluids for engines, transmissions, differentials or other in-car-systems, as well as premium grade fuels, are already formulated by the manufacturer and/or BMW NA with sophisticated additive packages designed to reduce sludge build-up, keep contaminants in suspension and maintain viscosity of the oil. Additional additives can compromise the manufacturer's or BMW NA's developed formulation.

BMW NA does not endorse or recommend the use of engine oil, fuel, differential oil, transmission oil additives or the use of other additives to any operating fluids, beyond the additives already included in the operating fluid manufacturer's additive package.

The use of engine crankcase flushing detergent chemicals and/or automated crankcase flushing machines is not a BMW recommended procedure and is thus prohibited under the terms of the BMW New Vehicle/SAV Limited Warranty or any other BMW NA administered programs.

Since the inclusion of such additional additives may lead to component damage or compromise the longevity or function of BMW components, warranty coverage may be affected on any component where the failure is likely caused by unapproved oils, operating fluids or add-on additives.



## REMINDER INDICATOR (RESET PROCEDURES)

BMW - 1982-19

### BRAKE PAD REPLACEMENT REMINDER

#### BRAKE PAD REPLACEMENT REMINDER RESET INDEX

Model & Year	Reset Procedure
5-Series	
1997-00 (w/High Inst.Cluster)	<a href="#">Brake Pad Replacement Reminder Reset - Procedure 01</a>
1997-00 (w/Base Inst.Cluster)	<a href="#">Brake Pad Replacement Reminder Reset - Procedure 02</a>
7-Series	
1997-00	<a href="#">Brake Pad Replacement Reminder Reset - Procedure 01</a>
All Appropriate Models	
From 2002-	<a href="#">Brake Pad Replacement Reminder Reset - Procedure 03</a>

#### BRAKE PAD REPLACEMENT REMINDER RESET - PROCEDURE 01

**NOTE:** Perform **PROCEDURE 01** first. If light does not reset, perform **PROCEDURE 02**. If these procedures are not successful, connect vehicle to DIS tester, access Instrument Cluster/IKE, then "clear fault memory".

**NOTE:** For 5-Series, this procedure applies to vehicles with the High Instrument Cluster.

**NOTE:** The base instrument cluster OIL SERVICE INSPECTION display is located on the bottom of the cluster, to the right of center. The base cluster is also equipped with a graphic display of the car that shows if a door or the trunk lid is open. The high instrument cluster OIL SERVICE INSPECTION display is located on the bottom of the cluster, to the left of center.

**NOTE:** Brake pad warning light should go out after replacement of brake pad thickness sensor. If warning light does not go out, turn ignition on, engine off, for 30-45 seconds. Warning light should go out. If the above procedure is not successful, connect vehicle to DIS tester, access Instrument Cluster/IKE, then "clear fault memory".

To reset light after replacing brake pads, turn ignition on with engine off. Wait 30 seconds. Brake pad warning indicator light will switch off.

#### BRAKE PAD REPLACEMENT REMINDER RESET - PROCEDURE 02

**NOTE:** Perform **PROCEDURE 01** first. If light does not reset, perform **PROCEDURE 02**. If the above procedures are not successful, connect vehicle to DIS tester, access Instrument Cluster/IKE, then "clear fault memory".

**NOTE:** For 5-Series, this procedure applies to vehicles with the Base Instrument Cluster.

**NOTE:** The base instrument cluster OIL SERVICE INSPECTION display is located on the bottom of the cluster, to the right of center. The base cluster is also equipped with a graphic display of the car that shows if a door or the

trunk lid is open. The high instrument cluster OIL SERVICE INSPECTION display is located on the bottom of the cluster, to the left of center.

**NOTE:** Brake pad warning light should go out after replacement of brake pad thickness sensor. If warning light does not go out, turn ignition on, engine off, for 30-45 seconds. Warning light should go out. If the above procedure is not successful, connect vehicle to DIS tester, access Instrument Cluster/IKE, then "clear fault memory".

Start engine. Brake pad warning indicator will switch off.

### **BRAKE PAD REPLACEMENT REMINDER RESET - PROCEDURE 03**

**NOTE:** The Condition Based Service (CBS) maintenance jobs can be reset in the car, but it is always recommended to reset the CBS jobs via the diagnosis system. It is only possible to code the statutory intervals specific to individual countries with the diagnosis system.

#### **CBS Reset With Diagnosis System**

**NOTE:** To be able to check and/or correct the car's on-board date properly, the diagnosis system requires the correctly set tester system date! The jobs may only be reset after the service measure has been completed.

**NOTE:** The brake pads can only be reset with a new brake pad wear sensor.

The CBS jobs can be reset via the diagnosis system on the following path:

1. Start diagnosis system.
2. Carry out vehicle identification.
3. Function selection.
4. Service functions.
5. Maintenance.
6. CBS reset.

#### **CBS Reset In The Car**

**NOTE:** A reset is only possible in the car if:

- There is no Check Control message
- Availability of the service job is under 90%
- On-board date must be correctly set

**NOTE:** Resetting of a service job must always be carried out after a maintenance measure has been completed. The resetting process is interrupted if the time is exceeded or if a terminal is changed.

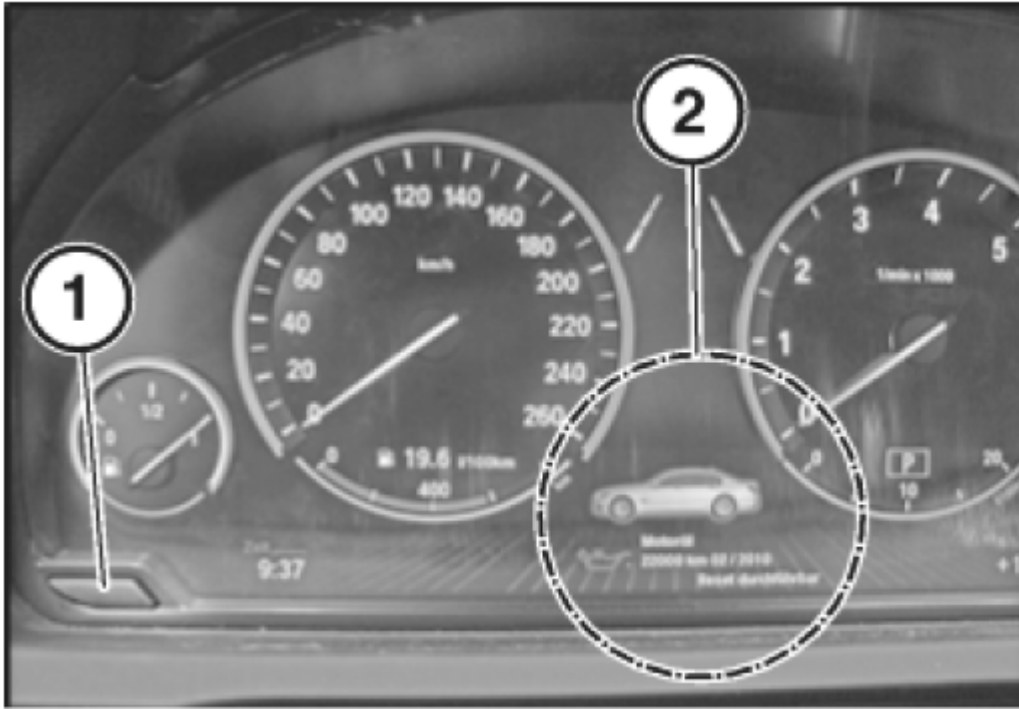
**NOTE:** Service operations can be reset at the instrument panel.

1. Switch the ignition ON.
2. Press the trip distance recorder reset button (1) for approx. 10 seconds until the first service job appears in the display (2). See [Fig. 1](#).
3. Bring up the next item by briefly pressing the reset button again. Select the desired service job.

**NOTE:** If a reset is possible, this is displayed in the instrument panel as "Reset executable".

4. Confirm text message "Execute reset?" by pressing the button for 3 seconds again.

5. The status of the reset is indicated in the display by a progress bar and in text as "Reset running".
6. The reset is confirmed after completion as "Reset successful".



**Fig. 1: Identifying Reset Button & Service Job Display.**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### CBS Reset Of Inspections/Tests Required By Law

The input of the target date for the statutory deadlines (vehicle inspection/exhaust-gas test) is done by clicking on the scope with the controller in the CBS menu of the control display.

- Select main menu and press controller
- Select vehicle information and press controller
- Select vehicle status and press controller
- Select Service requirements and press controller
- Select vehicle inspection and press controller
- Select Schedule date for service and press controller
- The target month or the target year can be set and acknowledged by turning and pressing

## EMISSIONS MAINTENANCE REMINDER

**NOTE:** To determine the appropriate reset procedure, refer to **EMISSIONS MAINTENANCE REMINDER RESET INDEX**. Only vehicles listed in this index have an Oxygen Sensor Warning Light.

### EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
All Models	
1983 & Earlier	<a href="#">Emissions Maintenance Reminder Reset - Procedure 01</a>
1984 & Later	<a href="#">Emissions Maintenance Reminder Reset - Procedure 02</a>

### EMISSIONS MAINTENANCE REMINDER RESET - PROCEDURE 01

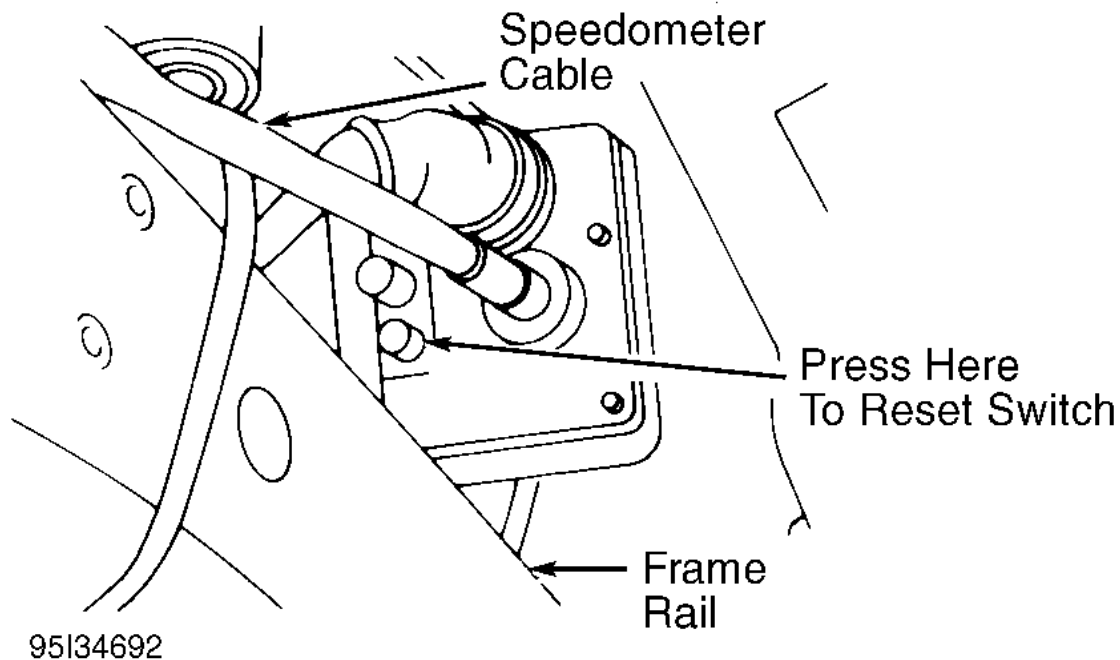
**NOTE:** Most vehicles are equipped with a Malfunction Indicator Light (MIL) or check engine light. If light comes on and remains on while driving, the vehicle requires some type of repair. See appropriate service and repair information. After repairing fault(s) and clearing fault code(s), the Malfunction Indicator Light (MIL) or check engine light should go out. Some models may use a dual-function indicator light, which is also used

to indicate emission component service is due. After performing required service, reset indicator light.

1. Every 30, 000 miles (25, 000 miles on 528i) the Oxygen Sensor Warning light in dash will come on as a reminder to replace the oxygen sensor.

**NOTE:** On 528e models, pull the protective metal plate off before removing oxygen sensor.

2. On 528e models, no interval reset switch is provided. After replacing sensor, remove instrument panel. Remove and discard bulb for OXYGEN sensor light.
3. On all other models, trace speedometer cable to interval switch (in-line with cable, mounted on frame rail left of transmission). Press White reset button. See [Fig. 2](#). Ensure warning light is out.



**Fig. 2: Locating Oxygen Sensor Warning Light Reset Switch (All BMW Models Before 1983)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **EMISSIONS MAINTENANCE REMINDER RESET - PROCEDURE 02**

**NOTE:** Most vehicles are equipped with a Malfunction Indicator Light (MIL) or check engine light. If light comes on and remains on while driving, the vehicle requires some type of repair. See appropriate service and repair information. After repairing fault(s) and clearing fault code(s), the Malfunction Indicator Light (MIL) or check engine light should go out. Some models may use a dual-function indicator light, which is also used to indicate emission component service is due. After performing required service, reset indicator light.

**NOTE:** Some late production (February 1985 and later) BMW models have a reset button on rear of the light control assembly located near pedal assembly. Press button to reset light after servicing oxygen sensor.

No reset switch is provided. When oxygen sensor light comes on, service oxygen sensor. Remove and discard bulb from indicator.

### **MAINTENANCE SERVICE REMINDER**



**NOTE:** This is sometimes referred to as the "Oil Change Light" or "Oil Service Light".

**NOTE:** To determine the appropriate reset procedure, refer to [MAINTENANCE SERVICE REMINDER RESET INDEX](#). Only vehicles listed in this index have a service interval reminder.

#### MAINTENANCE SERVICE REMINDER RESET INDEX

Model & Year	Reset Procedure
Models With Engine Compartment Diagnostic Connector	
1983-05	<a href="#">Maintenance Service Reminder Reset - Procedure 01</a>
Models Without Engine Compartment Diagnostic Connector	
2001-05	<a href="#">Maintenance Service Reminder Reset - Procedure 02</a>
Models Without Condition Based Service (CBS) Interval System	
2004-05	<a href="#">Maintenance Service Reminder Reset - Procedure 03</a>
Models With Condition Based Service (CBS) Interval System	
2002-06	<a href="#">Maintenance Service Reminder Reset - Procedure 04</a> or <a href="#">Maintenance Service Reminder Reset - Procedure 06</a>
2007-18	<a href="#">Maintenance Service Reminder Reset - Procedure 05</a> or <a href="#">Maintenance Service Reminder Reset - Procedure 06</a>

#### MAINTENANCE SERVICE REMINDER RESET - DESCRIPTION

The service indicator can only be reset using the reset mode in the instrument cluster or by using BMW hardware. This procedure applies to 3-Series from production date 9/99, and 5-Series and 7-Series from production date 9/00 (except 2002-05 7-Series and 2004-05 5-Series) without an engine compartment diagnostic connector.

- On models that still use the round diagnostic connector in engine compartment, use SIA reset tool to reset service lights. See [MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 01](#).
- On models without the round diagnostic connector in the engine compartment, the use of the SIA reset tool is not possible. See [MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 02](#).
- For 2002-up models with condition based service (CBS) interval system reset procedure, see [MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 03](#).

Starting in 1983 and ending on some models in 1999, service indicator on instrument panel consists of 5 Green, 3 Red and one Yellow Light Emitting Diodes (LED) and the inscriptions OIL SERVICE and INSPECTION. When ignition is on, as many as 5 Green LEDs will light up. The Green LEDs go out when the engine is started. If the Yellow LED glows and one of the inscriptions comes on and remains on when the engine is started, maintenance service is due immediately. When maintenance interval has been exceeded (after approximately 1000 miles) the Red LED's will come on in addition to the Yellow LED as a reminder for servicing.

Beginning on some models in 1999, a new method for displaying the service interval is used. Colored LEDs are no longer used to display the amount of time until the next service or inspection is due. The actual mileage remaining until the next service will be displayed for five seconds when the ignition is first switched on. The text OIL SERVICE or INSPECTION will also illuminate to show which service is due. A minus symbol (-) before the mileage display indicates that a service is past due.

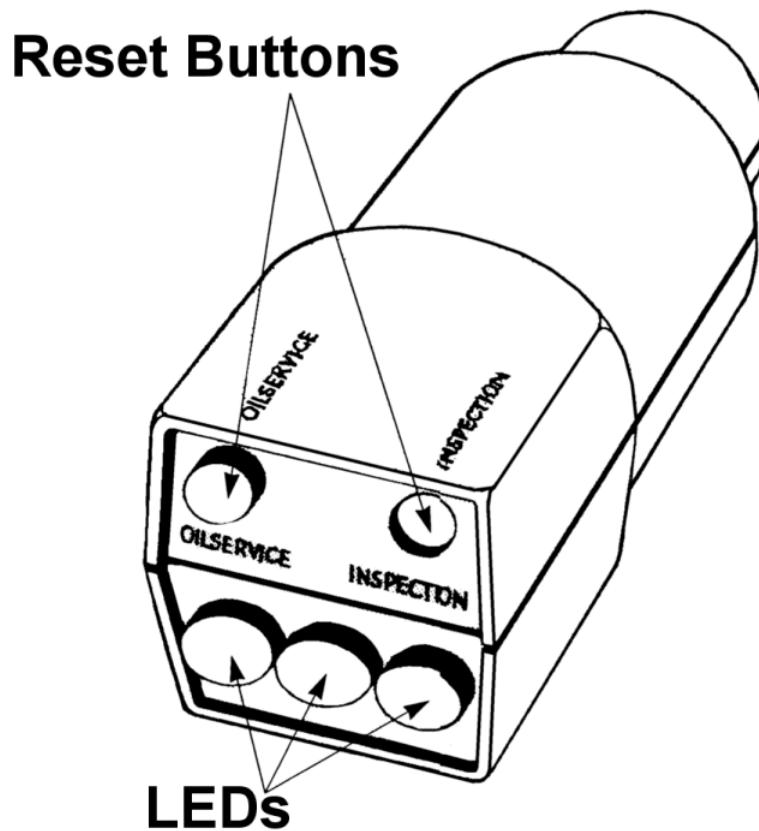
#### MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 01

**NOTE:** This procedure is for models with an engine compartment diagnostic connector.

1. To reset instrument cluster SIA OIL SERVICE indicator, turn ignition switch to ON position. Connect Service Indicator Resetter (62 1 110) to diagnosis connector in engine compartment. See

**Fig. 3.**

2. Press Yellow OIL SERVICE button. Green LED will illuminate. Wait until Yellow LED illuminates and then goes out again. Ensure that OIL SERVICE indicator has been reset.
3. To reset SERVICE INTERVAL indicator, press Red INSPECTION service button for inspection. Green LED illuminates. Wait until Red LED illuminates and then goes out again. Turn ignition switch to OFF position, wait 20 seconds and repeat procedure in order to adapt interval of annual inspection to inspection. Ensure that SERVICE INTERVAL indicator has been reset.



**Fig. 3: Identifying BMW Service Interval Reset Tool**

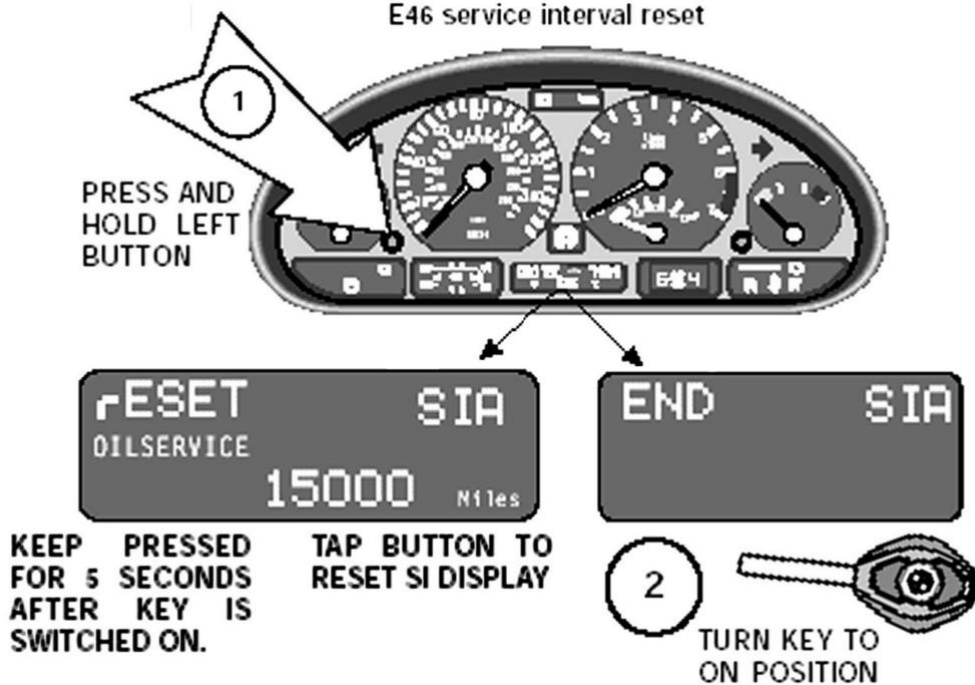
Courtesy of BMW OF NORTH AMERICA, INC.

**MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 02**

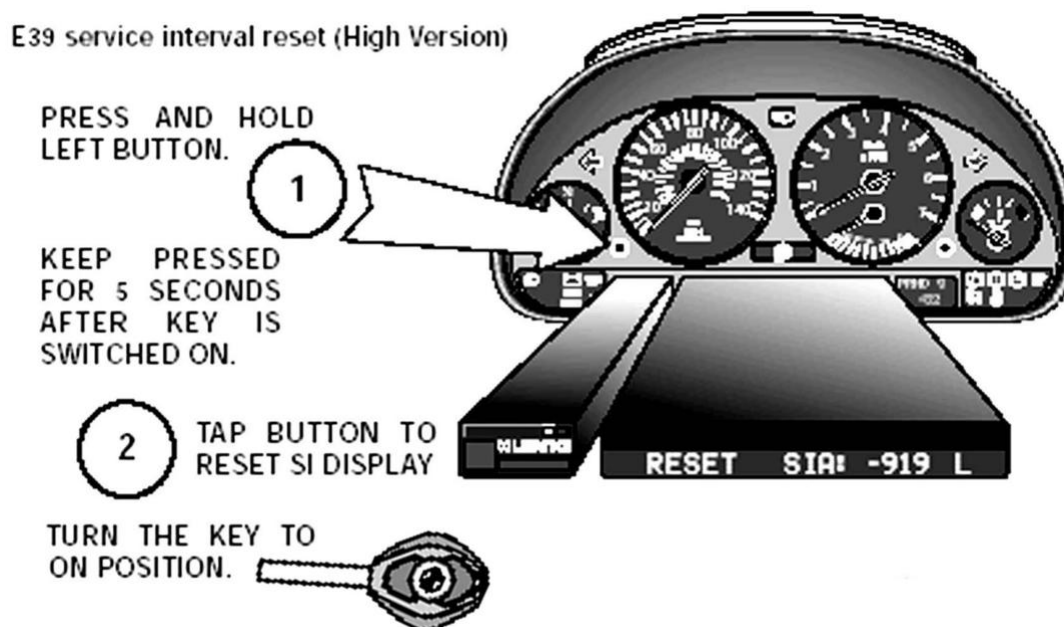
**NOTE:** This procedure is for models without an engine compartment diagnostic connector.

Reset service light by performing the following:

1. Ignition key must be in OFF position.
2. Press and hold trip odometer reset button in the instrument cluster (left button), and turn ignition key to first position.
3. Keep the button pressed for approximately 5 seconds until one of the following words appear in the display: "OIL SERVICE", or "INSPECTION", with "RESET".
4. Release reset button and press it again until "RESET" begins to flash in the display. See [Fig. 4](#) and [Fig. 5](#).
5. Service due is shown with "RESET" if coded minimum consumption limit has been reached and resetting is possible. If "RESET" is not shown, minimum limit has not been reached and resetting is not possible.
6. While "RESET" is flashing, press left button briefly to reset service interval. After display has shown new interval, following will appear: "END SIA".
7. System can only be reset again after 2.5 gallons of fuel have been consumed.



**Fig. 4: Resetting Service Interval Light (E46)**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 5: Resetting Service Interval Light (E39)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 03**

**NOTE:** This procedure is for models without a Condition Based Service (CBS) Interval System.

The BMW maintenance system SIA IV (service interval indicator) is used on X3 models (E83). The service interval indicator is a system subject to constant development which in its development stages has been integrated in various model series such as E85 (Z4) and E46 (3 and M3-Series).

The service indicator appears in the LC display in the instrument cluster's speedometer. The indicator is shown for 5 seconds in the LC display after terminal R is "ON". See [Fig. 6](#).



**Fig. 6: Identifying Service Interval Indicator**

Courtesy of BMW OF NORTH AMERICA, INC.

### Resetting Service Interval Indicator

Resetting the service interval indicator for the oil service and inspection procedures can only be done by pressing the left button (1) in the instrument cluster. See [Fig. 7](#).



1. Button for Reset of Trip Odometer, Time, and Service Interval
2. Button For Display of Time and Service Interval

**Fig. 7: Identifying Service Interval Indicator Reset Button**

Courtesy of BMW OF NORTH AMERICA, INC.

### **MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 04**

**NOTE:** This procedure is for models with a Condition Based Service (CBS) Interval System.

**NOTE:** On some models an appropriate scan tool may be used to reset CBS service schedules. By using suitable diagnostic equipment connected to the vehicle diagnostic connector it is possible to reset CBS service schedules at any time. By selecting the `CBS' option, the diagnostic equipment will gather information regarding the current state of CBS items from their relevant modules on the CAN network. See [PROCEDURE 06](#).

**NOTE:** Use this procedure on vehicles with an instrument panel like the ones shown in [Fig. 8](#), [Fig. 9](#), or [Fig. 10](#). If vehicle has an instrument panel like the one shown in [Fig. 11](#), see [PROCEDURE 05](#).

Models using a Condition Based Service (CBS) service interval system, which displays a Service Need Display (SND). When ignition is on, Service Need Display appears under the speedometer in the instrument cluster for 10 seconds in the place where the fuel tank level is normally displayed. The first

line corresponds to the mileage dependent service items. It specifies the mileage when the next service is due.

If the mileage is exceeded (service overdue), it appears with a minus sign. The second line corresponds to the time dependent service items and is displayed by a clock symbol. It specifies the weeks/months/years when the next service is due. If the service is overdue, it appears with a minus sign. The actual service item (with additional information) can be viewed in the control display.

Service reset is accomplished using instrument cluster:

1. Insert key into ignition.
2. Press ignition start/stop button without depressing the clutch or brake, and wait for the service reminder to disappear.
3. Immediately after the service reminder indicator goes out, press and hold the odometer reset button or stalk. After 3 secs a warning triangle will appear, keep the odometer button pressed and after another 2-3 secs an oil can will appear.

**NOTE:** If the odometer button is pressed too long (10 secs in total), German writing will appear (giving the software level/ can bus etc. of the vehicle). This indicates that you've overshoot the reset procedure and you need to re-start from the beginning.

4. The service menu should now be displayed. Use the button (twist if the switch is a stalk - or if a button, tap repeatedly) to scroll up/down through the various service items.

**NOTE:** On newer models, it may be the rocker/toggle switch on the turn indicator lever that is used to scroll up/down through the various service items. See [Fig. 10](#).

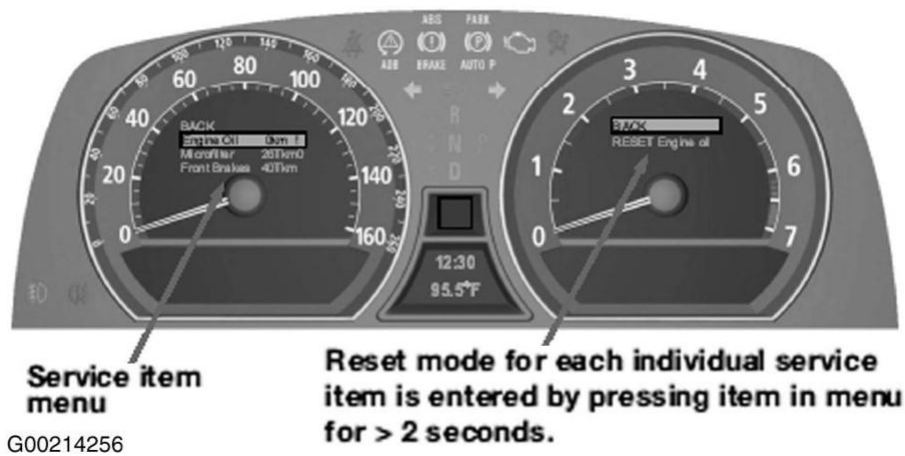
5. When the item to be reset is showing, press the BC button on end of turn indicator lever. "Reset" should now appear in the display. Press in and hold the BC button for 2-3 secs and a whirling clock icon will be displayed. The reset procedure for the selected service item is done.
6. Scroll up/down to select another item (as in step 4), or press the ignition start/stop button to exit.

**NOTE:** Residual wear or remaining time are specified (possibly with a minus sign). The "1" symbol means that you can reset service operation (early production vehicles may show an "F"), while a "0" indicates it is not resettable (the first 20 percent of the service interval is also protected against accidental reset). For additional information about Condition Based Service (CBS), see [RESETTING AND CORRECTING CONDITION BASED SERVICE](#) under PROGRAMMING in SELF-DIAGNOSIS - 7-SERIES article.

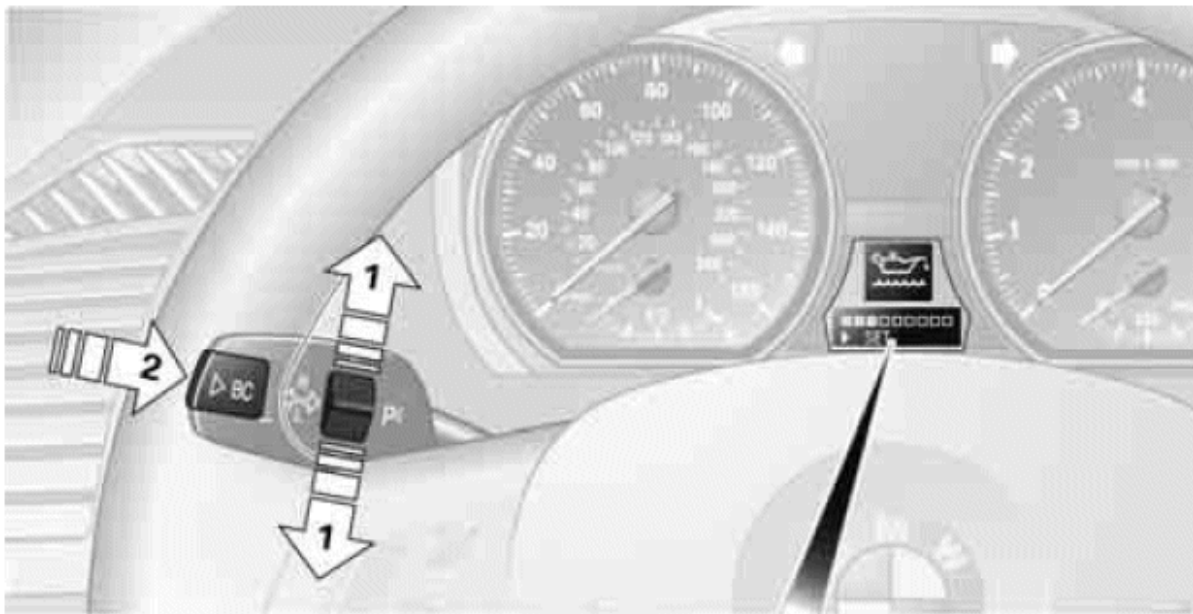


**Fig. 8: Identifying Condition Based Service (CBS) Instrument Panel Controls (Typical)**  
Courtesy of BMW OF NORTH AMERICA, INC.





**Fig. 9: Identifying Condition Based Service (CBS) Instrument Panel Controls (Typical)**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**1 Button for:**

- ▷ Selecting display
- ▷ Setting values

**2 Button for:**

- ▷ Confirming selected display or set values
- ▷ Calling up computer information

**Fig. 10: Identifying Condition Based Service (CBS) Instrument Panel Controls (Typical)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 05**

**NOTE:**

On some models an appropriate scan tool may be used to reset CBS service schedules. By using suitable diagnostic equipment connected to the vehicle diagnostic connector it is possible to reset CBS service schedules at any time. By selecting the `CBS' option, the diagnostic equipment will gather information regarding the current state of CBS items from their relevant modules on the CAN network. See [PROCEDURE 06](#).

**NOTE:**

Use this procedure on vehicles with an instrument panel like the one shown in [Fig. 11](#). If vehicle has an instrument panel like the ones shown in [Fig. 8](#), [Fig. 9](#), or [Fig. 10](#), see [PROCEDURE 04](#)

On-the-vehicle service operations can be reset at the instrument panel.

**NOTE:**

**A reset is only possible in the car if:**

- There is no Check Control message

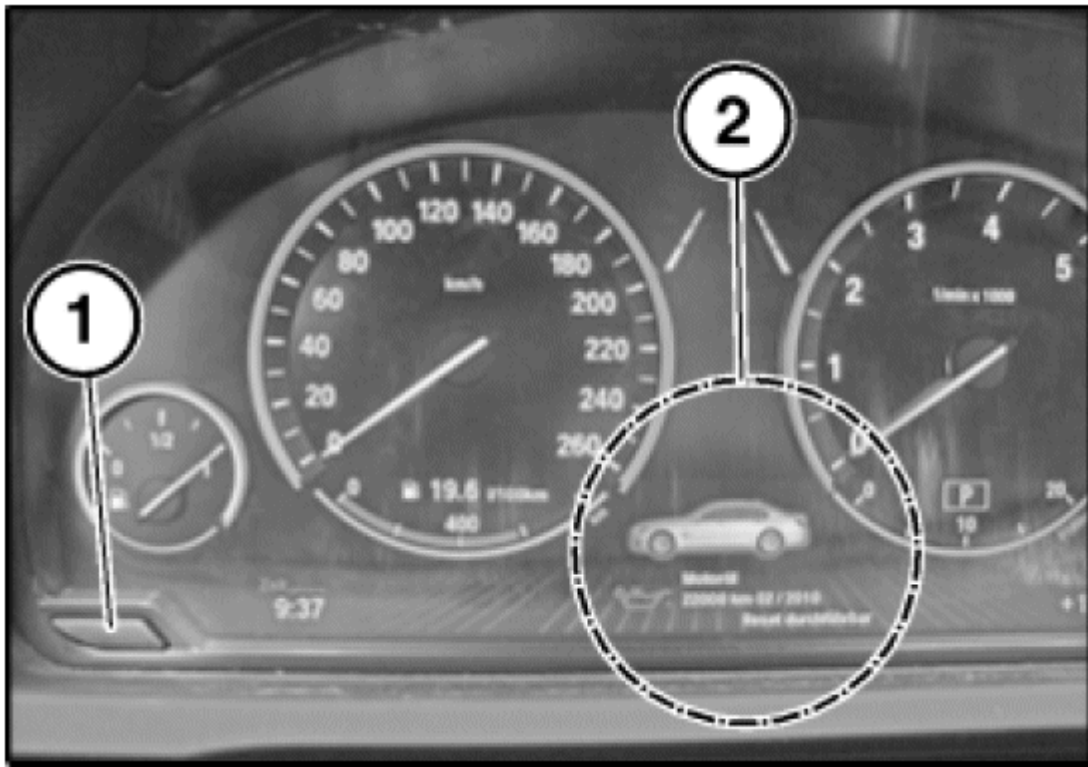


- Availability of the service job is under 90%
- On-board date must be correctly set

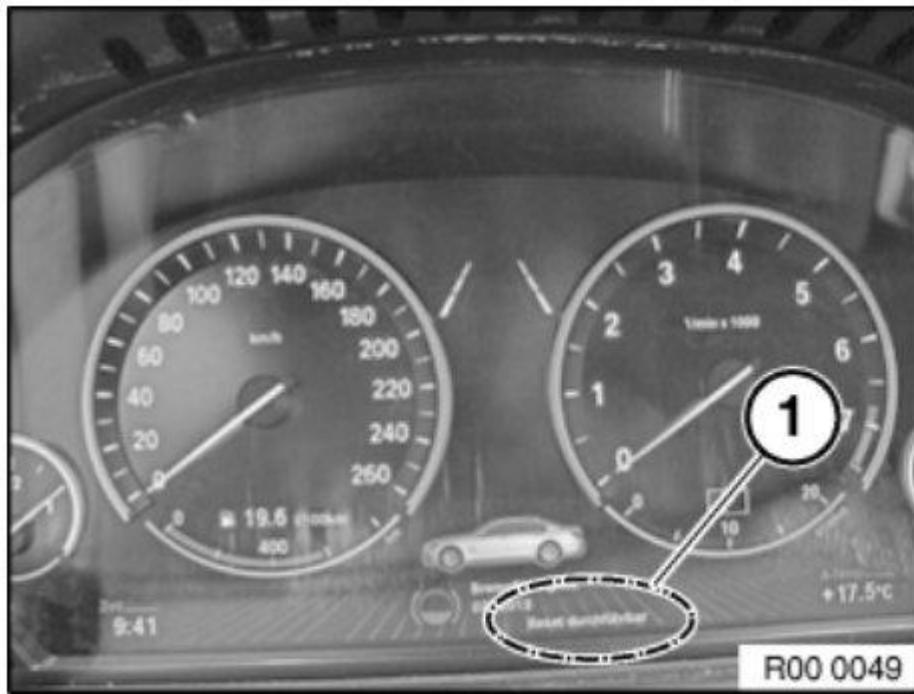
**NOTE:** Resetting of a service job must always be carried out after a maintenance measure has been completed.

**IMPORTANT:** If engine oil and vehicle check are reset at the same time, always reset engine oil first.

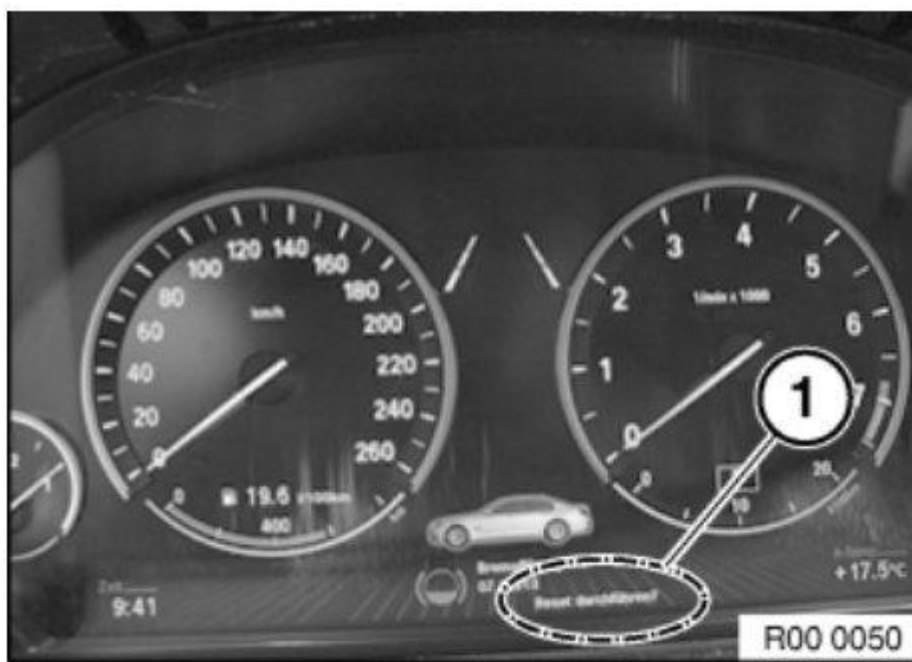
1. Switch the ignition on.
2. Press the odometer reset button (1) until the 1st service job appears in the display (2) - 6 to 10 seconds. See [Fig. 11](#).
3. Bring up the next item by briefly pressing the button again.
4. Select the desired service job.
5. If a reset is possible, this is displayed in the instrument panel as "Reset executable". See [Fig. 12](#).
6. Start the reset by pressing the button for 3 seconds.
7. Confirm text message "Execute reset?" by pressing the button for 3 seconds again. See [Fig. 13](#).
8. The status of the reset is indicated in the display by a progress bar and in text as "Reset running". See [Fig. 14](#).
9. The reset is confirmed after completion as "Reset successful". See [Fig. 15](#).



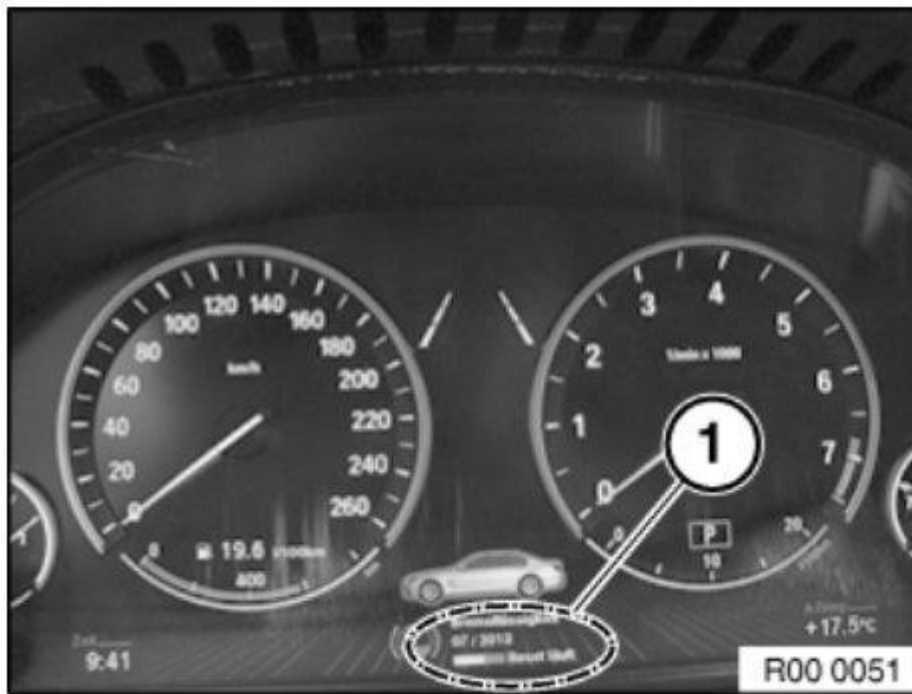
**[Fig. 11: Identifying Condition Based Service \(CBS\) Instrument Panel Controls & Display \(1 of 5\)](#)**  
Courtesy of BMW OF NORTH AMERICA, INC.



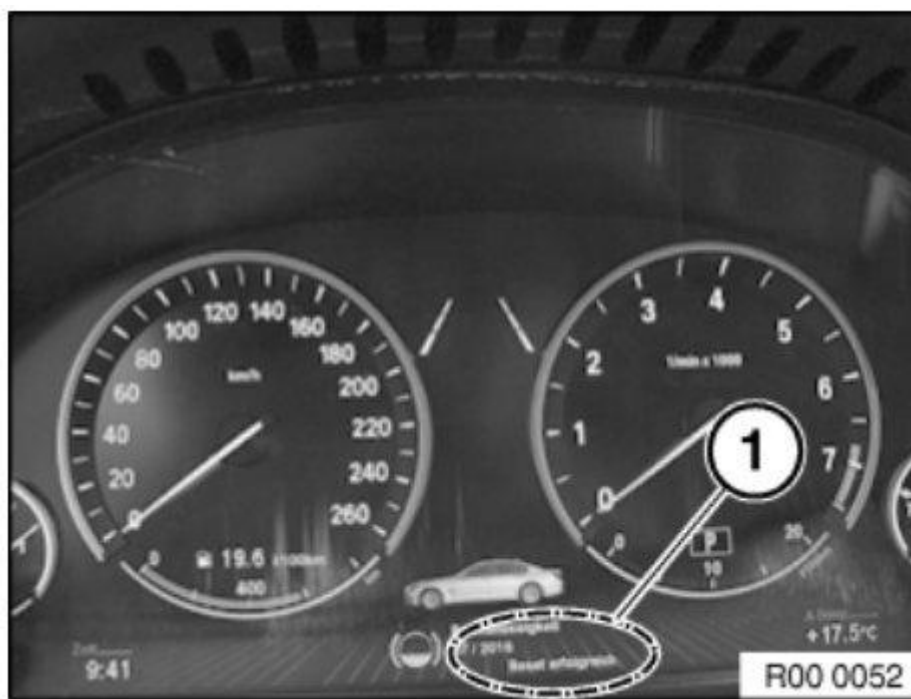
**Fig. 12: Identifying Condition Based Service (CBS) Instrument Panel Controls & Display (2 of 5).**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 13: Identifying Condition Based Service (CBS) Instrument Panel Controls & Display (3 of 5).**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 14: Identifying Condition Based Service (CBS) Instrument Panel Controls & Display (4 of 5)**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 15: Identifying Condition Based Service (CBS) Instrument Panel Controls & Display (5 of 5)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 06**

**NOTE:** This procedure is for Condition Based Service (CBS) reset using the BMW diagnosis system.

The 2002-12 models with condition based service (CBS) interval system uses an entirely different service interval system. See [PROCEDURE 04](#).

**IMPORTANT:** Although the CBS maintenance jobs can be reset using in-car controls, it is recommended that the reset procedure be done via the diagnosis system. It is only possible to code the statutory intervals specific to individual countries with the diagnosis system.

**IMPORTANT:** To be able to check and/or correct the car's on-board date properly, the diagnosis system requires the correctly set tester system date.

The jobs may only be reset after the service measure has been completed.

The brake pads can only be reset with a new brake pad wear sensor.

The CBS jobs can be reset via the diagnosis system on the following path:

- Start diagnosis
- Carry out vehicle identification
- Function Selection
- Service Functions
- Maintenance
- CBS Reset

## TIRE PRESSURE MONITOR SYSTEM REMINDER

**NOTE:** If a tire pressure has been adjusted, or a wheel or tire has been changed or replaced, or repairs have been made to air spring suspension, the TPM system must be reinitialized. System must be reinitialized both before and after pulling a trailer.

**CAUTION:** When driving with snow chains or a space-saver spare tire, DO NOT initialize the system.

**NOTE:** To determine the appropriate reset procedure, refer to [TIRE PRESSURE MONITOR SYSTEM REMINDER INDEX](#). Only vehicles listed in this index have a TPMS reset.

### TIRE PRESSURE MONITOR SYSTEM REMINDER INDEX

Model & Year	Reset Procedure
1-Series	
2008	<a href="#">TPMS Reminder Reset - Procedure 06</a>
2009-13	<a href="#">TPMS Reminder Reset - Procedure 07</a>
2-Series	
2014-17	<a href="#">TPMS Reminder Reset - Procedure 07</a>
2019	<a href="#">TPMS Reminder Reset - Procedure 08</a>
3-Series	
2001-08	<a href="#">TPMS Reminder Reset - Procedure 01</a>
2009-17	<a href="#">TPMS Reminder Reset - Procedure 07</a>
2019	<a href="#">TPMS Reminder Reset - Procedure 08</a>
4-Series	
2014-17	<a href="#">TPMS Reminder Reset - Procedure 07</a>
2019	<a href="#">TPMS Reminder Reset - Procedure 08</a>
5-Series	
2001-03	<a href="#">TPMS Reminder Reset - Procedure 01</a>
2004-09	<a href="#">TPMS Reminder Reset - Procedure 06</a>
2010-17	<a href="#">TPMS Reminder Reset - Procedure 07</a>
2019	<a href="#">TPMS Reminder Reset - Procedure 08</a>
6-Series	
2004-09	<a href="#">TPMS Reminder Reset - Procedure 06</a>
2010-17	<a href="#">TPMS Reminder Reset - Procedure 07</a>
2019	<a href="#">TPMS Reminder Reset - Procedure 08</a>
7-Series	
2002-05	<a href="#">TPMS Reminder Reset - Procedure 02</a>
2006-17	<a href="#">TPMS Reminder Reset - Procedure 07</a>
2019	<a href="#">TPMS Reminder Reset - Procedure 08</a>

<b>Model &amp; Year</b>	<b>Reset Procedure</b>
<b>ActiveHybrid Series</b>	
2012-16	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
<b>Alpina</b>	
2007-08	<a href="#"><u>TPMS Reminder Reset - Procedure 04</u></a>
2011-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>i-Series</b>	
2014-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>M2</b>	
2014-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>M3</b>	
2001-06	<a href="#"><u>TPMS Reminder Reset - Procedure 01</u></a>
2008	<a href="#"><u>TPMS Reminder Reset - Procedure 06</u></a>
2009-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>M4</b>	
2016-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>M5</b>	
2002-03	<a href="#"><u>TPMS Reminder Reset - Procedure 03</u></a>
2006-08	<a href="#"><u>TPMS Reminder Reset - Procedure 06</u></a>
2009-16	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>M6</b>	
2006-07	<a href="#"><u>TPMS Reminder Reset - Procedure 06</u></a>
2008-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>M7 (760i)</b>	
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>M-Coupe &amp; M-Roadster</b>	
2006-08	<a href="#"><u>TPMS Reminder Reset - Procedure 05</u></a>
<b>X1</b>	
2013-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>X2</b>	
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>X3</b>	
2004-10	<a href="#"><u>TPMS Reminder Reset - Procedure 05</u></a>
2011-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>X4</b>	
2015-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>X5 &amp; X5 M</b>	
2001-05	<a href="#"><u>TPMS Reminder Reset - Procedure 01</u></a>
2006	<a href="#"><u>TPMS Reminder Reset - Procedure 05</u></a>
2007-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>
2019	<a href="#"><u>TPMS Reminder Reset - Procedure 08</u></a>
<b>X6 &amp; X6 M</b>	
2008-17	<a href="#"><u>TPMS Reminder Reset - Procedure 07</u></a>



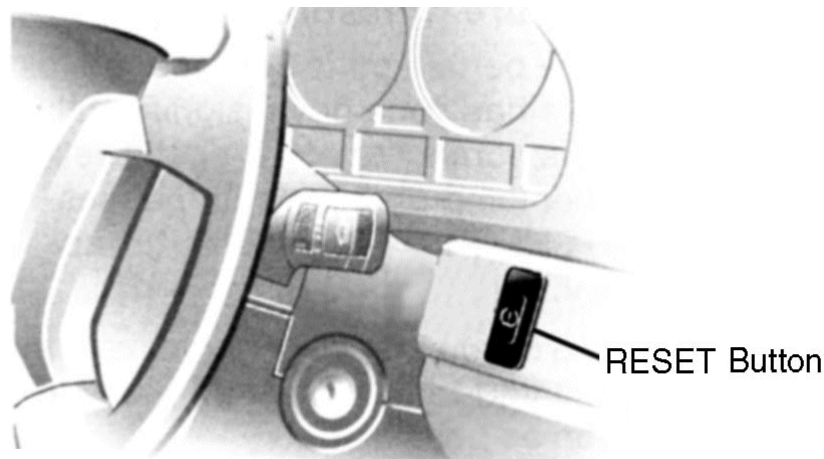
Model & Year	Reset Procedure
2019	<a href="#">TPMS Reminder Reset - Procedure 08</a>
Z3	
2001-02	<a href="#">TPMS Reminder Reset - Procedure 01</a>
Z4	
2003-06	<a href="#">TPMS Reminder Reset - Procedure 01</a>
2007-08	<a href="#">TPMS Reminder Reset - Procedure 05</a>
2009-16	<a href="#">TPMS Reminder Reset - Procedure 07</a>
Z8	
2001-03	<a href="#">TPMS Reminder Reset - Procedure 01</a>

### TPMS REMINDER RESET - PROCEDURE 01

1. Set the tire pressure on all wheels to specification.
2. Turn ignition switch to ON position, with engine off.
3. Press reset button (for no longer than 10 seconds) until tire pressure warning light illuminates Yellow for a few seconds. See [Fig. 16](#), [Fig. 17](#), [Fig. 18](#), or [Fig. 22](#) .

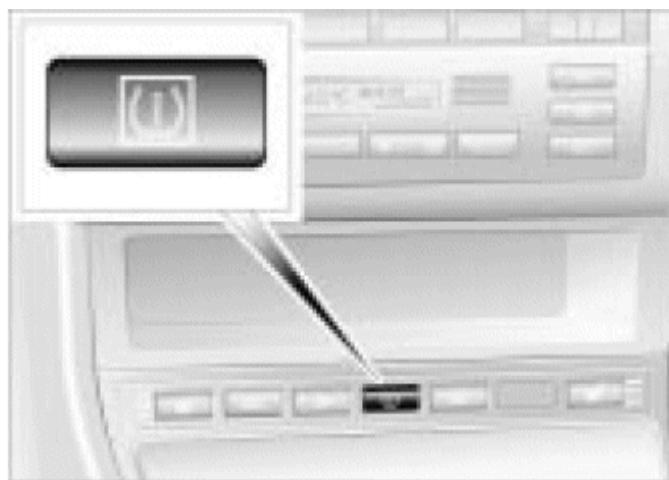
**NOTE:** On some X5 models, the reset button is marked "RDC".

4. Drive vehicle. Initialization is automatically completed during the drive, without any feedback issued.



**[Fig. 16: Locating TPM System Reset Button \(5-Series\)](#)**

Courtesy of BMW OF NORTH AMERICA, INC.

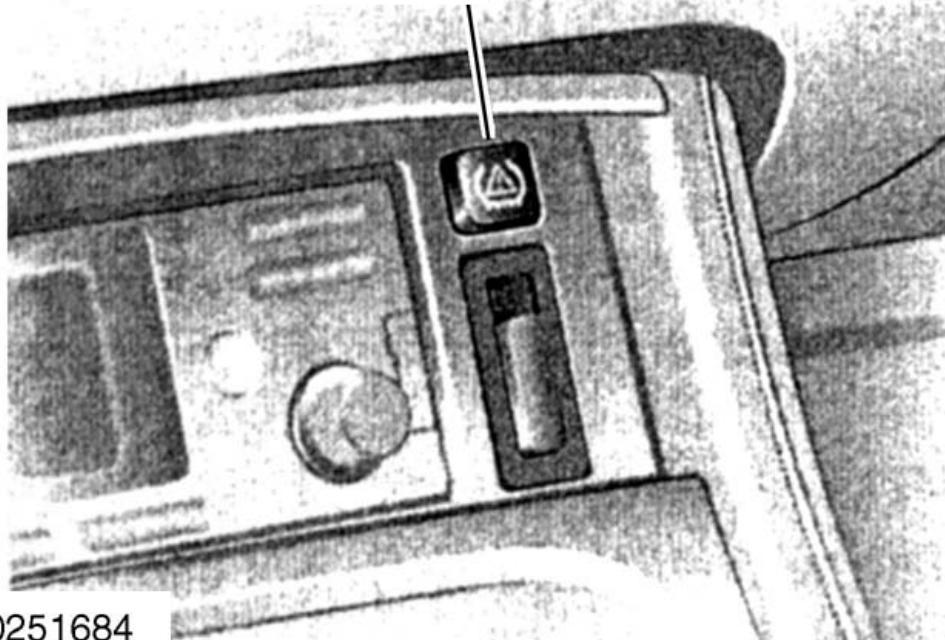


**[Fig. 17: Locating TPM System Reset Button \(3-Series & X5 - Typical\)](#)**

Courtesy of BMW OF NORTH AMERICA, INC.



## Reset Button



G00251684

**Fig. 18: Locating TPM System Reset Button (Z8).**  
Courtesy of BMW OF NORTH AMERICA, INC.

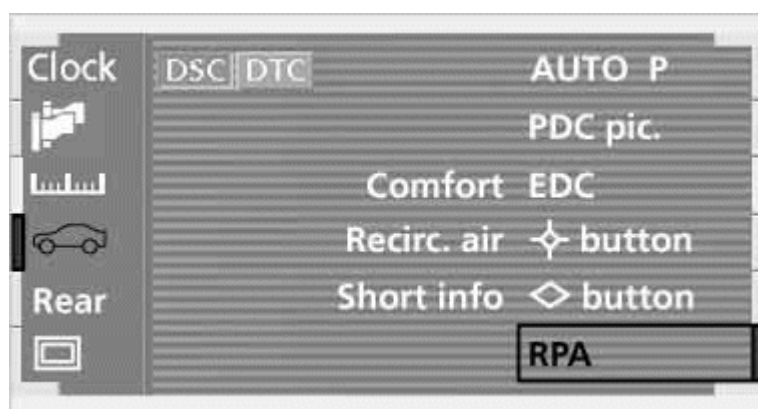
### **TPMS REMINDER RESET - PROCEDURE 02**

**NOTE:** The initialization finishes during driving, which can be interrupted at any time. When driving resumes, the initialization is continued automatically.

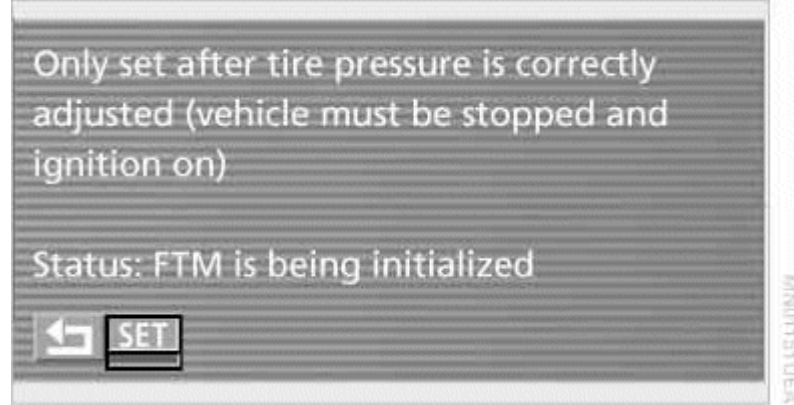
1. Set the tire pressure of all wheels to specification.
2. Start engine, but do not start driving.
3. On Control Center, select "RPA" from the "SETTINGS" menu and confirm selection. The initialization menu will appear. See [Fig. 19](#).
4. Select "SET" and confirm selection.
5. Drive vehicle. The message "FTM IS BEING INITIALIZED" will be displayed. See [Fig. 20](#).

**NOTE:** It takes at least 10 minutes before the TPM system can detect and report a flat tire.

6. Select counterclockwise left arrow button and confirm to exit from menu.



**Fig. 19: Identifying TPM System Reinitialization Messages (1 Of 2).**  
Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 20: Identifying TPM System Reinitialization Messages (2 Of 2)**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **TPMS REMINDER RESET - PROCEDURE 03**

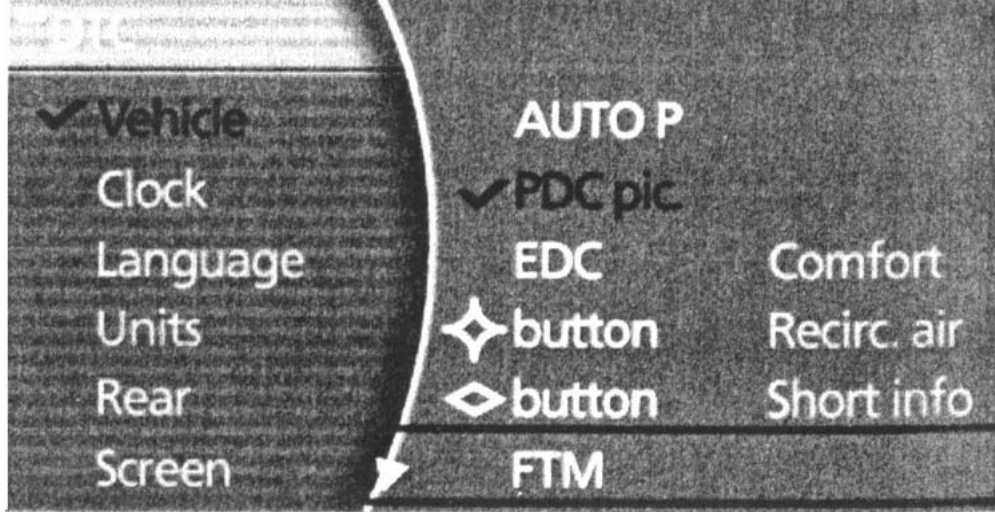
**NOTE:** The initialization finishes during driving, which can be interrupted at any time. When driving resumes, the initialization is continued automatically.

1. Set the tire pressure of all wheels to specification.
2. Start the engine.
3. Press iDrive knob down once to enter Vehicle Info.
4. Select Settings.
5. Select Vehicle Tires.
6. Select TPM.
7. Select Reset.
8. Scroll to Yes.
9. Select "YES" and press the controller.
10. After selecting Yes, drive vehicle until tires on iDrive screen turn green.

### **TPMS REMINDER RESET - PROCEDURE 04**

**NOTE:** The initialization finishes during driving, which can be interrupted at any time. When driving resumes, the initialization is continued automatically.

1. Set the tire pressure of all wheels to specification.
2. Press "MENU" button to open start menu.
3. Open the i-menu of the Control Center.
4. Select "SETTINGS" and press the controller.
5. Select "VEHICLE" and press the controller. See [Fig. 21](#).
6. Select "TIRES: TPM" and press controller.
7. Start engine, but do not start driving.
8. Select "RESET" and press the controller.
9. Select "YES" and press the controller.
10. Drive vehicle. The message "RESETTING TPM...." will be displayed. Initialization is automatically completed during the drive. When initialization is complete, "STATUS: TPM ACTIVE" message will be displayed.

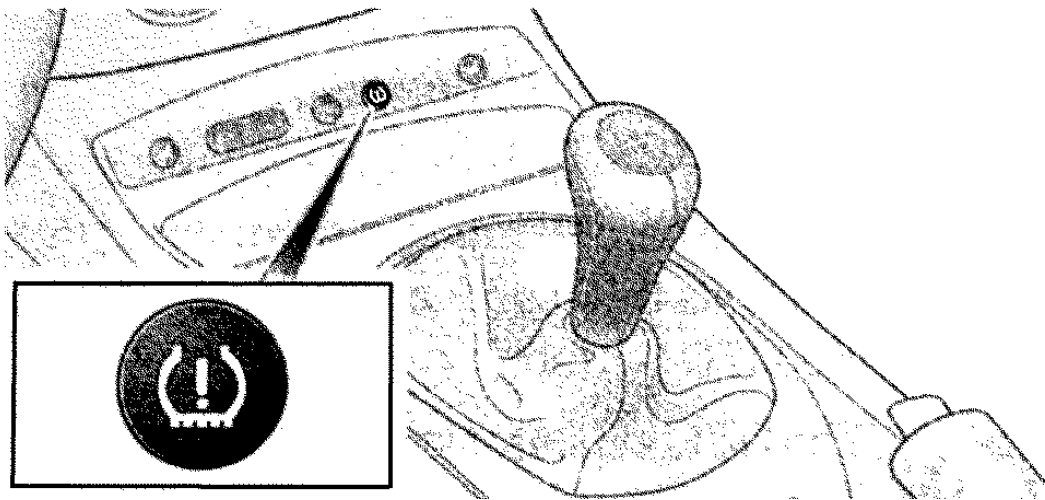


**Fig. 21: Identifying TPM System Reinitialization Messages**  
 Courtesy of BMW OF NORTH AMERICA, INC.

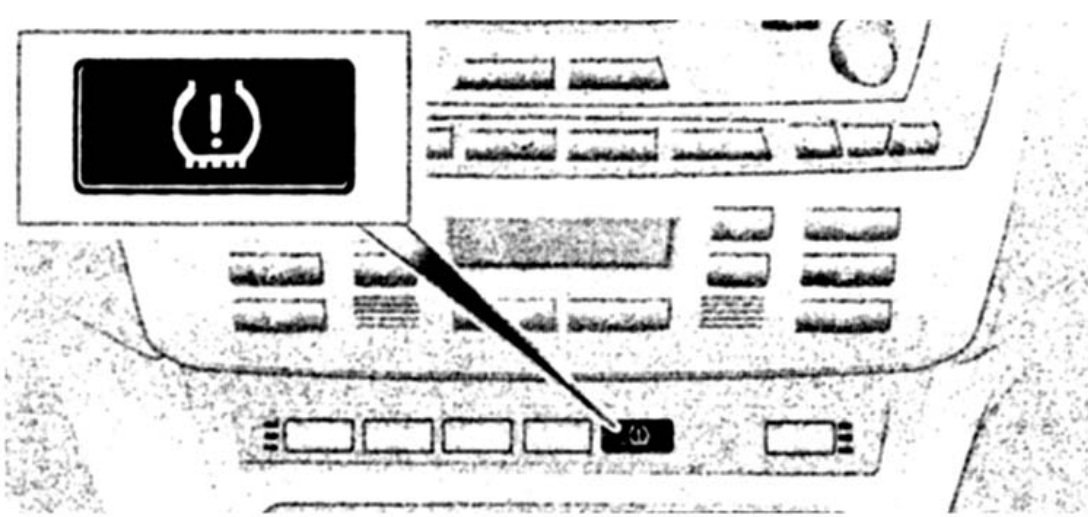
**TPMS REMINDER RESET - PROCEDURE 05**

**CAUTION:** When driving with snow chains or a space-saver spare tire, DO NOT initialize the system.

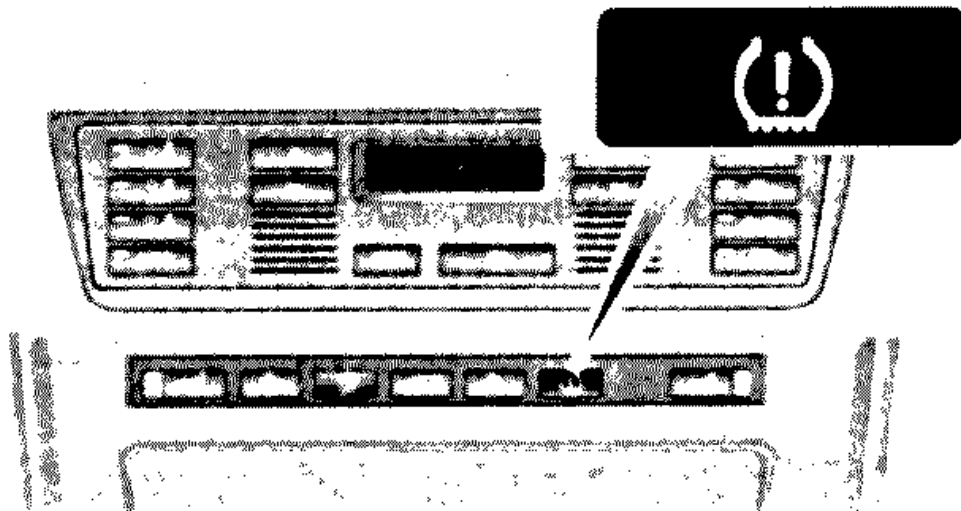
1. Set the tire pressure of all wheels to specification.
2. Start engine, but do not start driving.
3. Press reset button (for no longer than 10 seconds) until tire pressure warning light illuminates Yellow for a few seconds. See [Fig. 22](#), [Fig. 23](#) or [Fig. 24](#) .
4. Drive vehicle. Initialization is automatically completed during the drive, without any feedback issued.



**Fig. 22: Locating TPM System Reset Button (Z4, M-Coupe & Roadster)**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 23: Locating TPM System Reset Button (X3).**  
 Courtesy of BMW OF NORTH AMERICA, INC.



**Fig. 24: Locating TPM System Reset Button (X5).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **TPMS REMINDER RESET - PROCEDURE 06**

### **Resetting TPM With iDrive**

1. Set the tire pressure of all wheels to specification.
2. Turn ignition switch ON.
3. Press controller to call up I menu. See [Fig. 25](#).
4. Select SETTINGS and press controller.
5. Select CAR/TIRES and press controller.
6. If necessary, switch to top field and select TIRES/RDC and press controller.
7. Start engine.
8. Select CONFIRM TIRE PRESSURE and press controller.
9. Drive vehicle. Initialization is automatically completed during the drive, without any feedback issued.

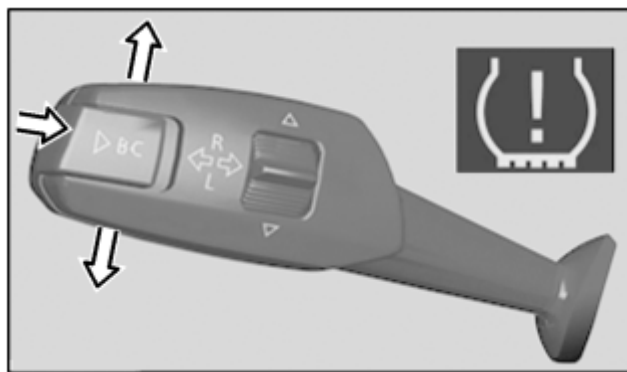




**Fig. 25: Locating TPM System Reset Button (With iDrive)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Resetting TPM Without iDrive**

1. Set the tire pressure of all wheels to specification.
2. Start engine.
3. Move turn signal lever up or down until TPM warning symbol and RESET appears. See [Fig. 26](#).
4. Press BC button on end of turn signal lever to confirm selection.
5. Press and hold BC button for approximately 5 seconds until a CHECK/TICK appears after RESET.
6. Drive vehicle. Initialization is automatically completed during the drive, without any feedback issued.



**Fig. 26: Locating TPM System Reset Button (Without iDrive)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**TPMS REMINDER RESET - PROCEDURE 07**

**With iDrive**

**Indirect System (Flat Tire Monitor)**

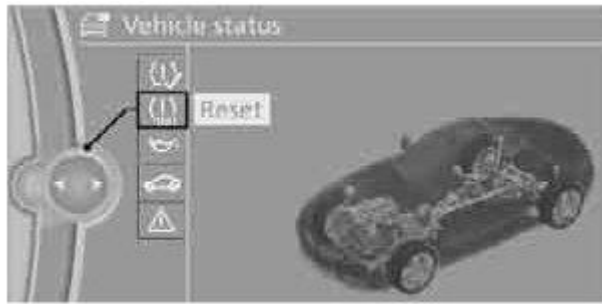
**CAUTION:** Do not initialize the system while snow chains are attached.

**NOTE:** Each time a tire inflation pressure has been corrected or a wheel or tire has been changed, reset the system.

**Initialization:**

1. Using the iDrive MENU button, choose:
2. "Vehicle Info"
3. "Vehicle status"
4. "Reset"
5. Start the engine.
6. Start the initialization using "Reset". See [Fig. 27](#).
7. Start to drive.

The initialization is completed during driving, which can be interrupted at any time. When driving resumes, the initialization is continued automatically.



**Fig. 27: iDrive Showing "Reset" Display**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### Checking FTM Status:

1. Using the iDrive MENU button, choose:
2. "Vehicle Info"
3. "Vehicle status"
4. "Flat Tire Monitor"
5. The status will be displayed. See [Fig. 28](#).



**Fig. 28: iDrive Showing Tire Monitor Status**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### Direct System (Tire Pressure Monitor)

**NOTE:** Each time a tire inflation pressure has been corrected or a wheel or tire has been changed, reset the system.

#### TPMS Status indicator on the Control Display:

The color of the tires represents the status of the tires and the system. TPM takes into account that tire pressures change while the vehicle is being driven. The tire pressures do not need to be corrected unless the TPM instructs you to do so by means of color indicators.

- **Green:** The tire inflation pressure corresponds to the established target value. "TPM active" appears on the Control Display.
- **One Wheel Yellow:** There is a flat tire or substantial loss of tire pressure in the indicated tire. A message appears on the Control Display.
- **All Wheels Yellow:** There is a flat tire or substantial loss of tire pressure in several tires. A message appears on the Control Display.
- **Gray:** The system cannot detect a puncture. Possible reasons for this:
  - TPM is being reset.
  - Temporary malfunction caused by systems or devices using the same radio frequency.
  - Malfunction.

#### Reset Procedure:



1. Using the iDrive MENU button, choose:
2. "Vehicle Info" (or My Vehicle)
3. "Vehicle status"
4. Reset "Tire Pressure Monitor"
5. Start the engine (or switch to Drive Readiness position). Do not begin driving.
6. Start the reset using "Perform Reset". See [Fig. 29](#).
7. Start to drive.
8. The tires are shown in gray and "Resetting TPM..." is displayed.

After driving a few minutes, the set inflation pressures in the tires are accepted as the target values to be monitored. The system reset is completed during your drive, and can be interrupted at any time. When driving resumes, the reset is continued automatically. On the Control Display, the tires are shown in green and "TPM active" is displayed again.

If a flat tire is detected while the system is resetting and determining the inflation pressures, all tires on the Control Display are displayed in yellow. The message "Low tire!" is shown.

### System Reset Failure:

- **Message For Unsuccessful System Reset:** The warning lamp lights up yellow. A message will appear on the Control Display. Check the tire inflation pressure and reset the system.
- **Malfunction:** The small warning lamp flashes in yellow and then lights up continuously; the larger warning lamp comes on in yellow. On the Control Display, the tires are shown in gray and a message appears. No punctures can be detected. This type of message is shown in the following situations:
  - If there is a malfunction. Have the system checked.
  - If a wheel without TPM electronics has been mounted.
  - If TPM is temporarily malfunctioning due to other systems or devices using the same radio frequency.



**Fig. 29: iDrive Showing "Reset" Display.**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### Without iDrive

#### Indirect System (Flat Tire Monitor)

**CAUTION:** Do not initialize the system while snow chains are attached.

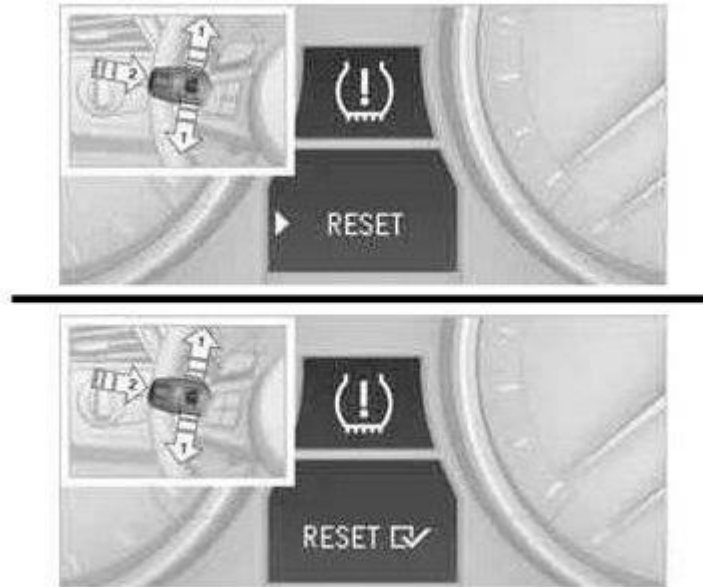
**NOTE:** Each time a tire inflation pressure has been corrected or a wheel or tire has been changed, reset the system.

### Reset:

1. Start the engine.
2. Lightly push button 1 on the turn indicator. See [Fig. 30](#).
3. Lever the turn indicator up or down repeatedly until the tire monitor symbol appears in the display, accompanied by the word "RESET". See [Fig. 30](#).

4. Press button 2 to confirm your choice of the Flat Tire Monitor.
5. Press button 2 for approx. 5 seconds until the a check mark is shown next to the "RESET" display.
6. Drive the vehicle.

The initialization is completed during driving, which can be interrupted at any time. When driving resumes, the initialization is continued automatically.



**Fig. 30: Flat Tire Monitor Status Display**  
 Courtesy of BMW OF NORTH AMERICA, INC.

#### Direct System (Tire Pressure Monitor)

**CAUTION:** Do not initialize the system while snow chains are attached.

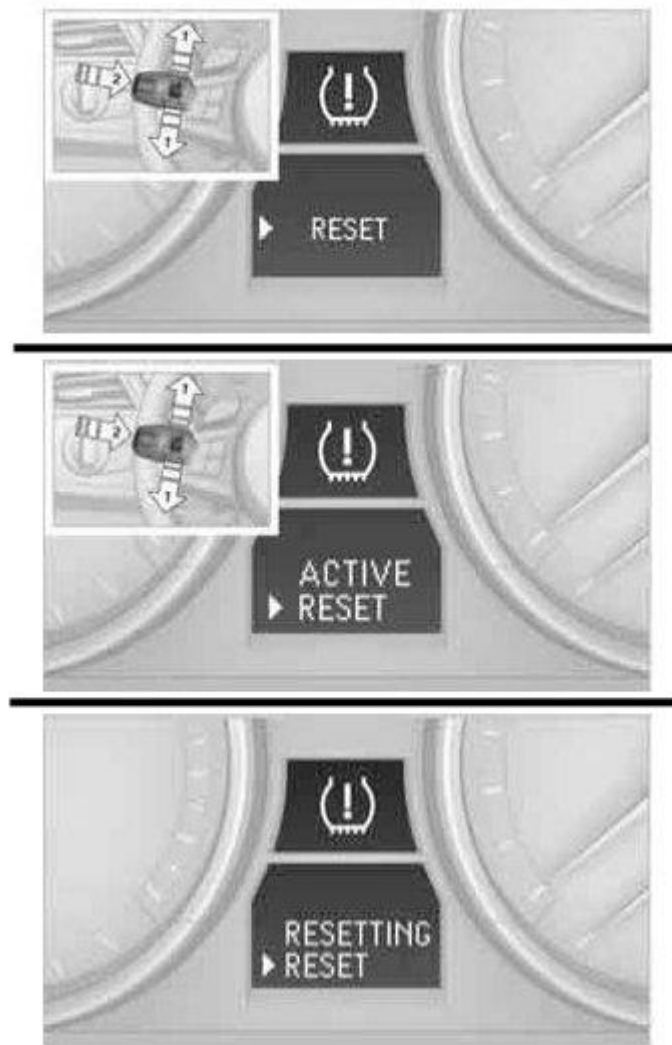
**NOTE:** Each time a tire inflation pressure has been corrected or a wheel or tire has been changed, reset the system.

**IMPORTANT:** The system does not work correctly if it has not been reset; for example, a flat tire may be indicated even though the tire inflation pressures are correct. The system is inactive and cannot indicate a flat tire if a wheel without TPM electronics, such as a compact spare wheel, has been mounted, or if TPM is temporarily malfunctioning due to other systems or devices using the same radio frequency.

#### Reset:

1. Start the engine.
2. Lightly push button 1 on the turn indicator. See [Fig. 31](#).
3. Lever the turn indicator up or down repeatedly until the tire monitor symbol appears in the display, accompanied by the word "RESET". See [Fig. 31](#).
4. Press button 2 to confirm your choice of the Tire Pressure Monitor. In the display, "ACTIVE" will appear above "RESET". See [Fig. 31](#).
5. Press button 2 for approx. 5 seconds. In the display, "RESETTING" will now appear above "RESET". See [Fig. 31](#).
6. Drive the vehicle.

After driving a few minutes, the set inflation pressures in the tires are accepted as the target values to be monitored. The system reset is completed during your drive, and can be interrupted at any time. When driving resumes, the reset is continued automatically. The indicator lamp goes out after the system reset is completed.



**Fig. 31: Tire Pressure Monitor Status Display**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**System Reset Failure:**

- **Message For Unsuccessful System Reset:** The warning lamp lights up yellow. The system was not reset. Check the tire inflation pressure and reset the system.
- **Malfunction:** The small warning lamp flashes in yellow and then lights up continuously; the larger warning lamp comes on in yellow. On the Control Display, the tires are shown in gray and a message appears. No punctures can be detected. This type of message is shown in the following situations:
  - If there is a malfunction. Have the system checked.
  - If a wheel without TPM electronics has been mounted.
  - If TPM is temporarily malfunctioning due to other systems or devices using the same radio frequency.

**TPMS REMINDER RESET - PROCEDURE 08**

Reset Using iDrive:

1. "My Vehicle".
2. "Vehicle Status".
3. [Reset] "Tire Pressure Monitor".
4. Start the engine but do not drive off.
5. Reset tire inflation pressure: "Perform Reset".
6. Drive away.
7. The wheels are displayed in gray and the following is displayed "Resetting Tire Pressure Monitor"

After driving faster than 19 mph (30 km/h) for a short period, the set tire inflation pressures are accepted as reference values. The reset is completed automatically while driving. You may interrupt this trip at any time. When you continue the reset resumes automatically.

After a successfully completed reset, the wheels on the Control Display are shown in green and "Tire Pressure Monitor active. See label for recommended pressures." is displayed.

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## RESTRAINTS

### Restraints - Repair - All I3 Models - i3

## SAFETY AND GENERAL INFORMATION

### 72 SAFETY INFORMATION AND GENERAL INFORMATION

#### Notes on safety:

- > [SAFETY REGULATIONS](#) for handling airbag modules and pyrotechnic belt tensioners
- > [NOTES ON SCRAPPING](#) vehicles with gas generators

#### Handling electrical system and electronics:

- > [UNLOCKING/LOCKING AIRBAG PLUG CONNECTIONS](#)
- > [REPAIRING AIRBAG CABLES](#)
- > [HANDLING OPTICAL FIBRES](#)

#### Check:

- > [CHECK SEAT BELT](#)
- > [CHECKLIST FOR SEAT BELT](#)

#### Airbag system:

- > See diagnosis system for FUB and check
- > [DEACTIVATING AIRBAGS](#)
- > [PROCEDURE AFTER AIRBAG DEPLOYMENT.](#)

#### Active pedestrian protection:

- > Procedure after actuator triggering

#### 72 00... Safety regulations for handling components with gas generators

**It is essential to comply with the regulations as specified in the law relating to the use of explosives when working on airbag units and seat belt tensioners.**

Airbags, seat belt tensioners etc. are pyrotechnical objects. Pyrotechnical objects are assigned to different danger classes on the basis of the quantity of propellant that they contain. The assignment can be ascertained from the identification marking on the product:

#### Attention!

Failure to comply with the warning notices and repair instructions for gas generator components can cause accidental deployment and result in injury and vehicle damage!

This applies in particular to the following components:

- Airbag modules (driver's/front passenger airbags, side airbags)
- Seat belt tensioner
- Head airbag
- Active knee protection

- Active head restraint
- Safety battery terminal

## 1. Regulations

In all other countries, the relevant legislation and regulations must be observed in each case.

Country-specific legal regulations that go beyond this information or court decisions based thereon must be followed in each case or given precedence over these regulations.

- Pyrotechnical restraint systems are subject to danger class PT1
- Gas generators are pyrotechnical objects belonging to danger class T1

Handling, transporting and storing non-fired gas generators are subject to the "Explosive Materials Act" (law relating to the use of explosives dated 13/09/1976).

The relevant trade supervisory authority must be notified at least 2 weeks before pyrotechnical objects are handled for the first time. In this process, notify the person responsible at the relevant authority (e.g. dealership owner, holder of general power of attorney, technical supervisor) in writing. A certificate of qualification, i.e. specific training, is not required for the person responsible.

## 2. Dismantling and installation

- Checking and installation work must be carried out by professionally trained personnel only.
- Work on airbag system components must only ever be carried out with a disconnected vehicle battery, covered negative terminal and disconnected plug connection of the cable leading to the gas generator. Observe the specified waiting period if merely the vehicle battery is disconnected:
  - min. for vehicles up to 9/93
  - min. for vehicles from 9/93 onward
- In the event of breaks in work, a component with a gas generator that has been removed must be secured against access by other persons.
- Individual components must never be repaired. Instead, always replace them.
- Do not treat airbag system components with cleaning agents or grease.
- Components of the airbag system must not be exposed to temperatures in excess of 75 °C.
- Airbag system components, including electronic diagnostic components, which have been dropped from heights in excess of 0.5 m must not be reinstalled in the vehicles.
- Do not remove components of the airbag system from the original packaging until immediately before they are to be installed in the vehicle.
- Before installing, subject components such as housing, connector pins, etc. of the airbag system (including diagnosis electronics) to a visual inspection for damage and replace if necessary.
- Airbag system components may only be electrically tested while they are installed and only with the diagnosis system.
- **Danger of injury:** The airbag module may only be set down with the airbag itself facing *upwards*. Otherwise the gas generator may be propelled upwards upon potential ignition of the gas generator.
- Do not point the ignition squib of a gas generator at other persons.
- Components with gas generators must not be fired while they are removed. They must be disposed of by special disposal companies or returned in the packaging of the new parts.
- When carrying out straightening and welding work with an electric welder:
  - Disconnect the vehicle battery
  - Cover negative terminal (post)
- Avoid all contact with the skin when removing a fired airbag module - wear gloves. Wash with water after contact with the skin.

## 3. Transport



Components with gas generators must be sent off in the packaging of the new components.

#### 4. Storage

Observe the regulations of the relevant trade supervisory authority and the applicable national regulations.

## SEAT BELTS

### 72 00... REPLACING THE SEAT BELT CLIP

Special tools required:

- [00 5 040](#)

**NOTE:** If the position of the seat belt clip (1) cannot be identified, the position of the seat belt clip on the opposite side of the vehicle is used.

Insert the seat belt clip (1) in the previous position on the seat belt (2).



**Fig. 1: Identifying Seat Belt Clip**

Courtesy of BMW OF NORTH AMERICA, INC.

Mount the counterpiece (1).

Press the seat belt clip with special tool [00 5 040](#) .

Check that the seat belt clip and counterpiece (1) are firmly seated.

**NOTE:** If the seat belt clip is pressed too firmly, the counterpiece may loosen (1).



**Fig. 2: Pressing Seat Belt Clip With Special Tool (00 5 040).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**72 11... CHECK LIST FOR AUTOMATIC SEAT BELT**

Was the automatic seat belt with lower strap replaced after an accident, e.g. frontal and/or oblique collision in which the impact absorbers/deformation elements were permanently deformed? (only while seat belt was fastened)	No	Replace complete automatic seat belt The following must also be checked and replaced, if necessary: seatbelt mounts on the vehicle body seatbelt mounts on the seat rails.
Yes	^	^
Does seat belt lock when pulled out suddenly?	No	Replace automatic seat belt (upper seat belt).
Does the automatic reel eliminate the belt slack?	No	Replace automatic seat belt (upper seat belt).
Yes	^	^
Yes	^	^
Can the seat belt strap be pulled out without jamming?	No	Automatic reel is loose - tighten reel. If fault persists: Return spring broken - replace automatic seat belt (upper seat belt).
Yes	^	^
Does the strap on the front seat belts retract automatically? Does the strap on the rear seat belts retract automatically, a small remaining loop is acceptable if this remaining loop is fully retracted when the seat belt strap is readjusted.	No	Automatic reel is loose - tighten reel. Excessive friction in belt guides - replace automatic seat belt (upper strap). Return spring broken - replace automatic seat belt (upper seat belt).
Yes	^	^
Does automatic reel make a squeaking noise when belt is fastened or unfastened?	Yes	Excessive friction in belt guides - replace automatic seat belt (upper strap). Automatic reel is loose - tighten reel. Return spring broken - replace automatic seat belt (upper seat belt).
No	^	^

--	--	--

Is the plastic casing on the belt tongue free from damage in the area of the belt opening?	No	Replace complete automatic seat belt
Yes	Ä	Ä
Is the fully extended seat belt strap free from pinches, burn marks, tears and cuts, creasing and unraveling?	No	Replace complete automatic seat belt
Yes	Ä	Ä
When the seat belt is fastened, is the belt tongue ejected by spring pressure from the buckle when the "red button" is pressed?	No	Replace complete automatic seat belt
Yes	Ä	Ä
Does fastened seat belt lock during emergency braking on a dry roadway at double walking speed?	No	Replace complete automatic seat belt
Yes	Ä	Ä
Is fully pulled-out seat belt strap free of serious dirt and other marks?	No	If dirt and marks cannot be removed with commercially available mild detergent, the automatic seat belt (upper seat belt) must be replaced.
Yes	Ä	Ä
In the case of seat-integrated seat belts, is front tongue of reclining mechanism or seat rail free of deformation?	No	Replace both damaged parts and complete automatic-reel seat belt. The following must also be checked and replaced, if necessary: seatbelt mounts on the vehicle body seatbelt mounts on the seat seat rails.
Yes	Ä	Ä
The automatic seat belt is OK!	Ä	Ä

## 72 11... CHECK THE 3-POINT AUTOMATIC-REEL BELT

*General considerations when checking seat belts:*

### 1. After replacing the EMA/REMA automatic reel

Check the additional functions for function when replacing the EMA/REMA automatic reel after programming/encoding the vehicle.

For the functional check of EMA/REMA automatic reel it is sufficient to check that the belt slack has been eliminated.

Check if belt slack was eliminated for **EMA to 07/12** :

- Get in, close the doors and latch the left seat belt buckle contact
- EMA eliminates belt slack

If belt slack was not eliminated, the procedure described below must be followed:

- Allow vehicle to assume complete sleep mode and repeat the functional check.
- All doors must be closed!
- EMA, left, must be installed and connected correctly.
- Work through all fault code entries before the repeating the functional check

Check if belt slack was eliminated for **REMA from 07/12 onwards** :

- Lock left seat belt buckle contact and perform functional check with diagnosis tester.
- Alternatively, take a test drive at a speed of > 10 km/h

The automatic reel is completely maintenance-free and must not be opened.

## 2. After an accident

The seat belts must be checked after an accident.

At the beginning of the check, attempt to obtain information about the occupation of the seats in the vehicle that was involved in an accident. If this is not possible, check all of the seat belts in the vehicle and replace them if necessary.

In the event of deformations on the vehicle, you must subject the components of the restraint system affected in this area such as e.g.

- Seat Belts
- Anchor fitting tensioner
- Seat belt height adjustment
- Seat belt tensioner
- Impact sensor
- etc.

to a function check and a visual inspection.

**If you are in any doubt as to the unimpaired operability of restraint system components, these components must be replaced in the interests of safety!**

If a seat belt has to be replaced following an accident (e.g. in the event of a frontal and/or oblique collision with permanently deformed impact absorbers/deformation elements or crossmembers), the complete seat belt must be replaced! The complete seat belt comprises:

- Upper seat belt
- Lower strap
- Anchor fitting tensioner
- Seat belt buckle (belt tensioner)
- Seat belt height adjustment
- Mounting bolts of all components

The following must also be checked and replaced, if applicable:

- Belt coding on the body
- Belt coding on the seat
- seat rails.
- Seat structure (frame, etc.)

**Alignment tests on the seat and the seat rails are not permitted!**

The following explanations and the **CHECK LIST** for the 3-point automatic-reel seat belt may be helpful.

An unusable seat belt or a seat belt worn in a serious accident should be destroyed immediately after removal to guarantee that it can not be used again.

*Check the automatic reel and seat belt strap:*

The automatic reel has two independent activation systems for seat-belt locking.

The first activation system locks the automatic reel when driving quickly around curves, driving in tight curves, on extreme inclinations (vehicle rolls over) and during sharp braking or crash.

To check, the backrest must be placed in the upright position and both hands held in a supporting position close to the steering wheel. The brakes are then operated with full intensity while driving on a dry roadway and at double walking speed.

The seat belt must lock.

The second activation system provides additional safety and is controlled by inertia mass.

If the reel locks when the seat belt strap is pulled out suddenly, this system is also OK.

In addition, the automatic reel (EMA/REMA) must eliminate belt slack.

Check whether an attempt was made to eliminate belt slack:

- Get in, close the doors and latch the left seat belt buckle contact
- EMA/REMA eliminates belt slack

If belt slack was not eliminated, the procedure described below must be followed:

- Allow vehicle to assume complete sleep mode and repeat the functional check.
- All doors must be closed!
- EM/REMA must be installed and connected correctly
- Work through all fault entries before the functional check is carried out again.

Replace the faulty or activated automatic reel.

The automatic reel is completely maintenance-free and must not be opened.

Precondition for complete, problem-free retraction of seat belt straps:

- The seat belt straps must not be twisted!
- The seat belt straps must not be damaged!

When placed to one side, the seat belt straps of the front seats must retract fully.

With the seat belt straps in the seat bench, a small remaining loop in the seat belt strap is acceptable due to increased friction between the seat belt strap and the seat bench cover if:

- this remaining loop is fully retracted when the seat belt strap is re-guided.

The seat belt strap should only be cleaned with a lukewarm soap solution or a commercial mild detergent.

Seat belt strap must never be cleaned chemically or dyed.

The automatic reel and seat belt strap must be replaced in the event of:

1. creasing
2. unraveling
3. pinches
4. cracks and tears
5. traces of melting
6. Traces of wear on the coating of the buckle tongue or on the seat belt guide loop.

*Check the lower strap (belt tensioner):*

To fasten a seat belt, the buckle tongue should insert easily and engage in the seat belt buckle with an audible click.

When the "Red button" is pressed, the buckle tongue must be ejected from the seat belt buckle under spring pressure.

If the seat belt buckle cover is missing or damaged, the lower strap must be replaced.

Replace the activated belt tensioner including the complete seat belt with seat belt height adjustment and mounting bolts and check the

- Belt coding on the body
- Belt coding on the seat
- seat rails.
- Seat structure

Criteria for an activated mechanical belt tensioner:

- very low position of seat belt buckle (comparisons with new part).

Criteria for an activated pyrotechnic belt tensioner:

- very low position of seat belt buckle (comparisons with new part).
- Airbag indicator light permanently lit: read out airbag system fault memory.

The belt tensioners can be activated under certain circumstances even when the seat is not occupied. If it is definite that the seat belt system was not used (seat was not occupied), there is no need to replace the following components after a check.

- upper strap
- Add-on parts (seat belt height adjustment, screws)
- Belt coding on the body
- Belt coding on the seat
- seat rails.

*Checking end fitting pretensioner:*

Replace the triggered end fitting pretensioner including the complete seat belt with seat belt height adjustment, lower strap and mounting bolts and check the

- Belt coding on the body
- Belt coding on the seat
- seat rails.
- Seat structure

Criteria for a triggered end fitting pretensioner:

- A triggered end fitting pretensioner can be recognized from the wrapped seat belt strap around the shaft.
- Airbag indicator light permanently lit: read out airbag system fault memory.

## **72 11 041 REMOVING AND INSTALLING/REPLACING FRONT LEFT OR RIGHT LOWER STRAP**

IMPORTANT: If any one of the following criteria applies, the backrest frame must be replaced. See **REPLACING BACKREST FRAME ON DRIVER'S SEAT** or **REPLACING BACKREST FRAME FROM FRONT PASSENGER SEAT** .

- Activate **END FITTING PRETENSIONER**
- Unclipped **OUTER COVER** as a result of an accident
- Torn **OUTER COVER** as a result of an accident
- Faulty clip connection on **OUTER COVER** as a result of an accident

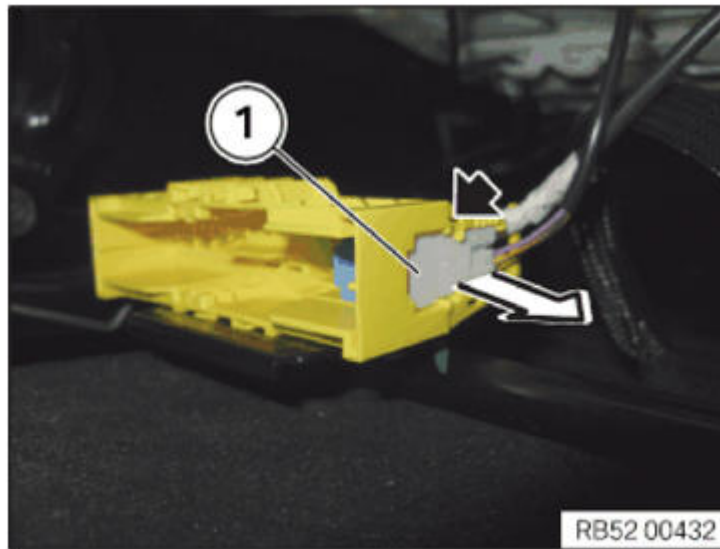
**Necessary preliminary work:**



- Remove front seat. See [REMOVING AND INSTALLING FRONT SEAT, DRIVER'S SIDE](#) or [REMOVING AND INSTALLING FRONT SEAT, PASSENGER'S SIDE](#) .

### Removal:

Unlock the connector (1) and pull it out of the connector housing.



**Fig. 3: Pulling Out Connector From Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

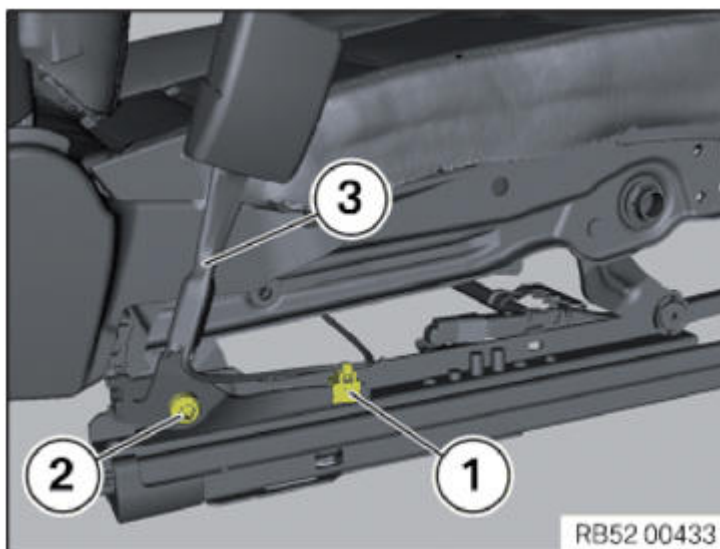
Unclip the clamp (1) from the seat mechanism.

Unclip any additional clamps from the seat mechanism.

Release screw (2).

Tightening torque [72 11 05AZ](#) .

Remove the belt tensioner (3).



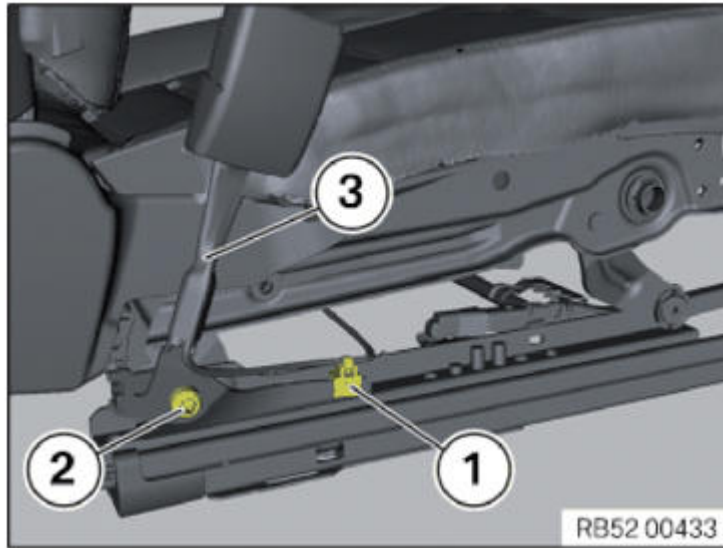
**Fig. 4: Identifying Belt Tensioner, Clamp And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

### Installation:

#### NOTE:

- Microencapsulated screws must be coated with Loctite when reused
- The screw connection must be completed within 20 mins (start of hardening)

- Microencapsulated screws must not be retightened
- The thread of the nut must be cleaned beforehand in the event of repeated use



**Fig. 5: Identifying Belt Tensioner, Clamp And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Tighten down screw (2).

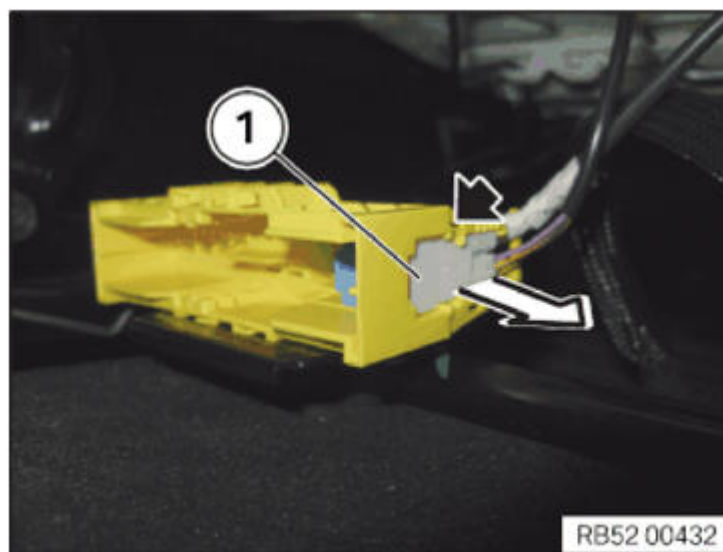
Tightening torque [72 11 05AZ](#) .

Clip the clamp (1) into the seat mechanism.

Clip any additional clamps into the seat mechanism.

**NOTE:**        **The belt tensioner (3) is encoded against incorrect assembly.**

Insert the connector (1) into the connector housing and lock.



**Fig. 6: Pulling Out Connector From Housing**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**72 11 033 REMOVING AND INSTALLING/REPLACING FRONT LEFT OR RIGHT SEAT BELT**

IMPORTANT: If any one of the following criteria applies, the backrest frame must be replaced. See [REPLACING BACKREST FRAME ON DRIVER'S SEAT](#) or [REPLACING](#)

## BACKREST FRAME FROM FRONT PASSENGER SEAT .

- Activated end fitting pretensioner
- Unclipped **OUTER COVER** as a result of an accident
- Torn **OUTER COVER** as a result of an accident
- Faulty clip connection on **OUTER COVER** as a result of an accident

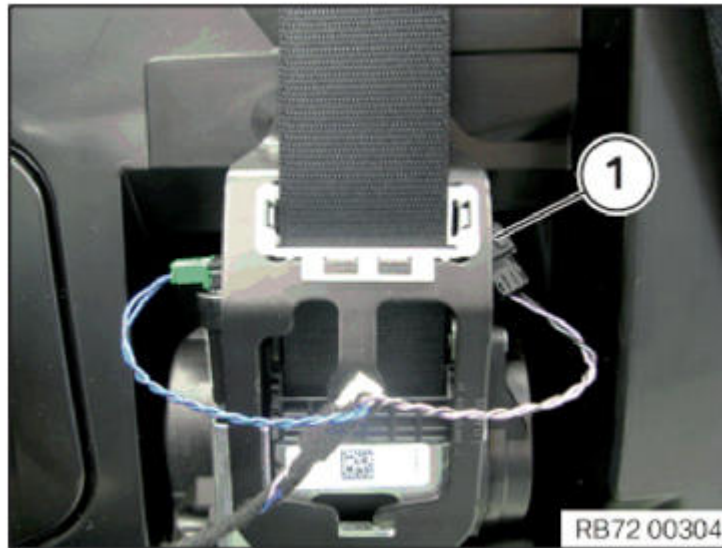
Observe **SAFETY REGULATIONS FOR HANDLING COMPONENTS OF AIRBAG SYSTEM.**

### **Necessary preliminary work:**

- Remove **REAR DOOR TRIM PANEL**

### **US version only:**

Unfasten plug connection (1) and disconnect.



### **Fig. 7: Identifying Plug Connection**

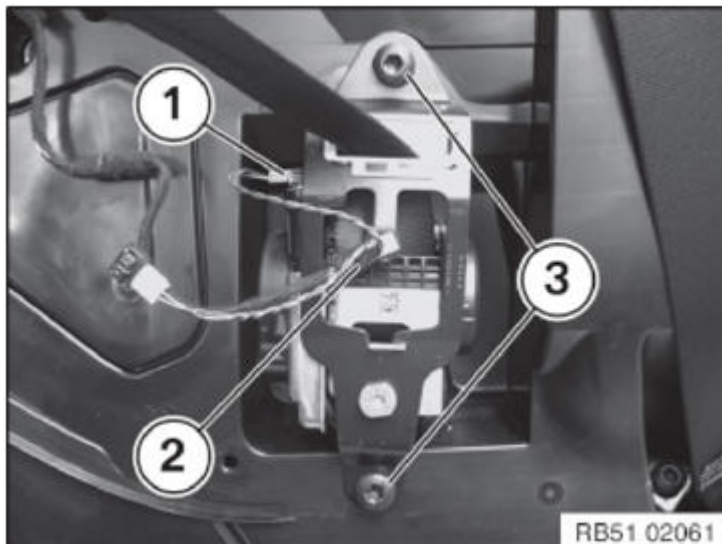
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) and disconnect.

Unfasten cable strap (2).

Release screws (3).

Tightening torque **72 11 1AZ** .



**Fig. 8: Identifying Plug Connection, Cable Strap And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) and remove guide loop (2).

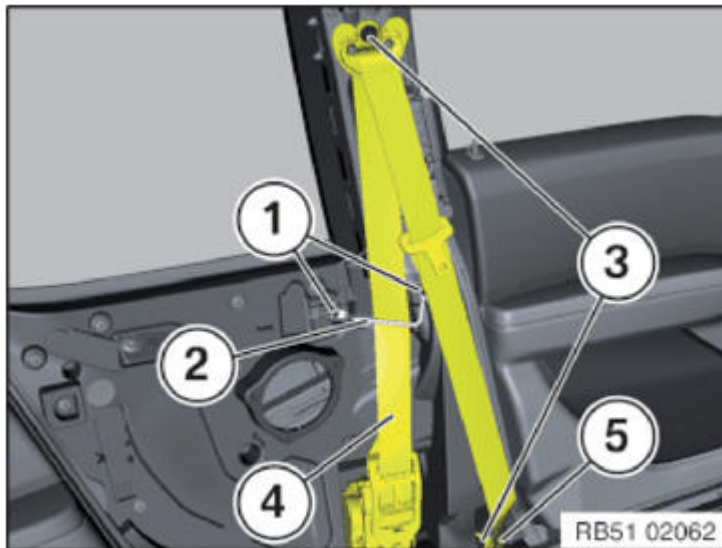
Tightening torque **72 11 4AZ** .

Release screws (3) and remove seat belt (4).

Tightening torque **72 11 2AZ** .

*Installation note:*

Encoding of end fitting (5) must be seated in door recess.



**Fig. 9: Identifying Seat Belt, Guide Loop, End Fitting And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**72 11 096 REMOVING AND INSTALLING/REPLACING REAR LEFT OR RIGHT LOWER STRAP**

**Necessary preliminary tasks:**

- Remove **REAR SEAT**

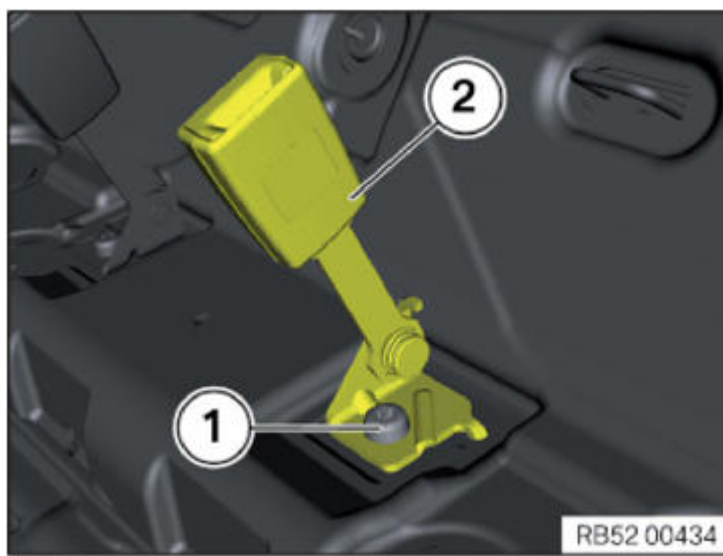
Release screw (1).

Tightening torque **72 11 23AZ** .

Remove seat belt buckle (2).

*Installation note:*

Seat belt buckle (2) is encoded against incorrect assembly.



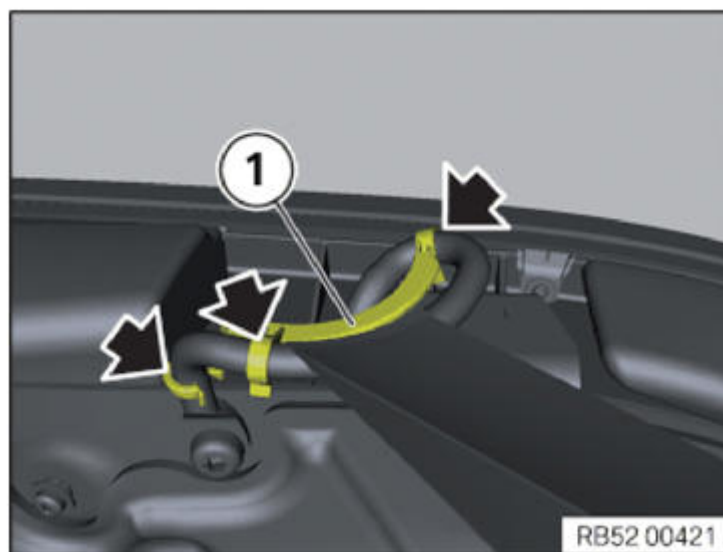
**Fig. 10: Identifying Seat Belt Buckle And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **72 11 092 REMOVING AND INSTALLING/REPLACING REAR LEFT OR RIGHT SEAT BELT**

**Necessary preliminary tasks:**

- Remove **LEFT OR RIGHT SHOULDER IN THE LUGGAGE COMPARTMENT**

Unclip belt strap guide (1) upwards.



**Fig. 11: Locating Belt Strap Guide Clip Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

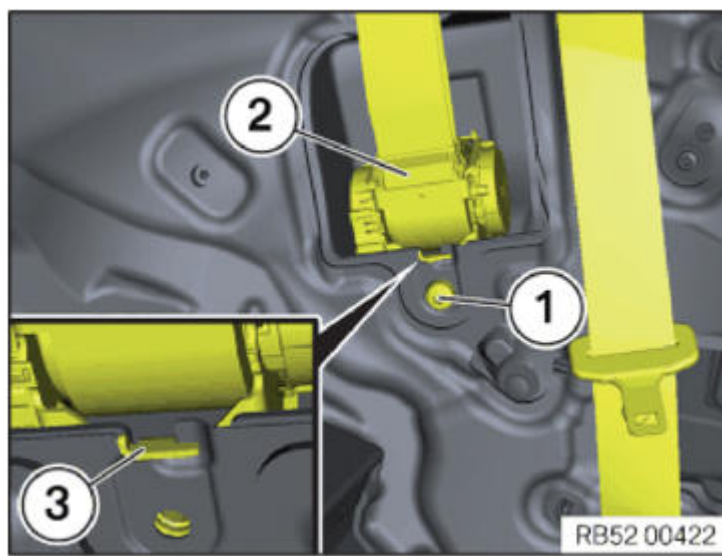
Release screw (1).

Tightening torque **72 11 20AZ** .

Remove inertia reel unit (2).

*Installation note:*

Correctly attach inertia reel guide (3) in body.



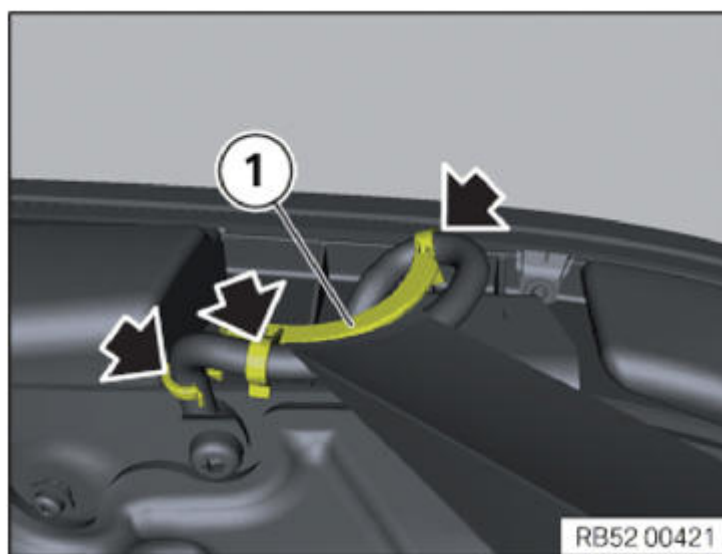
**Fig. 12: Identifying Reel Unit, Reel Guide And Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

**72 11 100 REMOVING AND INSTALLING/REPLACING REAR LEFT OR RIGHT SEAT BELT (COMPLETE)**

Necessary preliminary tasks:

- Remove **LEFT OR RIGHT SHOULDER IN THE LUGGAGE COMPARTMENT**
- Remove **REAR SEAT**

Unclip belt strap guide (1) upwards.



**Fig. 13: Locating Belt Strap Guide Clip Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

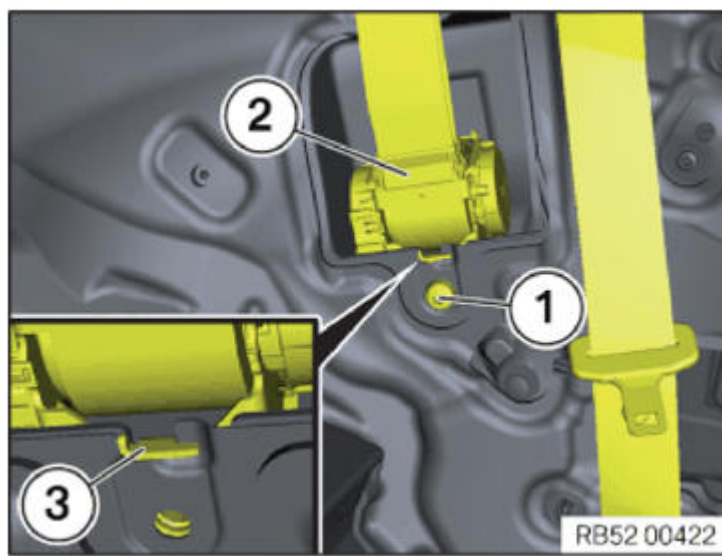
Tightening torque **72 11 20AZ** .

Remove inertia reel unit (2).

*Installation note:*

Correctly attach inertia reel guide (3) in body.





**Fig. 14: Identifying Reel Unit, Reel Guide And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

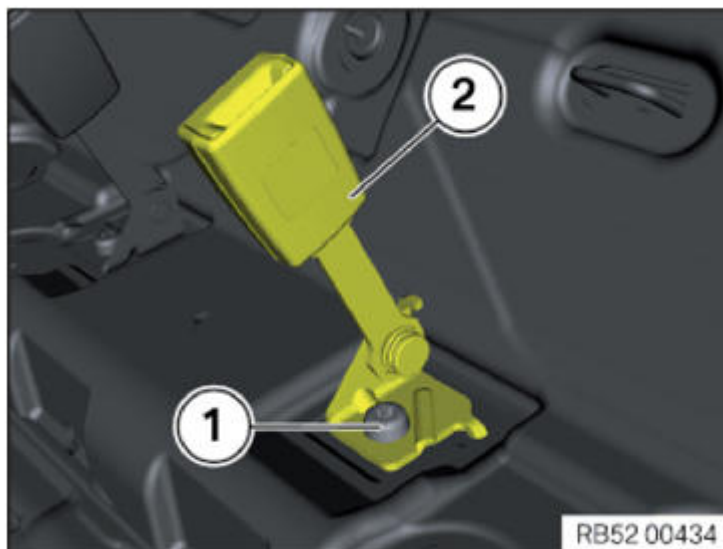
Release screw (1).

Tightening torque [72 11 23AZ](#) .

Remove seat belt buckle (2).

*Installation note:*

Seat belt buckle (2) is encoded against incorrect assembly.



**Fig. 15: Identifying Seat Belt Buckle And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **GAS GENERATORS, AIRBAG MODULES (WITH STEERING WHEEL AIRBAG 3234)**

**(61 00... REPAIRING AIRBAG CABLES)**

See [61 00... REPAIRING AIRBAG CABLES](#) .

**72 12... DEACTIVATING FRONT PASSENGER AIRBAGS WITH KEY SWITCH**

**WARNING:** The responsibility for deactivation/activation rests with the customer. When a child restraint system is used on the front passenger seat, the front passenger airbags must be deactivated, otherwise there is an

**increased risk of injury for the child in the event of airbag deployment even with a child restraint system.**

The front passenger airbag can only be deactivated in accordance with the following instructions if the vehicle is equipped with a suitable key switch!

The following airbags are deactivated simultaneously with the key switch (1):

- Front passenger airbag
- Side airbag (passenger's side)
- If necessary, knee airbag in US version (passenger's side)

The airbags can only be deactivated/reactivated while the vehicle is stationary and with the door open.

**Attention!**

The head airbag remains active.



**Fig. 16: Identifying Key Switch**

Courtesy of BMW OF NORTH AMERICA, INC.

**Deactivation**

A Turn key switch with integrated key (1) from the remote key to the "OFF" position.

Deactivated airbags on passenger's side out of operation.

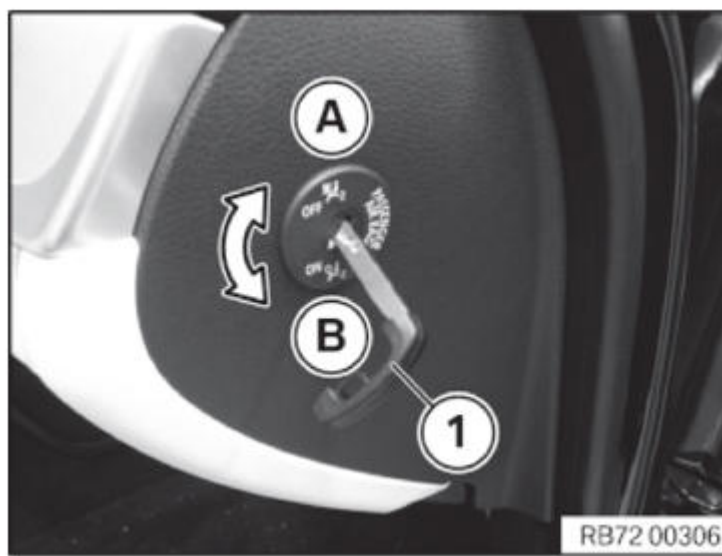
Head airbag on passenger's side remains active.

All airbags on driver's side remain active.

**Activate**

B Turn key switch with integrated key (1) from the remote key to the "ON" position.

All the airbags in the vehicle are activated and are triggered in appropriate situations.



**Fig. 17: Turning Key Switch With Integrated Key.**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### Indicator light

When the ignition key is turned in the ignition lock, the function of the airbag system is checked and the indicator light lights up for several seconds.

A The indicator light is continuously ON when the front passenger airbags are **deactivated**

B The indicator light goes out after a few seconds when the front passenger airbags are **activated**



**Fig. 18: Identifying Front Passenger Airbags Indicator Light**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **72 12... NOTES ON SCRAPPING VEHICLES WITH GAS GENERATORS (AIRBAG SYSTEM)**

The gas generator is a pyrotechnic component and is for the most part permanently mounted on the following components:

- Airbag module
  - Driver's/front passenger airbag
  - Side airbag
  - Head airbag
  - Knee airbag
- Electromotive automatic reel
- Belt end fitting tensioner

- Seat belt tensioner
- Safety battery terminal
- Active head restraint

In accordance with accident prevention regulations and specific national regulations, gas generators must be rendered unusable before they are scrapped. This is necessary because pyrotechnical objects can cause injury if improperly activated (e.g. scrapping with flame cutters).

In vehicles intended for scrapping it is paramount prior to draining and further stripping work to ensure that all gas generators **in the vehicle** have been activated. The fired gas generators can then be scrapped together with the vehicle.

**Gas generators that have not fired constitute a hazard (also to the environment)!**

**Ignition failure:**

If correct ignition is not possible, the relevant components must be removed and disposed of by special waste disposal companies!

Comply with **SAFETY REGULATIONS** for handling airbag system components.

If an ignition has failed:

- Disconnect the igniter from the vehicle battery and
- Wait a few minutes before approaching the vehicle

**The components of an airbag system must always be disposed of. Such components must not be sold on as used parts.**

**ignition:**

Ignition of the gas generators may only be carried out by expert personnel and under the supervision of a responsible person. Other standard accident prevention regulations (safety goggles, ear defenders etc.) must also be observed.

The gas generators must be fired from the outside in this vehicle which has been earmarked for scrapping. In this process

- the doors must be closed
- the tailgate must be open
- the side windows must be open and
- Slide/tilt sunroof open

Use igniters with the appropriate cables to activate the gas generators.

**WARNING:** Once gas generators have been fired, observe a ventilation period of 10 minutes with the doors opened. Only then is it permitted to continue work inside the vehicle.

Wear protective goggles and protective gloves when handling a fired gas generator!

The burning of solid propellant will heat up the airbag unit - danger of burns!

Wash skin with water after contact with fired gas generators!

**72 12... PROCEDURE AFTER AIRBAG DEPLOYMENT AS RESULT OF AN ACCIDENT**

**Replace all components that were affected by the accident and check all others!**

Check and/or replace following components after airbag deployment:

- Components
  - Sensor B-pillar (left/right)
  - Sensor front door (left/right)
  - Sensor seat, Driver-/passenger's side
  - Airbag control unit, vehicle interior
  - Sensor, pedestrian protection
  - Front sensor (engine compartment)
- Procedure
  - Inspect visually for mechanical damage (housing, plug connections). Replace damaged components.
  - Connect BMW diagnosis system
  - Read fault memory
  - Disconnect the vehicle battery and adhere to the waiting period (at least 30 seconds)
  - Inspect visually for mechanical damage
  - Rectify faults
  - Reconnect the vehicle battery and adhere to the waiting period (at least 10 seconds)
  - Delete fault memory
  - Switch off ignition and wait at least 2 minutes (no consumers may be switched on during this period such as interior light, radio, etc.)
  - Switch the ignition on (wait for at least 10 seconds)
  - Delete fault memory
  - If you cannot delete the fault memory: Replace the component that is causing the fault

*Replace the airbag control unit in the following cases only:*

- In the case of visible external damage
- In the case of a corresponding fault memory entry (airbag indicator light is illuminated)

*Cables and connectors*

- Components and procedure
  - Check cables and connectors for damage, replace if necessary.  
(e. g. corrosion, correct engagement, bent pin)

*Seat belt system*

- Components
  - Automatic reel
  - Seat belt tensioner
  - Seat belt height adjustment
  - Anchor fitting tensioner
  - Seat belt buckle
- Procedure
  - Check components, replace if necessary
  - Additional door lock: Check for foreign body, remove it if necessary.

*Seats*

- Components
  - Seat
  - Airbag module
  - Active head restraint
- Procedure

- Check seats (functional check of seat mechanism), replace if necessary
- Check seat connection
- Replace gas generator of active head restraint

If the severity of the crash has not caused any other damage to the seat, only the triggered gas generator needs to be replaced.

External feature: The triggered head restraint is folded forwards and engaged.

The repair work can be carried out in the vehicle with the rear panel removed. The entire system can be pushed back into its original position and the new gas generator installed.

The gas generator can be replaced up to 5 times.

- Replace airbag module and seat cover with upholstery
- **Only I01** : If one of the following criteria is fulfilled, the backrest frame must be replaced!

(Part number of backrest frame: 52 10 7 388 646)

- Activated belt tensioner
- Activated end fitting pretensioner
- Outer cover unclipped by a side collision
- Outer cover ripped off by a side collision
- Faulty clip connection on outer cover caused by a side collision

#### *Driver's airbag*

- Components
  - Airbag module
  - Steering Wheel
  - Steering column (if damaged)
- Procedure
  - Check components, replace if necessary
  - Replace steering wheel

#### *Front-passenger airbag*

- Components
  - Airbag module
  - Dashboard trim panel (must be replaced!)
  - Supporting tube (if damaged)
- Procedure
  - Check components, replace if necessary

#### *Side airbag, front/rear*

- Components
  - Airbag module
  - Door trim panel
  - Door in white
  - Seat
- Procedure
  - Check components; replace if necessary

#### *Head airbag*

- Components



- Airbag module
- A-pillar trim panel
- Roofliner
- B-pillar trim panel (if damaged)
- C-pillar trim panel (if damaged)
- Connection/mount (on side frame)
- Procedure
  - Check components, replace if necessary

### *Knee airbag*

- Components
  - Trim panel (driver's side)
  - Lower section of glove box
  - Knee protection(Driver- and passenger's side)
- Procedure
  - Check components, replace if necessary

### *Knee protection*

- Components
  - Trim panel (driver's side)
  - Glove box incl. knee protection (passenger's side)
- Procedure
  - Check components for damage, replace if necessary
  - Check retaining elements

## **72 12 000 REMOVING AND INSTALLING OR REPLACING AIRBAG MODULE ON PASSENGER'S SIDE**

### **Attention!**

Operations on pyrotechnical devices may only be carried out by authorized experts.

Improper, unauthorized operations may result in serious dangers.

**Unauthorized persons are strictly prohibited from performing any operations on this system.**

**WARNING:** Read and comply with **SAFETY INSTRUCTIONS** for handling airbag modules and pyrotechnical belt tensioners.

Incorrect handling can activate airbag and cause injury.

A damaged airbag must be replaced because its protective function is compromised or, in an extreme situation, it can no longer execute its protective function.

### **Attention!**

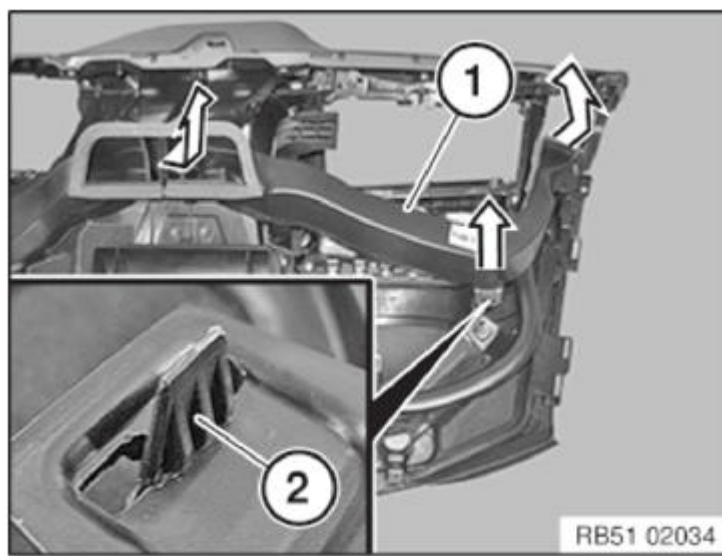
The front passenger airbag must not be screwed back on more than seven times.

### **Necessary preliminary tasks:**

- Remove **DASHBOARD**

Lever out the right-hand air duct (1) from the clip (2) and detach it in the direction of the arrow.

Remove right air duct.

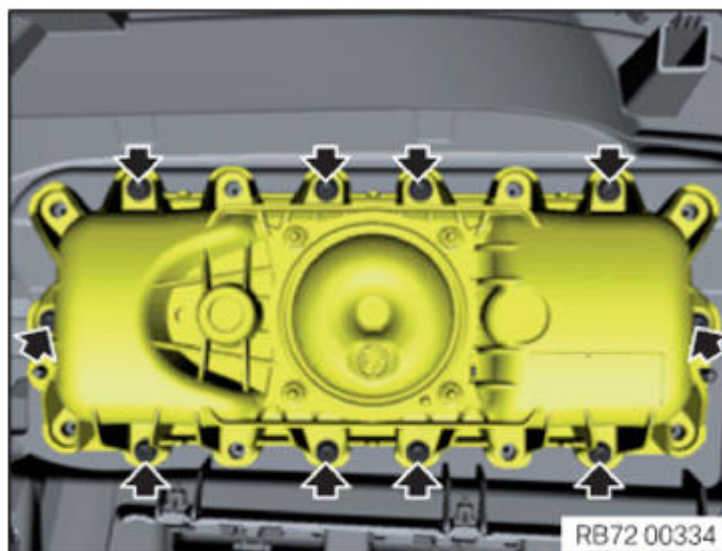


**Fig. 19: Levering Out Right-Hand Air Duct From Clip**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Removal:**

Release screws on airbag module.

Remove airbag module from dashboard.



**Fig. 20: Locating Airbag Module Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

**NOTE:** Although the screws were correctly tightened using the torque wrench, it is possible that the screw head (1) is not seated without a gap.

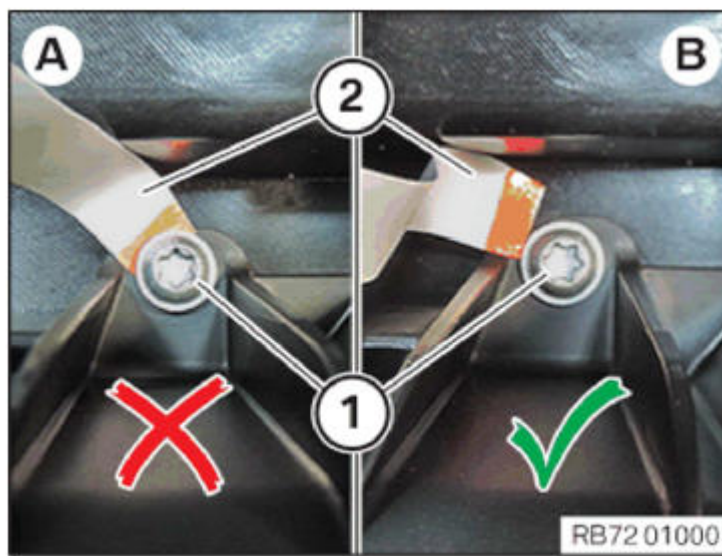
**Attention!**

**Risk of damage!**

**Retorquing** using the torque wrench is **not permitted!**

The prescribed tightening torque **must not be exceeded!**

**The following tightening specifications must be adhered to at all times.**



**Fig. 21: Identifying Screw Head Correct Seating Position**

Courtesy of BMW OF NORTH AMERICA, INC.

1. Tighten all screws on the airbag module to the **prescribed tightening torque without retorquing.**

Tightening torque **72 12 1AZ** .

2. Check that for **all screws** (1), the screw head (1) is seated without any gap, for example, by using a thin paper strip (2) as shown in the illustration:

- A. Paper strip (2) slides under the screw head (1). The screw (1) is not seated without a gap, screw connection is not correctly seated:

Loosen screw (1) and tighten it once again to the **same, prescribed tightening torque without retorquing.**

**Increasing the tightening torque in order to seat the screw head in the correct position is not permitted.**

Tightening torque **72 12 1AZ** .

- B. Paper strip (2) does not slide under the screw head (1). The screw (1) is seated without a gap, screw connection is correctly seated.

**NOTE:** **If the specified torque is not reached at one threaded fastener, the airbag has to be secured additionally at all bolting points (1).**

Drill out all bolting points (1).

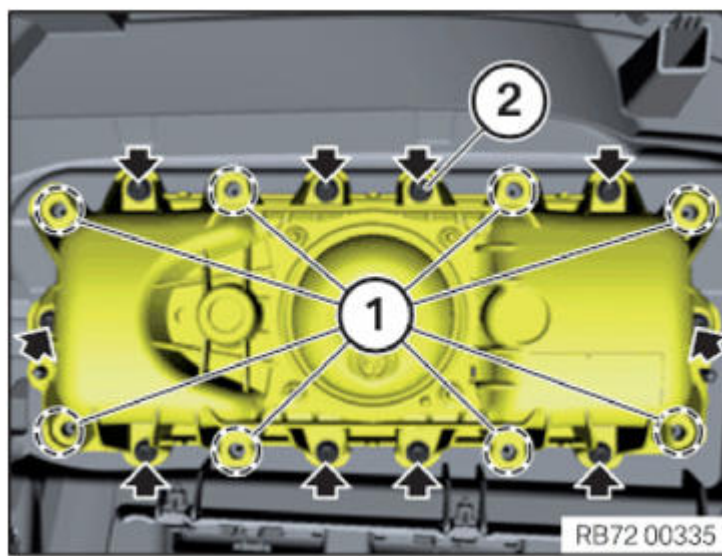
Diameter 4.7 mm

Depth (including airbag 17.5 - module) 18.0 mm

Do not re-use a faulty threaded fastener.

If there is more than **one** faulty threaded fastener the instrument panel has to be replaced.

**NOTE:** **Use a clockwise tightening sequence starting at bolt (2).**



**Fig. 22: Locating Airbag Module Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Required reworking:**

- Remove **DASHBOARD**
- Install the right-hand air duct.

**72 12 060 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT HEAD AIRBAG**

**WARNING:** High-voltage system - danger to life!  
 The following points must be strictly observed prior to starting work :  
 De-energize the **HIGH-VOLTAGE SYSTEM** .  
 Observe **SAFETY INFORMATION** for handling electric vehicles.

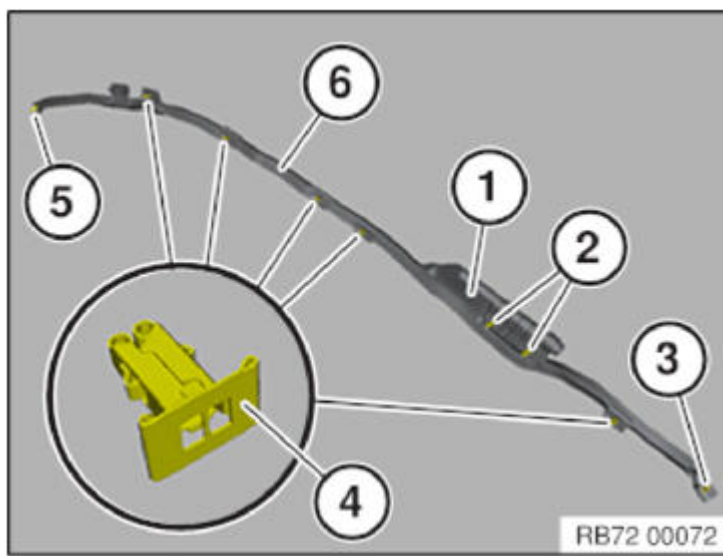
**IMPORTANT:** Operations on pyrotechnical devices may only be carried out by authorized experts. Improper, unauthorized operations may result in serious dangers. Unauthorized persons are strictly prohibited from performing any operations on this system.

**WARNING:** Read and comply with **SAFETY INSTRUCTIONS** for handling airbag modules and pyrotechnical belt tensioners. Incorrect handling can activate airbag and cause injury. A damaged head airbag must be replaced. A damaged head airbag exhibits an impaired protective function and in extreme cases loses its protective function altogether.

*Necessary preliminary tasks:*

- Disconnect **BATTERY NEGATIVE CABLE**
- Remove **HEADLINING**
- Follow notes for **UNLOCKING AND LOCKING AIRBAG CONNECTOR** connection

**Installation overview, retaining elements, head airbag:**



**Fig. 23: Overview Of Head Airbag Retaining Elements**  
 Courtesy of BMW OF NORTH AMERICA, INC.

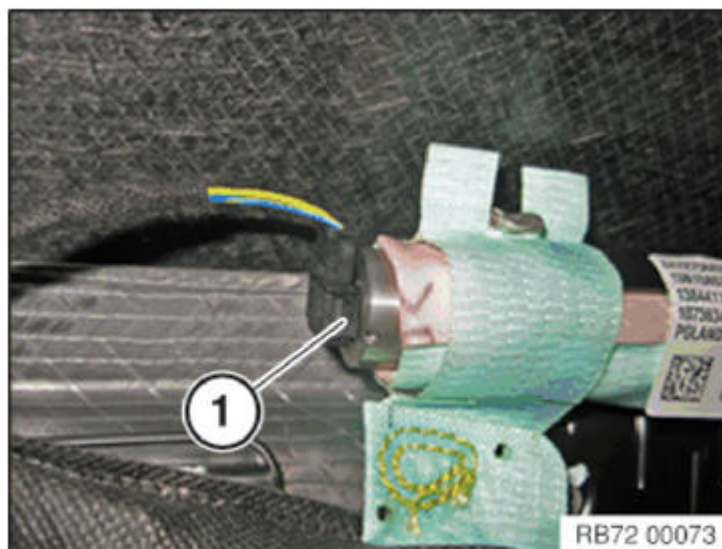
1. Gas generator
2. Mounting bolt for gas generator
3. Mounting bolt for folding pack on C-pillar
4. Retaining clips for folding pack
5. Mounting bolt for folding pack on A-pillar
6. Folding pack

When removing head airbag, do not damage

- IMPORTANT:
- Head airbag
  - Retaining clips
  - Trim panels

Do not damage!

Unfasten plug connection (1) **AND DISCONNECT.**



**Fig. 24: Identifying Head Airbag Plug Connection**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

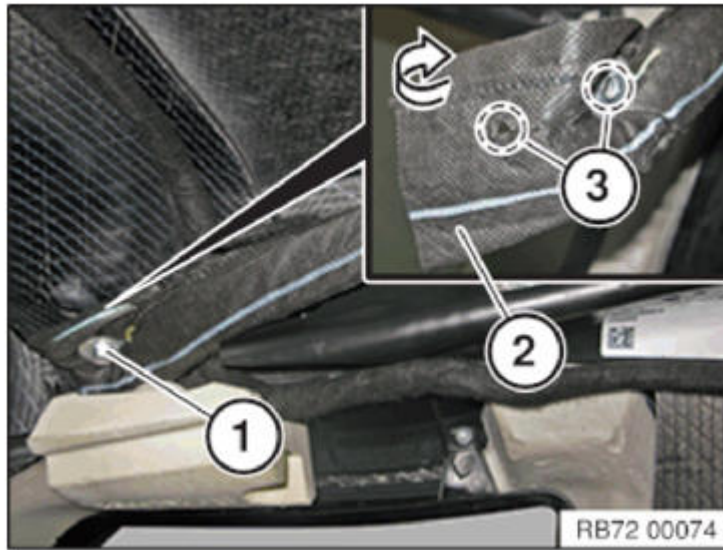


Tightening torque [72 12 4AZ](#) .

*Installation note:*

Fold over tab (2).

Guide screw (1) through both openings (3).



**Fig. 25: Folding Tab**

Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Tightening torque [72 12 4AZ](#) .

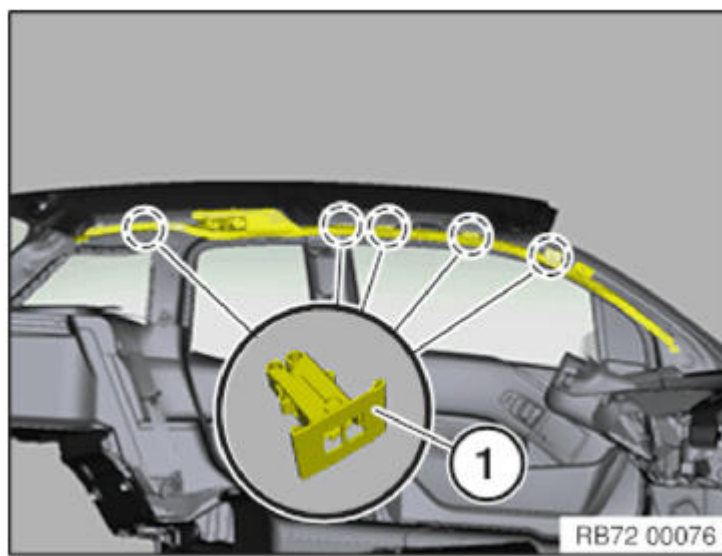


**Fig. 26: Identifying Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Position of retaining clips (1) for folding pack.





**Fig. 27: Identifying Folding Pack Retaining Clips Positions**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Unlock clamp (1) with screwdriver (2) on one side (3) and slightly pull out.

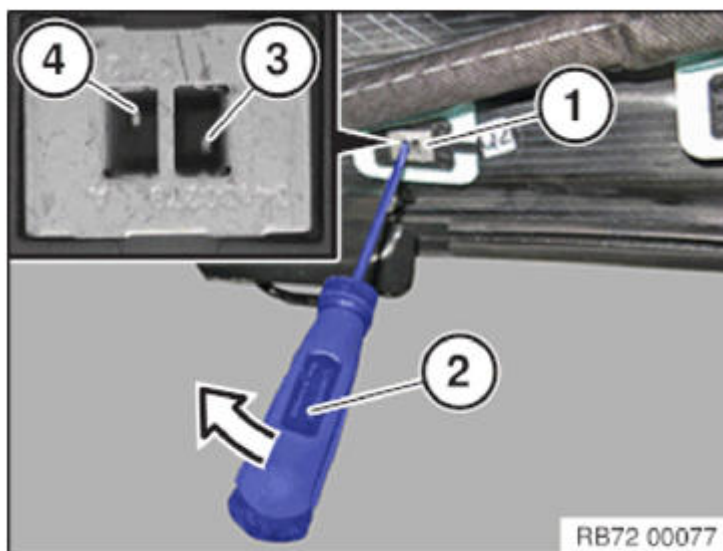
Unlock clamp (1) with screwdriver (2) on the other side (4) and remove.

*Installation note:*

Mounting clips of folding pack must not be damaged.

Replace faulty retaining clips.

Replace retaining clips after airbag deployment.

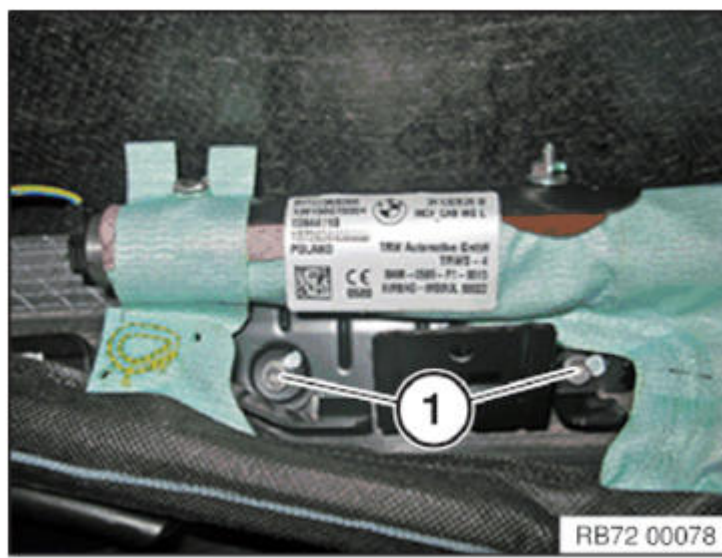


**Fig. 28: Unlocking Clamp With Screwdriver**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1).

Tightening torque [72 12 4AZ](#) .

Remove the gas generator with the folding pack.



**Fig. 29: Identifying Gas Generator Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Gas generator is coded against incorrect assembly.

## **72 12 050 REMOVING AND INSTALLING SIDE AIRBAG (FRONT SEAT)**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
Disconnect **HIGH-VOLTAGE SYSTEM FROM POWER** .  
Observe **SAFETY INFORMATION** for handling electric vehicles.

**IMPORTANT:** Operations on pyrotechnical devices may only be carried out by authorized experts.  
Improper, unauthorized operations may result in serious dangers.

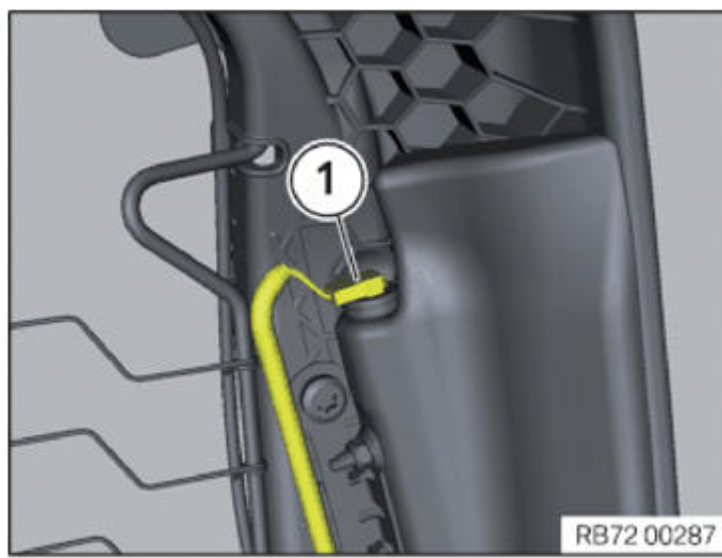
Unauthorized persons are strictly prohibited from performing any operations on this system.

**WARNING:** Observe **SAFETY REGULATIONS** for handling airbag modules and pyrotechnical seat belt tensioners.  
Incorrect handling can activate airbag and cause injury.  
A damaged airbag must be replaced because its protective function is compromised and, in an extreme situation, it can no longer execute its protective function.

Necessary preliminary tasks:

- Disconnect **BATTERY NEGATIVE CABLE**
- Remove backrest cover with upholstery. See **REPLACING BACKREST COVER FOR DRIVER'S SEAT** or **REPLACING BACKREST COVER FOR FRONT PASSENGER SEAT** .

Unlock **PLUG CONNECTION** (1) and disconnect.



**Fig. 30: Identifying Plug Connection**

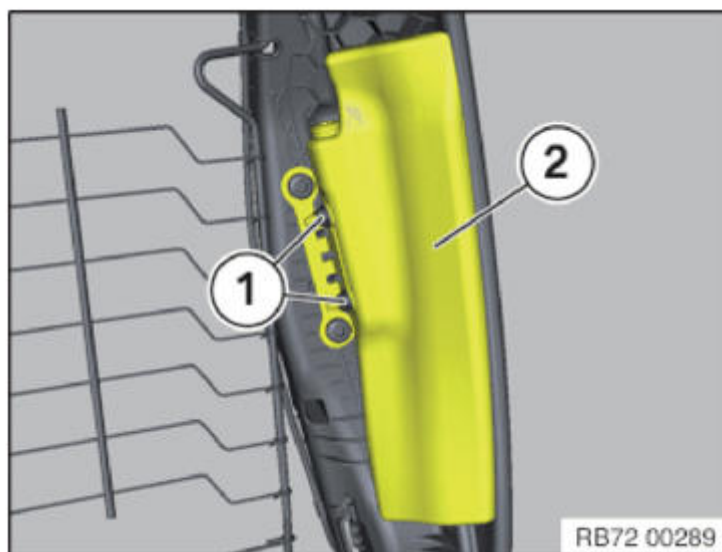
Courtesy of BMW OF NORTH AMERICA, INC.

Release nuts (1) and carefully remove airbag module.

Tightening torque [72 12 5AZ](#) .

*Installation note:*

Airbag module is coded against incorrect assembly.



**Fig. 31: Identifying Air Bag Module And Nuts**

Courtesy of BMW OF NORTH AMERICA, INC.

### **72 12 004 REMOVING AND INSTALLING/REPLACING AIRBAG MODULE FOR DRIVER'S KNEE PROTECTION**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work:  
Disconnect **HIGH-VOLTAGE SYSTEM** from power.  
Observe **SAFETY INFORMATION** for handling electric vehicles.

**WARNING:** Read and comply with **SAFETY REGULATIONS** for handling airbag modules and pyrotechnical belt tensioners.  
Incorrect handling can activate airbag and cause injury.

IMPORTANT: Operations on pyrotechnical devices may only be carried out by authorized experts.  
Improper, unauthorized operations may result in serious dangers.

Unauthorized persons are strictly prohibited from performing any operations on this system.

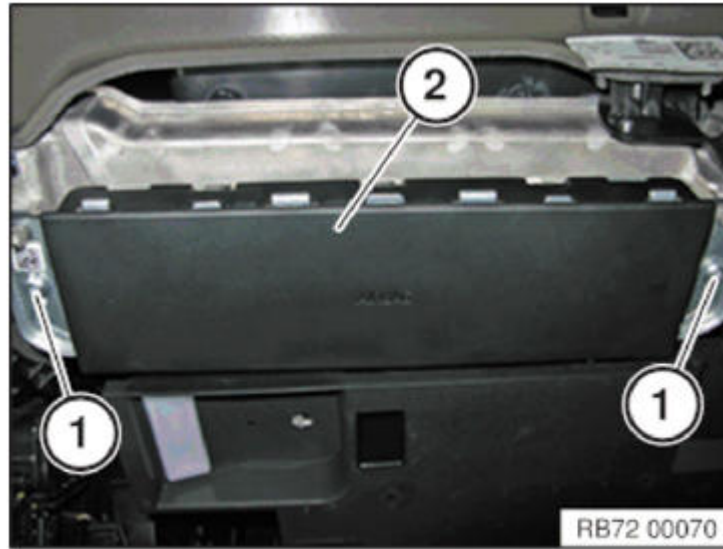
**Necessary preliminary tasks:**

- Clamp off **BATTERY EARTH LEAD**
- Remove **CENTER DASHBOARD TRIM PANEL**

Release screws (1).

Tightening torque **72 12 02AZ** .

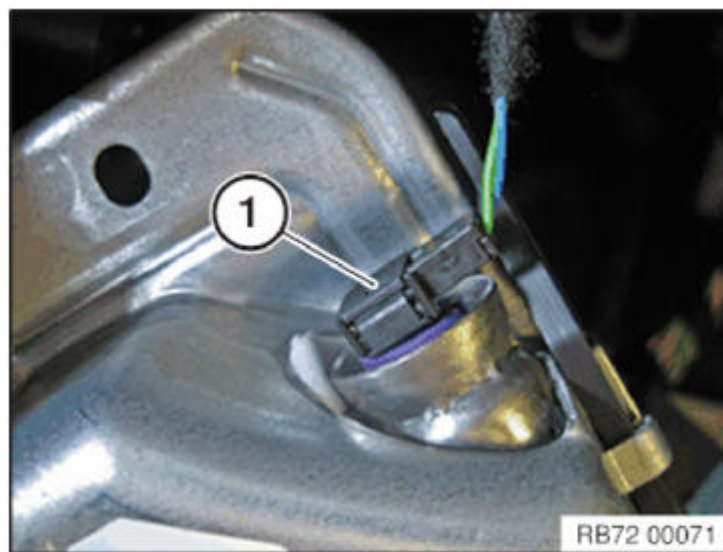
Airbag module (2) is coded against incorrect assembly.



**Fig. 32: Identifying Airbag Module And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) **AND DISCONNECT.**

Remove airbag module.



**Fig. 33: Identifying Airbag Module Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

**72 12 006 REMOVING AND INSTALLING/REPLACING AIRBAG MODULE FOR PASSENGER KNEE PROTECTION**

**WARNING:** High-voltage system - danger to life!



The following points must be strictly observed prior to starting work:  
Disconnect **HIGH-VOLTAGE SYSTEM** from power.  
Observe **SAFETY INFORMATION** for handling electric vehicles.

**WARNING:** Read and comply with **SAFETY REGULATIONS** for handling airbag modules and pyrotechnical belt tensioners.  
Incorrect handling can activate airbag and cause injury.

Operations on pyrotechnical devices may only be carried out by authorized experts.  
IMPORTANT: Improper, unauthorized operations may result in serious dangers.  
**Unauthorized persons are strictly prohibited from performing any operations on this system.**

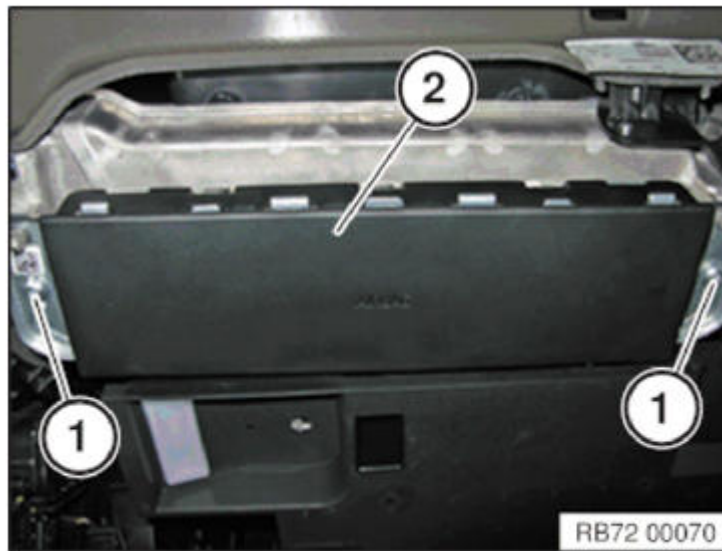
Necessary preliminary tasks:

- Clamp off **BATTERY LEAD FROM NEGATIVE CONNECTION POINT**
- Remove **CENTER DASHBOARD TRIM PANEL**

Release screws (1).

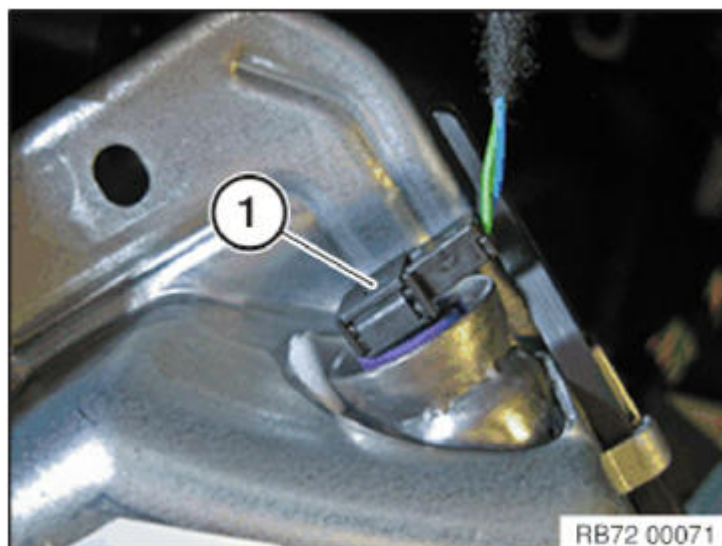
Tightening torque **72 12 02AZ**.

Airbag module (2) is coded against incorrect assembly.



**Fig. 34: Identifying Airbag Module And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unfasten plug connection (1) **AND DISCONNECT**.



## **72 12 061 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT HEAD AIRBAG (VERSION WITH SLIDE/TILT SUNROOF)**

**IMPORTANT:** Operations on pyrotechnical devices may only be carried out by authorized experts. Improper, unauthorized operations may result in serious dangers. **Unauthorized persons are strictly prohibited from performing any operations on this system.**

**WARNING:** Read and comply with **SAFETY INSTRUCTIONS** for handling airbag modules and pyrotechnical belt tensioners. **Incorrect handling can activate airbag and cause injury. A damaged head airbag must be replaced. A damaged head airbag exhibits an impaired protective function and in extreme cases loses its protective function altogether.**

**NOTE:** Except for the operations for **REMOVING HEADLINING** , this task is identical to:

- Removing and installing/replacing left or right **HEAD AIRBAG** (version without slide/tilt sunroof)

## **72 12... UNLOCKING/LOCKING AIRBAG PLUG CONNECTIONS**

**WARNING:** Read and comply with **SAFETY REGULATIONS** for handling airbag modules and pyrotechnical belt tensioners.

### **Attention!**

An airbag plug connection must be replaced if it is damaged.

Sourcing reference for airbag repair instructions (with plug connection).

Following versions of plug connections on airbag module/gas generator are possible:

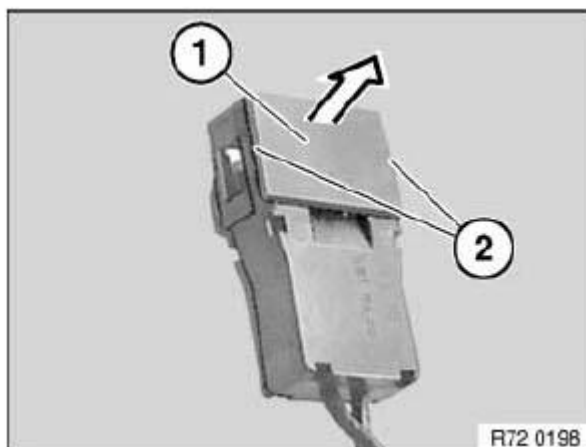
- Airbag plug connection on gas generator/airbag module is offset by 90°
- Airbag plug connection on gas generator/airbag module is straight (3 versions)

### **Airbag plug connection on gas generator/airbag module offset by 90°:**

There are two ways of unlocking this airbag plug connection on the gas generator/airbag module:

#### **Method 1:**

Simultaneously pull cover (1) upwards at lugs on left and right (2).



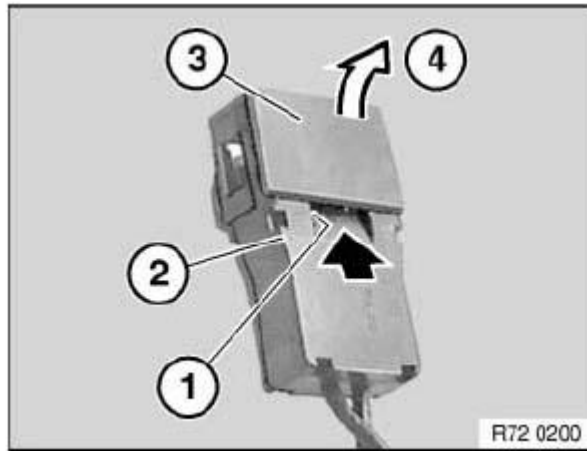


**Fig. 36: Pulling Air Bag Plug Connection Cover Upwards**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Method 2:**

Insert a narrow screwdriver into recess (1) in housing (2).

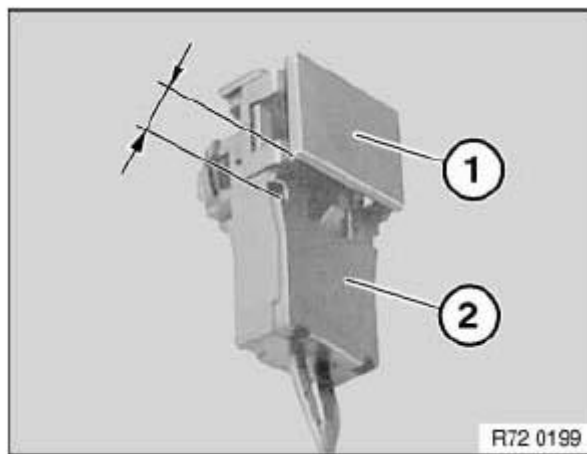
Carefully pry cover (3) off (4).



**Fig. 37: Removing Air Bag Plug Connection Cover**  
Courtesy of BMW OF NORTH AMERICA, INC.

Cover (1) is not positioned higher than housing (2).

The airbag plug connection is unlocked and can now be detached from the gas generator/airbag module.

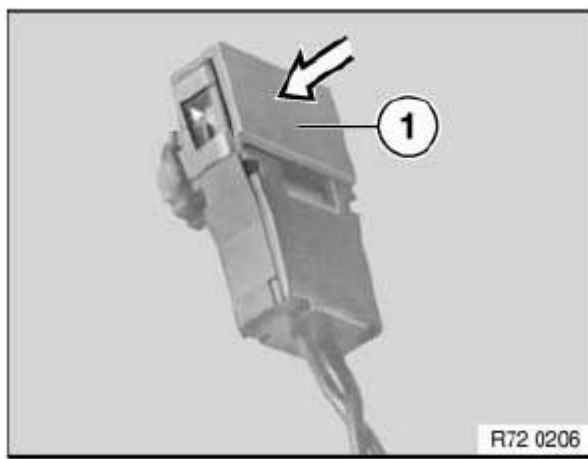


**Fig. 38: Identifying Air Bag Plug Connection Cover And Housing**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

After attaching airbag plug connection to gas generator/airbag module, press cover (1) downwards until it rests flat on housing.

Check that it catches properly.



**Fig. 39: Pressing Cover On Housing**

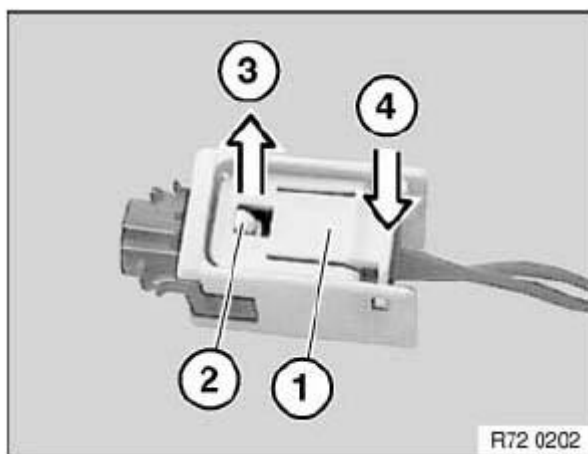
Courtesy of BMW OF NORTH AMERICA, INC.

**Airbag plug connection on gas generator/airbag module is straight (2 versions)**

**Version 1:**

Press locking/unlocking plate (1) at edge (4).

Locking/unlocking plate (1) snaps upwards at opposite edge (3) and releases detent lug (2).



**Fig. 40: Pressing Locking/Unlocking Plate**

Courtesy of BMW OF NORTH AMERICA, INC.

The airbag plug connection is unlocked and can now be detached from the gas generator/airbag module.



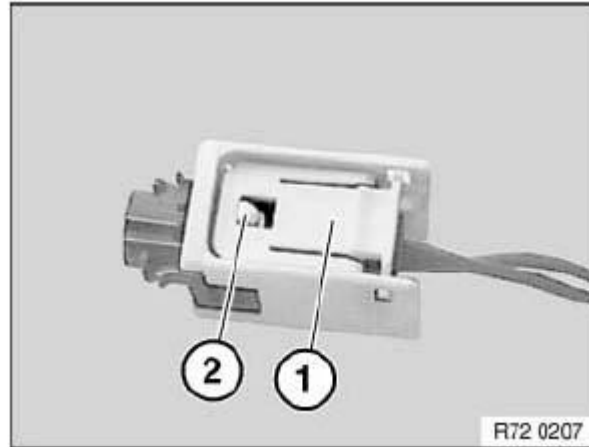
**Fig. 41: Identifying Airbag Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

After attaching airbag plug connection to gas generator/airbag module, check whether detent lug (2) is visible in opening of locking/unlocking plate (1).

Only if the detent lug (2) is visible will the airbag plug connection gas generator/airbag module be correctly engaged.



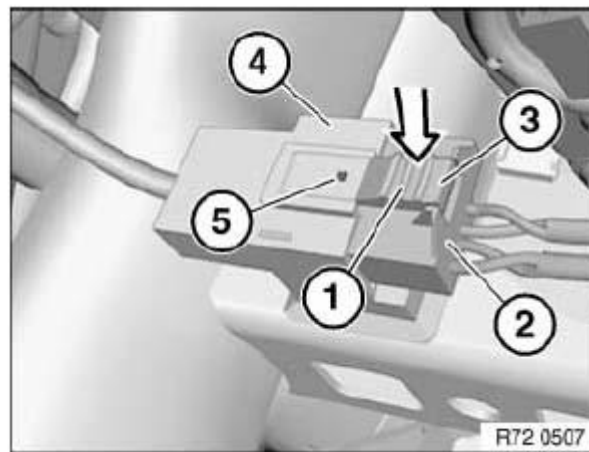
**Fig. 42: Identifying Locking/Unlocking Plate And Detent Lug**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Version 2:**

Press locking/unlocking plate (1) on edge (3) and pull plug (2) out of plug housing (4).

*Installation note:*

Only if the detent lug is visible in opening (5) will the gas generator/airbag module plug connection be correctly engaged.



**Fig. 43: Pressing Locking/Unlocking Plate On Edge**  
Courtesy of BMW OF NORTH AMERICA, INC.

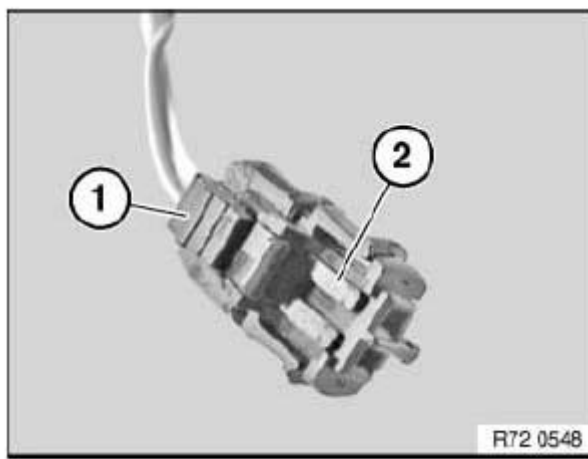
**Version 3:**

Press the lock (1) and pull out the connector (2) up to initial engagement position.

Detach connector (2) from firing pellet.

*Installation note:*

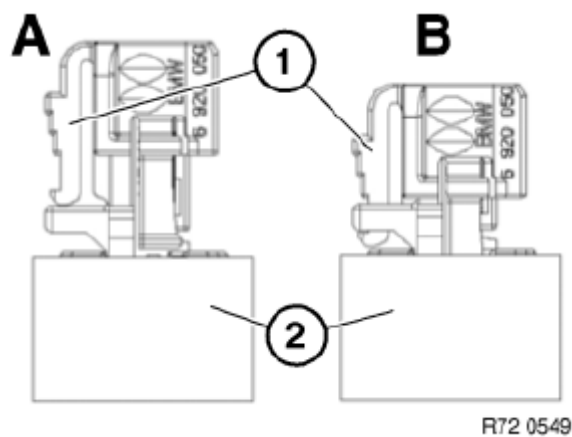
Insert plug connection in initial engagement position in gas generator/airbag module and engage in final engagement position.



**Fig. 44: Identifying Connector And Lock**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Illustration of version 3 with gas generator:**

- A. Initial engagement position
  - B. Final engagement position
1. Lock
  2. Gas generator



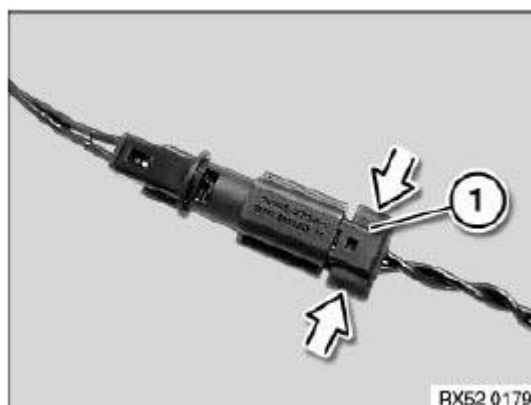
**Fig. 45: Identifying Gas Generator And Lock Initial And Final Engagement Position**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Version 4 - crash-active headrest:**

Press locking clip at edge and disconnect plug (1).

*Installation note:*

Check for correct engagement.





## RESTRAINTS

### Restraints - Tightening Torques - All I3 Models - i3

## AIRBAG MODULES

### 72 12 AIRBAG MODULES

#### TIGHTENING TORQUE SPECIFICATION - AIRBAG MODULES

Â	Type	Thread	Tightening specifications	Dimension
1AZ Passenger airbag module (instrument panel)	I01	Â	Â	3.5 Nm
	I12	Â	Â	5.0 Nm
2AZ Knee airbag - to support structure	I01	Â	Replace microencapsulated screws.	6.8 Nm
	I12	Â	Â	7.0 Nm
3AZ Airbag module - to backrest	I01	Â	Replace microencapsulated nuts.	6 Nm
4AZ Head airbag to body	I01	Â	Replace screws.	8 Nm
	I12	M5x16	Replace screws.	4.5 Nm
5AZ Side airbag to backrest frame	I01	Â	Replace nuts.	6 Â± 1 Nm

## SEAT BELTS

### 72 11 SEAT BELTS

#### TIGHTENING TORQUE SPECIFICATION - SEAT BELTS

Â	Type	Thread	Tightening specifications	Dimension
Seat belt, front:	Â	Â	Â	Â
1AZ Inertia reel to door Inertia reel to body	I01	Oval-head screw with ISA	Â	42 Nm
	I12	Oval-head screw with ISA	Â	42 Nm
2AZ Belt end fitting to door Belt end fitting to body	I01	Oval-head screw with ISA	Â	42 Nm
	I12	Oval-head screw with ISA	Â	42 Nm
3AZ Seat belt guide loop, outer - to door	I01	Oval-head screw with ISA	Â	42 Nm
4AZ Guide loop to door Guide loop to body	I01	Â	Â	2 Nm
	I12	Oval-head screw with ISA	Â	42 Nm
5AZ Lower strap - to seat mechanism	I01/I12	Oval-head screw with ISA	Â	42 Nm
Â	Â	Â	Â	Â
Seat belt, rear:	Â	Â	Â	Â
20AZ Inertia reel to body Inertia reel to holder	I01	Oval-head screw with ISA	Â	42 Nm
	I12	Oval-head screw with ISA	Â	42 Nm
21AZ Anchor fitting, belt - to body	I01/I12	Oval-head screw with ISA	Â	42 Nm
22AZ Wire corner hoop - to body	I01	Oval-head screw with ISA	Â	42 Nm



Â	Type	Thread	Tightening specifications	Dimension
23AZ Lower strap (seat belt buckle) - to body	I01/I12	Oval-head screw with ISA	Â	42 Nm

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**SPECIFICATIONS INDEX**

**SPECIFICATIONS INDEX**

**I3 SPECIFICATIONS INDEX**

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Axle Nut/Hub Nut (Collar Nut)	
Front	<a href="#"><u>TIGHTENING TORQUES</u></a>
Rear	<a href="#"><u>TIGHTENING TORQUES</u></a>
Battery	<a href="#"><u>BATTERY</u></a>
Brakes	
Bleeding Sequence	RR, LR, RF, LF
Disc Brakes	<a href="#"><u>TECHNICAL DATA</u></a>
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Engine Cooling (vehicles with Range Extender)	
À	<a href="#"><u>COOLANT, COOLING SYSTEM TEST</u></a>
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Fluid Specifications	See FLUIDS under MAINTENANCE tab. From within Manager or Service Writer, click the "30/60/90 Interval" or "Maint." button.
Fuel System	
Fuel Filter Location (vehicles with Range Extender)	<a href="#"><u>REMOVING/INSTALLING/REPLACING DUST FILTER</u></a>
Fuel Pump R & I	<a href="#"><u>REMOVING/INSTALLING/REPLACING FUEL PUMP</u></a>

System	Specification/Procedure
Pressure Release Procedure (vehicles with Range Extender)	N/A
Pressure Specification	specification not available, refer to procedure below for checking fuel pressure
Fuel Pressure Test Procedure (vehicles with Range Extender)	<b><u>CHECK FUEL DELIVERY PRESSURE</u></b>
<b>Spark Plug (vehicles with Range Extender)</b>	
Type	NGK LMAR8AI-8E
Gap	N/A
Torque (vehicles with Range Extender)	<b><u>TIGHTENING TORQUES</u></b>
<b>Wheel Alignment</b>	
Adjustment Specifications	<b><u>TECHNICAL DATA</u></b>
Torque	<b><u>TIGHTENING TORQUES</u></b>
<b>Wheel &amp; Tire</b>	
Wheel Lug Nut Torque	140 Nm

## STEERING

### Steering - Operating Fluids

## POWER STEERING OIL AND COMPONENT GREASE

### ZF RACK-AND-PINION STEERING

**NOTE:** The hydraulic fluid reservoirs are marked on the rim of the reservoir and/or the reservoir cap to show which type of oil can be used: ATF oil or Pentosin CHF oil.

The ZF rack-and-pinion steering has lifetime lubrication and is thus maintenance-free.

For topping up/filling hydraulic system:

#### POWER STEERING OIL

Trade name	BMW part number	Container size	Oil color
BMW automatic transmission fluid (ATF)	81 22 9 400 272	1-liter	Red
Pentosin CHF 11S	83 29 0 429 576	1-liter	Green

**NOTE:** Vehicles with AFS/ARS (Dynamic Drive / Active Steering / Active Roll Stabilization) are filled as standard with Pentosin CHF 11S.

In case of repair, the affected steering components must be lubricated with the following grease:

#### COMPONENT GREASE

Trade name	BMW part number	Container size
Calypsol SF-3-131-TMM 3	83 23 9 407 857	100 g tube

**NOTE:** Calypsol D 4024-OK is a sodium-saponified, cold-resistant grease whose lubricity ranges from -30 °C to +75 °C.

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## 2015-18 STEERING

### STEERING GEAR COLLISION WARNING - BMW / MINI

## STEERING GEAR COLLISION WARNING

### REPAIR INSTRUCTIONS

**NOTE:** Notes on Replacement of steering gear/steering column/steering shaft following accident damage.

#### Steering Gear Facts

In the event of accidents or driving conditions similar to accidents, shock-like loads can cause different types of damage to steering boxes. When a steering box is externally undamaged, it is sometimes only possible to identify damage with great difficulty and with great effort. However, damage of this nature poses an unacceptable risk to the vehicle because it can result in failure of the steering system.

Because of the disproportionate amount of effort involved, it is generally not sensible to check thoroughly all the individual components of the steering box and as an alternative it is necessary to take into user account other components which can be checked more easily.

#### Steering Gear Procedure

**NOTE:** The steering box must be replaced if one or more of the following points apply:

- A. Visible or noticeable damage to the steering box
  - Version with electric steering box (EPS): Examine in particular the control unit with all plug connections for damage and hairline cracks.
- B. Unacceptable torque increase and clamping when the steering box is turned from stop to stop (without hydraulic/electrical assistance)
- C. Fire damage
- D. Damage, permanent deformation or fractures to:
  - Wheel rims in the event of a negative result from the wheel alignment check.
  - Spring struts, steering stub axles, wheel carriers
  - Wishbones
  - Struts or trailing links or anti-roll bar with this function
  - Body-side screwing/attachment points for wheel guide/control components
  - Front axle carrier
  - Pitman arms
  - Tie rods
  - Steering box stands
  - Steering column

A lopsided steering wheel, significant deviations of camber/track values and noises when cranking the steering can be additional indications for the damage/deformations listed here.

**NOTE:** If the steering box replacement work which is required for safety reasons is refused by the customer or an insurance company for cost reasons, a memorandum to that effect must be drawn up and countersigned by the party bearing the costs of the accident repair.

**NOTE:** For corresponding specimen of memorandum, refer to Service

### Actual Situation Of The Steering Column And Steering Shaft

In the event of accidents or driving conditions similar to accidents, shock-like loads can cause different types of damage to the steering shaft and steering column. In case no external damaged of the steering column and the steering shaft can be noticed, it is sometimes only possible to identify damage with great difficulty and with great effort.

### Procedure For Steering Column And Steering Shaft

**NOTE:**        **The steering column and steering shaft must be replaced if one or more of the following points apply:**

- Visible or noticeable damage, deformation or breakage of the steering column or steering shaft
- Damage, permanent deformation or breakage of the tie rod
- Unacceptable torque increase and clamping when the steering column is cranked from stop to stop (without hydraulic/electrical assistance)
- If the wheel alignment nominal data cannot be reached after all the damaged wheel components are changed (exceedance of the permissible wheel alignment tolerances). If required, enclose the measurement protocol of the invoice/certificate.
- Positive check for activated crash system of the steering column:
- If no damage is visible on the steering column, the mechanical steering column must be checked for an activated crash system:
  1. Open steering column lock.
  2. Pull steering wheel out towards the driver (towards the body) until the physical stop is reached, but do not use excessive force.
  3. Push steering wheel towards engine compartment (approx. 20-30 mm away from body) into the comfort position and lock.

If no end stop is present when pulling out the steering column or the bellows of the steering column shroud has tension, the crash system has activated and the steering column is to be renewed.

**NOTE:**        **If the steering column/steering shaft replacement work which is required for safety reasons is rejected by the customer or an insurance company for cost reasons, a memorandum to that effect must be drawn up and countersigned by the party bearing the costs of the accident repair.**

**For corresponding specimen of the memorandum, refer to Service Information 320188(828) Appendix 1**

The vehicle's operating permit will be invalidated whenever the function of any of its safety components is compromised!

IMPORTANT:

This guideline is binding for all accident repairs to BMW, MINI and Rolls Royce vehicles!

### AIR - Technical Document

**NOTE:**        **Notes on replacement of steering gear/steering column/steering shaft following accident damage**

Certification of: \_\_\_\_\_

SIT -AN L-SI 1988-320188828\_A 1 \_US\_ VERSION

Enclosure 1 to SI 32 01 88 (828)

Certification of: \_\_\_\_\_



Re. Steering box on:

Vehicle: \_\_\_\_\_ Vehicle Identification Number:  
\_\_\_\_\_

Accident repair of: \_\_\_\_\_ Customer:  
\_\_\_\_\_

Dealer: \_\_\_\_\_ Dealer Number:  
\_\_\_\_\_

According to Directive 3200... "Information on Replacing Steering Box After Accident Damage" issued by the manufacturer, the steering box should be replaced after a vehicle has been involved in an accident, including experiencing driving conditions similar to an accident, if any of the following points are applicable.

Damage, permanent deformation or fractures to:

- wheel rims in the event of a negative result from the wheel/axle alignment check
- spring struts, steering stub axles and/or wheel carriers
- wishbones
- leading or trailing links or anti-roll bars with this function
- body-side screwing/attachment point for wheel-guide control components
- front axle support
- pitman arms
- tie rods
- steering box features
- steering column
- visible or otherwise noticeable damage to the steering box
- unacceptable torque increase and clamping when the steering box is turned from lock to lock (without hydraulic/electrical assistance)
- permissible tolerances exceeded during axle/wheel alignment
- fire damage

The points marked have been deemed to be damaged as a result of the accident, or driving conditions similar to an accident, in which the above-referenced vehicle was involved.

**IMPORTANT:** The vehicle's operating license will be invalidated whenever the function of any of its safety components is compromised!

The customer/insurer acknowledges that the points marked above have been deemed to be damaged as a result of the accident, or driving conditions similar to an accident, in which the above referenced vehicle was involved. The customer/insurer further acknowledges that in such instances, the directive issued by the manufacturer requires the steering box to be replaced. Notwithstanding the foregoing, the customer/insurer has chosen not to accept replacement of the steering box as directed by the manufacturer, and thereby assumes full and sole area of responsibility for the continued operation of the steering box in the above-referenced vehicle, including any technical, mechanical or legal consequences.

Stamp/Signature (customer and insurer):  
\_\_\_\_\_  
\_\_\_\_\_



**2016 SUSPENSION****BMW WHEEL ALIGNMENT SPECIFICATIONS - I SERIES****WHEEL ALIGNMENT SPECIFICATIONS****I SERIES (I01) (I3) STANDARD SUSPENSION 19" WHEEL****I SERIES (I01) (i3) Standard Suspension 19" Wheel**

Measurement	Minimum	Preferred	Maximum
Left Front Caster ( $\hat{A}^\circ$ )	0	0	0
Right Front Caster ( $\hat{A}^\circ$ )	0	0	0
Left Front Camber ( $\hat{A}^\circ$ )	-0.75	-0.33	0.09
Right Front Camber ( $\hat{A}^\circ$ )	-0.75	-0.33	0.09
Front Toe ( $\hat{A}^\circ$ )	0.16	0.23	0.3
Left SAI ( $\hat{A}^\circ$ )	0	0	0
Right SAI ( $\hat{A}^\circ$ )	0	0	0
Left Rear Camber ( $\hat{A}^\circ$ )	-1.75	-1.67	-1.59
Right Rear Camber ( $\hat{A}^\circ$ )	-1.75	-1.67	-1.59
Rear Toe ( $\hat{A}^\circ$ )	0.23	0.3	0.37
Thrust Angle	0.2	0	0
Left Toe Out, Inward ( $\hat{A}^\circ$ )	0	0	0
Right Toe Out, Inward ( $\hat{A}^\circ$ )	0	0	0
Left Toe Out, Outward ( $\hat{A}^\circ$ )	0	0	0
Right Toe Out, Outward ( $\hat{A}^\circ$ )	0	46	46
Left Max Turn, Inward ( $\hat{A}^\circ$ )	46	46	46
Right Max Turn, Inward ( $\hat{A}^\circ$ )	46	35.1	35.1
Left Max Turn, Outward ( $\hat{A}^\circ$ )	35.1	35.1	35.1
Right Max Turn, Outward ( $\hat{A}^\circ$ )	35.1	-	-

**I SERIES (I01) (I3) STANDARD SUSPENSION 20" WHEEL****I SERIES (I01) (i3) Standard Suspension 20" Wheel**

Measurement	Minimum	Preferred	Maximum
Left Front Caster ( $\hat{A}^\circ$ )	0	0	0
Right Front Caster ( $\hat{A}^\circ$ )	0	0	0
Left Front Camber ( $\hat{A}^\circ$ )	-0.75	-0.33	0.09
Right Front Camber ( $\hat{A}^\circ$ )	-0.75	-0.33	0.09
Front Toe ( $\hat{A}^\circ$ )	0.16	0.23	0.3
Left SAI ( $\hat{A}^\circ$ )	0	0	0
Right SAI ( $\hat{A}^\circ$ )	0	0	0
Left Rear Camber ( $\hat{A}^\circ$ )	-1.75	-1.67	-1.59
Right Rear Camber ( $\hat{A}^\circ$ )	-1.75	-1.67	-1.59
Rear Toe ( $\hat{A}^\circ$ )	0.23	0.3	0.37
Thrust Angle	0.2	0	0
Left Toe Out, Inward ( $\hat{A}^\circ$ )	0	0	0
Right Toe Out, Inward ( $\hat{A}^\circ$ )	0	0	0
Left Toe Out, Outward ( $\hat{A}^\circ$ )	0	0	0
Right Toe Out, Outward ( $\hat{A}^\circ$ )	0	46	46
Left Max Turn, Inward ( $\hat{A}^\circ$ )	46	46	46
Right Max Turn, Inward ( $\hat{A}^\circ$ )	46	35.1	35.1
Left Max Turn, Outward ( $\hat{A}^\circ$ )	35.1	35.1	35.1

Measurement	Minimum	Preferred	Maximum
Right Max Turn, Outward ( $\hat{A}^\circ$ )	35.1	-	-

### I SERIES (I12) 20" WHEEL COUP E (I8)

#### I SERIES (I12) 20" Wheel Coup e (i8)

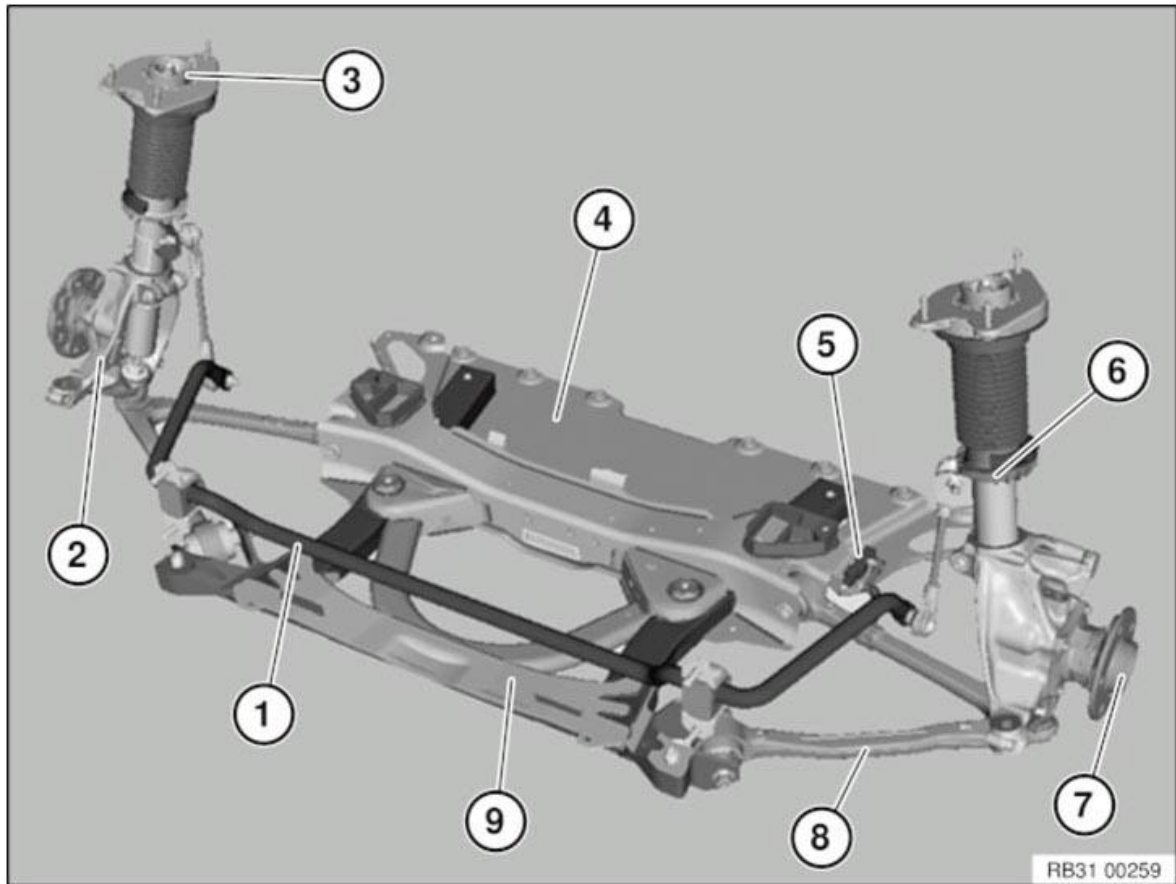
Measurement	Minimum	Preferred	Maximum
Left Front Caster ( $\hat{A}^\circ$ )	0	0	0
Right Front Caster ( $\hat{A}^\circ$ )	0	0	0
Left Front Camber ( $\hat{A}^\circ$ )	-0.57	-0.15	0.27
Right Front Camber ( $\hat{A}^\circ$ )	-0.57	-0.15	0.27
Front Toe ( $\hat{A}^\circ$ )	0.16	0.23	0.3
Left SAI ( $\hat{A}^\circ$ )	0	0	0
Right SAI ( $\hat{A}^\circ$ )	0	0	0
Left Rear Camber ( $\hat{A}^\circ$ )	-2.08	-2	-1.92
Right Rear Camber ( $\hat{A}^\circ$ )	-2.08	-2	-1.92
Rear Toe ( $\hat{A}^\circ$ )	0.26	0.33	0.4
Thrust Angle	0.2	0	0
Left Toe Out, Inward ( $\hat{A}^\circ$ )	0	0	0
Right Toe Out, Inward ( $\hat{A}^\circ$ )	0	0	0
Left Toe Out, Outward ( $\hat{A}^\circ$ )	0	0	0
Right Toe Out, Outward ( $\hat{A}^\circ$ )	0	38.72	38.72
Left Max Turn, Inward ( $\hat{A}^\circ$ )	38.72	38.72	38.72
Right Max Turn, Inward ( $\hat{A}^\circ$ )	38.72	30.98	30.98
Left Max Turn, Outward ( $\hat{A}^\circ$ )	30.98	30.98	30.98
Right Max Turn, Outward ( $\hat{A}^\circ$ )	30.98	-	-

## SUSPENSION

### Front Axle - Repair - i3 Hybrid & Plug-In - i3

## GENERAL INFORMATION

### 31 00... FRONT AXLE + STEERING WORK REQUIRING SUBSEQUENT WHEEL ALIGNMENT CHECK



**Fig. 1: Identifying Front Axle And Steering Wheel Alignment Related Components**  
Courtesy of BMW OF NORTH AMERICA, INC.

A wheel/chassis alignment check must be carried out after the following work:

**Release the following screw connections:**

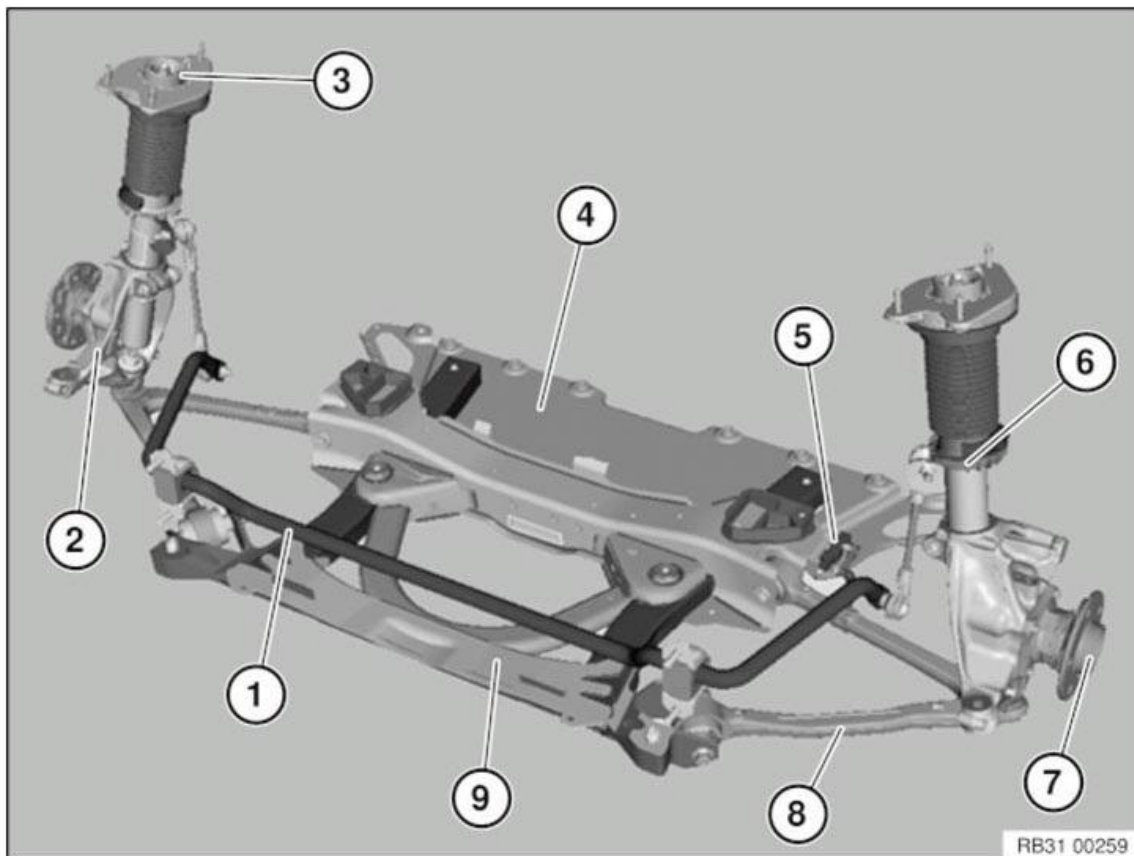
- Steering box to front axle carrier
- Lower wishbone to front axle carrier
- Track rod end to track rod

**Replace the following components:**

- EPS steering box
- Front axle support
- Wishbone
- Track rod end
- Track rod
- Swivel bearing

See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE](#)

## 31 FRONT AXLE OVERVIEW



- 1 [Anti-roll bar / anti-roll bar link](#)
- 2 [Swivel bearing](#)
- 3 [Support bearing](#)
- 4 [Stiffening plate](#)
- 5 [Ride height sensor](#)
- 6 [Spring strut/coil spring](#)
- 7 [Wheel bearing](#)
- 8 [Wishbone](#)
- 9 [Front axle support](#)

**Fig. 2: Identifying Front Axle Related Components**  
Courtesy of BMW OF NORTH AMERICA, INC.

## 31 00... INFORMATION ON REPLACING SHOCK ABSORBERS

### **Situation:**

When a shock absorber is faulty on one side (leaking, noises, etc.), often both shock absorbers on the axle in question are replaced.

### **Effect:**



This is not necessary for technical reasons and causes the manufacturer not to recognize the unnecessarily removed shock absorbers as defective parts. Unnecessarily high costs for the customer can be avoided by replacing the shock absorber on one side only.

### **Procedure:**

If one shock absorber is damaged, it is only necessary to replace both shock absorbers when the car has driven in excess of 80 000 km.

### **31 00... INSTRUCTIONS (CHASSIS COMPONENTS MADE OF ALUMINUM)**

Due to the chemical and corrosion characteristics of aluminum, always comply with the following points when handling aluminum components:

- Do not bring into contact with battery acid!
- Do not clean with wire brushes made of brass or iron! Always use wire brushes with stainless steel bristles!
- Do not expose to flying sparks when grinding/separating! Cover components!
- Do not strike with steel welding chips! Cover components!
- Do not expose to temperatures  $> 80 \text{ }^{\circ}\text{C}$ , even for brief periods! Temperatures in paint facilities do not have the same impact

### **LIFTING THE VEHICLE USING A VEHICLE HOIST**

#### **WARNING:**

**Danger to life!**

**Read and follow operating instructions for vehicle hoist.**

**Do not exceed approved load-carrying capacity and load distribution of vehicle hoist.**

**Weight compensation may be necessary due to the loading situation of the vehicle.**

**This also applies in the event of considerable removal of parts or conversions on the vehicle.**

#### **NOTE:**

**The vehicle hoist must comply with the relevant statutory/country-specific accident prevention regulations and be serviced according to the regulations.**

Risk of damage!

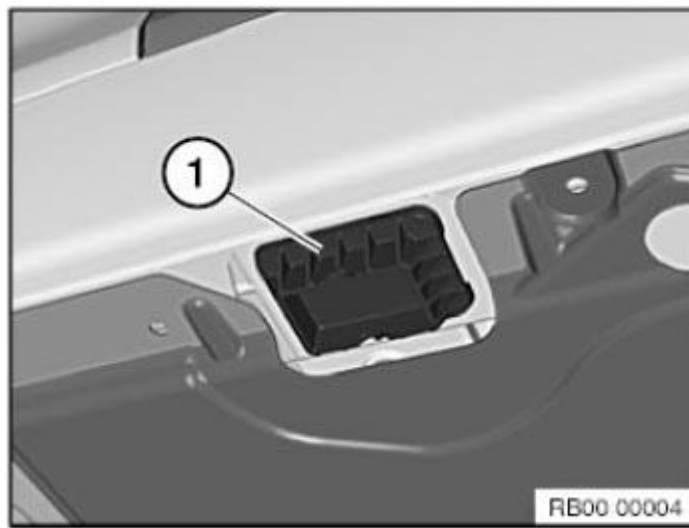
**IMPORTANT:** Before driving onto a vehicle hoist, make sure there is sufficient ground clearance between the vehicle hoist and the vehicle.

The vehicle may only be raised with the vehicle hoist at the four jacking points.

#### **Necessary preliminary tasks:**

- If necessary, remove jacking points from equipment pack (with new vehicles) and insert from below into openings in front and rear sill areas

**IMPORTANT:** All four jacking points (1) must be available!  
Never raise the vehicle without the jacking points (1)!



**Fig. 3: Identifying Vehicle Jacking Points**

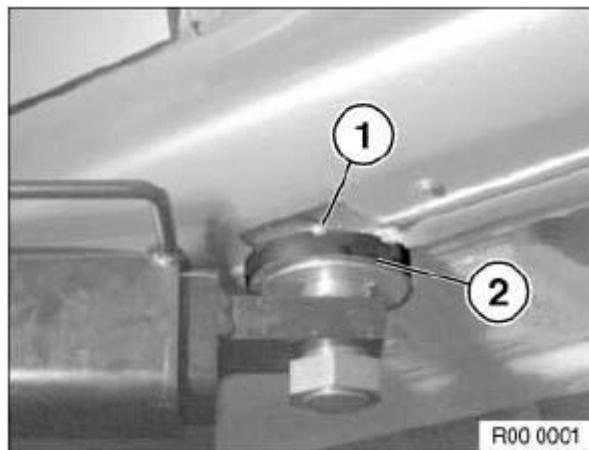
Courtesy of BMW OF NORTH AMERICA, INC.

Risk of damage!

Align support plates (2) of lifting platform arms to jacking points (1) in such a way that

IMPORTANT: no adjoining components are touched and thereby damaged.

**In electric vehicles, there is a risk of damage to the high-voltage component behind the underbody panelling!**



**Fig. 4: Aligning Lifting Platform Support Plates And Jacking Points**

Courtesy of BMW OF NORTH AMERICA, INC.

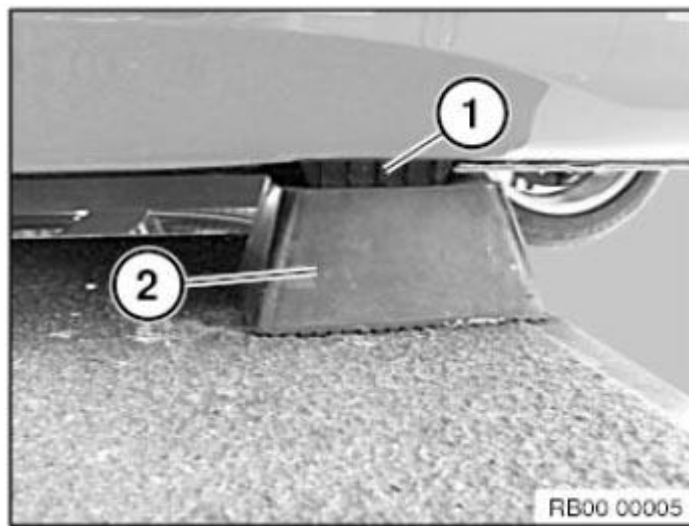
Risk of damage!

Align the rubber block (2) with the jacking points (1) in such a way that no adjoining components are touched and thereby damaged.

IMPORTANT: **Never raise the vehicle without rubber blocks (or rigid foam blocks)!**

There is a major risk of damage to the vehicle underbody!

**In electric vehicles, there is a risk of damage to the high-voltage component behind the underbody panelling!**



**Fig. 5: Identifying Jacking Points And Rubber Block**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **31 00 MOBILE TABLE LIFT**

**WARNING:**

**Danger of injury!**

**Before beginning work, position table lift with the lower frame securely on the floor.**

**Danger area around mechanism below platform.**

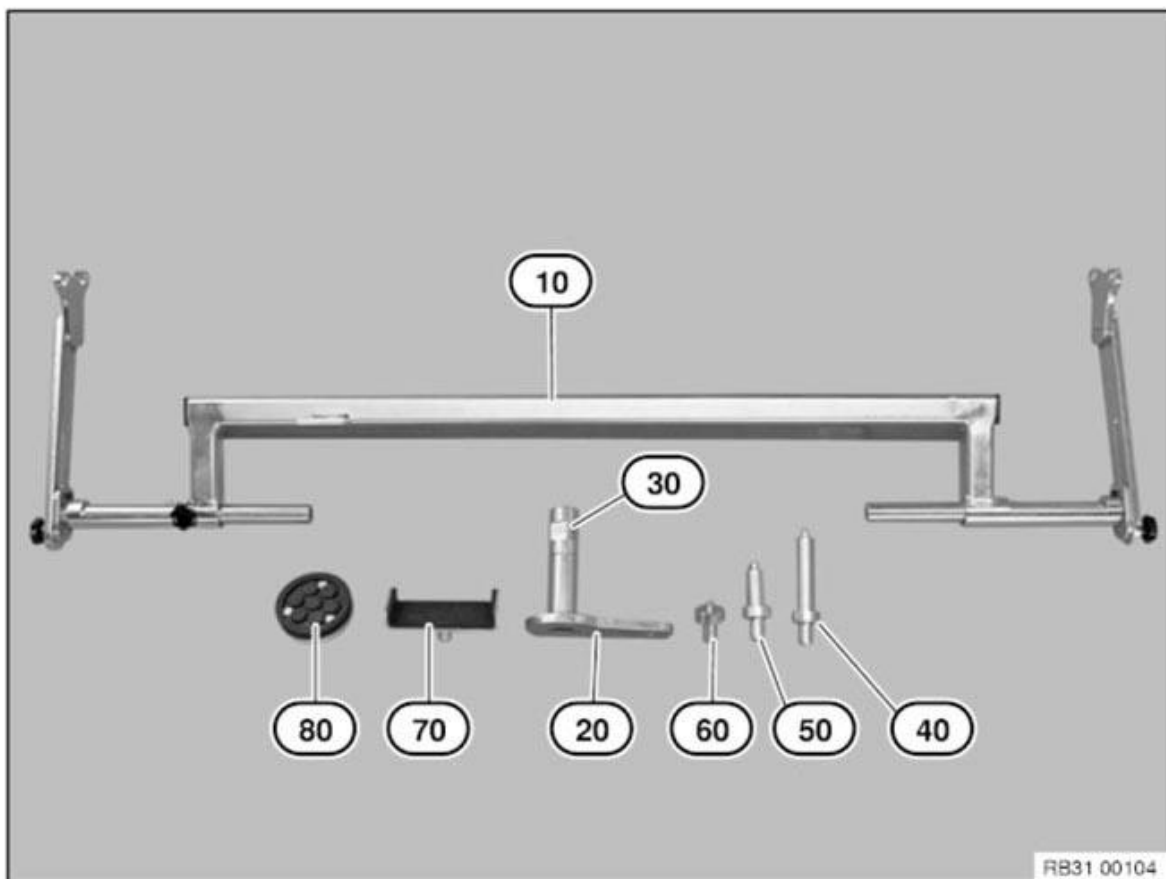
- **Do not reach into or step into the danger area.**
- **Note permissible bearing capacity of table lift.**
- **Mount load centrally (danger of tipping) and secure against shifting.**

**Follow the operating instructions from the equipment manufacturer.**

The mobile table lift is used for collision repairs and when removing large engines.

Adaptations for mounting front axle with engine and transmission.

No. 10	For mounting swivel bearing with brake disc
No. 20	Retaining element for adjustable fixture
No. 30	Adjustable fixture
No. 40	Distance pin 40 x 160 mm
No. 50	Distance pin 40 x 110 mm
No. 60	Distance pin 40 x 60 mm
No. 70	Fixture with U-profile
No. 80	Plate fixture $\tilde{\Lambda}=100$ mm



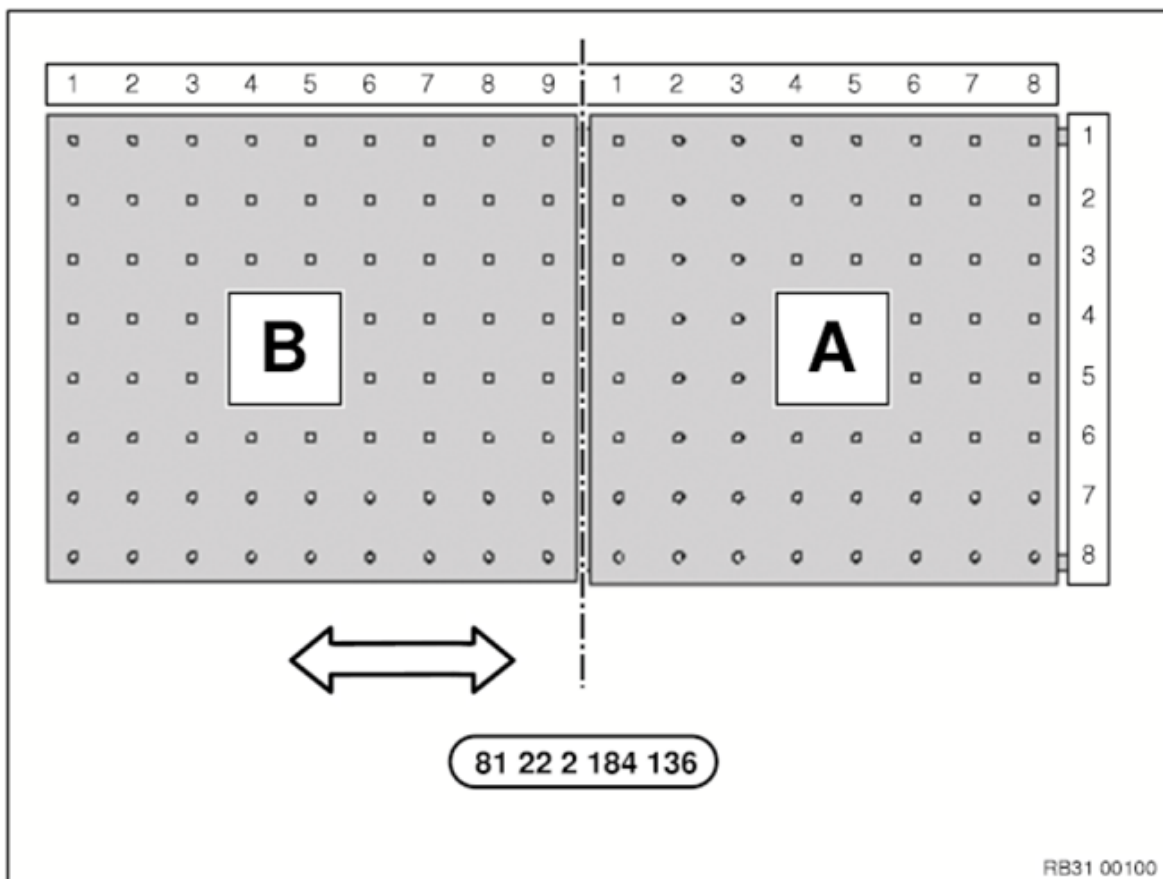
**Fig. 6: Identifying Mobile Table Lift Related Components**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Release star knob screw on working plate (B) of table lift; the working surface (B) can be extended by approx. 310 mm.

Release all push-pull clamps and the working plates can be shifted by approx. 20 mm.

Working plate (A and B) can be raised and lowered by  $3^{\circ}$  on the long side and by  $5^{\circ}$  on the transverse side.

Working plate (A and B) is subdivided by a coordinate system and a possible installation position is recommended in the respective repair manual.



**Fig. 7: Identifying Working Plate**

Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Follow the operating instructions from the equipment manufacturer.

**41 00... NOTES ON REPAIRING THREADS**

IMPORTANT: Install Helicoil thread inserts so that they are flush with the original thread!

**NOTE:** Damaged threads may be repaired with Helicoil thread inserts. Observe the **PROCEDURE** described in the example.

Screw connection	Vehicle	Bolting point	Helicoil thread insert
Front axle support to front axle module	I01	Front	M12x1.5x24
	I01	Center	M12x1.5x24
	I01	Rear	M12x1.5x28

**31 00... NOTES ON REPAIRING THREADS**

IMPORTANT: Install Helicoil thread inserts so that they are flush with the original thread.

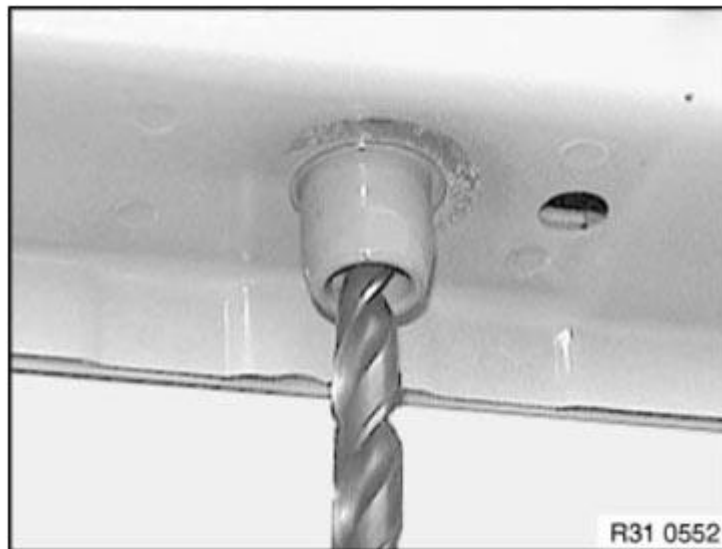
**NOTE:** Damaged threads on the engine support may be repaired with Helicoil thread inserts. Follow the procedure described in the example.



**Fig. 8: Identifying Helicoil Thread Insert**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Procedure:**

1. Create a clean core hole; if necessary, drill out screw remnants



**Fig. 9: Drilling Clean Core Hole**  
Courtesy of BMW OF NORTH AMERICA, INC.

2. Create locating thread for Helicoil thread insert





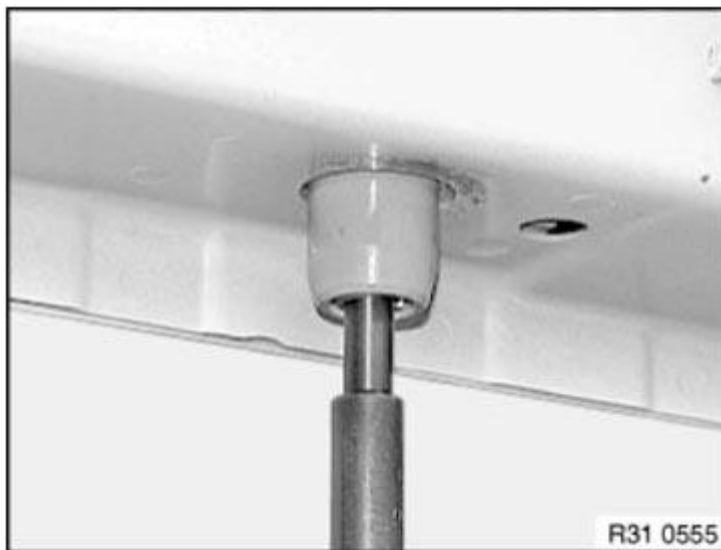
**Fig. 10: Creating Locating Thread For Helicoil Thread Insert**  
Courtesy of BMW OF NORTH AMERICA, INC.

3. Pick out Helicoil thread insert in accordance with the table and screw into the locating thread until flush with the original thread



**Fig. 11: Installing Locating Thread**  
Courtesy of BMW OF NORTH AMERICA, INC.

4. Break drive pin and remove



**Fig. 12: Breaking Drive Pin**  
Courtesy of BMW OF NORTH AMERICA, INC.

**31 00... NOTES ON WHEEL BEARING REPLACEMENT FOLLOWING ACCIDENT DAMAGE**

**Wheel bearing facts:**

In the event of accidents or driving conditions similar to accidents, shock-like loads to the wheel bearing units can cause slight damage to the bearing track. Despite initial running without noise, with continued use, this results in later noise generation at the wheel bearing.

**Procedure:**

The wheel bearing must be replaced on the damaged side of the axle if one or several of the following points apply:

- Visible or noticeable damage to the wheel bearing

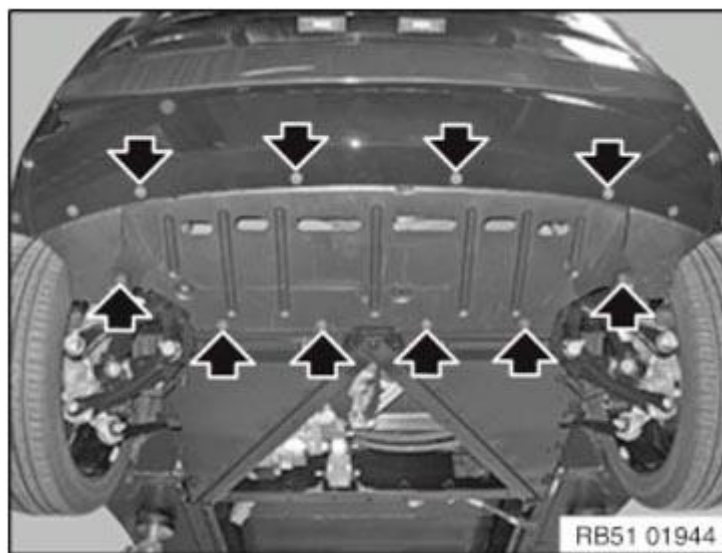
- Rolling noises, radial/lateral runout on the wheel bearing
- Permissible tolerance for the wheel alignment is exceeded and no longer adjustable without the exchange of additional components
- Damage, permanent deformation or fractures to:
  - Wheel rims (major damage) and simultaneous negative result for wheel alignment
  - Spring struts, swivel bearings, wheel carriers
  - Wishbones
  - Struts or trailing links or anti-roll bar with this function
  - Body-side screwing/attachment points for wheel guide/control components
  - Track rods
  - Steering box fixtures

This guideline is binding for all accident repairs to BMW, MINI and Rolls-Royce vehicles!

## **51 75 110 REMOVING AND INSTALLING/REPLACING REAR UNDERBODY PANELLING**

Release screws.

Remove underbody panelling.



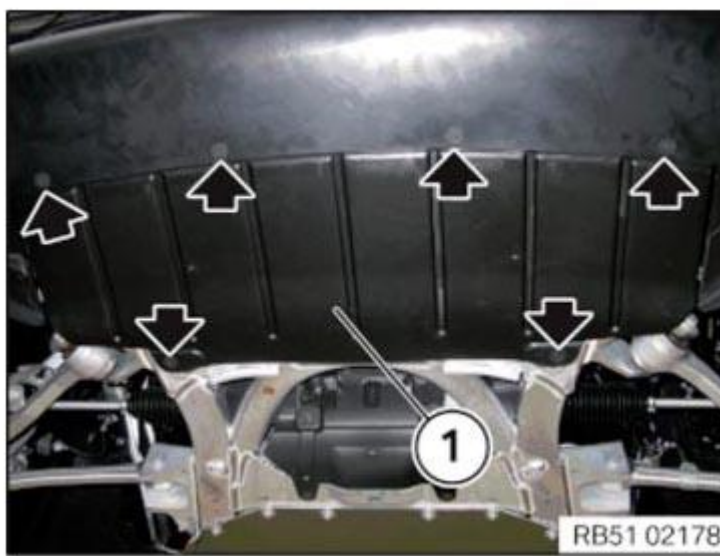
**Fig. 13: Locating Underbody Panelling Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **FRONT UNDERBODY PROTECTION**

### **51 47 490 REMOVING AND INSTALLING/REPLACING FRONT UNDERBODY PROTECTION**

Release screws.

Remove underbody protection (1).



**Fig. 14: Locating Underbody Protection Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **FRONT SUB-FRAME**

### **31 11 506 LOWERING/RAISING FRONT AXLE SUPPORT (UNIVERSAL LIFTER) - NO RANGE EXTENDER**

#### **Special tools required:**

- 31 5 251
- 00 2 030
- 31 5 255
- 31 5 253

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:** Danger of injury!

Failure to comply with the following instructions may result in the vehicle slipping off the lifting platform and critically injuring other persons.

When supporting components, make sure that:

- the vehicle can no longer be raised or lowered.
- the vehicle does not lift off the locating plates on the vehicle hoist.

Before lowering/removing front axle support:

IMPORTANT: Observe **SAFETY INFORMATION** for raising the vehicle.

In order to avoid damage to vehicle hoist, perform weight compensation on vehicle.

#### **Necessary preliminary tasks:**

- Disconnect **BATTERY** .
- Remove **FRONT LUGGAGE COMPARTMENT WELL** .

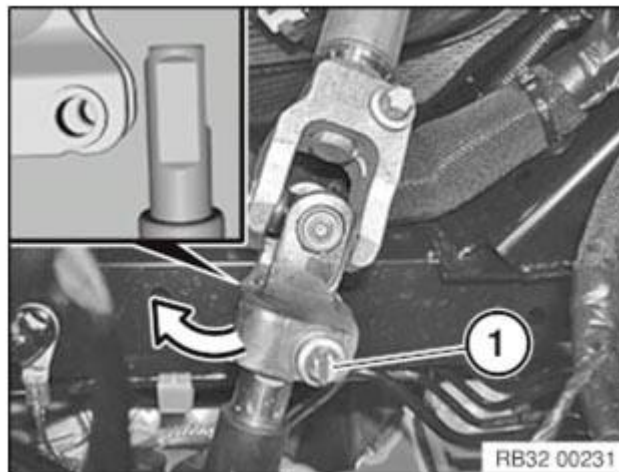
Move steering to straight-ahead position.

Release clamping bolt (1).

Tightening torque [32 31 2AZ](#) .

Swing out universal joint of steering gear.

**IMPORTANT:** After the steering shaft is separated from the steering gear, do not twist the steering shaft and the steering gear to avoid damaging the steering column switch cluster.



**Fig. 15: Removing Front Axle Support Clamping Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

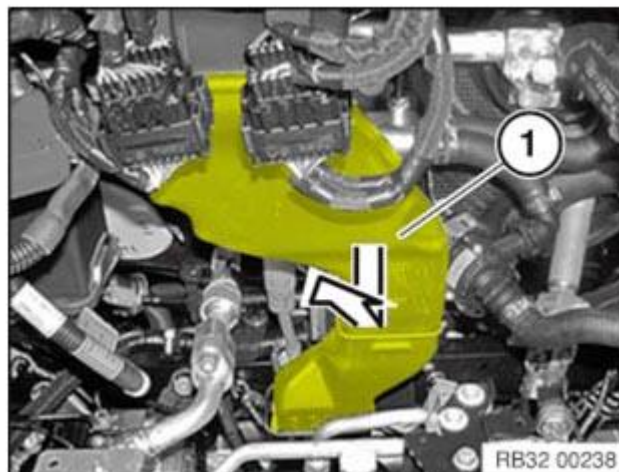
*Installation note:*

Renew clamping bolt.

Recut thread in universal joint to remove remnants of the screw locking adhesive.

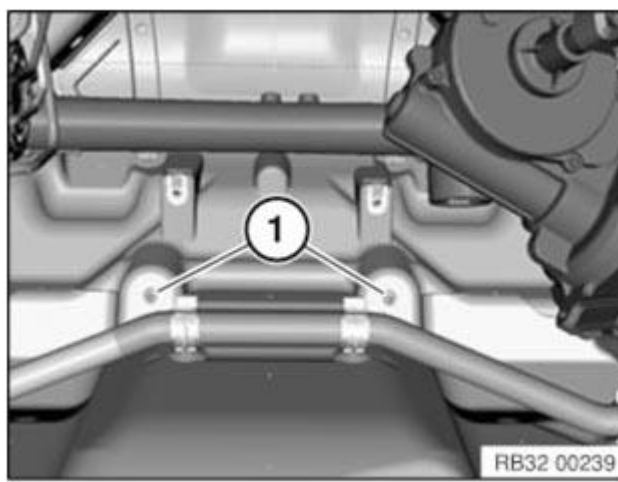
Universal joint can only be installed in one position.

Remove water drain channel (1).



**Fig. 16: Removing Water Drain Channel**  
Courtesy of BMW OF NORTH AMERICA, INC.

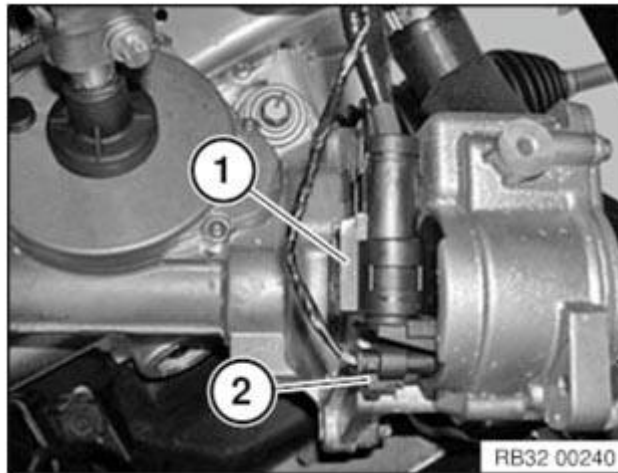
Release screws (1) for upper section of radiator module air duct at lower section.



**Fig. 17: Identifying Radiator Module Air Duct Upper Section Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect plug connection (1) on steering gear.

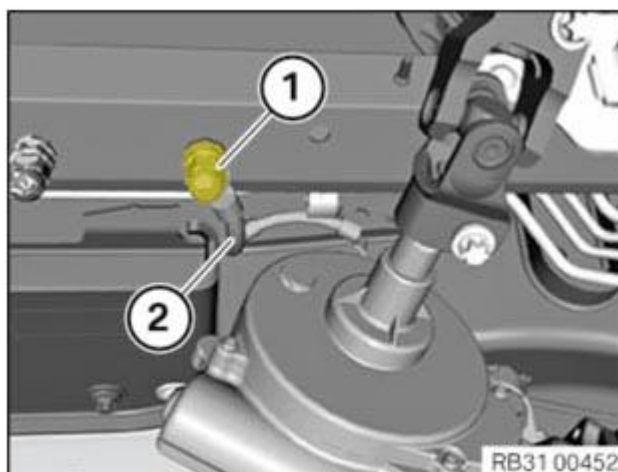
Unfasten plug connection (2) and disconnect.



**Fig. 18: Identifying Steering Gear Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Loosen the ground cable (2) from the bolt.

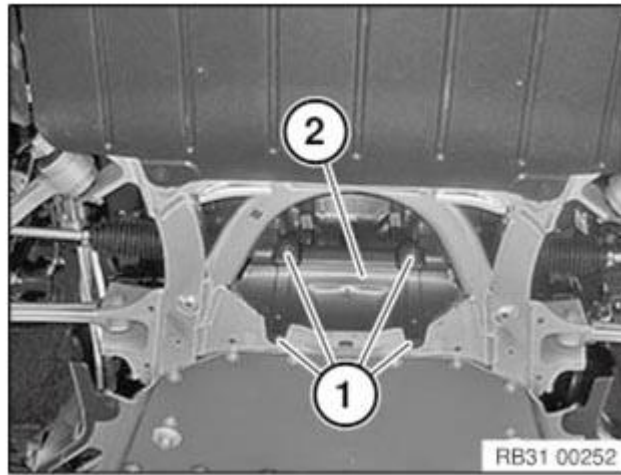


**Fig. 19: Identifying Front Axle Support Nut And Ground Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Loosen screws (1).



Remove air module service cap.

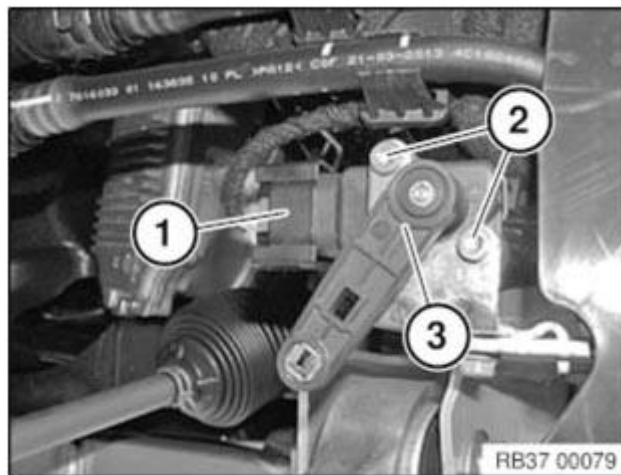


**Fig. 20: Identifying Air Module Service Cap And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

- Remove **FRONT UNDERBODY PROTECTION.**
- Remove **STIFFENING PLATE.**
- Remove **ANTI-ROLL BAR LINKS ON ANTI-ROLL BAR ON LEFT AND RIGHT.**

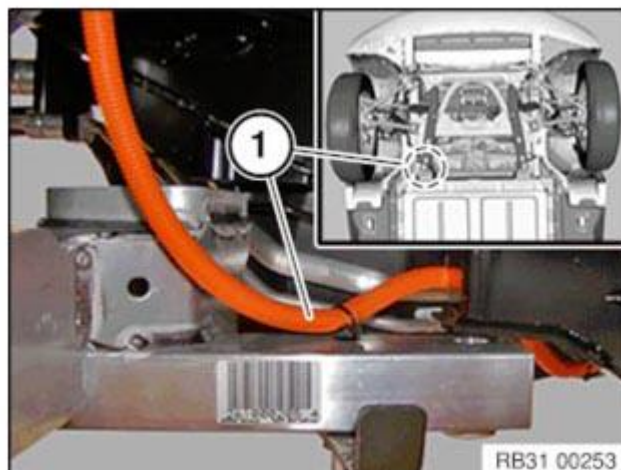
Disconnect plug connection (1) at the left ride height sensor if necessary.



**Fig. 21: Identifying Left Ride Height Sensor Plug Connection**

Courtesy of BMW OF NORTH AMERICA, INC.

Release high-voltage cable (1) from front axle support.





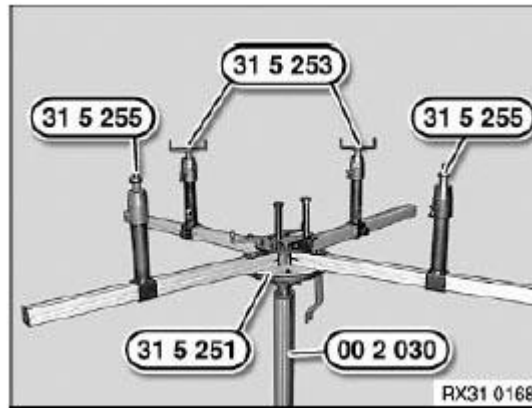
**Fig. 22: Identifying Front Axle Support High Voltage Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Engage special tool 31 5 251 with a 2nd person helping completely on workshop jack 00 2 030.

Insert special tools 31 5 255 in telescopic supports of a profile rail pair.

Insert special tools 31 5 253 in telescopic supports of other profile rail pair.

**NOTE:** In a profile rail pair, two profile rails are connected to one another by gearing.



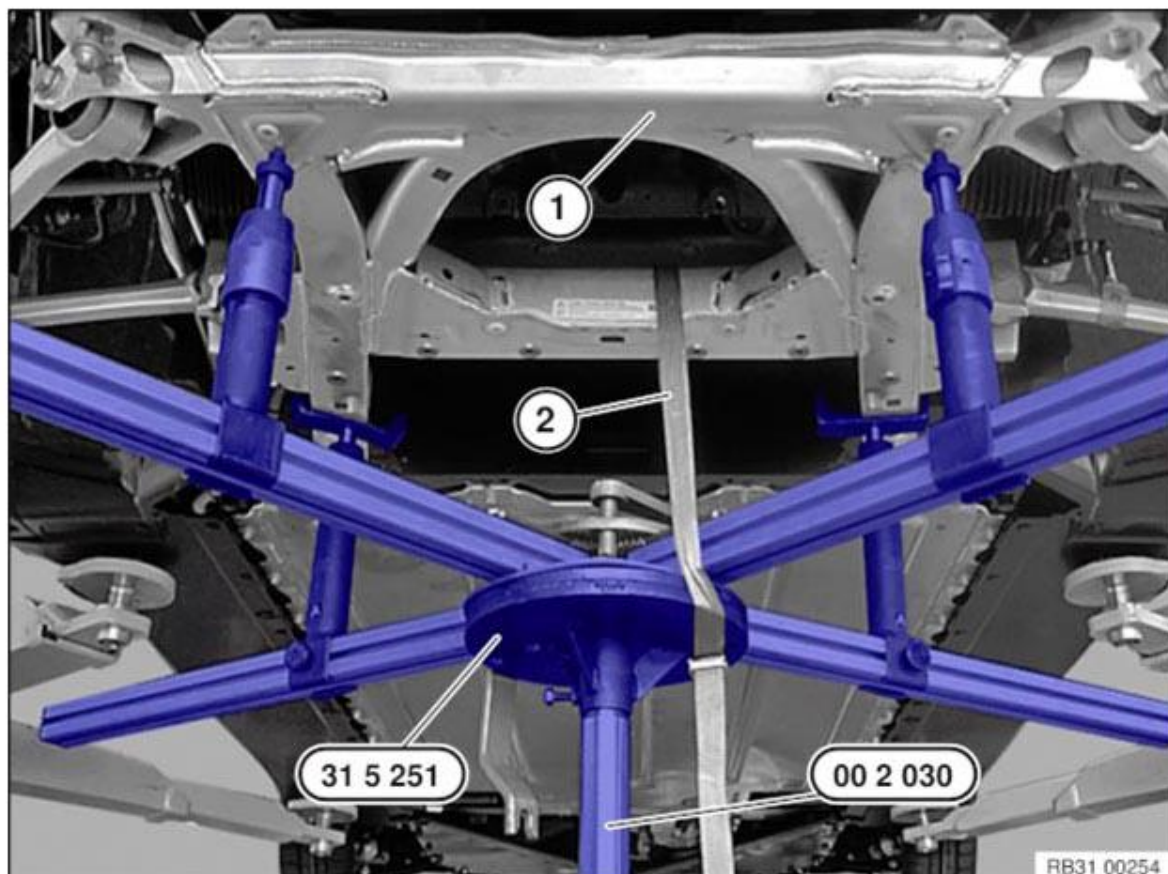
**Fig. 23: Installing Special Tools Into Profile Rail Pair Telescopic Supports**  
Courtesy of BMW OF NORTH AMERICA, INC.

Align special tools 31 5 251, 31 5 253 and 31 5 255 to front axle support.

Support front axle support by operating workshop jack 00 2 030.

Secure front axle support (1) on special tool 31 5 251 with tensioning strap (2).

**IMPORTANT:** The center of gravity of the front axle support must be positioned centrally over the workshop jack.



**Fig. 24: Securing Front Axle Support Onto Special Tool (31 5 251) Using Tensioning Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release bolts (1-3).

Tightening torque **31 10 1AZ** .

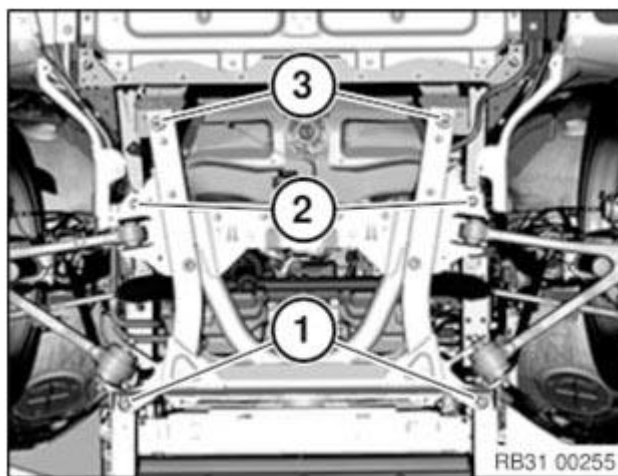
Lower front axle support by no more than 10 cm.

*Installation note:*

Check threads for damage; if necessary, repair with **HELICOIL THREAD INSERTS**.

Note installation locations of screws.

- Bolt (1) M12x98
- Bolt (2) M12x60
- Screw (3) M12x98



**Fig. 25: Identifying Front Axle Support Bolts And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**31 11 506 LOWERING/RAISING FRONT AXLE SUPPORT (UNIVERSAL LIFTER) - WITH RANGE EXTENDER**

**Special tools required:**

- 31 5 251
- 00 2 030
- 31 5 255
- 31 5 253

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:** Danger of injury!

Failure to comply with the following instructions may result in the vehicle slipping off the lifting platform and critically injuring other persons.

When supporting components, make sure that:

- the vehicle can no longer be raised or lowered.
- the vehicle does not lift off the locating plates on the vehicle hoist.

Before lowering/removing front axle support:

IMPORTANT: Observe **SAFETY INFORMATION** for raising the vehicle.

In order to avoid damage to vehicle hoist, perform weight compensation on vehicle.

### Necessary preliminary tasks:

- Disconnect **BATTERY** .
- Remove **FRONT LUGGAGE COMPARTMENT WELL** .

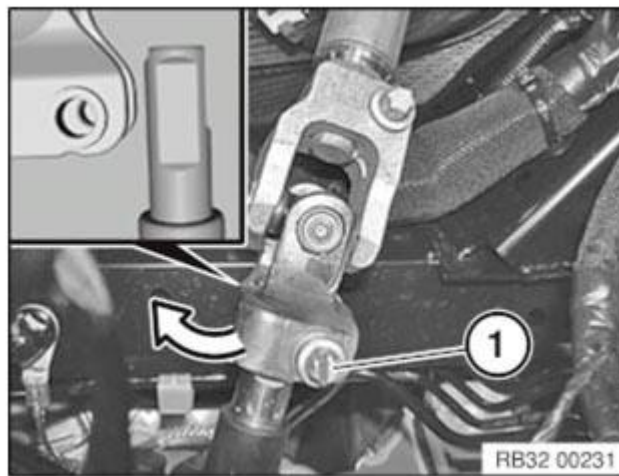
Move steering to straight-ahead position.

Release clamping bolt (1).

Tightening torque **32 31 2AZ** .

Swing out universal joint of steering gear.

IMPORTANT: After the steering shaft is separated from the steering gear, do not twist the steering shaft and the steering gear to avoid damaging the steering column switch cluster.



**Fig. 26: Removing Front Axle Support Clamping Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

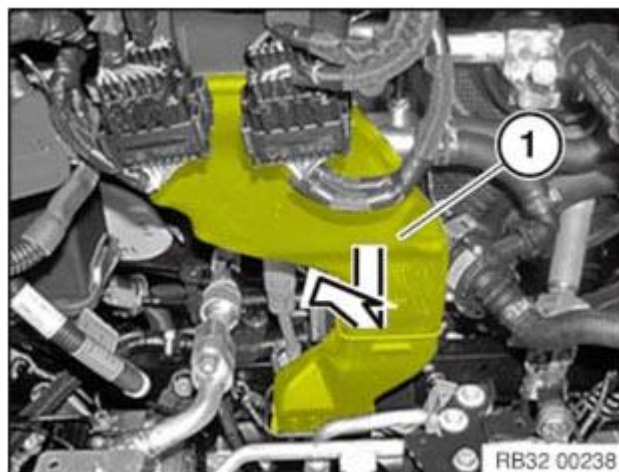
*Installation note:*

Renew clamping bolt.

Recut thread in universal joint to remove remnants of the screw locking adhesive.

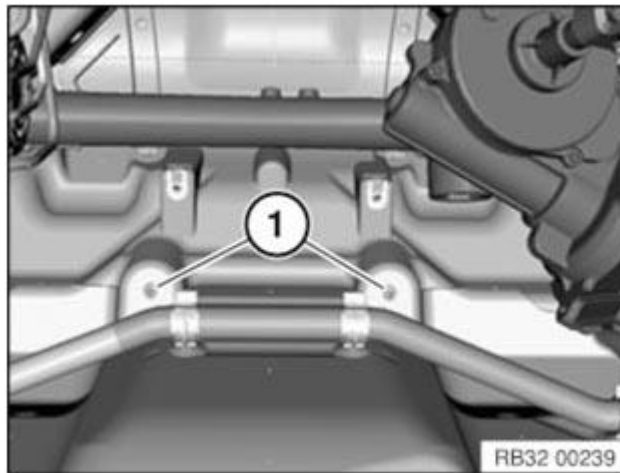
Universal joint can only be installed in one position.

Remove water drain channel (1).



**Fig. 27: Removing Water Drain Channel**  
Courtesy of BMW OF NORTH AMERICA, INC.

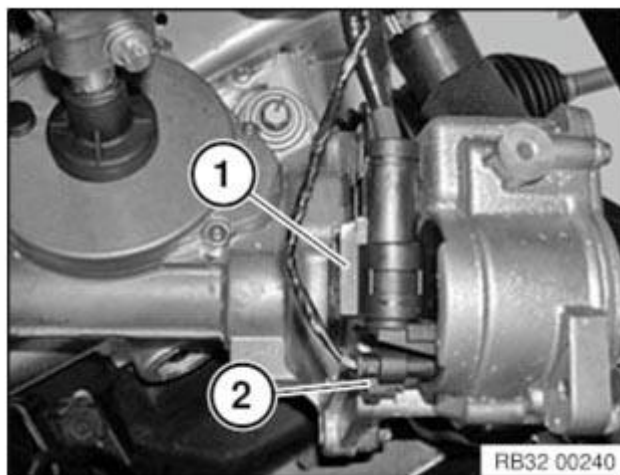
Release screws (1) for upper section of radiator module air duct at lower section.



**Fig. 28: Identifying Radiator Module Air Duct Upper Section Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock and disconnect plug connection (1) on steering gear.

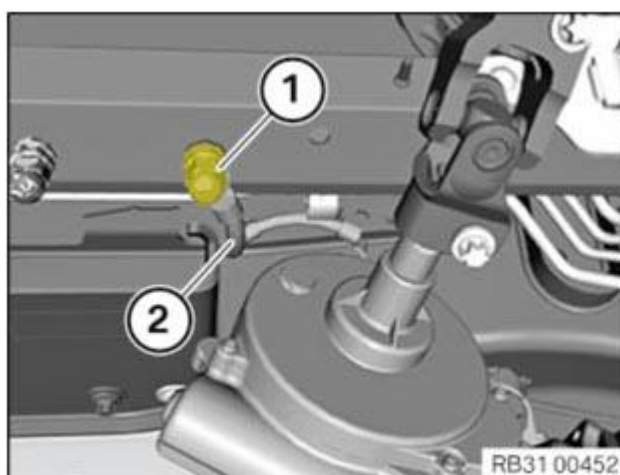
Unfasten plug connection (2) and disconnect.



**Fig. 29: Identifying Steering Gear Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Loosen the ground cable (2) from the bolt.

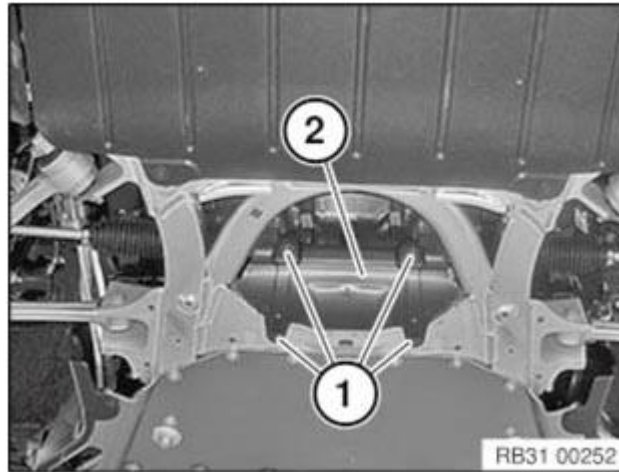




**Fig. 30: Identifying Front Axle Support Nut And Ground Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Loosen screws (1).

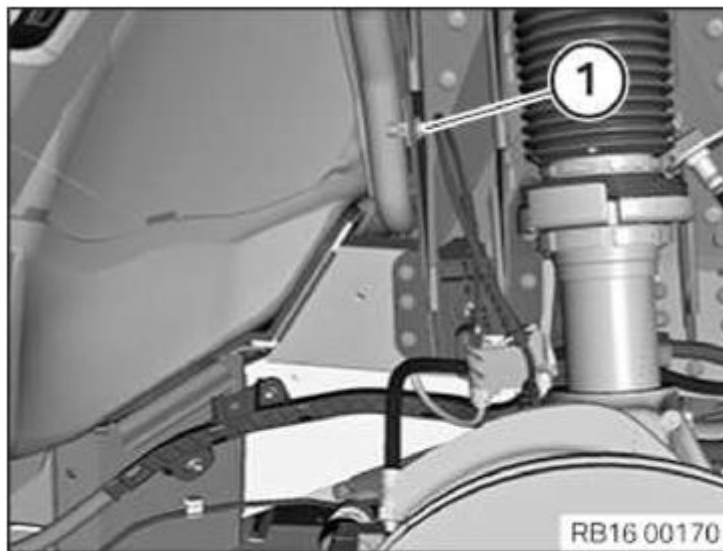
Remove air module service cap.



**Fig. 31: Identifying Air Module Service Cap And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Remove **FRONT RIGHT WHEEL ARCH PANEL** (rear section).
- Remove **FRONT UNDERBODY PROTECTION**.
- Remove **STIFFENING PLATE**.
- Remove **ANTI-ROLL BAR LINKS ON ANTI-ROLL BAR ON LEFT AND RIGHT**.

Release screw (1) on fuel filler pipe in wheel arch.



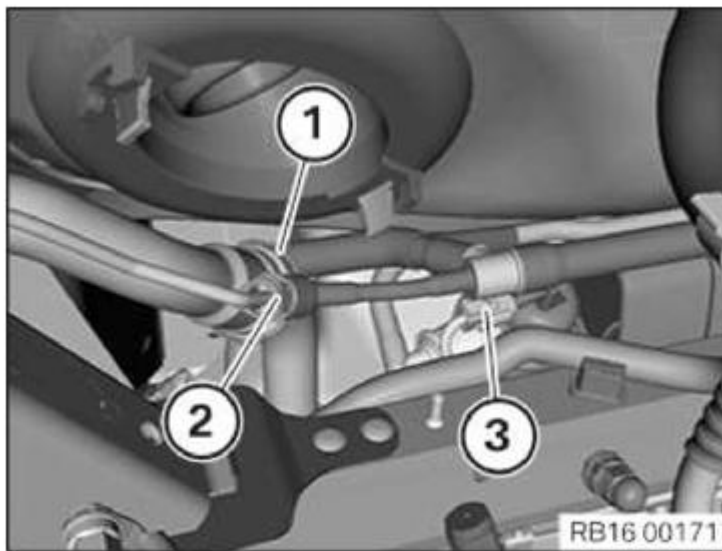
**Fig. 32: Identifying Wheel Arch Fuel Filler Pipe Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock retaining clip (1).

Loosen fuel filler pipe from fuel tank.

Unlock and disconnect snap fastener (2).

Ensure adequate ventilation in the workbay!  
Avoid skin contact (wear gloves)!  
**IMPORTANT:** In rare cases, a minimal amount of fuel may leak out of the fuel filler pipe when the fuel filler pipe is disassembled from the fuel tank.

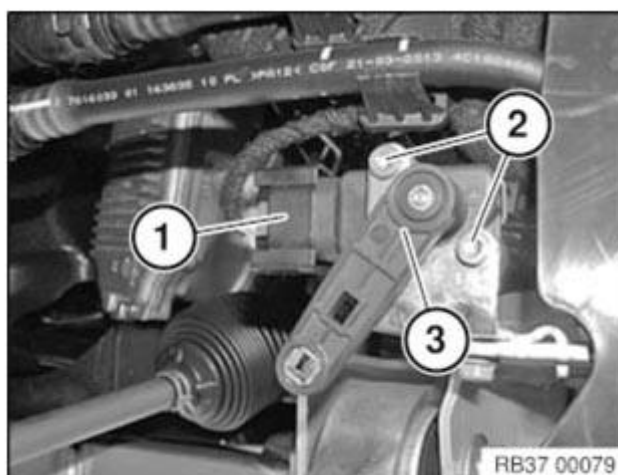


**Fig. 33: Identifying Retaining Clip, Fuel Filler Pipe And Snap Fastener**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

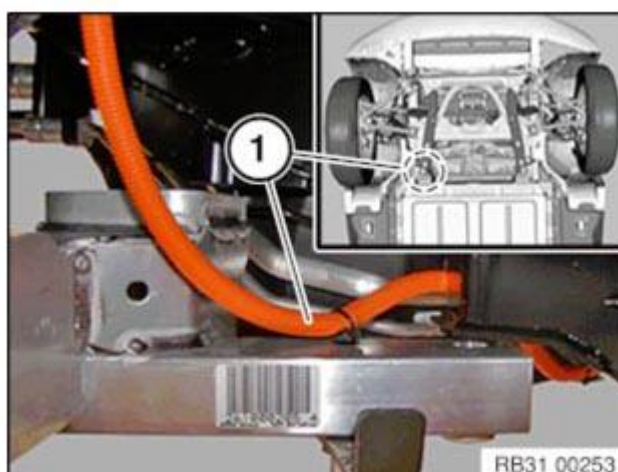
Slide the fuel tank into the fuel filler pipe when lifting the front axle.

Disconnect plug connection (1) at the left ride height sensor if necessary.



**Fig. 34: Identifying Left Ride Height Sensor Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release high-voltage cable (1) from front axle support.



**Fig. 35: Identifying Front Axle Support High Voltage Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

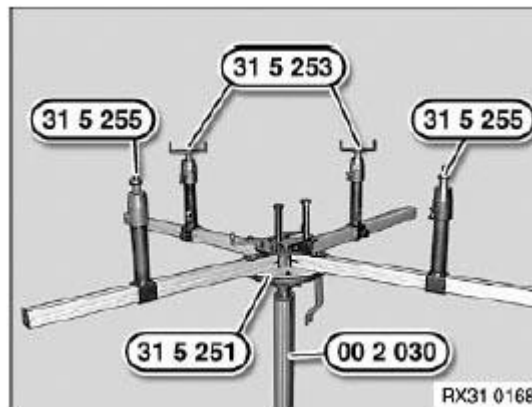


Engage special tool 31 5 251 with a 2nd person helping completely on workshop jack 00 2 030.

Insert special tools 31 5 255 in telescopic supports of a profile rail pair.

Insert special tools 31 5 253 in telescopic supports of other profile rail pair.

**NOTE:** In a profile rail pair, two profile rails are connected to one another by gearing.



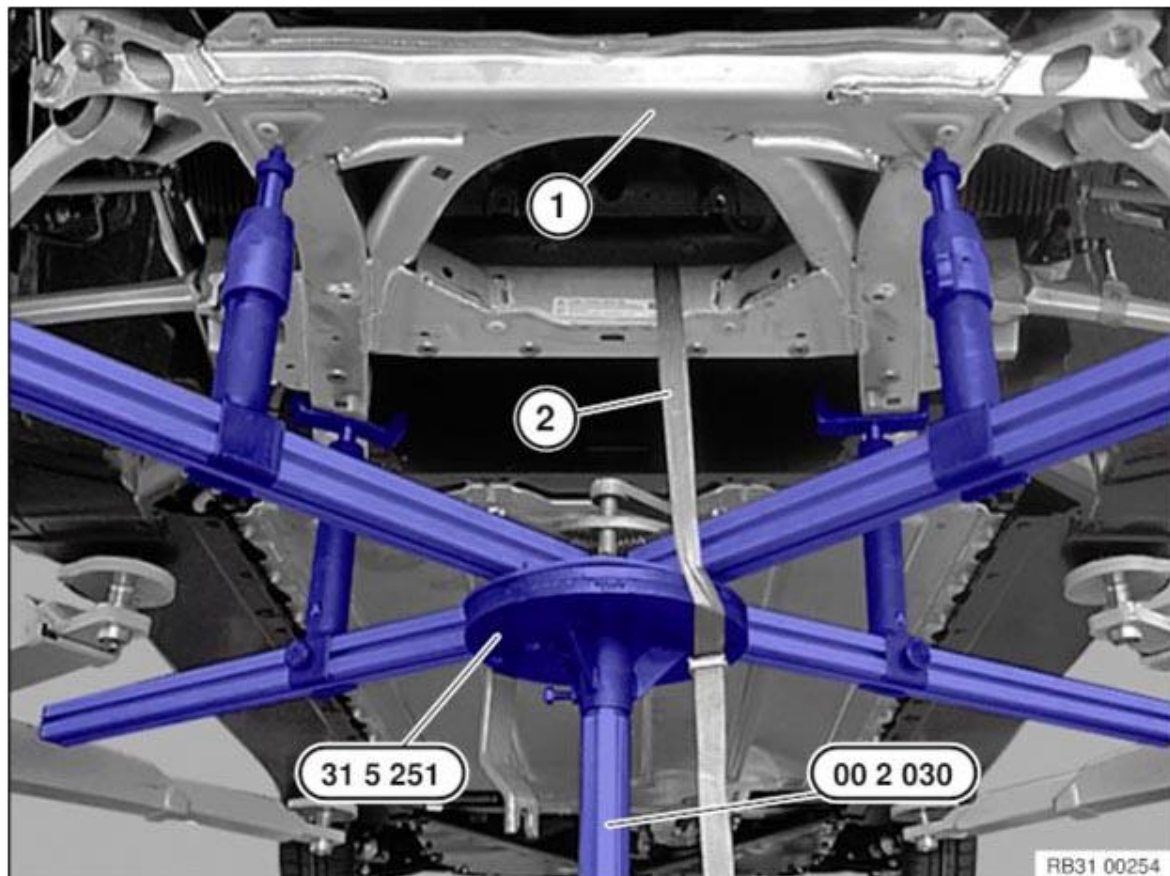
**Fig. 36: Installing Special Tools Into Profile Rail Pair Telescopic Supports**  
Courtesy of BMW OF NORTH AMERICA, INC.

Align special tools 31 5 251, 31 5 253 and 31 5 255 to front axle support.

Support front axle support by operating workshop jack 00 2 030.

Secure front axle support (1) on special tool 31 5 251 with tensioning strap (2).

**IMPORTANT:** The center of gravity of the front axle support must be positioned centrally over the workshop jack.



**Fig. 37: Securing Front Axle Support Onto Special Tool (31 5 251) Using Tensioning Strap**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release bolts (1-3).

Tightening torque [31 10 1AZ](#) .

Lower front axle support by no more than 10 cm.

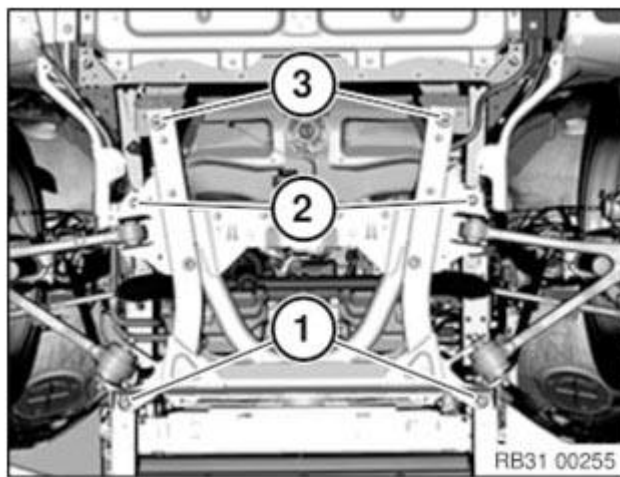
*Installation note:*

Slide the fuel tank into the fuel filler pipe when lifting the front axle.

Check threads for damage; if necessary, repair with [HELICOIL THREAD INSERTS](#).

Note installation locations of screws.

- Bolt (1) M12x98
- Bolt (2) M12x60
- Screw (3) M12x98



**Fig. 38: Identifying Front Axle Support Bolts And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **31 11 040 REMOVING AND INSTALLING/REPLACING STIFFENING PLATE**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

IMPORTANT: Driving **without** stiffening plate is not permissible!

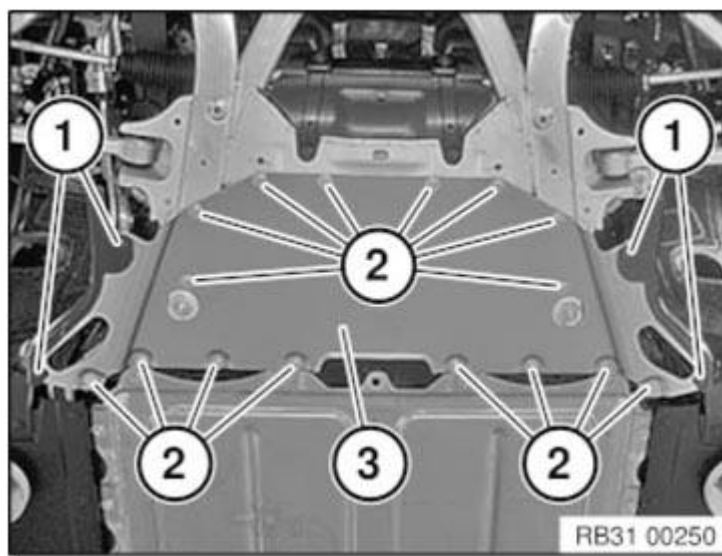
Release screws (1).

Only with range extender: Release coolant lines on stiffening plate on left and right.

Unfasten screws (2).

Tightening torque [31 10 2AZ](#) .

Remove stiffening plate (reinforcement plate) (3).



**Fig. 39: Identifying Stiffening Plate And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **31 11 001 REPLACING FRONT AXLE SUPPORT**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**WARNING:** Danger of injury!

Failure to comply with the following instructions may result in the vehicle slipping off the lifting platform and critically injuring other persons.

When supporting components, make sure that:

- the vehicle can no longer be raised or lowered
- the vehicle does not lift off the locating plates on the vehicle hoist.

Before lowering/removing front axle support:

Observe **SAFETY INFORMATION** on raising the vehicle.

**IMPORTANT:** In order to avoid damage to vehicle hoist, perform weight compensation on vehicle.

- Load spring strut domes with sand bags.

**Necessary preliminary tasks:**

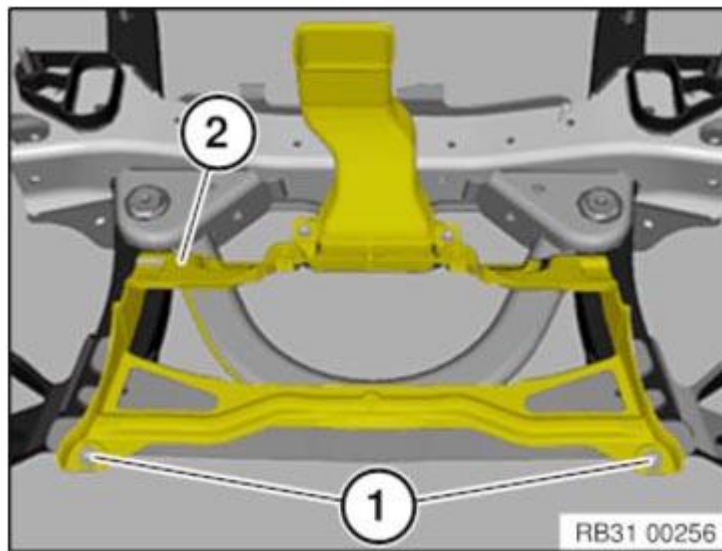
- Disconnect **BATTERY EARTH LEAD** .
- Remove **FRONT WHEELS** .
- Remove **BOTH TRACK RODS FROM SWIVEL BEARING** .
- Remove **WISHBONE FROM FRONT AXLE SUPPORT** .
- With range extender: Remove **FUEL TANK** .

The subsequent procedure is described under "Lowering/raising front axle support." See **LOWERING/RAISING FRONT AXLE SUPPORT (UNIVERSAL LIFTER) - NO RANGE EXTENDER** or **LOWERING/RAISING FRONT AXLE SUPPORT (UNIVERSAL LIFTER) - WITH RANGE EXTENDER** .

Remove **STEERING BOX** .

Release screws (1).

Remount lower section of radiator module (2) with lower section of water drain channel.



**Fig. 40: Identifying Radiator Module Lower Section And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Carry out wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

## **FRONT WISHBONE**

### **31 12 000 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT WISHBONE**

**Special tools required:**

- 31 2 230

**WARNING:** High-voltage system - danger to life

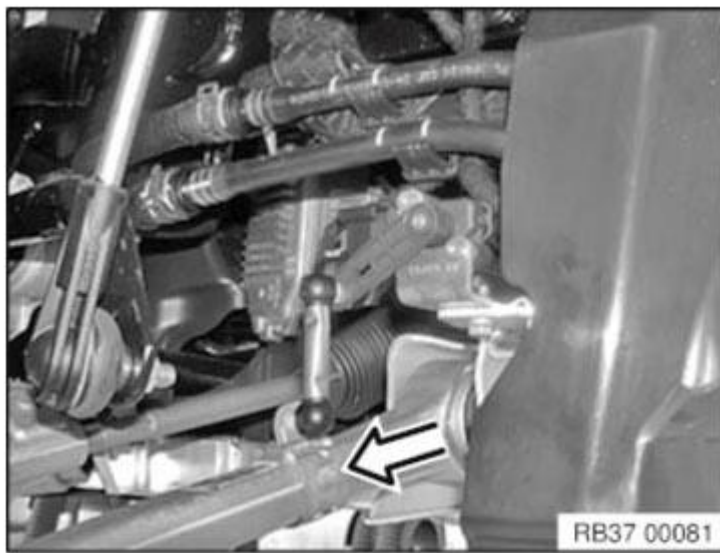
- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**NOTE:** If the wishbone is detached from the front axle support, it will be necessary to carry out the wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

**Necessary preliminary tasks:**

- Remove [FRONT WHEEL](#) .

Release wishbone on left, and release ride height sensor if necessary.



**Fig. 41: Removing Left Wishbone**  
Courtesy of BMW OF NORTH AMERICA, INC.

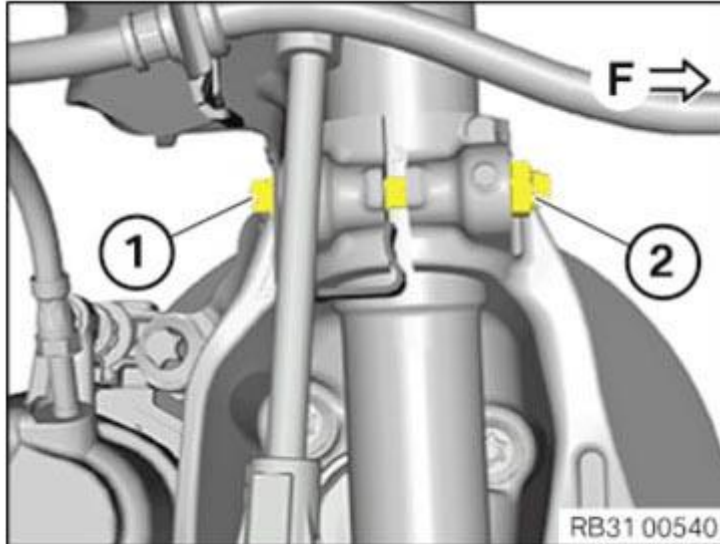
Loosen the nut (2).

Tightening torque [31 31 3AZ](#) .

Pull out screw (1).

**NOTE:** The screw (1) may have been mounted ex works facing in/away from the direction of travel.

In the event of repairs the screw (1) must always be mounted in the direction of travel (F).



**Fig. 42: Identifying Wishbone Screw, Nut And Screw Travel Direction**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Renew screw (1) and nut (2).

Screw head faces away from direction of travel (F).

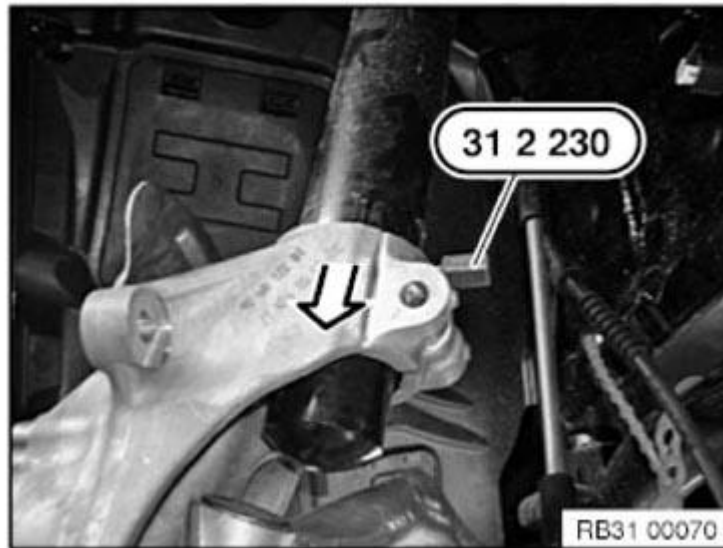
Tightening torque via nut!

To release wishbone connection at swivel bearing:

- Expand swivel bearing with special tool 31 2 230.



- Pull swivel bearing approx. 5 cm towards the bottom.



**Fig. 43: Expanding Swivel Bearing Using Special Tool (31 2 230).**  
Courtesy of BMW OF NORTH AMERICA, INC.

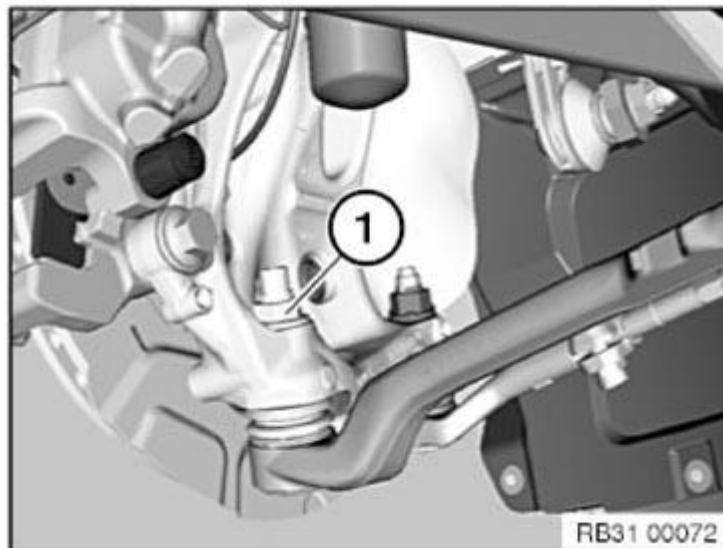
Release nut (1), if necessary, grip at inner Torx socket.

Tightening torque [31 12 2AZ](#)

*Installation note:*

Keep wishbone to swivel bearing connection clean and free from oil and grease.

Replace self-locking nut.



**Fig. 44: Identifying Wishbone Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide swivel bearing (1) back onto spring strut.

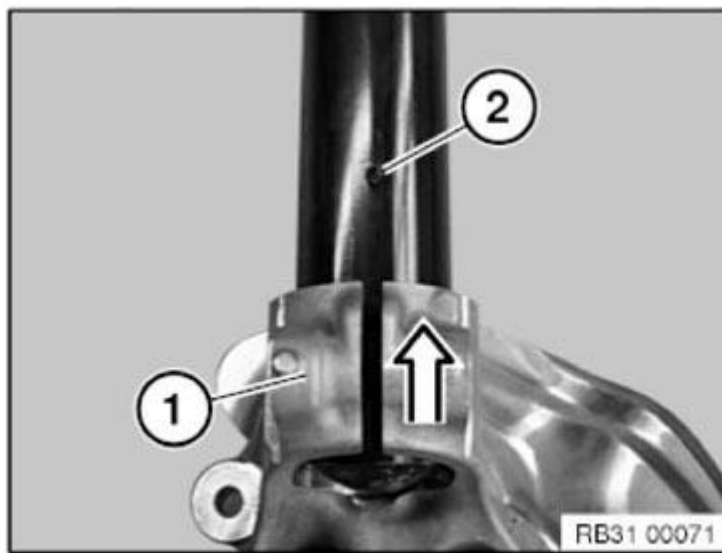
Release expansion of swivel bearing and remove special tool 31 2 230.

*Installation note:*

Keep press fit of swivel bearing and spring strut in lower area clean and free from oil and grease.

Align swivel bearing (1) to positioning pin (2) on the rear side of the spring strut along the gap and slide all the way in.





**Fig. 45: Sliding Swivel Bearing Into Spring Strut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release nuts (1, 3).

Tightening torque **31 12 1AZ**

Take out screws (2, 4) toward the front.

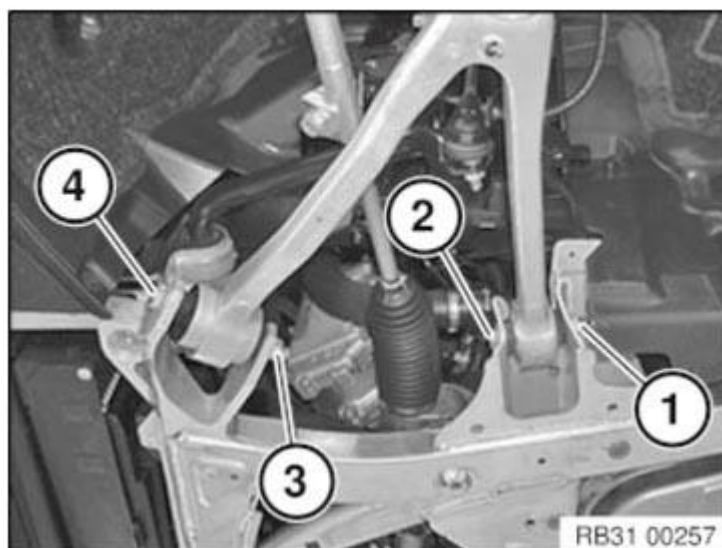
Take off wishbone.

*Installation note:*

Renew screws and nuts.

Bolt head points in direction of travel.

Tighten down screw connection in **NORMAL POSITION** .



**Fig. 46: Identifying Wishbone Nuts And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Carry out wheel alignment procedure. See **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)** .

## **WHEEL BEARINGS AND STUB AXLE**

## 31 21 090 REPLACING LEFT/RIGHT SWIVEL BEARING

### Special tools required:

- 31 2 230

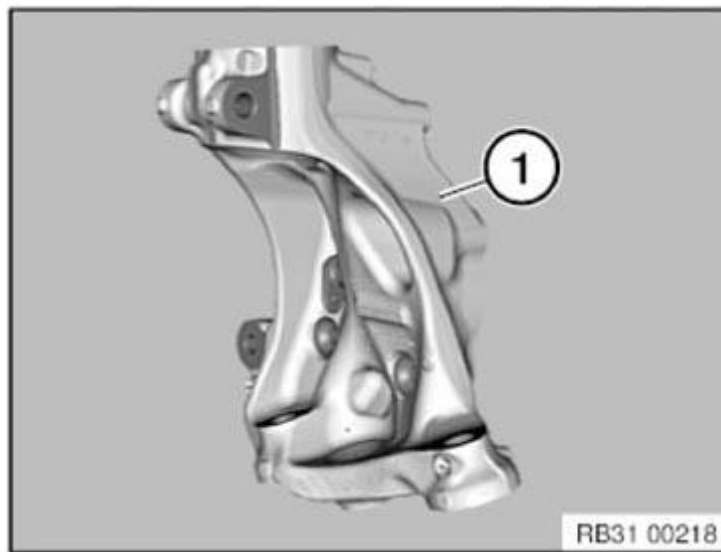
**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**NOTE:** When replacing swivel bearing pay attention to camber correction swivel bearings.

Camber correction swivel bearing are used to correct the camber values by  $\hat{A}\pm 30$  minutes. To be used only if the camber tolerance values are exceeded and undershot.

Identification is made at the [PART NUMBER ON SWIVEL BEARING](#) .



**Fig. 47: Identifying Swivel Bearing**

Courtesy of BMW OF NORTH AMERICA, INC.

### Necessary preliminary tasks:

- Remove [BRAKE DISC](#) .
- Remove [PULSE SENSOR FROM SWIVEL BEARING](#) .

### Attention!

Prior to installation, check sensor head and cable from pulse sensor and renew if necessary.

Slacken [WISHBONE BOLT CONNECTION ON FRONT AXLE SUPPORT](#) in order to prevent wishbone rubber mount from being damaged.

Remove [WISHBONE FROM SWIVEL BEARING](#).

Remove [TRACK ROD END FROM SWIVEL BEARING](#) .

Support swivel bearing with workshop jack and suitable fixture.

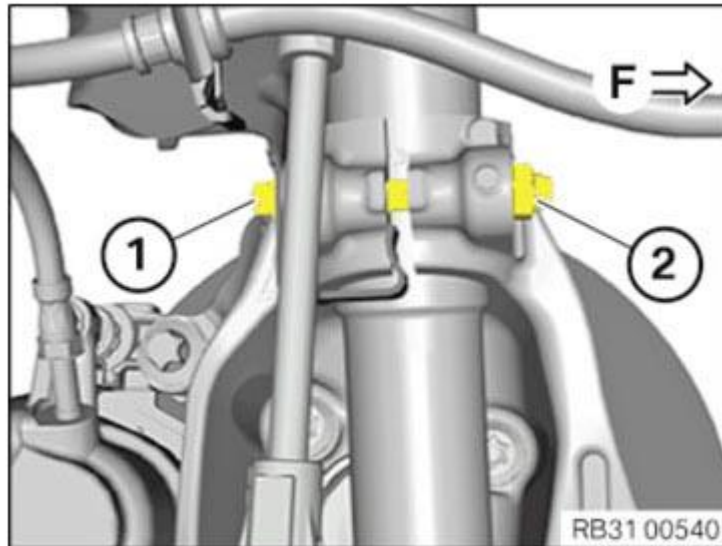
Slacken nut (2).

Tightening torque [31 31 3AZ](#)

Pull out screw (1).

**NOTE:** The screw (1) may have been mounted ex works facing in/away from the direction of travel.

In the event of repairs the screw (1) must always be mounted in the direction of travel (F).



**Fig. 48: Identifying Wishbone Screw, Nut And Screw Travel Direction**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Renew screw (1) and nut (2).

Screw head faces away from direction of travel (F).

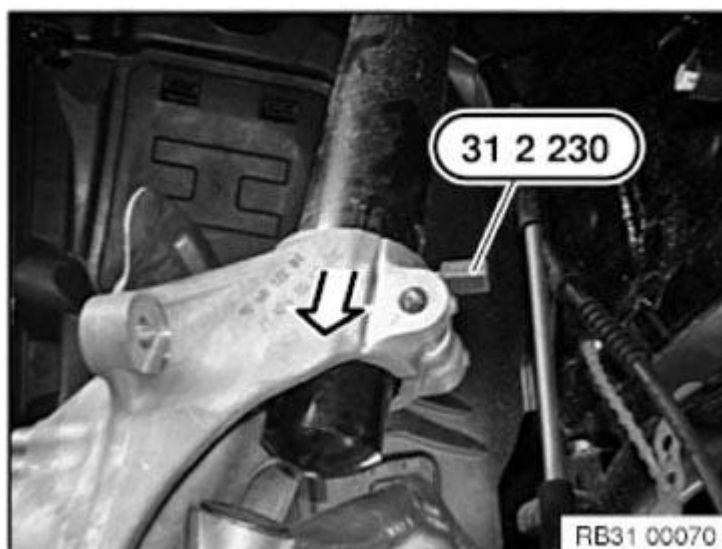
Tightening torque via nut!

Expand swivel bearing with special tool 31 2 230.

Lower workshop jack and remove swivel bearing.

*Installation note:*

Keep press fit of swivel bearing and spring strut in lower area clean and free from oil and grease.



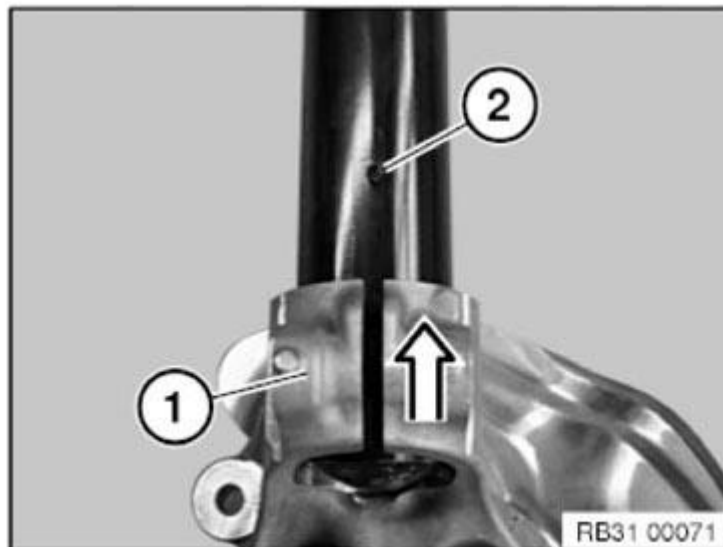
**Fig. 49: Expanding Swivel Bearing Using Special Tool (31 2 230).**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Expand swivel bearing with special tool 31 2 230.

Align gap on swivel bearing (1) to positioning pin (2) on spring strut.

Slide on swivel bearing to limit position.



**Fig. 50: Sliding Swivel Bearing Into Spring Strut**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Remount **WHEEL BEARING** or replace if necessary.
- Remount **BRAKE GUARD PLATE** or replace if necessary.

**After installation:**

- Carry out wheel alignment procedure. See **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)**.

**31 21 180 REPLACING WHEEL BEARING FOR FRONT WHEEL**

**Special tools required:**

- 31 2 230
- **11 8 580**

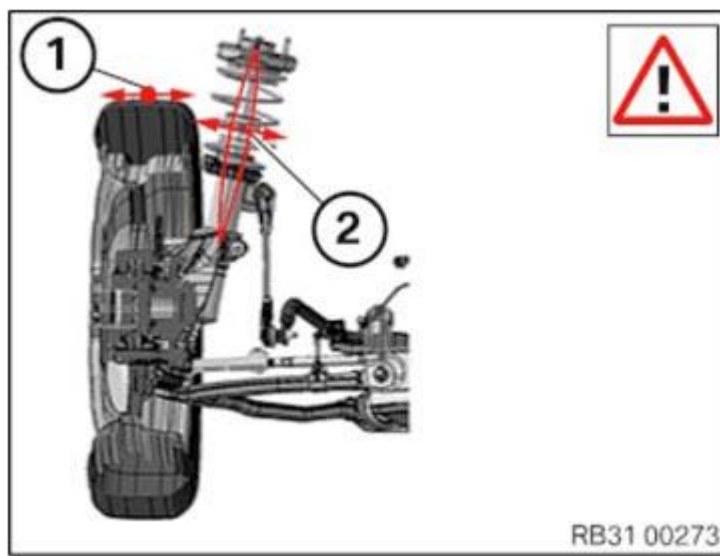
**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**Attention!**

Faulty wheel bearing play diagnosis possible due to piston rod play on spring strut!

During alternating manual application of force (1) (shaking) about the transverse wheel axis, some wheel play may be noticeable that feels similar to large wheel bearing play.



**Fig. 51: Shaking Piston Rod Play\_(Transverse Direction)**

**Courtesy of BMW OF NORTH AMERICA, INC.**

Because of elasticity, fit and a very slight preload in the transverse direction, piston rod play (2) may be noticeable on the spring strut. This is **not** a fault!

In nearly all cases, it is not possible to permanently reproduce this effect. During changes in the vehicle load, immediately following journeys, during steering wheel movements or other instances of front axle bracing against the roadway, this effect is often no longer noticeable.

**NOTE:** The piston rod play is no longer noticeable when the vehicle is on the hoist with hanging wheels (sufficient preload due to transverse spring force).

Unlike wheel bearing play, piston rod play is not noticeable during shaking about the vertical axis.

**Necessary preliminary tasks:**

- Remove **BRAKE DISC** .

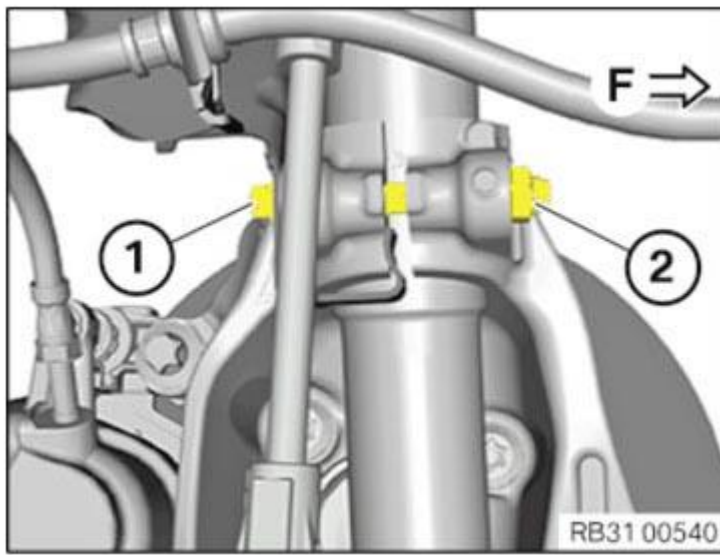
Loosen the nut (2).

Tightening torque **31 31 3AZ** .

Pull out screw (1).

**NOTE:** The screw (1) may have been mounted ex works facing in/away from the direction of travel.

In the event of repairs the screw (1) must always be mounted in the direction of travel (F).



**Fig. 52: Identifying Wishbone Screw, Nut And Screw Travel Direction**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

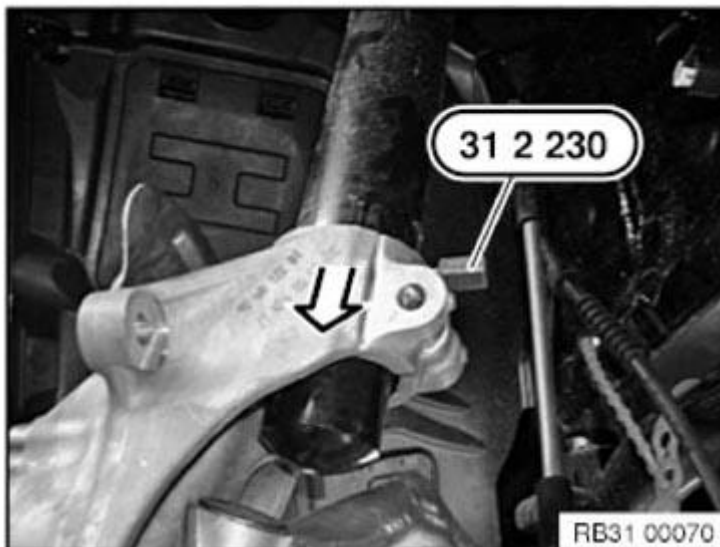
Renew screw (1) and nut (2).

Screw head faces away from direction of travel (F).

Tightening torque via nut!

To release wheel bearing screw connection:

- Expand swivel bearing with special tool 31 2 230.
- Pull swivel bearing approx. 5 cm towards the bottom.



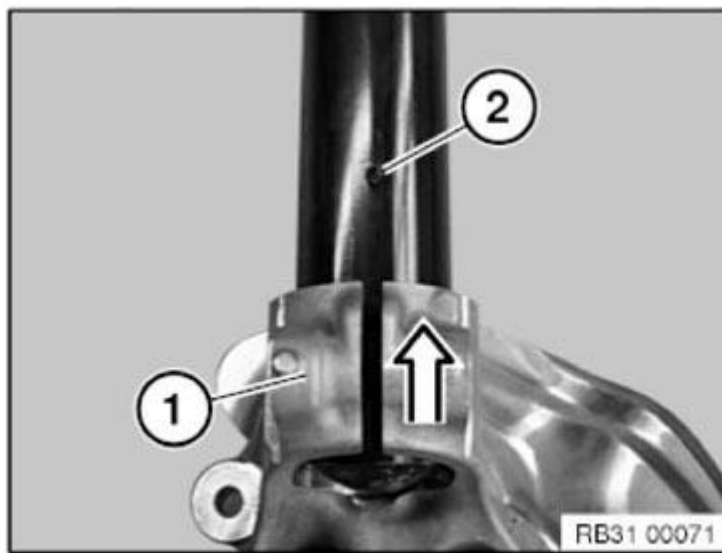
**Fig. 53: Expanding Swivel Bearing Using Special Tool (31 2 230)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Keep press fit of swivel bearing and spring strut in lower area clean and free from oil and grease.

Align swivel bearing (1) to positioning pin (2) on the rear side of the spring strut along the gap and slide all the way in.





**Fig. 54: Sliding Swivel Bearing Into Spring Strut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screws (1) with special tool [11 8 580](#) .

Tightening torque [31 21 1AZ](#) .

Press off wheel bearing from swivel bearing using a suitable tool.

*Installation note:*

Replace microencapsulated screws.

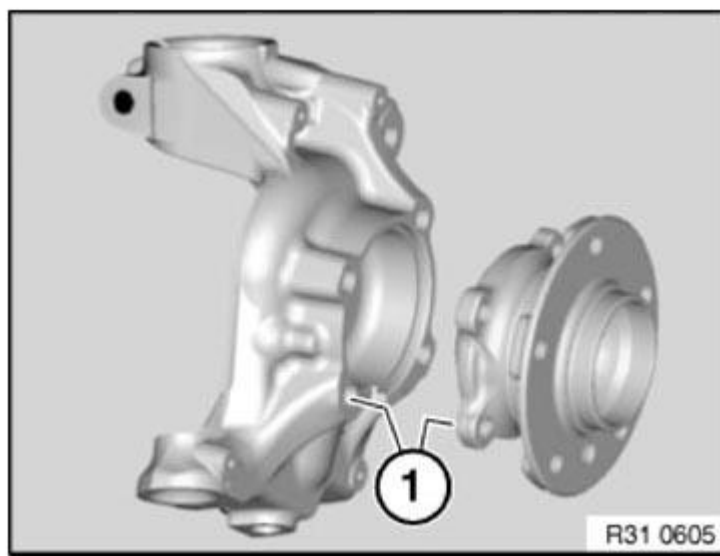


**Fig. 55: Removing Front Wheel Bearing Screws Using Special Tool (11 8 580)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Keep contact surface (1) of swivel bearing and wheel bearing clean and free from oil and grease.

When reusing, all the threads on the wheel bearing must be recut.



**Fig. 56: Identifying Swivel And Wheel Bearing Contact Surfaces**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **SPRING STRUT**

### **31 31 ADJUSTING FRONT SPRING STRUT**

#### **Special tools required:**

- 31 3 340
- 31 3 341
- 2 318 833
- [2 356 943](#)

Before adjusting the spring strut, the actual value of the **VEHICLE HEIGHT** must be measured.

Risk of damage!

**IMPORTANT:** Spring struts must only be adjusted with pretensioned coil springs. Noncompliance can cause damage to the thread of the height adjustment on the spring strut.

**WARNING:** Before using the special tool 31 3 340 take care to read through the Owner's Handbook!  
**All the safety precautions and instructions contained in the Owner's Handbook must be strictly observed!**  
**Failure to observe these safety precautions and instructions increases the risk of serious physical injury, damage to your health and damage to property and equipment!**

1. Prior to each use, check the special tools for defects, modifications and operational reliability.
2. Damaged/modified special tools must not be used!
3. No changes or modifications may be made to the special tools!

**IMPORTANT:**

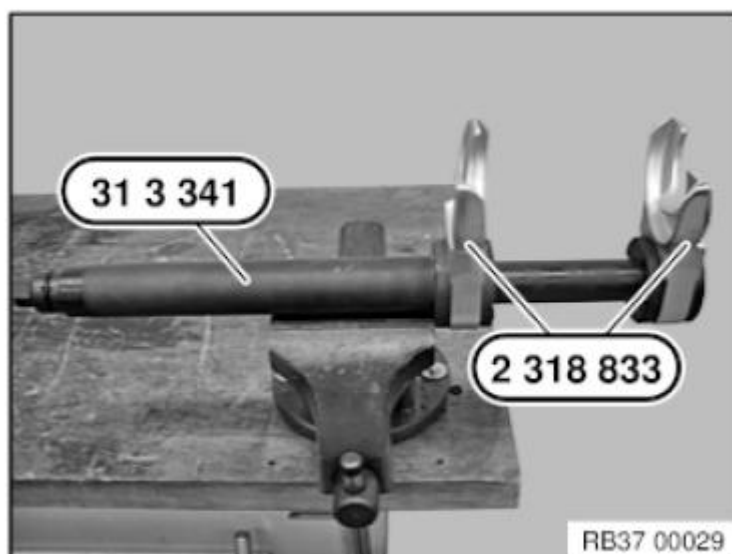
4. These special tools are intended solely for the purpose of tightening and relieving cylindrical and tapered suspension springs.
5. Keep special tools dry, clean and (down to the spindle) free from grease.
6. Impact screwdrivers are prohibited!
7. Do not compress coil spring to full extent.

#### **Necessary preliminary work:**

- Remove **FRONT SPRING STRUT SHOCK ABSORBER**.

Clamp special tool 31 3 341 in vice.

Fit special tools 2 318 833 from above on special tool 31 3 341 until locking pins (1) can be felt and heard to snap into place.



**Fig. 57: Installing Special Tools (2 318 833) And (31 3 341)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Clean coil spring to remove contamination.**

**Spring must be free of grease, clean and dry.**

Accommodate coil spring with special tools 2 318 833.

**IMPORTANT:** Coils of coil spring must be located completely in recesses of special tools 2 318 833!



**Fig. 58: Accommodating Coil Spring Using Special Tools (2 318 833)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tension coil spring until the lower spring cup is relieved.

Use the table below to calculate how many times the adjusting nut needs to be turned in order to compensate for the height offset:

**NOTE:**

- **If the vehicle is too high, the adjusting nut must be adjusted**

- downwards.
- If the vehicle is too low, the adjusting nut must be adjusted upwards.

Vehicle height adjustment required (in mm)	Turns of the adjusting nut
0.8	1
1.1	1.5
1.5	2
1.9	2.5
2.3	3
2.6	3.5
3	4
3.4	4.5
3.8	5
4.1	5.5
4.5	6
4.9	6.5
5.3	7

Make a mark on the adjusting nut.

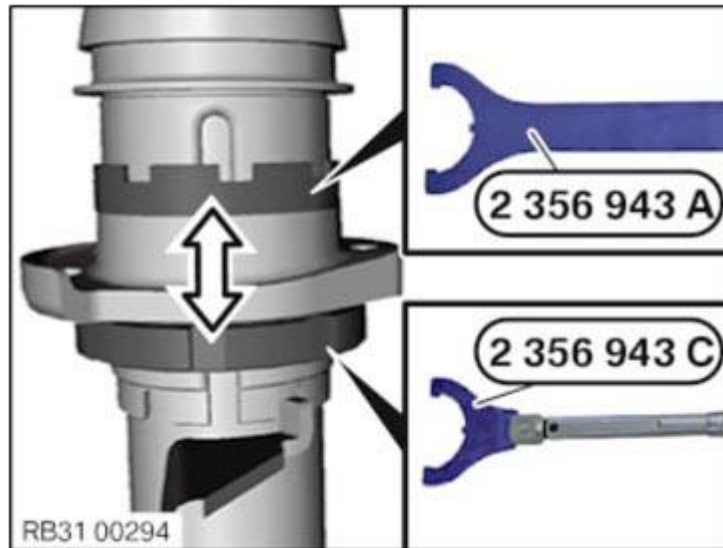
- (This mark can be used to count the turns of the adjusting nut.)

Undo bottom nut using special tool [2 356 943 C](#) and a torque wrench.

- Counterhold top nut using special tool [2 356 943 A](#).

Adjust adjusting nut (bottom nut) by the calculated number of turns.

Bring lock nut (top nut) into contact with spring cup.



**[Fig. 59: Adjusting Front Spring Strut Bottom And Top Nuts Using Special Tools \(2 356 943 A\) And \(2 356 943 C\)](#)**

Courtesy of BMW OF NORTH AMERICA, INC.

Tighten adjusting nut (bottom nut) using special tool [2 356 943 C](#) and a torque wrench.

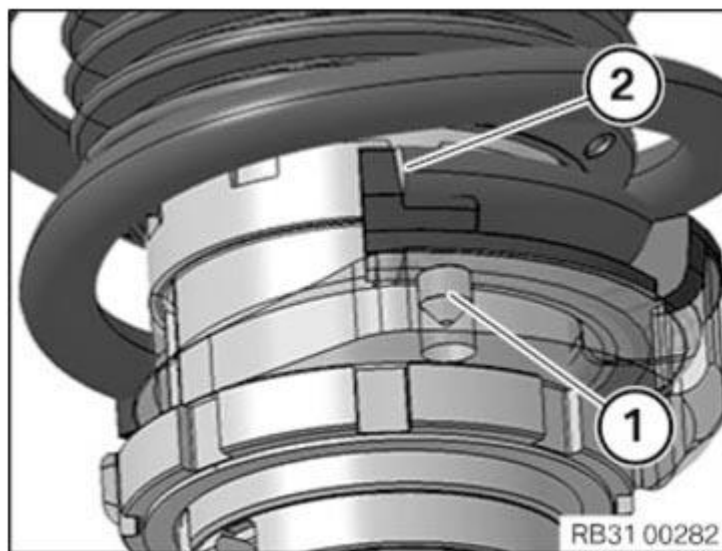
- Counterhold top nut using special tool [2 356 943 A](#).

Tightening torque [31 31 4AZ](#) .

Check position of spring pad pin (1).

Pin (1) must be in bore hole of spring cup.

Bottom coil spring end must be at limit position (2) of spring pad.



**Fig. 60: Identifying Spring Pad Pin And Spring Pad Limit Position**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check top spring pad is positioned correctly.

Upper coil spring end must be at limit position of spring pad.



**Fig. 61: Checking Top Spring Pad Position**  
Courtesy of BMW OF NORTH AMERICA, INC.

Relieve tension on coil spring.

Remove spring strut from spring tensioner.



**Fig. 62: Accommodating Coil Spring Using Special Tools (2 318 833)**

Courtesy of BMW OF NORTH AMERICA, INC.

- Install **FRONT SPRING STRUT SHOCK ABSORBER**.
- Check **VEHICLE RIDE HEIGHT** .

### **31 31 000 REMOVING AND INSTALLING COMPLETE LEFT OR RIGHT SPRING STRUT SHOCK ABSORBER**

**Special tools required:**

- 31 2 230

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

*Installation note:*

1. All screws, nuts, bolts and hose clamps removed during the repair must be replaced.
2. Retaining elements on chassis and suspension and steering parts must be replaced.

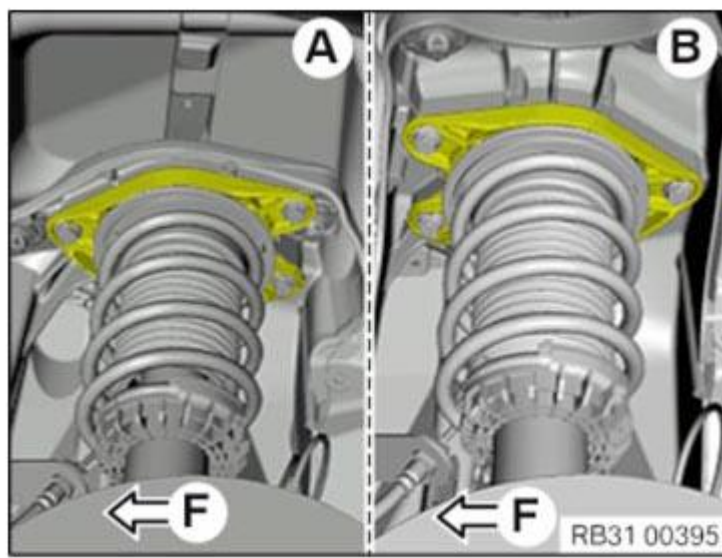
**NOTE:** **Modified positioning of the support bearing on the Drive module (see illustration):**

**A = vehicles from 04/2014**

**B = vehicles before 04/2014**

Arrow (F) points in direction of travel.





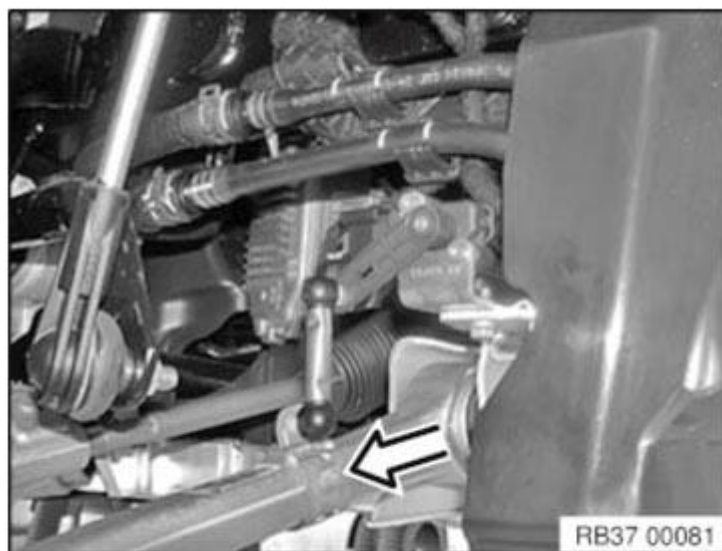
**Fig. 63: Identifying Spring Strut Shock Absorbers And Travel Direction**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Necessary preliminary tasks:**

- Remove **FRONT WHEEL** .
  - Remove **FRONT BRAKE DISC** .
- (Risk of damage to wishbone rubber mount: Reduction of weight.)
- Remove **ANTI-ROLL BAR LINK FROM SPRING STRUT**.

**Only on ride-height sensor at left:**

Release link at wishbone.



**Fig. 64: Removing Left Wishbone**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release socket head cap screw (1).

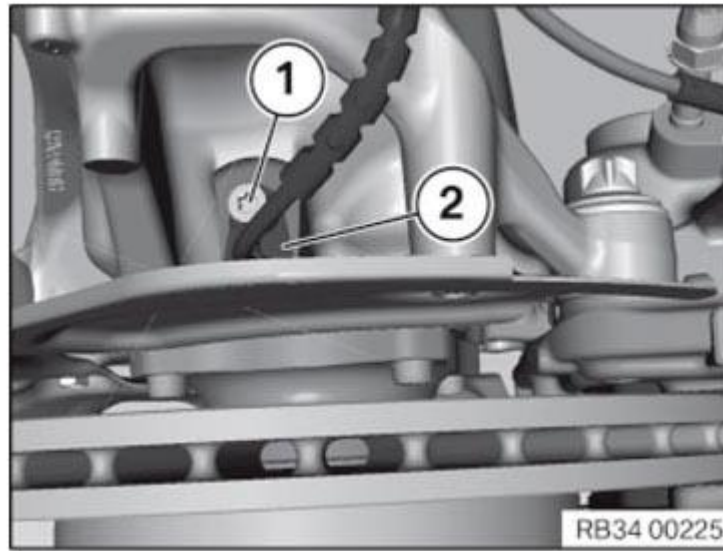
Tightening torque **34 51 3AZ** .

Withdraw wheel speed sensor (2) from bore hole.

*Installation note:*

Check sensor head prior to installation for damage, **REPLACING** if necessary.

Clean bore for pulse sensor and lubricate with Staburags NBU 12/K lubricating grease.

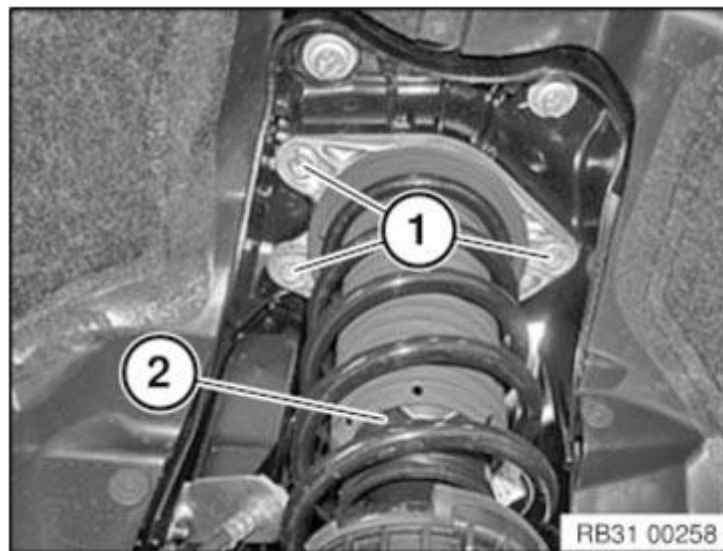


**Fig. 65: Identifying Socket Head Capscrew And Wheel Speed Sensor**  
Courtesy of BMW OF NORTH AMERICA, INC.

Loosen screws (1).

Tightening torque [31 31 1AZ](#) .

Remove spring strut (2).



**Fig. 66: Identifying Spring Strut And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque [31 31 3AZ](#)

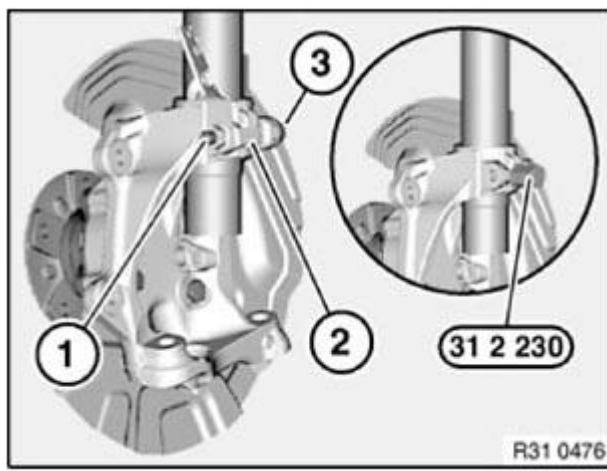
Take off holder (2).

Pull out screw (3).

Expand swivel bearing with special tool 31 2 230.

Pull spring strut out of swivel bearing and remove.

*Installation note:*



**Fig. 67: Expanding Swivel Bearing Using Special Tool (31 2 230).**

Courtesy of BMW OF NORTH AMERICA, INC.

Keep press fit of swivel bearing and spring strut in lower area clean and free from oil and grease.

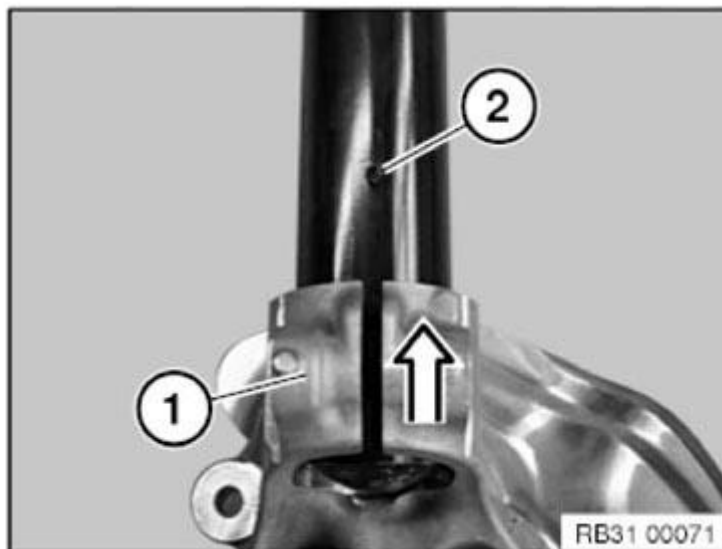
Screw head must point in direction of travel.

Replace self-locking nut (1) and screw.

*Installation note:*

Expand swivel bearing (1) with special tool 31 2 230.

Align swivel bearing (1) to positioning pin (2) on the rear side of the spring strut along the gap and slide all the way in.



**Fig. 68: Sliding Swivel Bearing Into Spring Strut**

Courtesy of BMW OF NORTH AMERICA, INC.

### **31 31 041 REPLACING FRONT LEFT OR RIGHT SPRING STRUT**

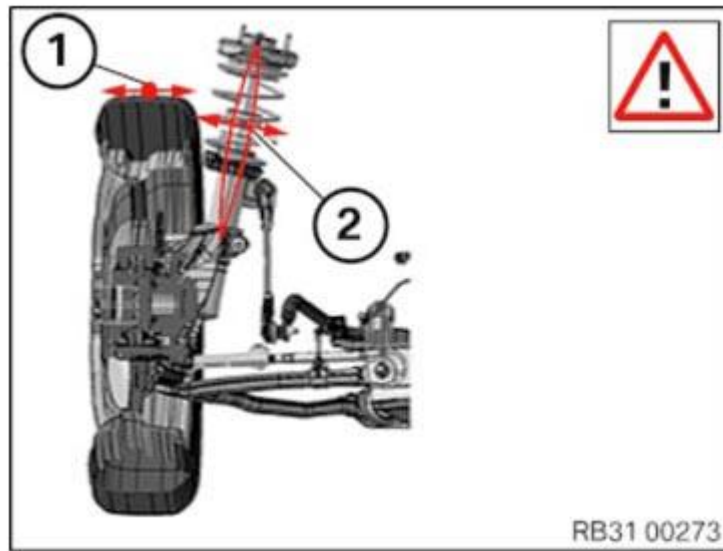
**Special tools required:**

- 31 3 340
- 31 3 341
- 2 318 833
- 33 0 040
- 33 0 042
- **2 356 943**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

IMPORTANT: During alternating manual application of force (1) (shaking) about the transverse wheel axis, some wheel play may be noticeable that feels similar to large wheel bearing play. Because of elasticity, fit and a very slight preload in the transverse direction, piston rod play (2) may be noticeable on the spring strut. This is **not** a fault!  
In nearly all cases, it is not possible to permanently reproduce this effect. During changes in the vehicle load, immediately following journeys, during steering wheel movements or other instances of front axle bracing against the roadway, this effect is often no longer noticeable.



**Fig. 69: Shaking Piston Rod Play (Transverse Direction)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** The piston rod play is no longer noticeable when the vehicle is on the hoist with hanging wheels (sufficient preload due to transverse spring force).  
Unlike wheel bearing play, piston rod play is not noticeable during shaking about the vertical axis.

- IMPORTANT:
- If there is a spring strut leak, check piston rod for bending.
  - If the spring strut piston rod is bent, then the **TRACK ROD** must also be replaced on the corresponding side!
  - When replacing the spring strut, replace the auxiliary damper as well!
  - After installing a new spring strut, it is mandatory to measure the vehicle height and adjust this if necessary!

**WARNING:** Before using the special tool 31 3 340 take care to read through the Owner's Handbook!  
All the safety precautions and instructions contained in the Owner's Handbook must be strictly observed!  
Failure to observe these safety precautions and instructions increases the risk of serious physical injury, damage to your health and damage to property and equipment!

- IMPORTANT:
1. Prior to each use, check the special tools for defects, modifications and operational reliability.

2. Damaged/modified special tools must not be used!
3. No changes or modifications may be made to the special tools!
4. These special tools are intended solely for the purpose of tightening and relieving cylindrical and tapered suspension springs.
5. Keep special tools dry, clean and (down to the spindle) free from grease.
6. Impact screwdrivers are prohibited!

**Risk of damage inside the shock absorber!**

7. Do not compress coil spring to full extent.

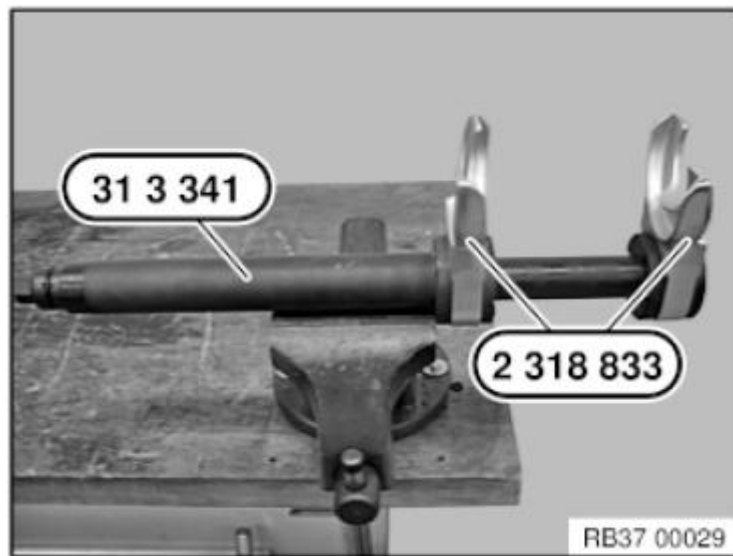
**Necessary preliminary work:**

- Remove **FRONT SPRING STRUT**.

**Removing:**

Clamp special tool 31 3 341 in vice.

Fit special tools 2 318 833 from above on special tool 31 3 341 until locking pins (1) can be felt and heard to snap into place.



**Fig. 70: Installing Special Tools (2 318 833) And (31 3 341)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Clean coil spring to remove contamination.**

**Spring must be free of grease, clean and dry.**

Accommodate coil spring with special tools 2 318 833.

**IMPORTANT:** Coils of coil spring must be located completely in recesses of special tools 2 318 833!

Compress coil spring until stress on piston rod is relieved.

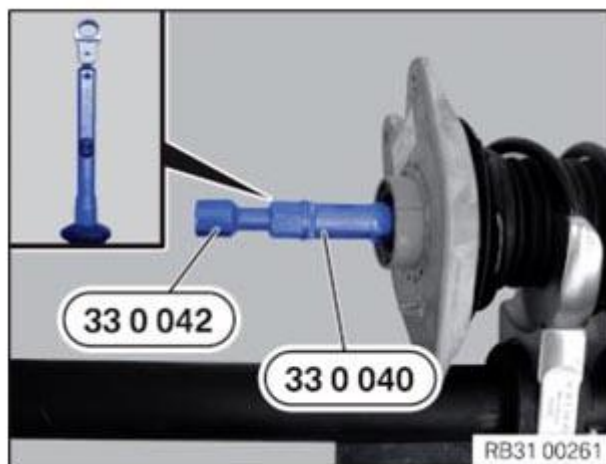


**Fig. 71: Accommodating Coil Spring Using Special Tools (2 318 833)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut with special tool 33 0 040 and 33 0 042.

*Installation note:*

Replace nut.



**Fig. 72: Removing Spring Strut Nut Using Special Tools (33 0 040) And (33 0 042)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Impact screwdrivers are prohibited!

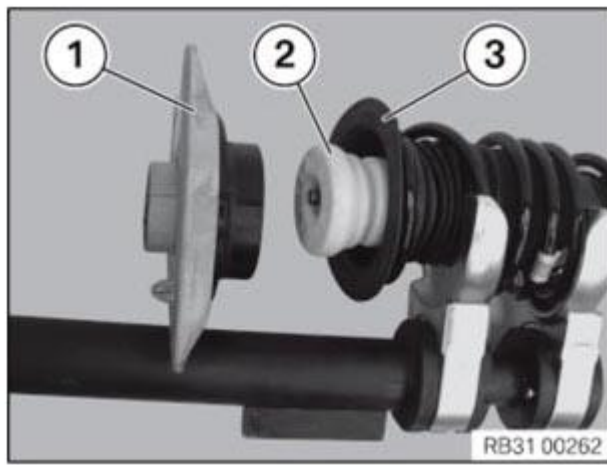
**Risk of damage inside the shock absorber!**

Remove spring strut mounting (1).

Remove spring pad/protective tube (3) and auxiliary damper.

Remove shock absorber from tensioned spring.





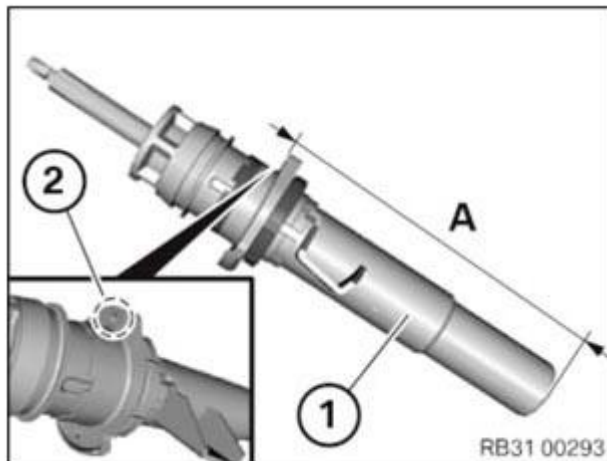
**Fig. 73: Identifying Spring Strut Mounting And Spring Pad/Protective Tube**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Assembly:**

Check dimension A on the new spring strut (1).

Dimension A = 258 mm

**NOTE:** Measure only from measuring point (2) on the spring cup to the spring strut base!

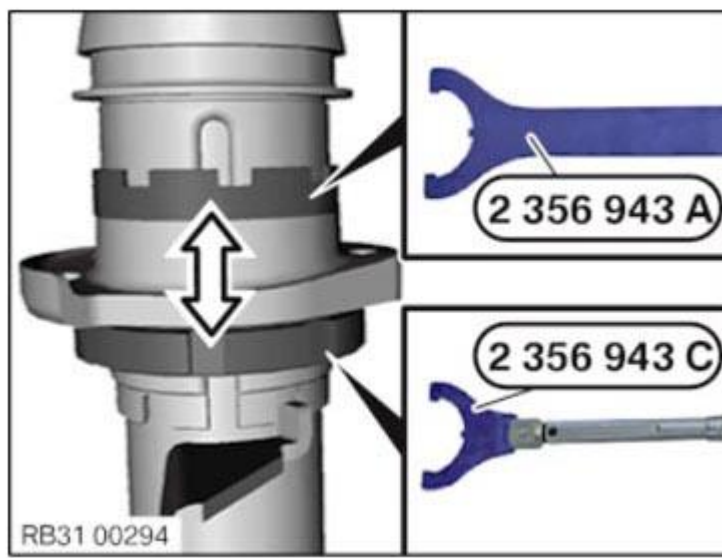


**Fig. 74: Checking Spring Strut Dimensions**  
 Courtesy of BMW OF NORTH AMERICA, INC.

If necessary, adjust dimension A:

- Undo bottom nut using special tool [2 356 943 C](#) and a torque wrench.  
 Counterhold top nut using special tool [2 356 943 A](#).
- Adjust the dimension A by turning the top and bottom nuts.
- Tighten bottom nut with special tool [2 356 943 C](#) and a torque wrench.  
 Counterhold top nut using special tool [2 356 943 A](#).

Tightening torque [31 31 4AZ](#) .

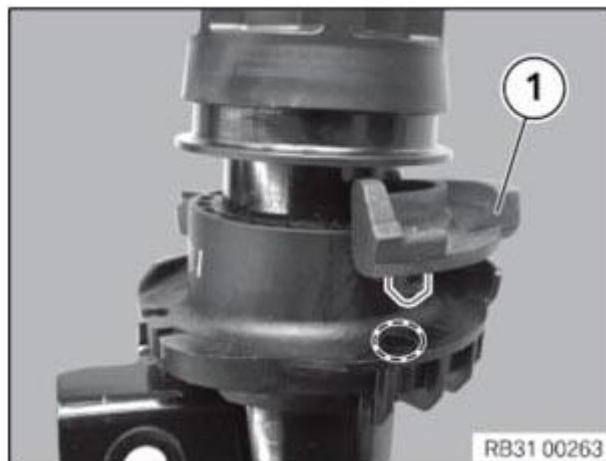


**Fig. 75: Adjusting Front Spring Strut Bottom And Top Nuts Using Special Tools (2 356 943 A) And (2 356 943 C)**

Courtesy of BMW OF NORTH AMERICA, INC.

Fit spring pad (1) on new spring strut, replace if necessary.

**NOTE:** Illustration of spring strut base.

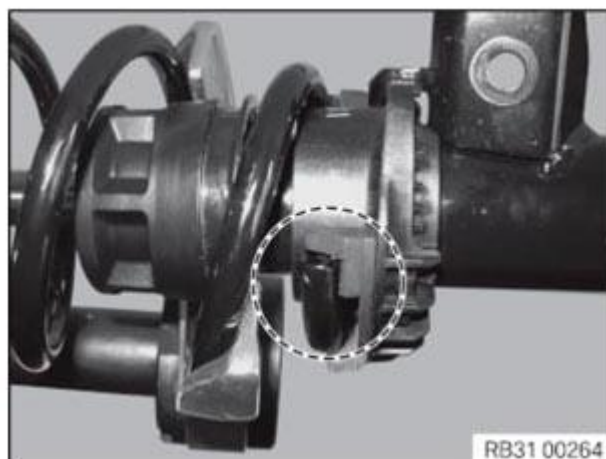


**Fig. 76: Identifying Spring Pad**

Courtesy of BMW OF NORTH AMERICA, INC.

Insert spring strut into tensioned coil spring.

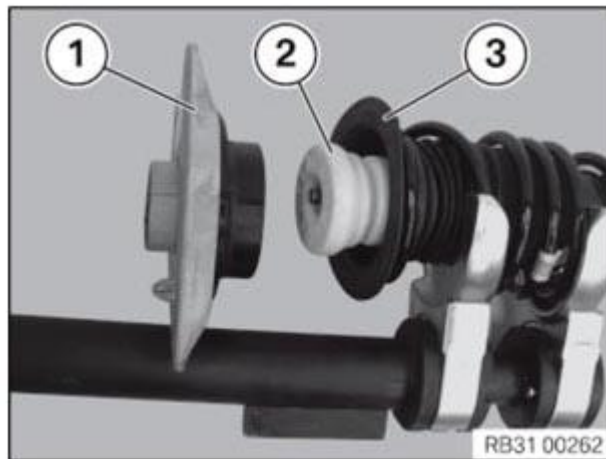
**IMPORTANT:** Align the lower end of spring flush with spring pad.



**Fig. 77: Aligning Spring Flush And Spring Pad Lower End**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check support bearing, spring pad/protective tube (3) and auxiliary damper (2) for damage and replace as needed.

Connect spring pad/protective tube (3) and auxiliary damper (2) to piston rod.



**Fig. 78: Identifying Spring Strut Mounting And Spring Pad/Protective Tube**  
Courtesy of BMW OF NORTH AMERICA, INC.

Align spring pad to end of coil spring.

Connect support bearing.



**Fig. 79: Checking Top Spring Pad Position**  
Courtesy of BMW OF NORTH AMERICA, INC.

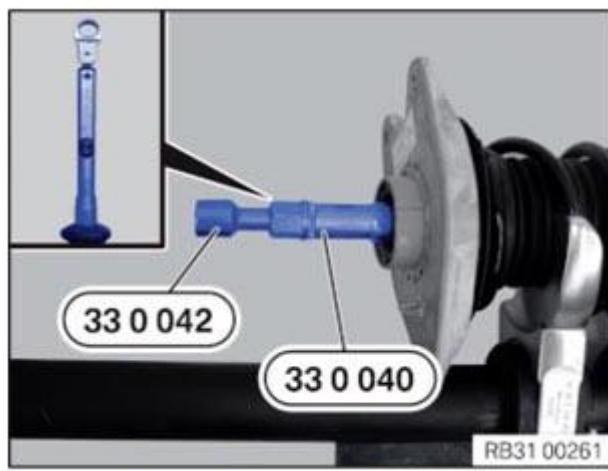
Tighten new nut with torque wrench and ring attachment SW21 with special tool 33 0 040.

Tightening torque [31 31 2AZ](#).

Relieve tension on coil spring.

Impact screwdrivers are prohibited!

**Risk of damage inside the shock absorber!**



**Fig. 80: Removing Spring Strut Nut Using Special Tools (33 0 040) And (33 0 042)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- **MEASURE VEHICLE RIDE HEIGHT**, adjust if necessary.

### 31 31 031 REPLACING FRONT LEFT OR RIGHT SPRING STRUT SHOCK ABSORBER

#### Special tools required:

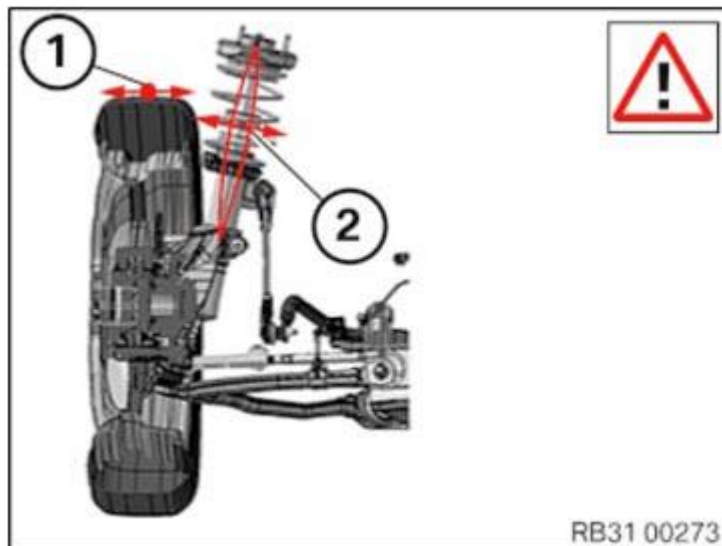
- 31 3 340
- 31 3 341
- 2 318 833
- 33 0 040
- 33 0 042

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

During alternating manual application of force (1) (shaking) about the transverse wheel axis, some wheel play may be noticeable that feels similar to large wheel bearing play. Because of elasticity, fit and a very slight preload in the transverse direction, piston rod play (2) may be noticeable on the spring strut. This is **not** a fault!

**IMPORTANT:** In nearly all cases, it is not possible to permanently reproduce this effect. During changes in the vehicle load, immediately following journeys, during steering wheel movements or other instances of front axle bracing against the roadway, this effect is often no longer noticeable.



**NOTE:** The piston rod play is no longer noticeable when the vehicle is on the hoist with hanging wheels (sufficient preload due to transverse spring force).  
Unlike wheel bearing play, piston rod play is not noticeable during shaking about the vertical axis.

- IMPORTANT:**
- If there is a spring strut leak, check piston rod for bending.
  - If the spring strut piston rod is bent, then the **TRACK ROD** must also be replaced on the corresponding side!
  - When replacing the spring strut, replace the auxiliary damper as well!
  - **Renew spring pad in motor vehicles up to 05/2015**

**WARNING:** Before using the special tool 31 3 340 take care to read through the Owner's Handbook!  
All the safety precautions and instructions contained in the Owner's Handbook must be strictly observed!  
Failure to observe these safety precautions and instructions increases the risk of serious physical injury, damage to your health and damage to property and equipment!

- IMPORTANT:**
1. Prior to each use, check the special tools for defects, modifications and operational reliability.
  2. Damaged/modified special tools must not be used!
  3. No changes or modifications may be made to the special tools!
  4. These special tools are intended solely for the purpose of tightening and relieving cylindrical and tapered suspension springs.
  5. Keep special tools dry, clean and (down to the spindle) free from grease.
  6. Impact screwdrivers are prohibited!

**Risk of damage inside the shock absorber!**

7. Do not compress coil spring to full extent.

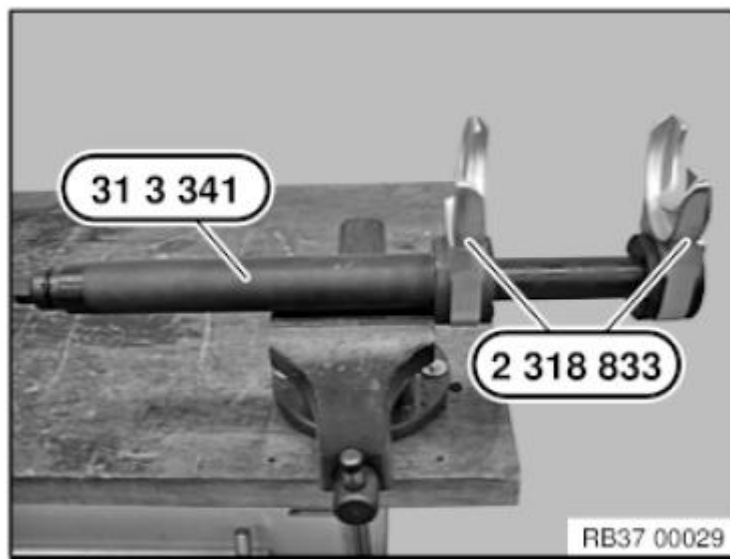
**Necessary preliminary work:**

- Remove **FRONT SPRING STRUT**.

**Removing:**

Clamp special tool 31 3 341 in vice.

Fit special tools 2 318 833 from above on special tool 31 3 341 until locking pins (1) can be felt and heard to snap into place.



**Fig. 82: Installing Special Tools (2 318 833) And (31 3 341)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Clean coil spring to remove contamination.**

**Spring must be free of grease, clean and dry.**

Accommodate coil spring with special tools 2 318 833.

IMPORTANT: Coils of coil spring must be located completely in recesses of special tools 2 318 833!

Compress coil spring until stress on piston rod is relieved.



**Fig. 83: Accommodating Coil Spring Using Special Tools (2 318 833)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut with special tool 33 0 040 and 33 0 042.

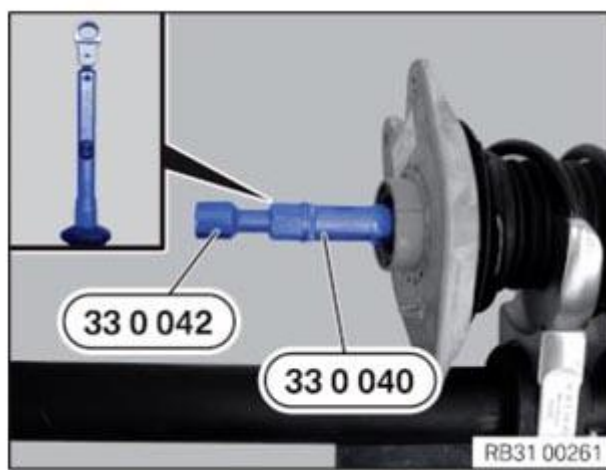
*Installation note:*

Replace nut.

Impact screwdrivers are prohibited!

**Risk of damage inside the shock absorber!**



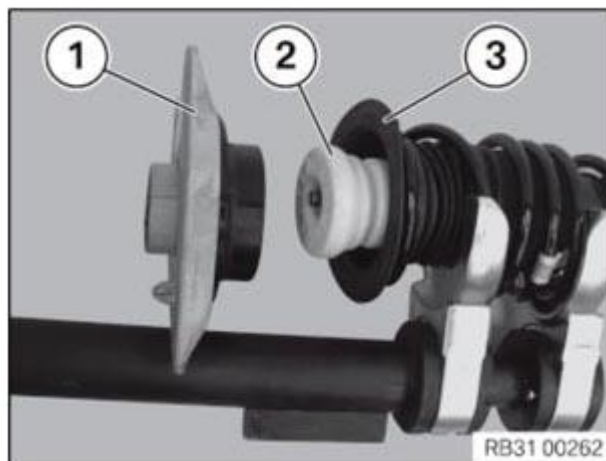


**Fig. 84: Removing Spring Strut Nut Using Special Tools (33 0 040) And (33 0 042)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Remove spring strut mounting (1).

Remove spring pad/protective tube (3) and auxiliary damper.

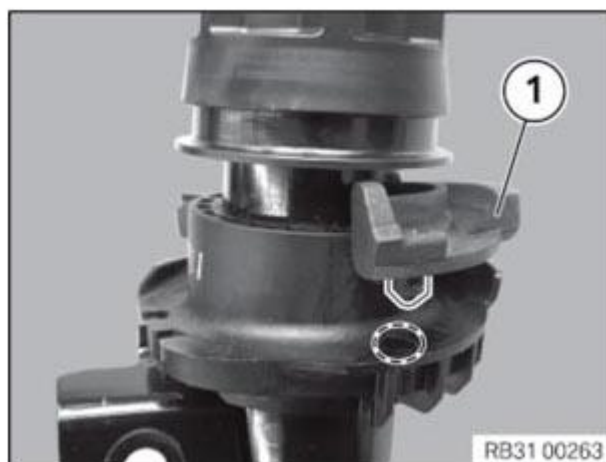
Remove shock absorber from tensioned spring.



**Fig. 85: Identifying Spring Strut Mounting And Spring Pad/Protective Tube**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Assembly:**

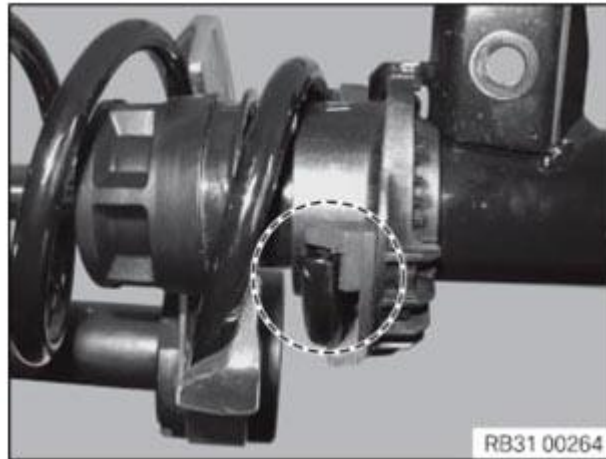
Remove the spring pad (1) and mount onto the new spring strut, replace if necessary.



**Fig. 86: Identifying Spring Pad**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert spring strut into tensioned coil spring.

IMPORTANT: Align the lower end of spring flush with spring pad.

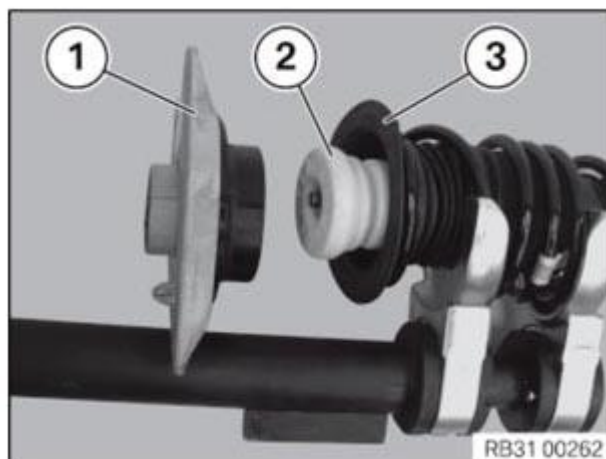


**Fig. 87: Aligning Spring Flush And Spring Pad Lower End**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check support bearing, spring pad/protective tube (3) and auxiliary damper (2) for damage and replace as needed.

**Renew spring pad (3) in motor vehicles up to 05/2015.**

Connect spring pad/protective tube (3) and auxiliary damper (2) to piston rod.



**Fig. 88: Identifying Spring Strut Mounting And Spring Pad/Protective Tube**  
Courtesy of BMW OF NORTH AMERICA, INC.

Align spring pad to end of coil spring.

Connect support bearing.



**Fig. 89: Checking Top Spring Pad Position**  
 Courtesy of BMW OF NORTH AMERICA, INC.

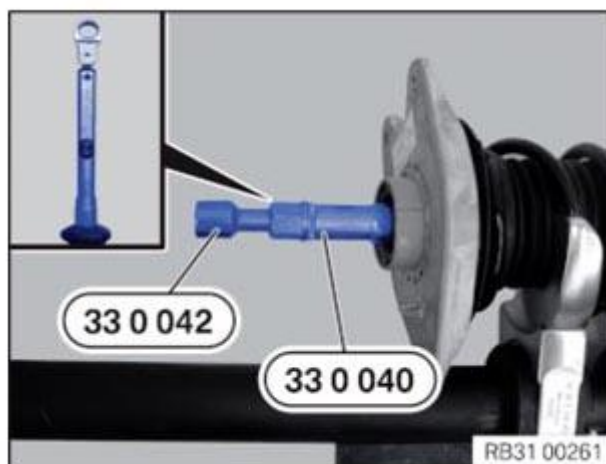
Tighten new nut with torque wrench and ring attachment SW21 with special tool 33 0 040.

Tightening torque [31 31 2AZ](#) .

Relieve tension on coil spring.

Impact screwdrivers are prohibited!

**Risk of damage inside the shock absorber!**

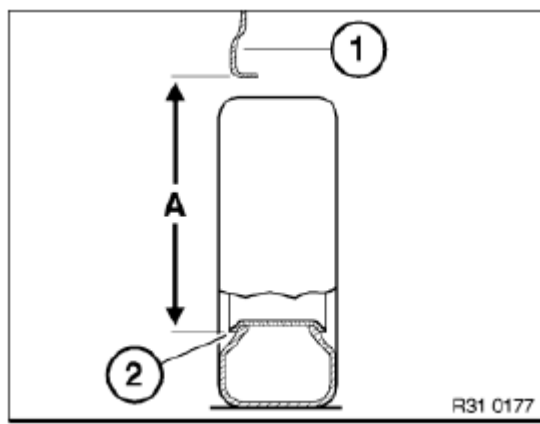


**Fig. 90: Removing Spring Strut Nut Using Special Tools (33 0 040) And (33 0 042)**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## **SPRING WITH SUSPENSION**

### **31 33... MEASURING VEHICLE RIDE HEIGHT**

Determine actual ride height (A) - to do so, attach tape measure to rim flange (2) at bottom middle and measure to wheel arch lower edge (1).



**Fig. 91: Checking Actual Ride Height**

Courtesy of BMW OF NORTH AMERICA, INC.

### 31 33 100 REPLACING FRONT LEFT OR RIGHT COIL SPRING

**IMPORTANT:** Both coil springs on the relevant axle must be replaced only in the event of corrosion breakage!

The coil spring is allocated in the BMW parts catalogue under according to the vehicle identification number (VIN) and the optional equipment of the particular vehicle.

**NOTE:** Procedure is described in REPLACING FRONT LEFT AND RIGHT SPRING STRUT.

**After installation:**

- Check HEADLIGHT ADJUSTMENT , correct if necessary.

### 31 33 001 REPLACING FRONT LEFT OR RIGHT SPRING STRUT SUPPORT BEARING

*Installation note:*

1. All screws, nuts, bolts and hose clamps removed during the repair must be replaced.
2. Retaining elements on chassis and suspension and steering parts must be replaced.

**NOTE:** Procedure is described in "REPLACING FRONT LEFT OR RIGHT SPRING STRUT".

## STABILIZER BAR

### 31 35 000 REMOVING AND INSTALLING/REPLACING FRONT ANTI-ROLL BAR

**WARNING:** High-voltage system - danger to life

- Observe SAFETY INFORMATION for working with electric vehicles.

**Necessary preliminary work:**

- Lower front axle support. See LOWERING/RAISING FRONT AXLE SUPPORT (UNIVERSAL LIFTER) - NO RANGE EXTENDER or LOWERING/RAISING FRONT AXLE SUPPORT (UNIVERSAL LIFTER) - WITH RANGE EXTENDER.

Release screws (1).

Tightening torque 31 35 1AZ .

Remove retaining brackets.

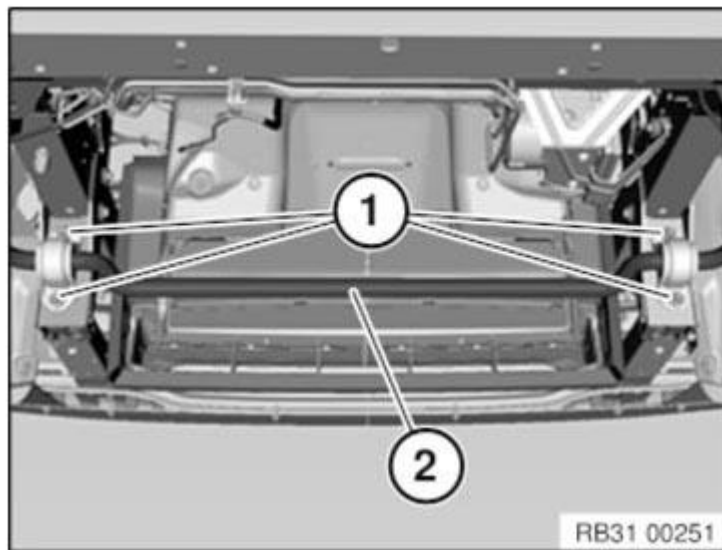
Remove anti-roll bar (2) forward.

*Installation note:*

Replace screws (1).

Check both rubber mounts for damage.

- In the event of rubber mount damage, the anti-roll bar must be renewed.



**Fig. 92: Identifying Anti-Roll Bar And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

### **31 35 005 REMOVING AND INSTALLING/REPLACING PUSH ROD (ANTI-ROLL BAR LINK) FOR LEFT/RIGHT ANTI-ROLL BAR**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

#### **Risk of damage!**

- Avoid bending the head of the anti-roll bar during assembly!
- An impact screwdriver must not be used!

#### **Necessary preliminary tasks:**

- Remove **FRONT WHEEL** .

**IMPORTANT:** It is important to counterhold Torx socket when loosening push rod screw connection (1).

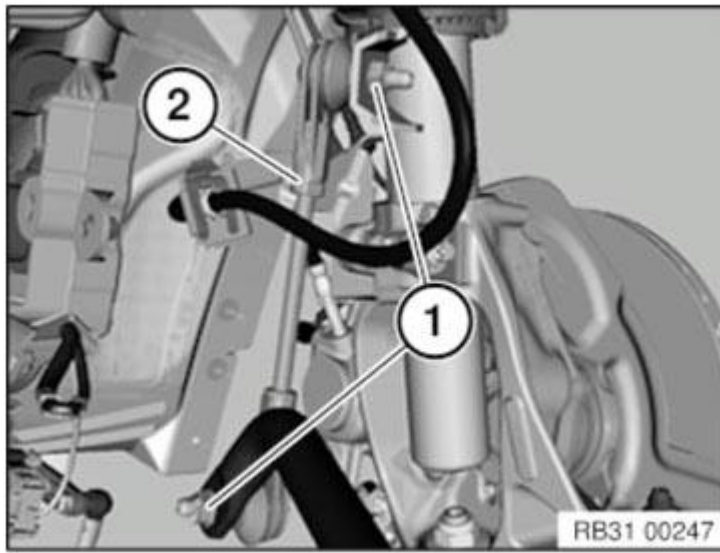
Unscrew nuts (1).

Tightening torque **31 35 2AZ** .

Remove anti-roll bar link (2).

*Installation note:*

Replace self-locking nuts.



**Fig. 93: Identifying Anti Roll Bar Link And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

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[Back To Article](#)

## SUSPENSION

### Front Axle - Special Tools - All I3 Models - i3

#### FRONT AXLE

##### 2156277 ADAPTER AM

**NOTE:** Adapter N4 (Ã~ 39mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 1: Identifying Adapter (2156277)**

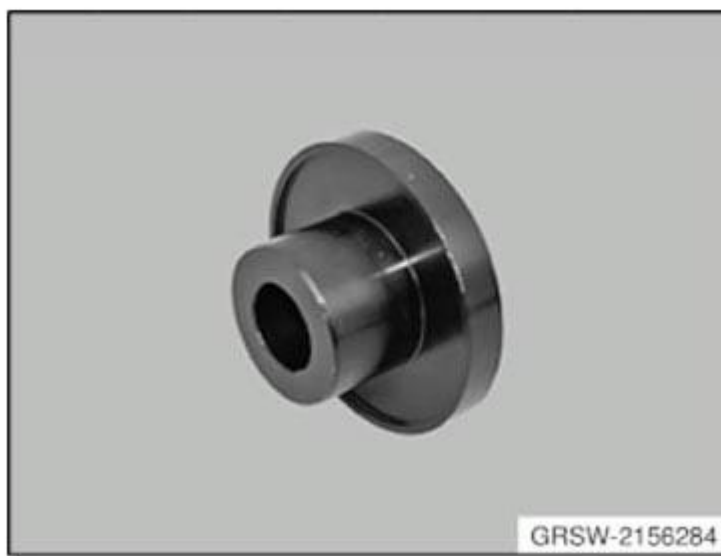
Courtesy of BMW OF NORTH AMERICA, INC.

##### 2156284 ADAPTER AM

**NOTE:** Adapter P1 (Ã~ 45/85mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



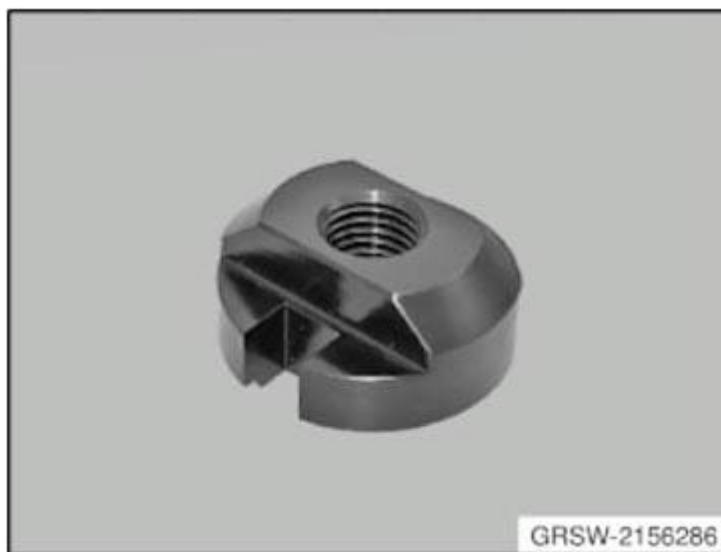
**Fig. 2: Identifying Adapter (2156284).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156286 ADAPTER AM**

**NOTE:** Adapter R5 (M24/Ä~ 59/70mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 3: Identifying Adapter (2156286).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159724 ADAPTER AM**

**NOTE:** Adapter R1 (M24/Ä~ 77/82mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 4: Identifying Adapter (2159724).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159722 ADAPTER AM**

**NOTE:** Adapter M6 (Ã~ 102/113mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 5: Identifying Adapter (2159722).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156287 ADAPTER AM**

**NOTE:** Adapter R4 (M24/Ã~ 64/75mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 6: Identifying Adapter (2156287).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159723 ADAPTER AM**

**NOTE:** Adapter M2 (Ã 88mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 7: Identifying Adapter (2159723).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156257 ADAPTER AM**

**NOTE:** Adapter G2 (M24x1.5/M20) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 8: Identifying Adapter (2156257).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156278 ADAPTER AM**

**NOTE:** Adapter N3 (Ã~ 42mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 9: Identifying Adapter (2156278).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2348436 ADAPTER AM**

**NOTE:** Adapter R8 (M24/Ã~ 74/83mm) in connection with adapter kit F03 (81642348804) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 02 13 (900)



**Fig. 10: Identifying Adapter (2348436)**

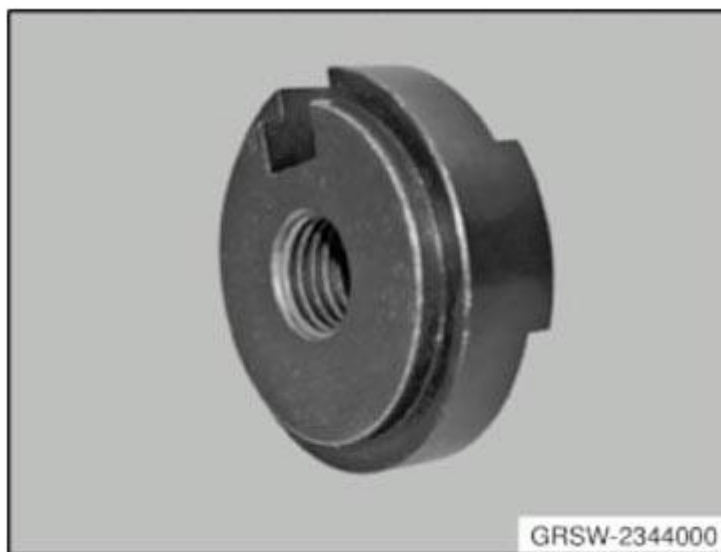
Courtesy of BMW OF NORTH AMERICA, INC.

**2344000 ADAPTER AM**

**NOTE:** Adapter R6 (M24/Ä~ 63/75mm) in connection with adapter kit F30 (84mm wheel bearings) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 09 12 (873)



**Fig. 11: Identifying Adapter (2344000)**

Courtesy of BMW OF NORTH AMERICA, INC.

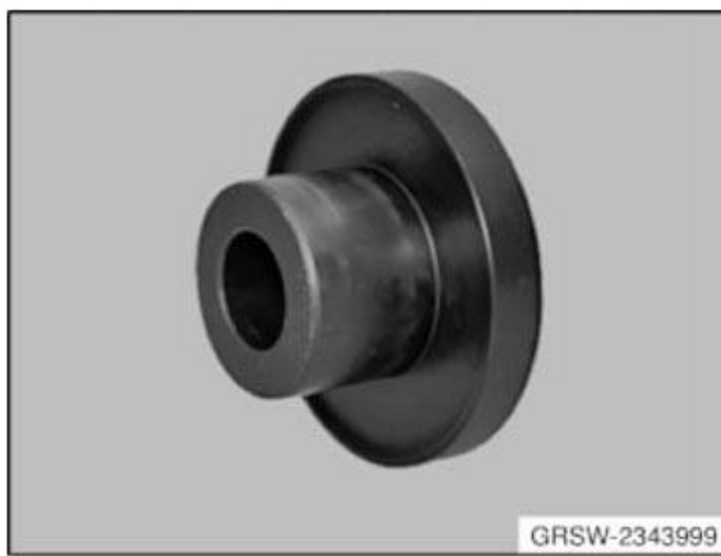
**2343999 ADAPTER AM**

**NOTE:** Adapter P5 (Ä~ 45/82.5mm) in connection with wheel bearing adapter kit F30 (84mm, no longer in Catalogue) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 09 12 (873)





**Fig. 12: Identifying Adapter (2343999).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2348432 ADAPTER AM**

**NOTE:** Adapter P6 (1 1/2" ~ 51/89mm) in connection with adapter kit F03 (81 64 2 348 804) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 02 13 (900)



**Fig. 13: Identifying Adapter (2348432).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2348434 ADAPTER AM**

**NOTE:** Adapter R7 (M24 1/2" ~ 87/95mm) in connection with adapter kit F03 (81 64 2 348 804) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 02 13 (900)



**Fig. 14: Identifying Adapter (2348434).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156253 ADAPTER AM**

**NOTE:** Adapter B1 in connection with adapter kit 1 (BMW), (81 64 2 155 745) and MINI adapter kit (81 64 2 294 517), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 15: Identifying Adapter (2156253).**

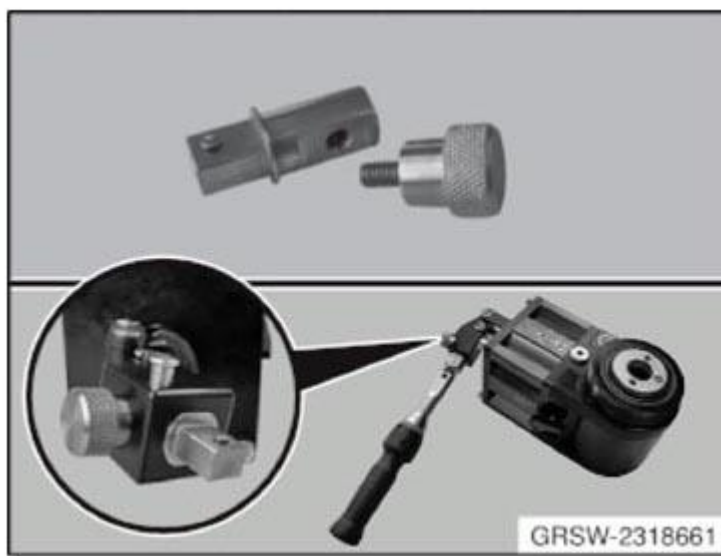
Courtesy of BMW OF NORTH AMERICA, INC.

**2318661 ADAPTER AM**

**NOTE:** Adapter Z1 to attach torque wrench. Used in connection with hydraulic cylinder, (81642156246), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 04 12 (797)



**Fig. 16: Identifying Adapter (2318661).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156276 ADAPTER AM**

**NOTE:** Adapter M3 (Ã~ 102mm) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 06 09 (544)



**Fig. 17: Identifying Adapter (2156276).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156256 ADAPTER AM**

**NOTE:** Adapter G3 (M27x1.5/M20) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 18: Identifying Adapter (2156256).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2348435 ADAPTER AM**

**NOTE:** Adapter M8 for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



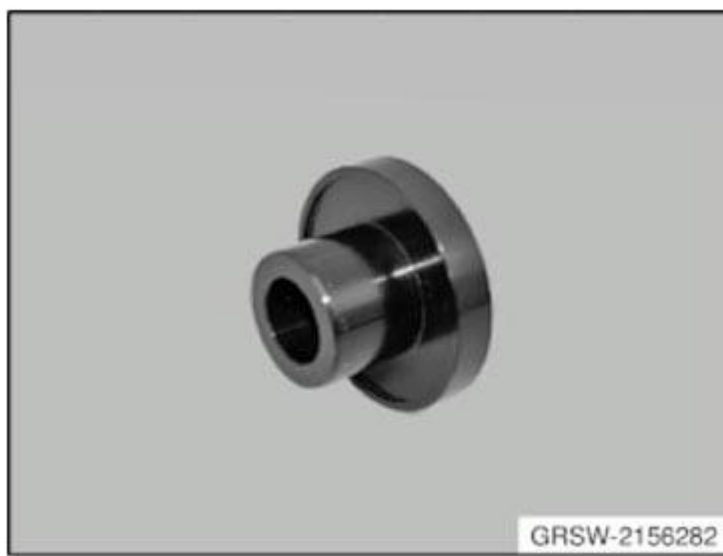
**Fig. 19: Identifying Adapter (2348435).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156282 ADAPTER AM**

**NOTE:** Adapter P3 (Ã~ 39/72mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 20: Identifying Adapter (2156282).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156260 ADAPTER AM**

**NOTE:** Adapter E2 (M24) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 21: Identifying Adapter (2156260).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156275 ADAPTER AM**

**NOTE:** Adapter M4 (Ã~ 96mm) in connection with adapter kit 2 (BMW), (81642155746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 22: Identifying Adapter (2156275).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2348431 ADAPTER AM**

**NOTE:** Adapter N5 (1.5" ~ 51mm) in connection with adapter kit F03 (81642348804) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 02 13 (900)



**Fig. 23: Identifying Adapter (2348431).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2159720 ADAPTER AM**

**NOTE:** Adapter G1 (M22x1.5/M20) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)





**Fig. 24: Identifying Adapter (2159720).**

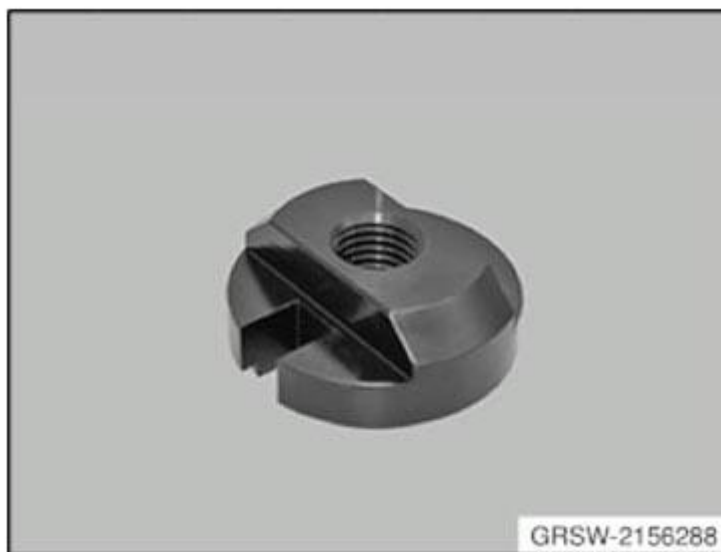
Courtesy of BMW OF NORTH AMERICA, INC.

**2156288 ADAPTER AM**

**NOTE:** Adapter R3 (M24/Å~ 69/79mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 25: Identifying Adapter (2156288).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156280 ADAPTER AM**

**NOTE:** Adapter N1 (Å~ 49mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 26: Identifying Adapter (2156280).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156279 ADAPTER AM**

**NOTE:** Adapter N2 (Ã~ 45mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 27: Identifying Adapter (2156279).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2159721 ADAPTER AM**

**NOTE:** Adapter M1 (Ã~ 100/101mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 28: Identifying Adapter (2159721)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156273 ADAPTER AM**

**NOTE:** Adapter M5 (Ã~ 90mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 29: Identifying Adapter (2156273)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2159985 ADAPTER AM**

**NOTE:** Adapter H2 (tooth finder) in combination with adapter kit 1 BMW (81 64 2 155 745) for removal and installation of wheel bearings, output shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 30: Identifying Adapter (2159985).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156289 ADAPTER AM**

**NOTE:** Adapter R2 (M24 tapered) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 31: Identifying Adapter (2156289).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156285 ADAPTER AM**

**NOTE:** Adapter P2 (Ã~ 49/90mm) in connection with adapter kit 2 (BMW) and adapter kit 3 RR for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 32: Identifying Adapter (2156285).**

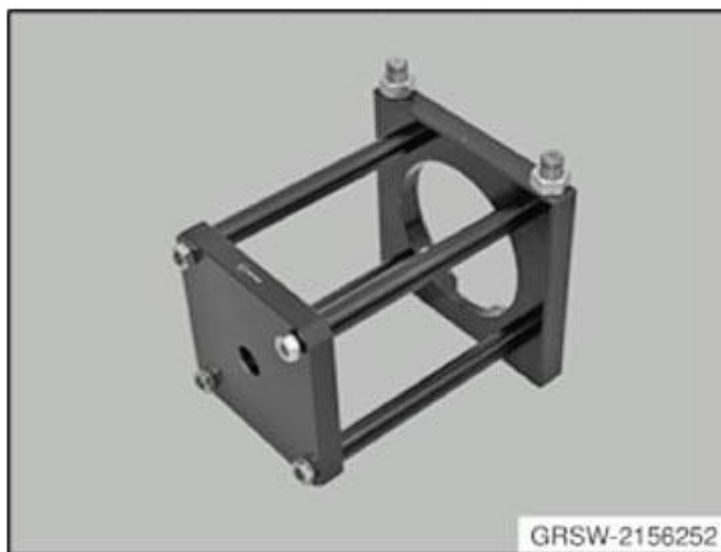
Courtesy of BMW OF NORTH AMERICA, INC.

**2156252 DEVICE AM**

**NOTE:** Device A1 in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 33: Identifying Device (2156252).**

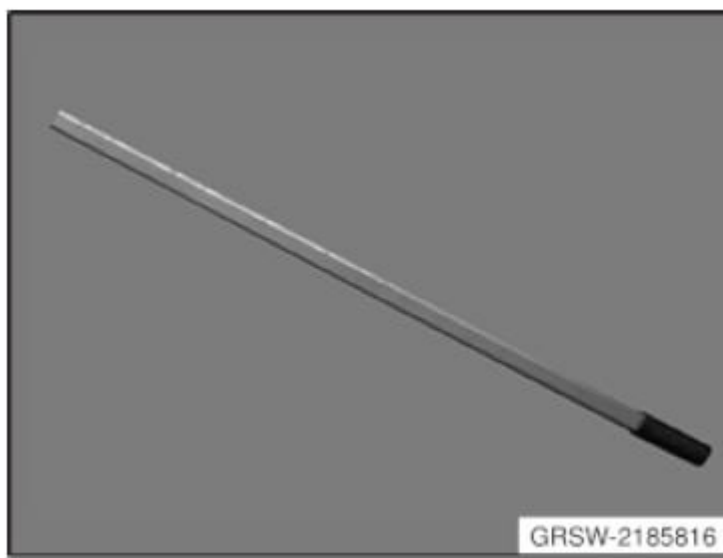
Courtesy of BMW OF NORTH AMERICA, INC.

**2185816 EXTENSION AM**

**NOTE:** Extension lever (extension) to loosen and tighten the screw connections on wishbone and tension strut in conjunction with special tools set 81642185817 (ring spanner).

**SI number**

08 04 10 (656)



**Fig. 34: Identifying Extension (2185816)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156258 HOLDING SLEEVE AM**

**NOTE:** Sleeve E1 (M24) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 35: Identifying Holding Sleeve (2156258)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156254 HOLDING SLEEVE AM**

**NOTE:** Sleeve C1 in connection with adapter kit 1 (BMW), (81 64 2 155 745) and MINI adapter kit (81 64 2 294 517), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)





**Fig. 36: Identifying Holding Sleeve (2156254)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159986 HOLDING SLEEVE AM**

**NOTE:** Sleeve H1 (removing gear finding component) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



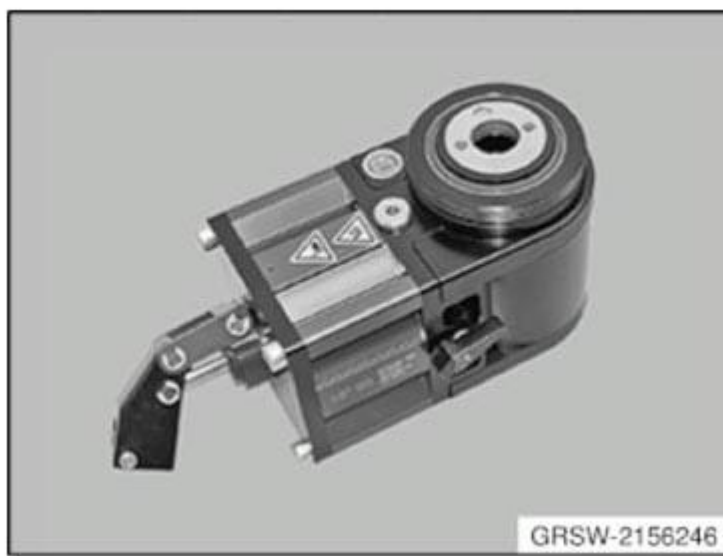
**Fig. 37: Identifying Holding Sleeve (2159986)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156246 HYDRAULIC CYLINDERS AM**

**NOTE:** Hydraulic cylinder (hydraulic actuator) in connection with lever, (81 64 2 156 247), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 38: Identifying Hydraulic Cylinders (2156246)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2156247 LEVER AM**

**NOTE:** Lever in connection with hydraulic cylinder (hydraulic actuator), (81 64 2 156 246), for removal and installation of wheel bearings, propeller shafts and drive flanges.

#### **SI number**

08 06 09 (544)



**Fig. 39: Identifying Lever (2156247)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **315130 MANDREL MINIMUM SET: MECHANICAL TOOLS**

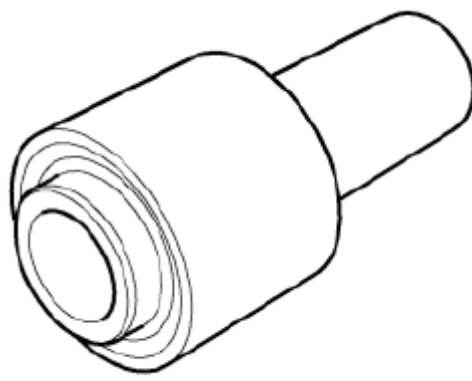
**NOTE:** (Drift set) For driving in the radial seal rings of the output shaft on the front axle differential (E46/16)

#### **Storage Location**

C12

#### **SI number**

01 15 99 (483)



W31 5 130

**Fig. 40: Identifying Mandrel (315130)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2208574 NUT AM**

**NOTE:** TR18 nuts for removing and installing the rubber mount on the rear axle support. Contained in threaded spindle set 81642208573. TR18 nuts cannot be ordered separately.

**SI number**

08 06 10 (658)



**Fig. 41: Identifying Nut (2208574)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2185817 RING SPANNER AM**

**NOTE:** Ring fitting tool (ring spanner) to loosen and tighten the screw connections on wishbone and tension strut in conjunction with special tools set 81642185816 (extension).

**SI number**

08 04 10 (656)



**Fig. 42: Identifying Ring Spanner (2185817)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159983 SCREW AM**

**NOTE:** Screws K1 (M12x1.5) for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 43: Identifying Screw (2159983)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159984 SCREW AM**

**NOTE:** Screws K2 (M14x1.5) for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 44: Identifying Screw (2159984)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2208575 SPINDLE AM**

**NOTE:** M12 threaded spindles for removing and installing the rubber mount on the rear axle support. Contained in threaded spindle set 81642208573. Threaded spindles M12 cannot be ordered separately.

#### **SI number**

08 06 10 (658)



**Fig. 45: Identifying Spindle (2208575)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2156271 SPINDLE AM**

**NOTE:** Spindle F1 (M24/425 mm) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts drive flanges.

#### **SI number**

08 06 09 (544)



**Fig. 46: Identifying Spindle (2156271)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156262 SPINDLE AM**

**NOTE:** Spindle F3 (M24/270mm) in connection with adapter kit 1 (BMW), (81 64 2 155 745) and MINI adapter kit (81 64 2 294 517) for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 47: Identifying Spindle (2156262)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2208577 SPINDLE AM**

**NOTE:** M18 threaded spindles for removing and installing the rubber mount on the rear axle support. Contained in threaded spindle set 81642208573. Threaded spindles M18 cannot be ordered separately.

SI number

08 06 10 (658)





**Fig. 48: Identifying Spindle (2208577)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156270 SPINDLE AM**

**NOTE:** Spindle F2 (M20/M24/355mm) in connection with adapter kit 1 (BMW), (81 64 2 155 745), and MINI adapter kit, (81 64 2 294 517), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 49: Identifying Spindle (2156270)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2344011 TOOL AM**

**NOTE:** Tool (wheel hub grinder) for cleaning the connection of the wheel rim (wheel contact face) to the wheel hub.

**SI number**

08 08 12 (872)



**Fig. 50: Identifying Tool (2344011)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2155746 TOOL SET AM**

**NOTE:** Adapter kit 2 (BMW), (BMW-specific adapters), for installation and removal of wheel bearings, propeller shafts and drive shafts.

**SI number**

08 12 14 (155)

Consisting of:

1 = 2159721

14 = 2159722

18 = 2156282



**Fig. 51: Identifying Tool Set (2155746)**

**Courtesy of BMW OF NORTH AMERICA, INC.**

17 = 2156283

19 = 2156290

2 = 2159723

16 = 2156275

15 = 2156273

13 = 2156280

12 = 2156279

11 = 2156278

10 = 2156277

3 = 2156285

4 = 2159724

5 = 2156289

6 = 2156288

7 = 2156287

8 = 2156286

9 = 2156284

**2155745 TOOL SET AM**

**NOTE:** Wheel bearing adapter kit 1 (BMW), (spindles and tensioning nuts) for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 12 14 (155)

Consisting of:

15 = 2156262

14 = 2159720

13 = 2156257



**Fig. 52: Identifying Tool Set (2155745)**

**Courtesy of BMW OF NORTH AMERICA, INC.**

12 = 2156256

11 = 2318476

10 = 2159986

9 = 2159985

1 = 2156252

2 = 2156253

3 = 2156254

4 = 2156255

5 = 2156258

6 = 2156260

7 = 2156265

8 = 2156271

16 = 2156270

**2208573 TOOL SET AM**

**NOTE:** Threaded spindle set for removing and installing the rubber mount on the rear axle support.

**SI number**

08 06 10 (658)

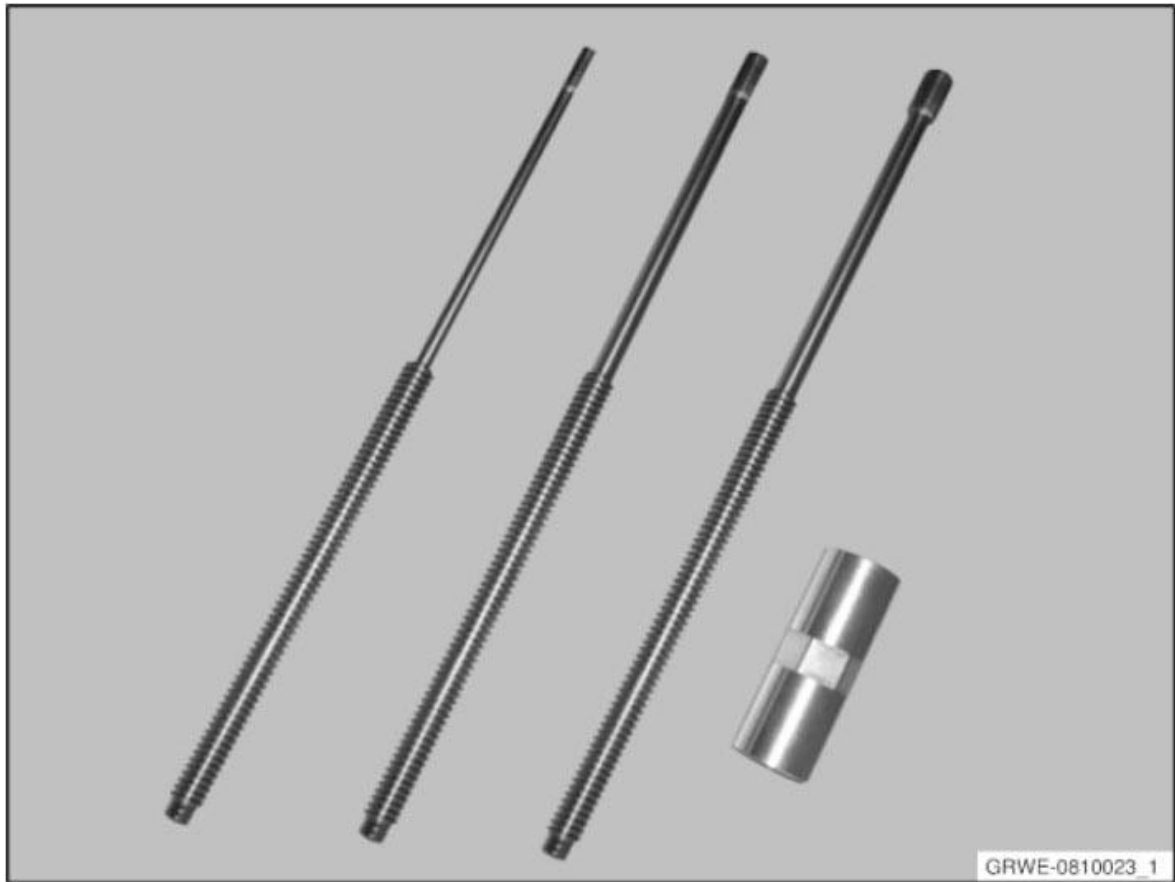
Consisting of:

4 = 2208574

3 = 2208575

2 = 2208576

1 = 2208577



**Fig. 53: Identifying Tool Set (2208573)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2155744 TOOL SET AM**

**NOTE:** Hydraulic unit (basic unit) for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 12 14 (155)

Consisting of:

2 = 2156247

1 = 2156246



**Fig. 54: Identifying Tool Set (2155744)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156255 WASHER AM**

**NOTE:** Contact disc D1 in connection with adapter kit 1 (BMW), (81 64 2 155 745) and MINI adapter kit (81 64 2 294 517), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 55: Identifying Washer (2156255)**

Courtesy of BMW OF NORTH AMERICA, INC.

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**SUSPENSION****Front Axle - Technical Data - All I3 Models - i3****FRONT AXLE - RIDE HEIGHT****31 00 FRONT AXLE - RIDE HEIGHT I01****FRONT AXLE - RIDE HEIGHT I01 SPECIFICATION**

Ride height in normal position: Attach tape measure to bottom middle of rim flange and measure to lower edge of wheel arch		Â
Tolerance ride height in <ul style="list-style-type: none"> <li>-<b>NORMAL POSITION</b> max Â±1 0 mm</li> <li>-<b>CONSTRUCTION POSITION</b> max Â±2 mm</li> </ul>		Â
Difference ride height between left/right in <ul style="list-style-type: none"> <li>-<b>NORMAL POSITION</b> 10 mm</li> <li>-<b>DESIGN POSITION</b> 2 mm</li> </ul>		Â
Standard suspension	mm	Â
19" wheel rim	mm	668
20" rim	mm	681
Standard suspension Japan	Â	Â
19" rim	mm	638
20" rim	mm	651

**GENERAL - TRACK WIDTH/WHEELBASE, JAPANESE VERSION****31 00 GENERAL - TRACK WIDTH/WHEELBASE I01 JAPANESE VERSION****GENERAL - TRACK WIDTH/WHEELBASE I01 JAPANESE VERSION SPECIFICATION**

Track width for normal position and rim offset (ET)	Â	Â
-ET 43	mm	1574
Wheelbase	mm	2570

**GENERAL - TRACK WIDTH/WHEELBASE****31 00 GENERAL - TRACK WIDTH/WHEELBASE I01 SERIES****GENERAL - TRACK WIDTH/WHEELBASE I01 SERIES SPECIFICATION**

Track width for normal position and rim offset (ET)	Â	Â
-ET 43	mm	1571
Wheelbase	mm	2570

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## SUSPENSION

### Front Axle - Tightening Torques - All I3 Models - i3

#### ANTI-ROLL BAR

##### 31 35 ANTI-ROLL BAR

#### TIGHTENING TORQUE SPECIFICATION - ANTI-ROLL BAR

Part	Type	Thread	Tightening specifications	Dimension
1AZ Anti-roll bar bracket to front axle module	I01	M10	Replace screws. (Always comply with tightening specifications: 1. Tighten all screws with jointing torque 2. Conduct final torque.) Jointing torque Final torque	30 Nm 56 Nm
2AZ Anti-roll bar link to anti-roll bar/spring strut	I01	M10	Replace nut.	56 Nm

#### FRONT AXLE SUSPENSION

##### 31 10 FRONT AXLE SUSPENSION

#### TIGHTENING TORQUE SPECIFICATION - FRONT AXLE SUSPENSION

Part	Type	Thread	Tightening specifications	Dimension
1AZ Front axle support to front axle module	I01	M12x98 (rear)	Replace screws.	104 Nm
		M12x60 (center)	Replace screw.	104 Nm
		M12x98 (front)	Replace screw. Jointing torque Angle of rotation	96 Nm 90 °
2AZ Stiffening plate to front axle support	I01	M8	Replace nut.	28 Nm

#### SPRING STRUTS

##### 31 31 SPRING STRUTS

#### TIGHTENING TORQUE SPECIFICATION - SPRING STRUTS

Part	Type	Thread	Tightening specifications	Dimension
1AZ Support bearing to front axle module	I01	M8	Replace nut.	28 Nm
2AZ Spring strut shock absorber to support bearing	I01	M12	Renew nut.	64 Nm
3AZ Spring strut shock absorber to swivel bearing	I01	M12	Renew screw and nut. Tightening torque via nut! Jointing torque Angle of rotation	44 Nm 90 °
4AZ Adjusting nut for coilover (Japan chassis and suspension)	I01	Replace nut.	Counterhold the lock nut - torque via adjusting nut	59 Nm

#### TRAILING ARMS AND STRUTS

## 31 12 TRAILING ARMS AND STRUTS

### TIGHTENING TORQUE SPECIFICATION - TRAILING ARMS AND STRUTS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Wishbone to front axle support	I01	M12	Replace screw and nut. <b>TIGHTEN DOWN IN NORMAL POSITION</b> . Jointing torque Angle of rotation	100 Nm 90 Â°
2AZ Wishbone to swivel bearing	I01	M16	Replace nut. Jointing torque Angle of rotation	100 Nm 90 Â°

## WHEEL BEARINGS AND STEERING KNUCKLE

### 31 21 WHEEL BEARINGS AND STEERING KNUCKLE

#### TIGHTENING TORQUE SPECIFICATION - WHEEL BEARINGS AND STEERING KNUCKLE

Â	Type	Thread	Tightening specifications	Dimension
1AZ Wheel bearing to swivel bearing	I01	M12x1.5	Replace screws. Jointing torque Angle of rotation	80 Nm 90 Â°

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## SUSPENSION

### Front Axle Operating Fluids

## GENERAL INFORMATION ON HIGH TEMPERATURE MULTI-PURPOSE GREASE

### GENERAL REQUIREMENTS

High-temperature multipurpose grease consists of a lithium complex soap in a mineral oil raffinate in combination with select additive combinations. The soap is contained in the oil with a very fine distribution and virtually serves as a structure.

This lubricating grease has the following quality features:

- Thermal stability:
  - At operating temperatures of minus 30Â° C to plus 150Â° C in continuous operation as well as high load, the structure and consistency must be maintained over a long service life.
- Oxidation resistance:
  - To prevent oxidation at high operating temperature, lubricating grease contains effective inhibitors (inhibitors that limit or prevent chemical processes).
- Water resistance and corrosion prevention:
  - The high-temperature multipurpose greases are resistant against water. At the same time, the greased components are optimally protected by corrosion inhibitors against corrosive effects.

## OIL FOR FRONT AXLE DIFFERENTIAL

### APPROVED OIL

Trade Name	BMW Part Number
BMW Synthetics OSP (1 liter)	33 11 7 695 240
BMW Synthetics OSP (60-liter drum)	83 22 9 407 768
Hypoid Axle Oil G1 (3 x 500 ml)	83 22 2 295 532

## GREASE FOR WHEEL BEARINGS

### TAPER ROLLER BEARING

High-temperature multipurpose grease is used to grease the taper roller bearing.

Grease filling in the wheel hub 50 g and in the wheel hub protective cap 20 g per wheel.

Trade name	BMW part number
BMW part number	83 23 9 407 845

The wheel hub protective caps must always be replaced and glued into the wheel hubs during installation with the following adhesive.

Trade name	BMW part number
Loctite No. 638	81 22 9 407 420

### ANGULAR-CONTACT BALL BEARING UNIT

Bearing unit lubricated for life, cannot be dismantled, no re-greasing possible.

**Grooved ball bearing (rear axle) E12, E21, E23, E24 up to mod. 5.82**

<b>Trade name</b>	<b>BMW part number</b>
Shell Retinax EP 2	83 23 9 407 845

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## SUSPENSION

### Integrated Suspension Systems - Repair - All I3 Models - i3

## ELECTRICAL COMPONENTS

### 37 14 511 REPLACING FRONT RIDE HEIGHT SENSOR

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

IMPORTANT: Read and comply with notes on [PROTECTION AGAINST ELECTROSTATIC DAMAGE \(ESD PROTECTION\)](#).

Turn steering wheel to right.

Slacken nut (1).

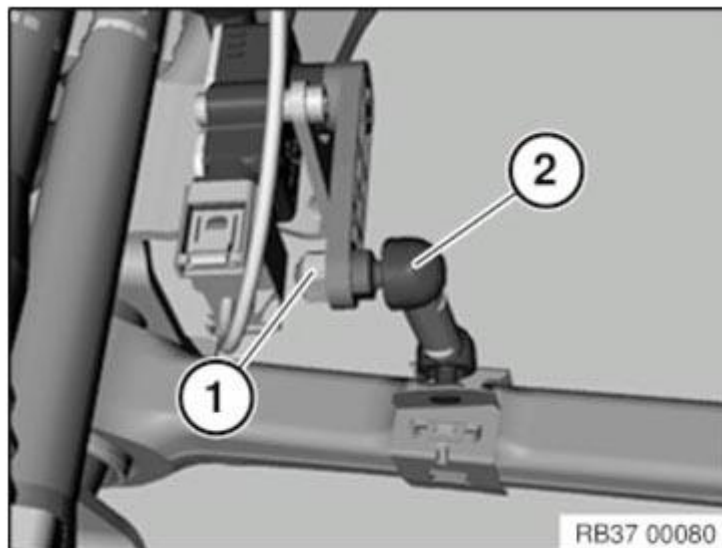
Tightening torque [37 14 4AZ](#).

Detach jointed rod (2).

*Installation note:*

Replace nut.

Sensor lever points in direction of travel starting from ride height sensor.



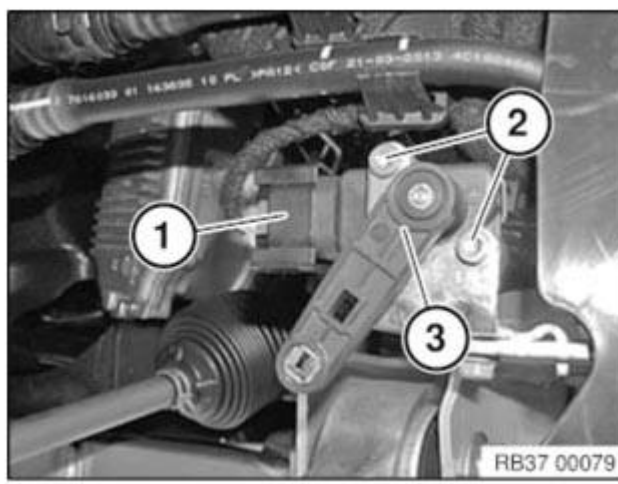
**Fig. 1: Identifying Ride Height Sensor Jointed Rod And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect plug connection (1).

Unfasten screws (2).

Tightening torque [37 14 3AZ](#).

Remove ride height sensor (3).



**Fig. 2: Identifying Left Ride Height Sensor Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

After installation:

- Check **HEADLIGHT ADJUSTMENT** , correct if necessary.

### 37 14 512 REPLACING REAR RIDE HEIGHT SENSOR

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

IMPORTANT: Read and comply with notes on **PROTECTION AGAINST ELECTROSTATIC DAMAGE (ESD PROTECTION)** .

Necessary preliminary tasks:

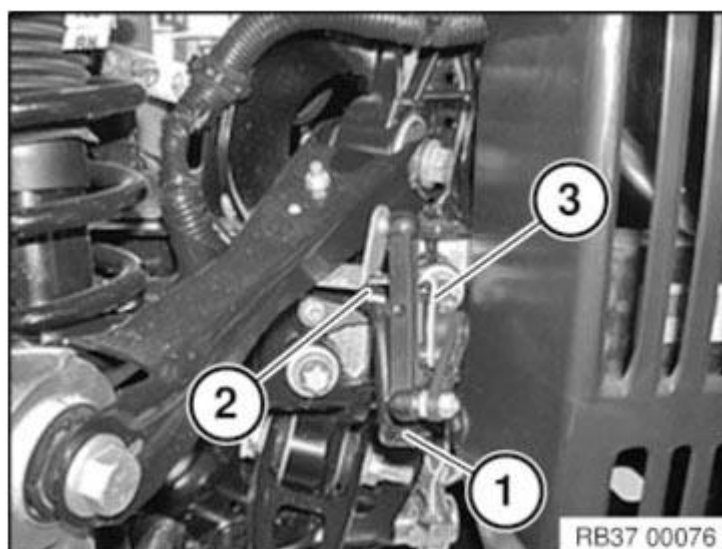
- Remove **LEFT REAR WHEEL** .

Disconnect connector (1) from ride height sensor (3).

Unclip cable at holder (2).

*Installation note:*

Replace faulty cable clips.



**Fig. 3: Identifying Ride Height Sensor Connector And Holder**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque [37 14 4AZ](#) .

Detach jointed rod.

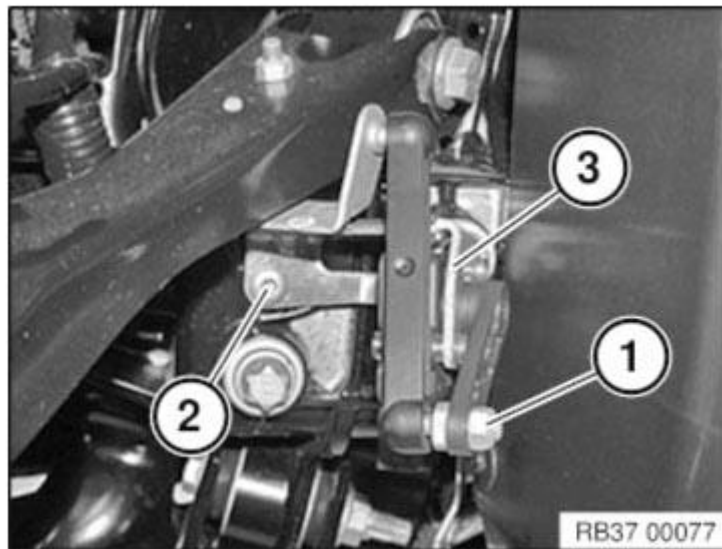
Release screw (2).

Tightening torque [37 14 2AZ](#) .

Remove ride height sensor (3).

*Installation note:*

Replace nut (1).



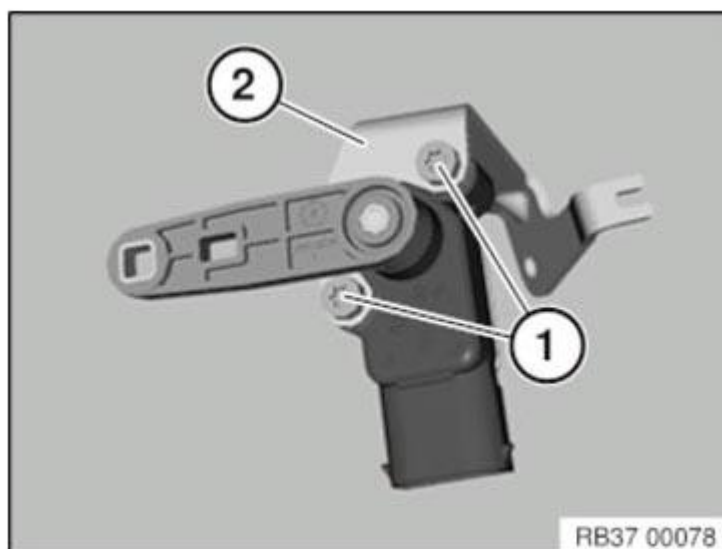
**Fig. 4: Identifying Ride Height Sensor Screw And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Replacement:**

Unscrew screws (1).

Tightening torque [37 14 3AZ](#) .

Take off ride height sensor from holder (2).



**Fig. 5: Identifying Ride Height Sensor Holder And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Check **HEADLIGHT ADJUSTMENT** , correct if necessary.
-

## SUSPENSION

### Integrated Suspension Systems - Tightening Torques - All I3 Models - i3

## ELECTRIC COMPONENTS

### 37 14 ELECTRIC COMPONENTS

#### TIGHTENING TORQUE SPECIFICATION - ELECTRIC COMPONENTS

Â	Type	Thread	Tightening specifications	Dimension
1AZ Ride height sensor holder to front axle support	I01	M6	Â	8 Nm
2AZ Ride height sensor holder to rear axle module	I01	M6	Â	8 Nm
3AZ Ride height sensor to holder	I01	M5	Replace screws	5 Nm
4AZ Sensor lever, ride height sensor to jointed rod	I01	M6	Replace nut	8 Nm
5AZ Jointed rod to wishbone	I01	M6	Replace nut	8 Nm

---

## SUSPENSION

### Integrated Suspension Systems Operating Fluids

## APPROVED HYDRAULIC FLUIDS

### ZF RACK-AND-PINION STEERING

**NOTE:** The hydraulic fluid reservoirs are marked on the rim of the reservoir and/or the reservoir cap to show which type of oil can be used: ATF oil or Pentosin CHF oil.

The ZF rack-and-pinion steering has lifetime lubrication and is thus maintenance-free.

For topping up/filling hydraulic system:

### POWER STEERING OIL

Trade name	BMW part number	Container size	Oil color
BMW automatic transmission fluid (ATF)	81 22 9 400 272	1-liter	Red
Pentosin CHF 11S	83 29 0 429 576	1-liter	Green

**NOTE:** Vehicles with AFS/ARS (Dynamic Drive / Active Steering / Active Roll Stabilization) are filled as standard with Pentosin CHF 11S.

In case of repair, the affected steering components must be lubricated with the following grease:

### COMPONENT GREASE

Trade name	BMW part number	Container size
Calypsol SF-3-131-TMM 3	83 23 9 407 857	100 g tube

**NOTE:** Calypsol D 4024-OK is a sodium-saponified, cold-resistant grease whose lubricity ranges from -30 °C to +75 °C.

### E24, E28, E32, E34, AND E38

#### E24, E28 produced prior to 9/87

Pentosin CHF 4548 was used for initial factory filling.

For filling up and replacement the following oil is to be used:

Pentosin CHF 7.1 BMW Part No. 81 22 1 468 879

Pentosin CHF 4548 and CHF 7.1 can be mixed in these cars.

For complete system oil replacement:

Reputable brand name LHM oils (green color) can also be used (Shell, Castrol, Exxon, etc.)

**NOTE:** Mixing of CHF and LHM oils is not permitted.

#### E24, E28 produced since 9/87

Pentosin CHF 7.1 is used for initial factory filling.

For filling up and replacement use only Pentosin CHF 7.1



For complete oil replacement:

Reputable brand name LHM oils (green color) can also be used.

**NOTE:**        **Mixing of CHF 7.1 and LHM oils is not permitted.**

**E32 produced prior to 9/91**

Use only Pentosin CHF 7.1.

Mixing with other oils is not permitted.

**E32, E34 produced since 9/91**

Use only Pentosin CHF 11S

**NOTE:**        **All cars have a label indicating the respective type on the hydraulic fluid reservoir. Since both Pentosin CHF 11S and CHF 7.1 are green in color, the reservoir label must be carefully checked prior to adding fluid.**

Mixing CHF 11S and CHF 7.1 is not permitted.

Pentosin CHF 11S BMW Part No. 82 11 1 468 041

**E38 produced since 1/94**

Use only Pentosin CHF 11S

**NOTE:**        **All cars have a label indicating the respective type on the hydraulic fluid reservoir. Since both Pentosin CHF 11S and CHF 7.1 are green in color, the reservoir label must be carefully checked prior to adding fluid.**

Mixing CHF 11S and CHF 7.1 is not permitted.

Pentosin CHF 11S BMW Part No. 82 11 1 468 041

**LHM HYDRAULIC FLUID**

LHM hydraulic fluid has a favorable viscosity range and permits problem-free operation of the self-leveling rear suspension at very low and very high temperatures. The solidification point is -78°F/-61°C.

**CHECKING HYDRAULIC FLUID LEVELS**

The hydraulic fluid level must be checked on an unloaded car and at every Inspection I or, for cars without a Service Indicator, at 10, 000 mi/15, 000 km intervals.

**NOTE:**        **Not required as of 1993 model year vehicles.**

Special checking instructions apply to the E32 - always refer to the latest edition of the Repair Instructions.

**NOTE:**        **Never fill above the "max" mark. There are no replacement intervals for hydraulic fluid.**

---

## SUSPENSION

### Rear Axle - Repair - All I3 Models - i3

## GENERAL INFORMATION

### 33 00... INFORMATION ON REPLACING SHOCK ABSORBERS

#### Situation:

When a shock absorber is faulty on one side (leaking, noises, limit violation on the shock tester), often both shock absorbers on the axle in question are replaced.

#### Effect:

This is not necessary for technical reasons and causes the manufacturer not to recognize the unnecessarily removed shock absorbers as defective parts. Unnecessarily high costs for the customer can be avoided by replacing the shock absorber on one side only.

#### Procedure:

If one shock absorber is damaged, it is only necessary to replace both shock absorbers when the car has driven in excess of 80 000 km.

### 33 00... INSTRUCTIONS (CHASSIS COMPONENTS MADE OF ALUMINUM)

Due to the chemical and corrosion characteristics of aluminum, always comply with the following points when handling aluminum components:

- Do not bring into contact with battery acid!
- Do not clean with wire brushes made of brass or iron! Always use wire brushes with stainless steel bristles!
- Do not expose to flying sparks when grinding/separating! Cover components!
- Do not strike with steel welding splashes! Cover components!
- Do not expose to temperatures  $> 80 \text{ }^{\circ}\text{C}$ , even for brief periods! Temperatures in paint facilities do not have the same impact

### LIFTING THE VEHICLE USING A VEHICLE HOIST

#### **WARNING:**

**Danger to life!**

**Read and follow operating instructions for vehicle hoist.**

**Do not exceed approved load-carrying capacity and load distribution of vehicle hoist.**

**Weight compensation may be necessary due to the loading situation of the vehicle.**

**This also applies in the event of considerable removal of parts or conversions on the vehicle.**

#### **NOTE:**

**The vehicle hoist must comply with the relevant statutory/country-specific accident prevention regulations and be serviced according to the regulations.**

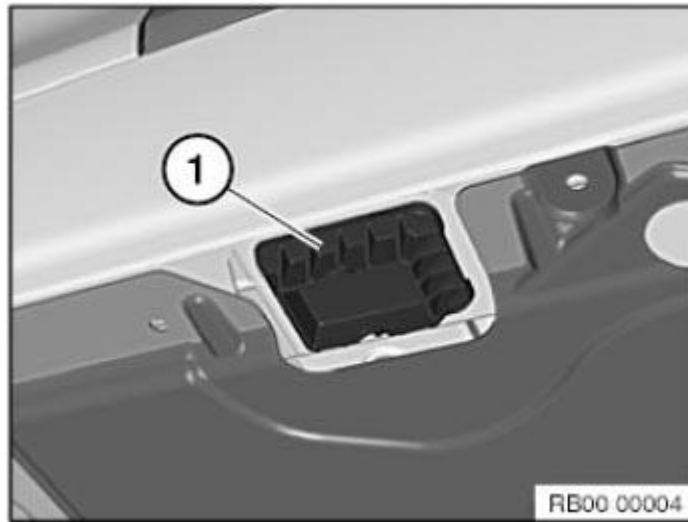
**IMPORTANT:** Risk of damage!  
Before driving onto a vehicle hoist, make sure there is sufficient ground clearance between the vehicle hoist and the vehicle.

The vehicle may only be raised with the vehicle hoist at the four jacking points.

#### **Necessary preliminary tasks:**

- If necessary, remove jacking points from equipment pack (with new vehicles) and insert from below into openings in front and rear sill areas

**IMPORTANT:** All four jacking points (1) must be available!  
**Never raise the vehicle without the jacking points (1)!**

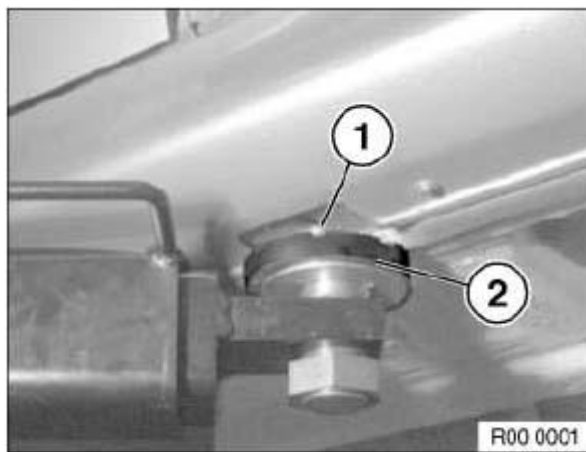


**Fig. 1: Identifying Vehicle Jacking Point**  
Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Risk of damage!

Align support plates (2) of lifting platform arms to jacking points (1) in such a way that no adjoining components are touched and thereby damaged.

**In electric vehicles, there is a risk of damage to the high-voltage component behind the underbody panelling!**



**Fig. 2: Aligning Lifting Platform Arms Supporting Plates And Jacking Points**  
Courtesy of BMW OF NORTH AMERICA, INC.

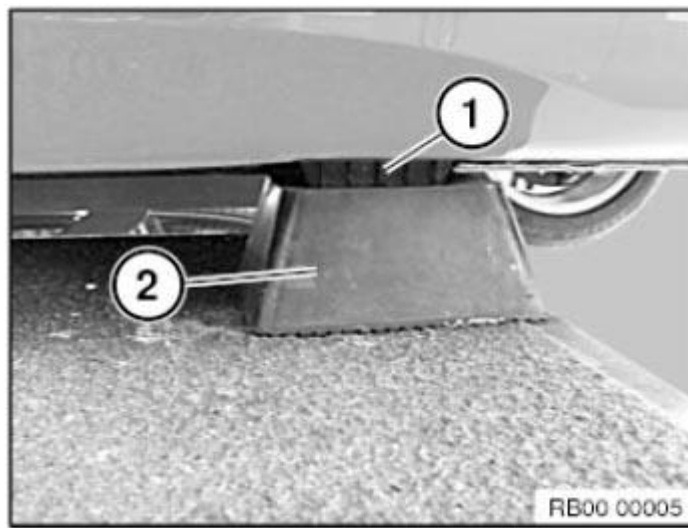
**IMPORTANT:** Risk of damage!

Align the rubber block (2) with the jacking points (1) in such a way that no adjoining components are touched and thereby damaged.

**Never raise the vehicle without rubber blocks (or rigid foam blocks)!**

There is a major risk of damage to the vehicle underbody!

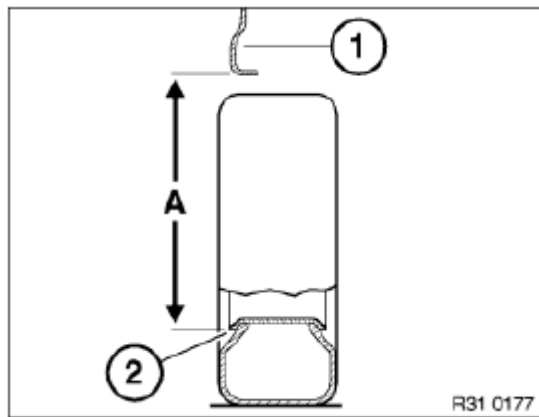
**In electric vehicles, there is a risk of damage to the high-voltage component behind the underbody panelling!**



**Fig. 3: Aligning Rubber Block And Vehicle Jacking Points**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **33 52 MEASURING VEHICLE RIDE HEIGHT**

Determine actual ride height (A) - to do so, attach tape measure to rim flange (2) at bottom middle and measure to wheel arch lower edge (1).



**Fig. 4: Checking Vehicle Actual Ride Height**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **41 00... NOTES ON REPAIRING THREADS**

IMPORTANT: Install Helicoil thread inserts so that they are flush with the original thread!

**NOTE:** Damaged threads may be repaired with Helicoil thread inserts. Observe the **PROCEDURE** described in the example.

Screw connection	Vehicle	Bolting point	Helicoil thread insert
Front axle support to front axle module	I01	Front	M12x1.5x24
	I01	Center	M12x1.5x24
	I01	Rear	M12x1.5x28

### **31 00... NOTES ON WHEEL BEARING REPLACEMENT FOLLOWING ACCIDENT DAMAGE**

#### **Wheel bearing facts:**

In the event of accidents or driving conditions similar to accidents, shock-like loads to the wheel bearing units can cause slight damage to the bearing track. Despite initial running without noise, with continued use, this results in later noise generation at the wheel bearing.

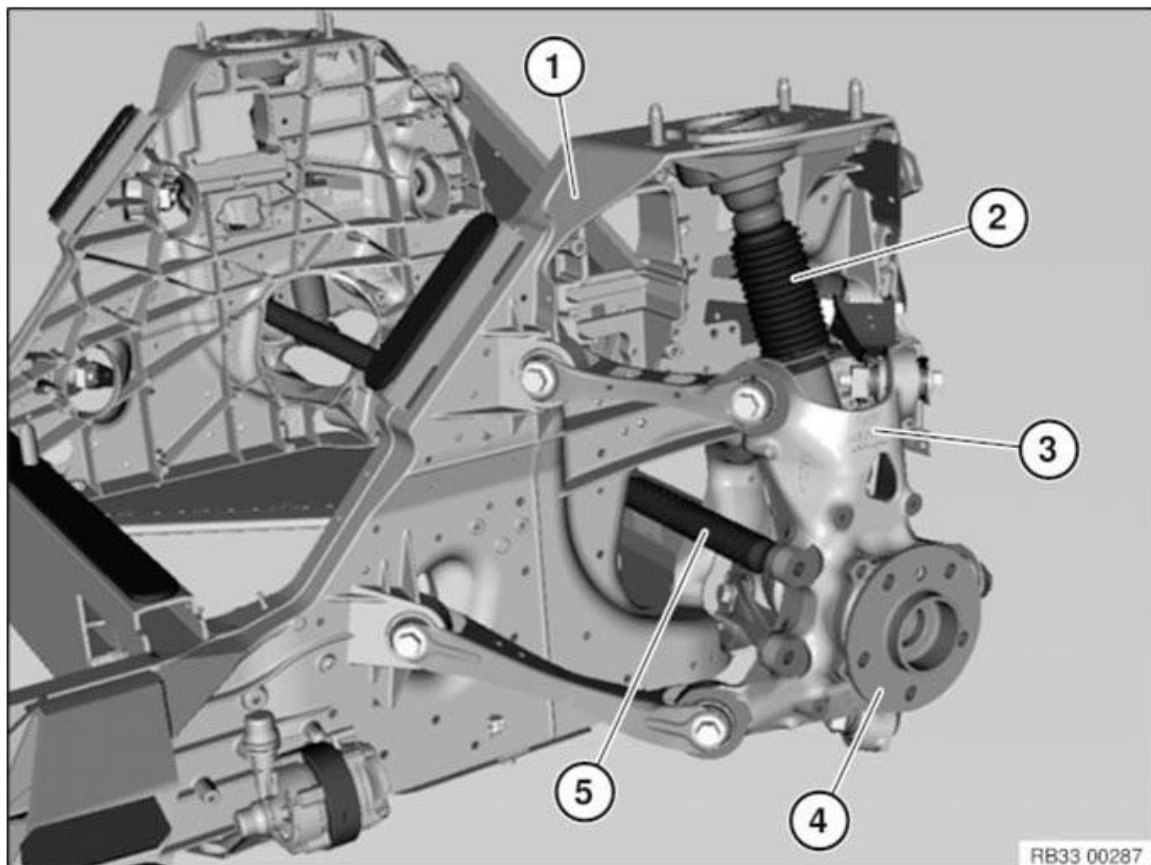
## Procedure:

The wheel bearing must be replaced on the damaged side of the axle if one or several of the following points apply:

- Visible or noticeable damage to the wheel bearing
- Rolling noises, radial/lateral runout on the wheel bearing
- Permissible tolerance for the wheel alignment is exceeded and no longer adjustable without the exchange of additional components
- Damage, permanent deformation or fractures to:
  - Wheel rims (major damage) and simultaneous negative result for wheel alignment
  - Spring struts, swivel bearings, wheel carriers
  - Wishbones
  - Struts or trailing links or anti roll bar with this function
  - Body side screwing/attachment points for wheel guide/control components
  - Track rods
  - Steering box fixtures

This guideline is binding for all accident repairs to BMW, MINI and Rolls-Royce vehicles!

## 33 REAR AXLE LAYOUT



1 [Rear axle module](#)

5 [Output shaft](#)

2 [Spring strut shock absorber](#)

3 [Wheel carrier](#)

4 [Wheel bearing / drive flange](#)

**33 00... REAR AXLE: WHEEL ALIGNMENT CHECK MUST BE CARRIED OUT AFTER THE FOLLOWING WORK**

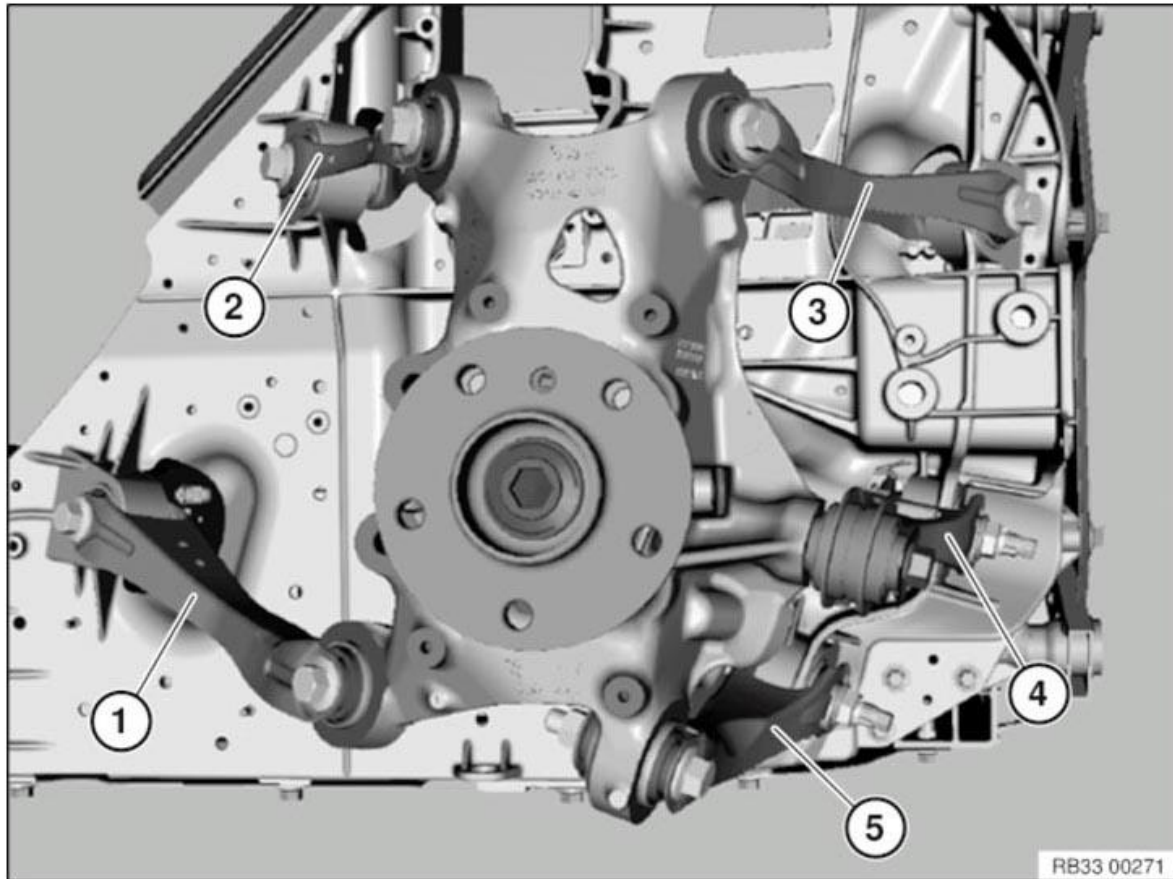


Fig. 6: Identifying Rear Axle Wheel Alignment Related Components  
Courtesy of BMW OF NORTH AMERICA, INC.

A wheel/chassis alignment check must be carried out after the following work: See ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION or ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD) .

- **Release the following screw connection:**
  - Track control arm on rear axle module (4)
  - Toe arm to wheel carrier (4)
  - Camber control arm on rear axle module (5)
  - Camber arm to wheel carrier (5)
- **Replacement of following parts:**
  - Rubber mount for track control arm (4) in rear axle module
  - Rubber mount for camber control arm (5) in rear axle module
  - Toe arm (4)
  - Toe arm (5)
  - Control arm (2)
  - Wishbone (3)
  - Wheel carrier

## **FINAL DRIVE**

### **33 10 027 REPLACING BOTH RADIAL SHAFT SEALS FOR OUTPUT SHAFTS ON E-TRANSMISSION**

**Special tools required:**



- [31 5 130](#)

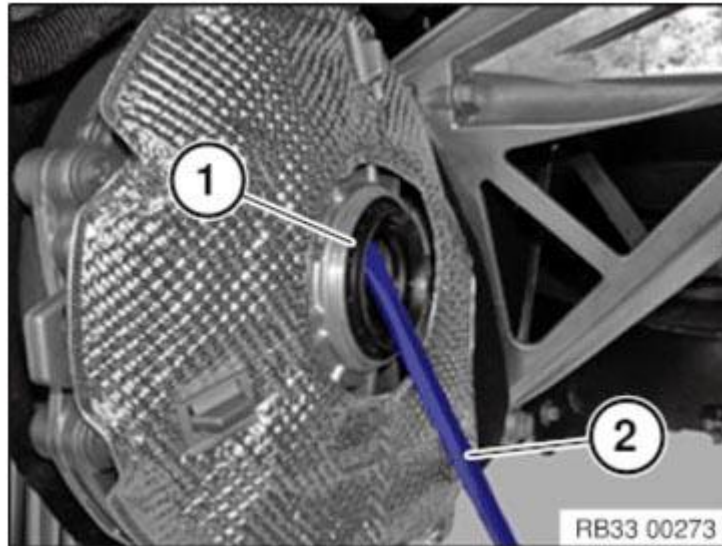
**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

Necessary preliminary tasks:

- Remove output shaft on left and right. See [REPLACING LEFT OUTPUT SHAFT](#) and [REPLACING RIGHT OUTPUT SHAFT](#).

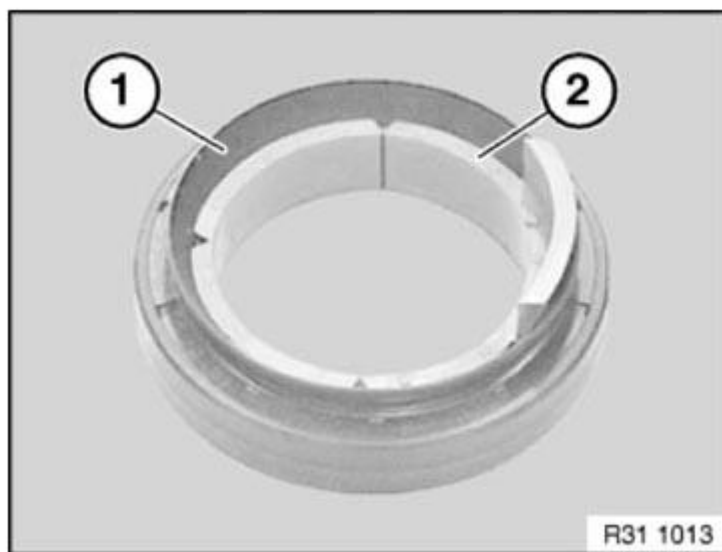
Lever out both radial shaft seals (1) from E-transmission with screwdriver (2).



**Fig. 7: Removing E Transmission Radial Shaft Seals Using Screwdriver**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Protective grommet (2) serves to protect the sealing lips of radial shaft seal (1) from being damaged when the output shaft is inserted into the E-transmission.

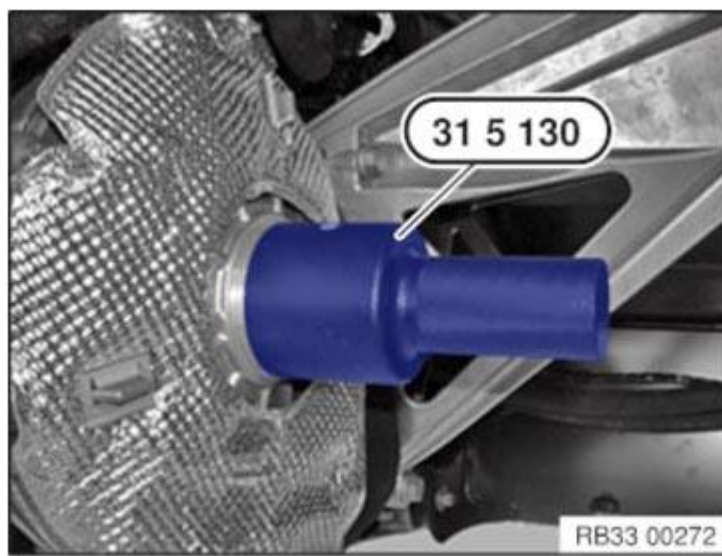


**Fig. 8: Identifying Radial Shaft Seal And Protective Grommet**

Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Drive in both radial shaft seals up to limit position with special tool [31 5 130](#).



**Fig. 9: Installing Radial Shaft Seals Using Special Tool (31 5 130).**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Check TRANSMISSION OIL LEVEL , top up if necessary.

**OUTPUT SHAFTS**

**33 21 001 REMOVING AND INSTALLING/REPLACING LEFT OUTPUT SHAFT**

**WARNING:** High-voltage system - danger to life

- Observe SAFETY INFORMATION for working with electric vehicles.

IMPORTANT: In case of a **twisted and damaged gaiter** , the following components are to be replaced as well:

- Replace LEFT AND RIGHT SUPPORT BEARING incl. screw
- Replace the mounting bracket on the left and right. See TRANSMISSION BEARING BLOCK .  
 Vehicles with range extender: see MOUNTING BRACKET OF ELECTRICAL MACHINE and MOUNTING BRACKET OF RANGE EXTENDER .

IMPORTANT: Always place a new circlip on the output shaft when removing and reinstalling!

After every removal of output shaft, the RADIAL SHAFT SEAL OF THE OUTPUT SHAFT on the transmission is to be replaced!

**NOTE:** When the camber control arm and/or the track control arm is released from the wheel carrier, a wheel alignment must be performed after installation. See ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION or ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD) .

**Necessary preliminary tasks:**

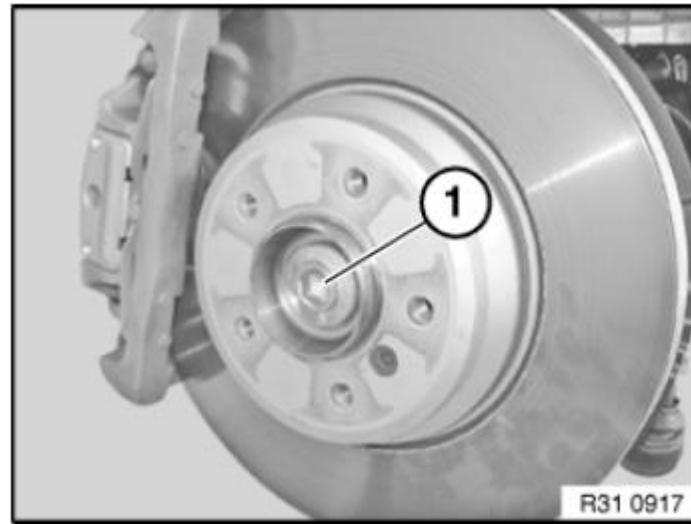
- Remove REAR WHEEL .
- Remove LEFT HORIZONTAL STRUT .

Release collar bolt (1), press brake pedal to floor for this purpose.

Tightening torque 33 41 1AZ .

*Installation note:*

Replace the collar bolt.



**Fig. 10: Identifying Left Output Shaft Collar Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

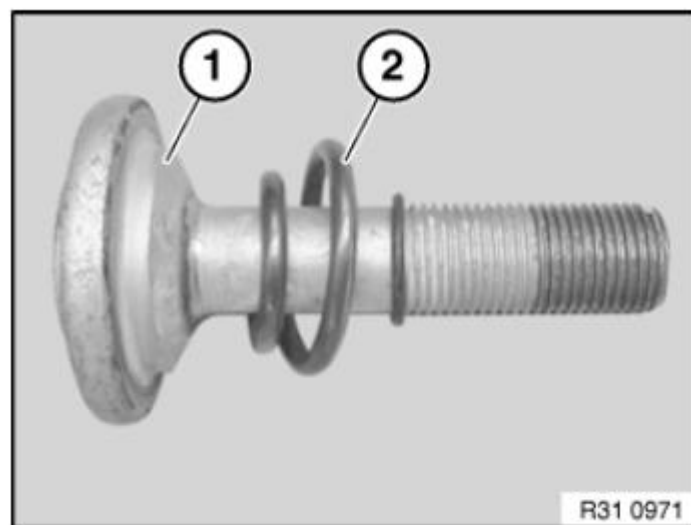
*Installation note:*

Replace collar bolt (1) and compression spring (2).

Pay attention to installation position of compression spring (2).

Keep collar bolt and spur gearing of wheel bearing/output shaft clean and free from grease.

**Follow installation note of the spur gearing.**



**Fig. 11: Identifying Collar Bolt And Compression Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen **TRAILING ARM ON WHEEL CARRIER.**
- Loosen **CAMBER ARM ON WHEEL CARRIER.**
- Remove **TOE ARM FROM WHEEL CARRIER.**

IMPORTANT: Secure output shaft against falling out.

Press output shaft out of transmission using a mounting lever.

- Rest mounting lever against a piece of wood (e.g. hammer shaft), see illustration

Pull wheel carrier aside and take out output shaft.

*Installation note:*

Replace **RADIAL SHAFT SEAL OF THE OUTPUT SHAFT.**



**Fig. 12: Supporting Output Shaft Mounting Lever Using Wooden Piece**  
Courtesy of BMW OF NORTH AMERICA, INC.

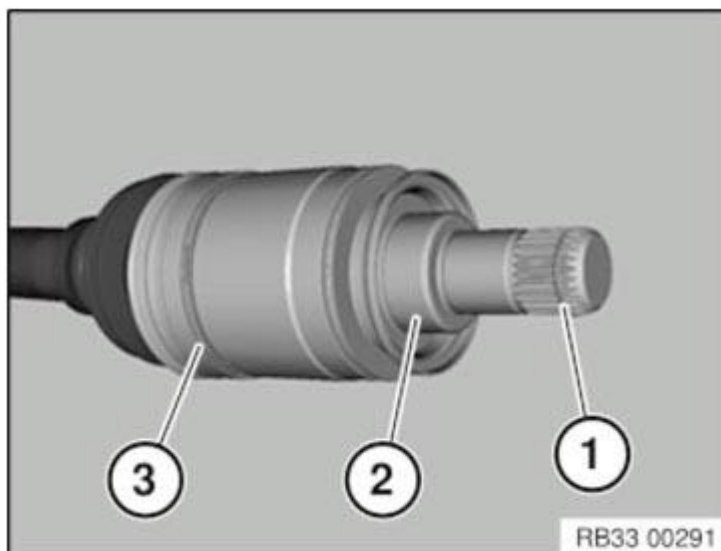
*Installation note:*

High installation forces indicate a damage and/or deformation of the gearing at the output shaft!

Check gearing, replaced damaged parts if necessary.

Install retaining ring (1).

Coat contact surface (2) of the output shaft (3) with an approved transmission oil.



**Fig. 13: Identifying Output Shaft, Retaining Ring And Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Note on installation for spur gearing must be observed without fail!

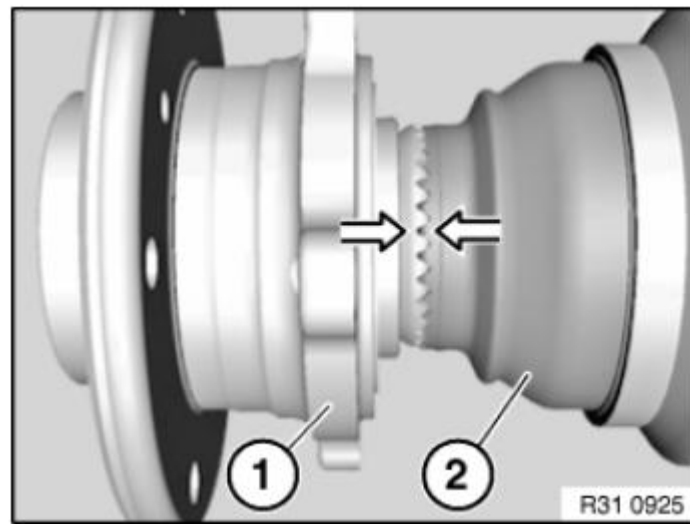
*Installation note:*

Spur gearing of wheel bearing (1) and output shaft (2) must be installed form-fit (tooth in tooth position)!

Tighten new collar bolt and compression spring by hand.

Check whether spur gearing is locked tooth in tooth by reciprocally rotating wheel hub/output shaft.

Once a form-fit has been ensured, tighten to final torque.



**Fig. 14: Locking Wheel Bearing And Output Shaft**  
Courtesy of BMW OF NORTH AMERICA, INC.

Tightening torque [33 41 1AZ](#) .

**After installation:**

- Check [OIL LEVEL IN TRANSMISSION](#) and correct, if necessary.
- Carry out wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

### **33 21 002 REMOVING AND INSTALLING/REPLACING RIGHT OUTPUT SHAFT**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**IMPORTANT:** In case of a **twisted and damaged gaiter** , the following components are to be replaced as well:

- Replace [LEFT AND RIGHT SUPPORT BEARING](#) incl. screw.
- Replace transmission mounting bracket to the right and left. See [TRANSMISSION BEARING BLOCK](#) . Vehicles with range extender: see [MOUNTING BRACKET OF ELECTRICAL MACHINE](#) and [MOUNTING BRACKET OF RANGE EXTENDER](#) .

**IMPORTANT:** Always place a new circlip on the output shaft when removing and reinstalling!

After every removal of output shaft, the [RADIAL SHAFT SEAL OF THE OUTPUT SHAFT](#) on the transmission is to be replaced!

**NOTE:** When the camber control arm and/or the track control arm is released from the wheel carrier, a wheel alignment must be performed after installation. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

**Necessary preliminary tasks:**

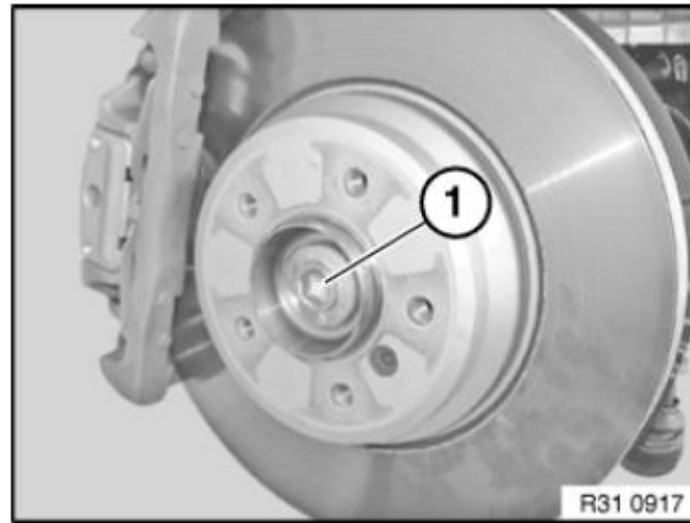
- Remove [REAR WHEEL](#) .

Release collar bolt (1), press brake pedal to floor for this purpose.

Tightening torque [33 41 1AZ](#) .

*Installation note:*

Replace the collar bolt.



**Fig. 15: Identifying Left Output Shaft Collar Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

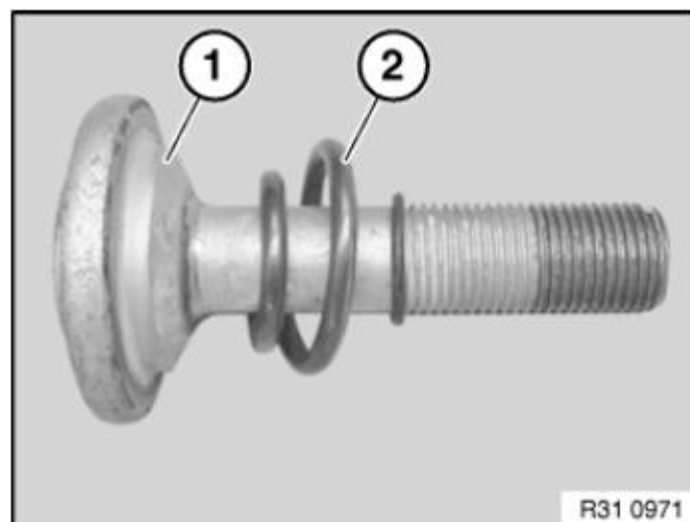
*Installation note:*

Replace collar bolt (1) and compression spring (2).

Pay attention to installation position of compression spring (2).

Keep collar bolt and spur gearing of wheel bearing/output shaft clean and free from grease.

**Follow installation note of the spur gearing.**



**Fig. 16: Identifying Collar Bolt And Compression Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Loosen [TRAILING ARM ON WHEEL CARRIER](#).
- Loosen [CAMBER ARM ON WHEEL CARRIER](#).
- Remove [TOE ARM FROM WHEEL CARRIER](#).

**IMPORTANT:** Secure output shaft against falling out.



Press output shaft out of transmission using a mounting lever.

- Rest mounting lever against a piece of wood (e.g. hammer shaft), see illustration
- Risk of damage to heat shield.
  - Only rest the piece of wood against the oil drain plug.

Pull wheel carrier aside and take out output shaft.

*Installation note:*



**Fig. 17: Supporting Output Shaft Mounting Lever Using Wood Piece**  
Courtesy of BMW OF NORTH AMERICA, INC.

Replace **RADIAL SHAFT SEAL OF THE OUTPUT SHAFT.**

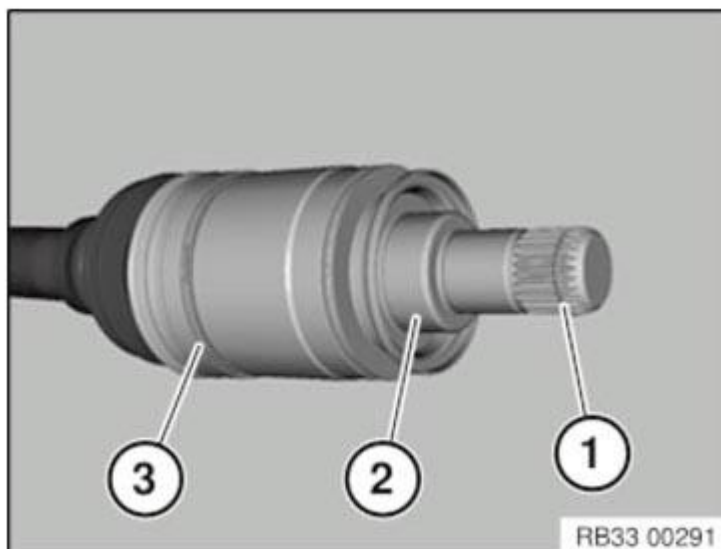
*Installation note:*

High installation forces indicate a damage and/or deformation of the gearing at the output shaft!

Check gearing, replaced damaged parts if necessary.

Install retaining ring (1).

Coat contact surface (2) of the output shaft (3) with an approved transmission oil.



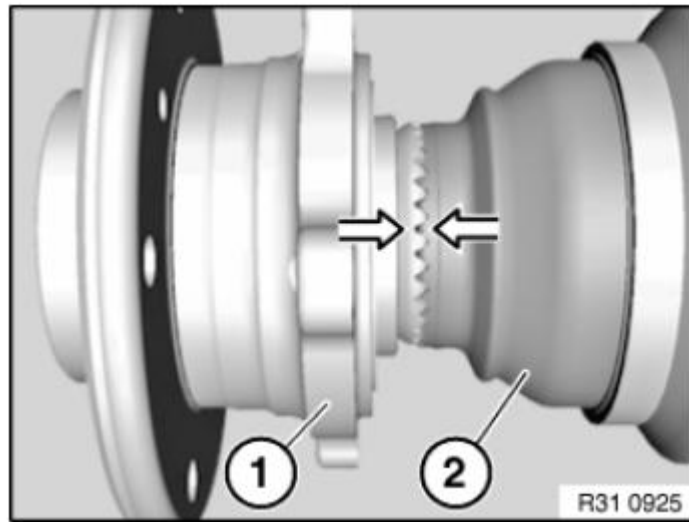
**Fig. 18: Identifying Output Shaft, Retaining Ring And Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Note on installation for spur gearing must be observed without fail!

*Installation note:*

Spur gearing of wheel bearing (1) and output shaft (2) must be installed form-fit (tooth in tooth position)!

Tighten new collar bolt and compression spring manually.



**Fig. 19: Locking Wheel Bearing And Output Shaft**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check whether spur gearing is locked tooth in tooth by reciprocally rotating wheel hub/output shaft.

Once a form-fit has been ensured, tighten to final torque.

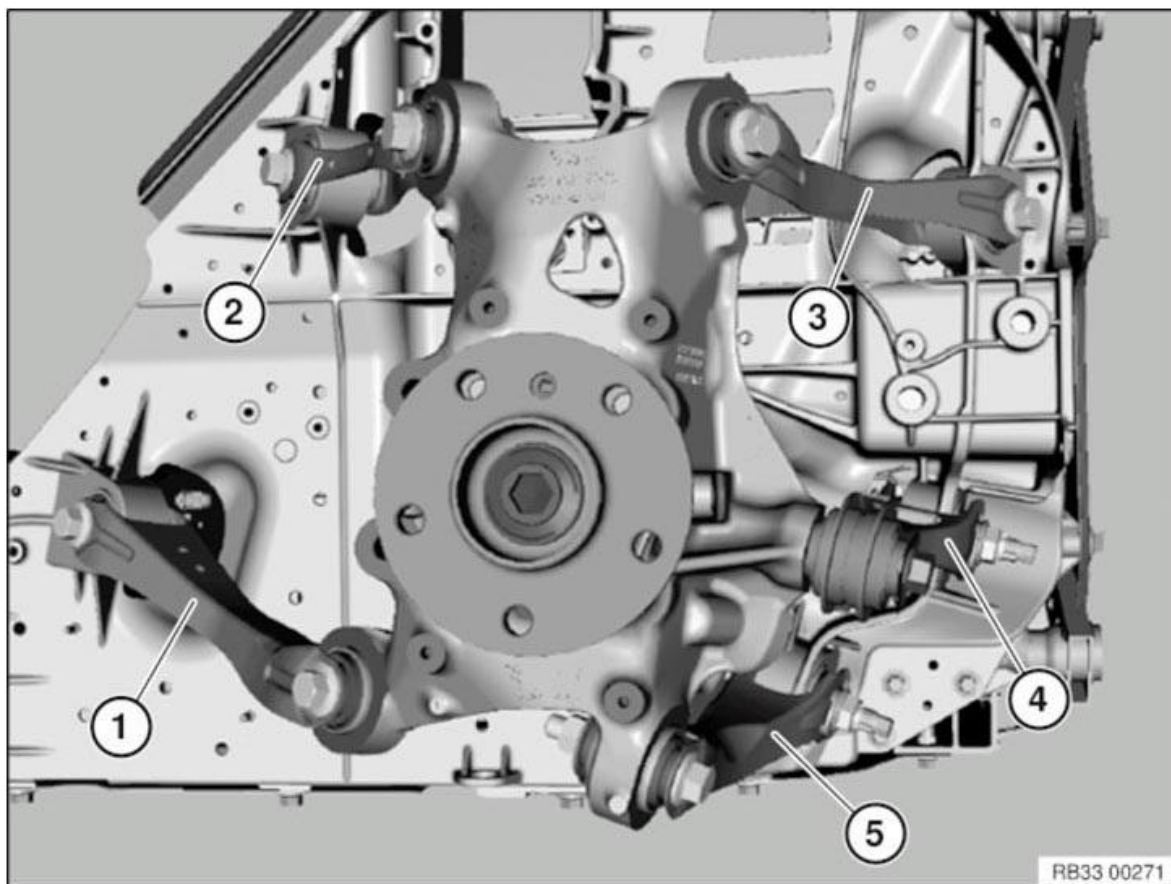
Tightening torque [33 41 1AZ](#) .

**After installation:**

- Check [OIL LEVEL IN TRANSMISSION](#) and top up if necessary.
- Carry out wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

## **CONTROL ARMS AND STRUTS**

### **33 32... OVERVIEW OF CONTROL ARM AND RELATED COMPONENTS**



- |                                  |                              |
|----------------------------------|------------------------------|
| 1 <a href="#">Trailing arm</a>   | 4 <a href="#">Toe arm</a>    |
| 2 <a href="#">Traction strut</a> | 5 <a href="#">Camber arm</a> |
| 3 <a href="#">Wishbone</a>       |                              |

**Fig. 20: Overview Of Control Arm And Related Components**

Courtesy of BMW OF NORTH AMERICA, INC.

### **33 32 077 REMOVING AND INSTALLING/REPLACING TOP RIGHT WISHBONE**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**Necessary preliminary tasks:**

- Remove [REAR WHEEL](#) .
- Remove rear part of [WHEEL ARCH PANEL](#) .

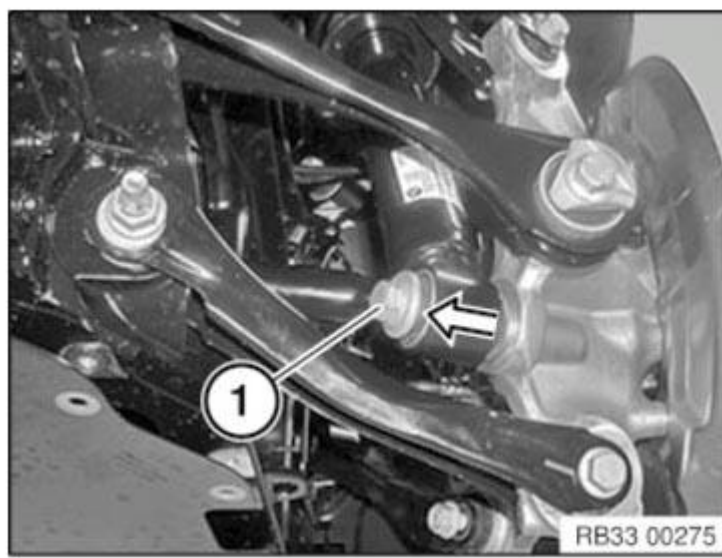
Release screw (1) from spring strut shock absorber on wheel carrier.

Tightening torque [33 52 3AZ](#) .

Release spring strut shock absorber from wheel carrier.

**IMPORTANT:** The wheel carrier is preloaded and moves up toward the normal position when the shock absorber is released.

*Installation note:*

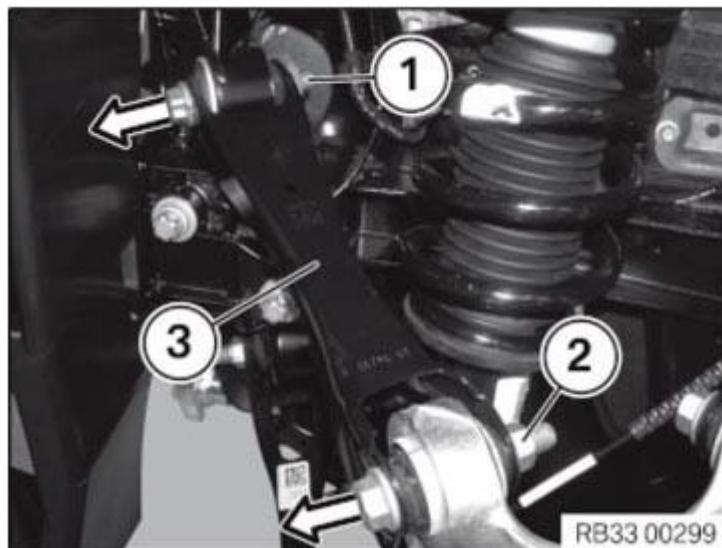


**Fig. 21: Removing Wheel Carrier Spring Strut Shock Absorber Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Recut thread on wheel carrier.

**NOTE:** From 02/2014 on, the nuts (1) and (2) are fixed tightly to the wishbone.

The screw connections are loosened and tightened via the screws.



**Fig. 22: Removing Wishbone Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque [33 32 5AZ](#) .

Slacken nut (2).

Tightening torque [33 32 6AZ](#) .

Unscrew bolts.

Remove wishbone (3).

*Installation note:*

Up to build date 02/2014: Replace nuts and screws.

Version from 02/2014: Replace screws.

Tighten wishbone in normal position.

*Installation note:*

**Adjusting normal position:**

**NOTE:** Spring strut shock absorber may still not be screwed with the wheel carrier.

Push wheel carrier up to dimension A with workshop jack.

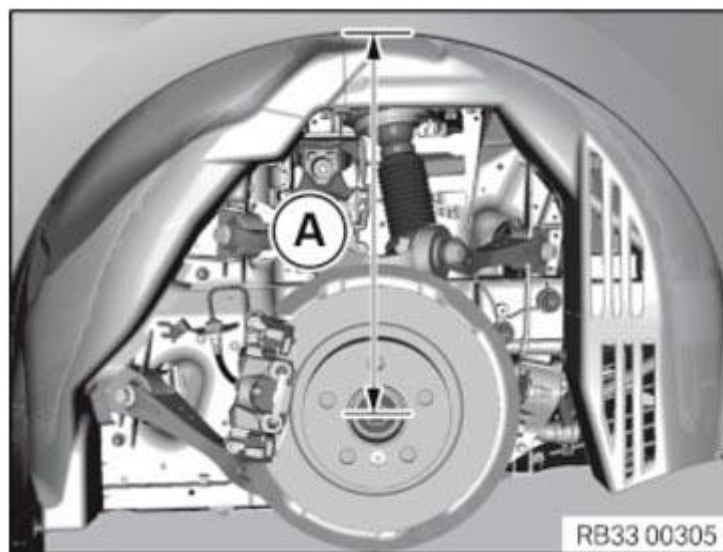
Dimension A = middle of wheel hub to upper edge of wheel arch

**Conventional chassis and suspension:**

A = 408 mm

**Threaded chassis (Japan):**

A = 378 mm



**Fig. 23: Identifying Wheel Hub Middle And Wheel Arch Upper Edge Dimension**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Replacement only: Perform wheel alignment check. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

### **33 32 131 REMOVING AND INSTALLING/REPLACING A WHEEL CARRIER**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**Necessary preliminary tasks:**

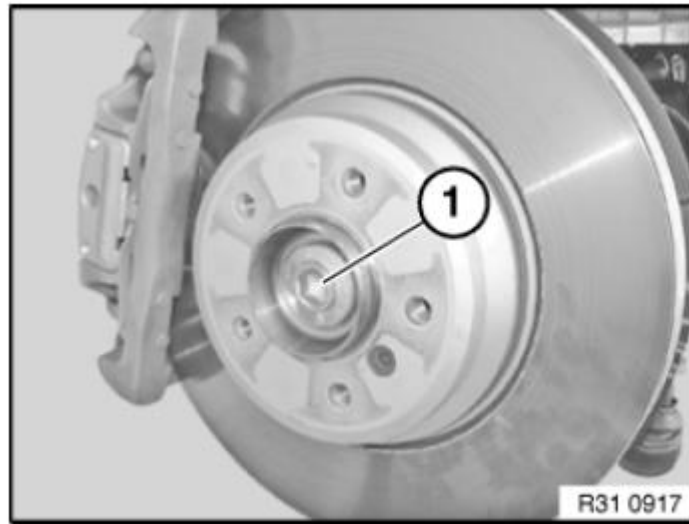
- Remove [REAR WHEEL](#) .

Release collar bolt (1), press brake pedal to floor for this purpose.

Tightening torque [33 41 1AZ](#) .

*Installation note:*

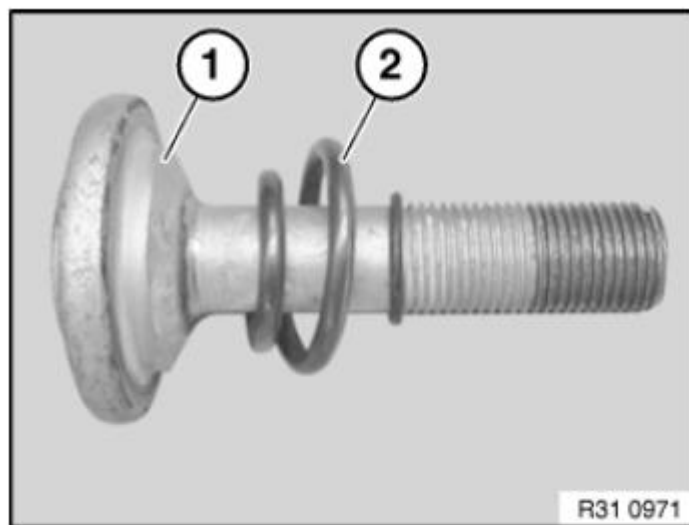
Replace the collar bolt.



**Fig. 24: Identifying Left Output Shaft Collar Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Replace collar bolt (1) and compression spring (2).
- Pay attention to installation position of compression spring (2).
- Keep collar bolt and spur toothing of bearing/propeller shaft clean and free of grease
- **Follow installation note of the spur gearing.**



**Fig. 25: Identifying Collar Bolt And Compression Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

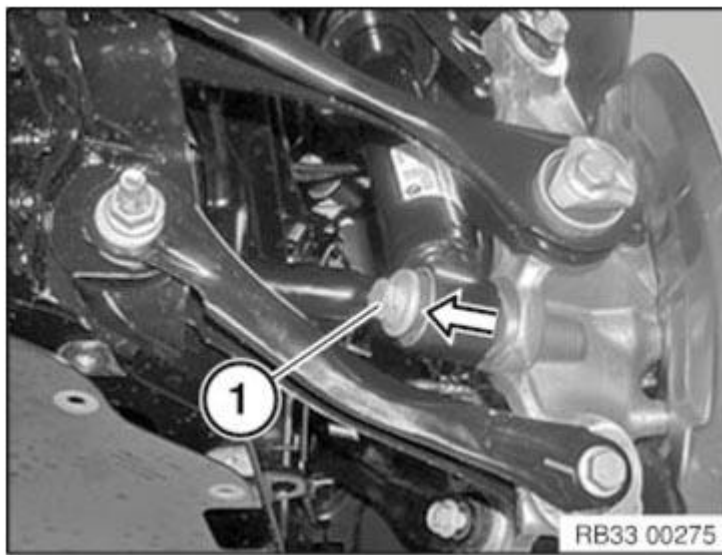
Release screw (1) from spring strut shock absorber on wheel carrier.

Tightening torque [33 52 3AZ](#) .

Release spring strut shock absorber from wheel carrier.

**IMPORTANT:** The wheel carrier is preloaded and moves up toward the normal position when the shock absorber is released.





**Fig. 26: Removing Spring Strut Shock Absorber Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Recut thread on wheel carrier.

- Remove **BRAKE DISC** .
- Remove **PULSE SENSOR FROM WHEEL CARRIER** .

IMPORTANT: • Check sensor head and line from pulse sensor prior to installation for external damage, replacing if necessary.

IMPORTANT: Secure wheel carrier against falling out.

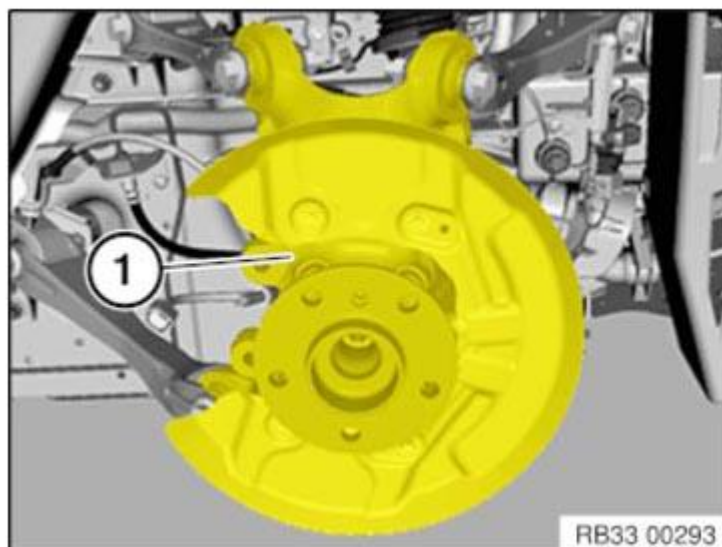
Loosen **TRAILING ARM** on wheel carrier.

Loosen **CONTROL ARM** on wheel carrier.

Loosen **CAMBER CONTROL ARM** on wheel carrier.

Remove **TRACK CONTROL ARM** from wheel carrier.

Release wishbone on wheel carrier. See **REPLACING TOP LEFT WISHBONE** or **REPLACING TOP RIGHT WISHBONE**.



**Fig. 27: Identifying Wheel Carrier**  
Courtesy of BMW OF NORTH AMERICA, INC.

Take off wheel carrier (1).

**Replacement:**

Remount **WHEEL BEARING**.

Remount **BRAKE ANCHOR PLATE/BRAKE GUARD PLATE**.

**After installation:**

- Carry out wheel alignment procedure. See **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)**.

**33 32 091 REMOVING AND INSTALLING/REPLACING CONTROL ARM**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**NOTE:** If the control arm is replaced, a wheel alignment must be performed after installation. See **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)**.

**Necessary preliminary tasks:**

- Remove **REAR WHEEL**.

Release spring strut shock absorber at wheel carrier.

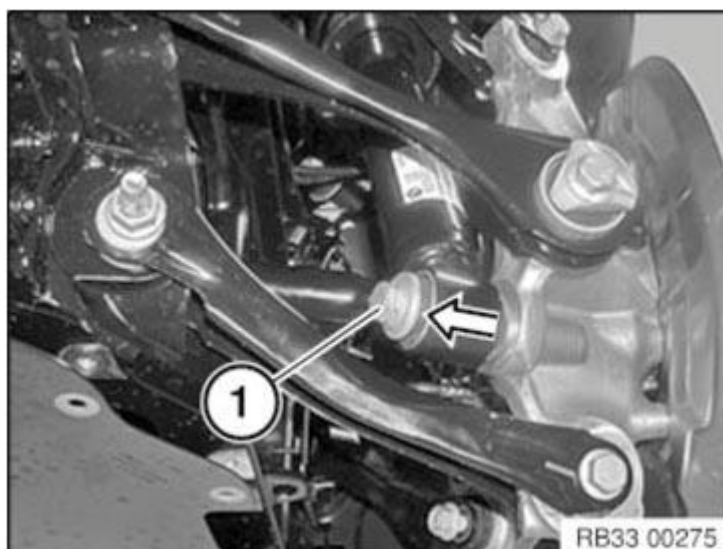
Tightening torque **33 52 3AZ**.

Release spring strut shock absorber from wheel carrier.

**IMPORTANT:** The wheel carrier is preloaded and moves up toward the normal position when the shock absorber is released.

*Installation note:*

Recut thread in wheel carrier.



**Fig. 28: Removing Spring Strut Shock Absorber Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unclip cables for wheel speed sensor (right: wheel speed sensor and brake pad wear sensor) at holder (3).

Slacken nut (1).

Tightening torque [33 32 4AZ](#) .

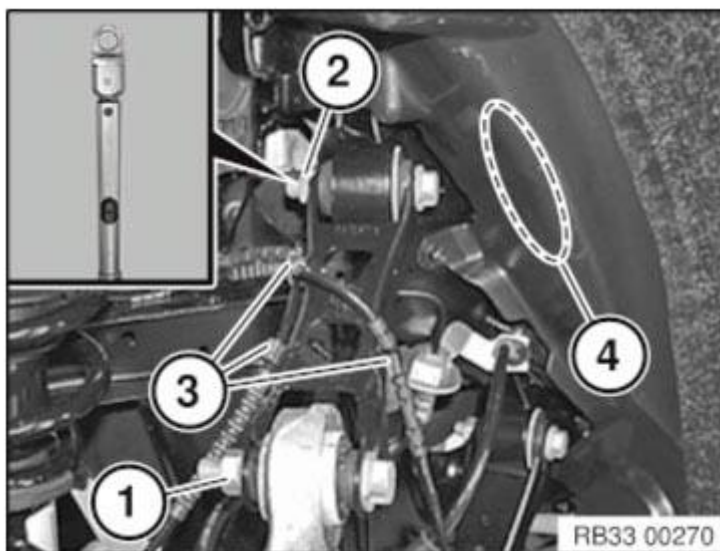
Pull out screw.

Slacken nut (2).

- Use torque wrench with ring spanner attachment.

Tightening torque [33 32 3AZ](#) .

Press wheel arch cover to one side in marked area (4).



**Fig. 29: Identifying Wheel Speed Sensor Holder, Nuts And Wheel Arch Cover Marked Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out screw.

Remove control arm.

*Installation note:*

Replace screws and nuts.

Tighten control arm in normal position!

*Installation note:*

**Adjusting normal position:**

**NOTE:** Spring strut shock absorber must not be installed yet.

Push wheel carrier up to dimension A with workshop jack.

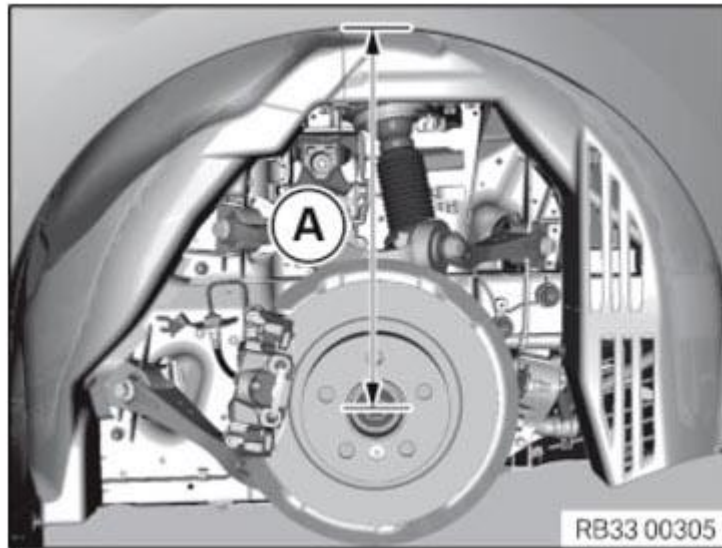
Dimension A = middle of wheel hub to upper edge of wheel arch

**Conventional chassis and suspension:**

A = 408 mm

## Threaded chassis (Japan):

A = 378 mm



**Fig. 30: Identifying Wheel Hub Middle And Wheel Arch Upper Edge Dimension**  
Courtesy of BMW OF NORTH AMERICA, INC.

Replacement only:

- Carry out wheel alignment procedure. See **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)** .

### **33 32 190 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT CAMBER ARM**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**NOTE:** A wheel alignment must be performed after installation. See **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)** .

Necessary preliminary tasks:

- Remove **REAR WHEEL** .

Release spring strut shock absorber at wheel carrier.

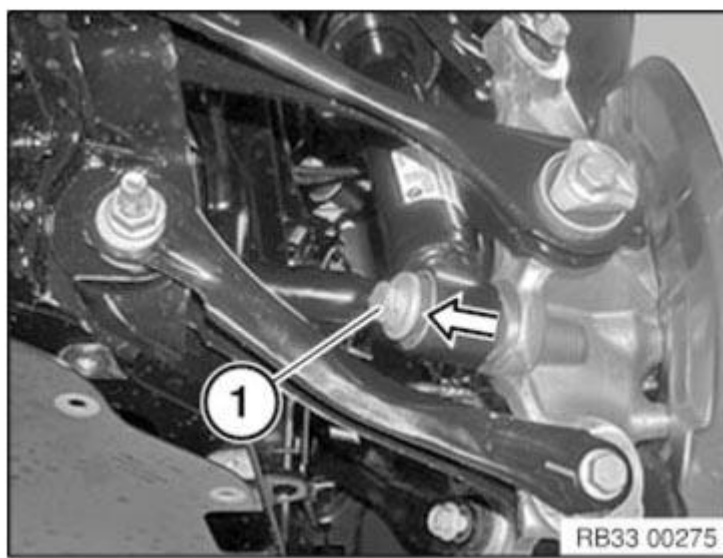
Tightening torque **33 52 3AZ** .

Release spring strut shock absorber from wheel carrier.

**IMPORTANT:** The wheel carrier is preloaded and moves up toward the normal position when the shock absorber is released.

*Installation note:*

Recut thread in wheel carrier.



**Fig. 31: Removing Spring Strut Shock Absorber Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Mark position of eccentric adjustment washer relative to rear axle module to simplify subsequent adjustment of rear axle.

Slacken nut (1).

Tightening torque [33 32 10AZ](#) .

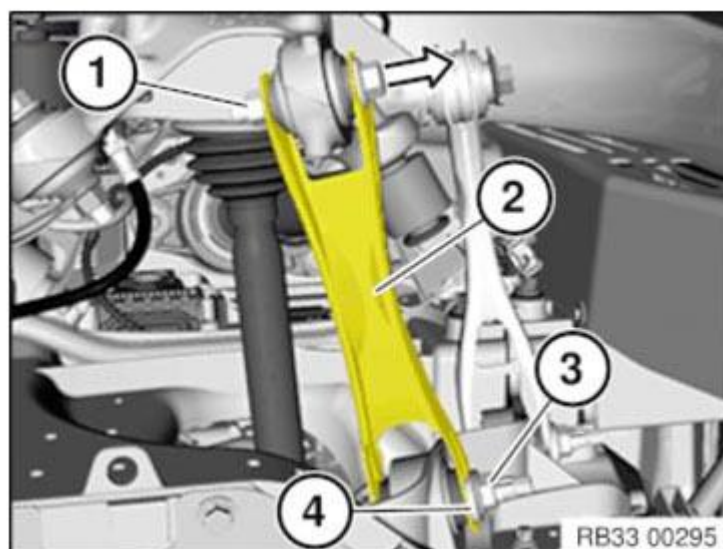
Pull out screw.

Unscrew nut (3).

Tightening torque [33 32 9AZ](#) .

Remove eccentric washer (4) and pull out screw.

Take off camber control arm (2).



**Fig. 32: Identifying Camber Control Arm, Eccentric Washer And Nuts**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace screws, eccentric washer and nuts.

Note direction of insertion of screw.



Tighten down screw connection in NORMAL POSITION .

**After installation:**

- Carry out wheel alignment procedure. See ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION or ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD) .

### 33 32 180 REMOVING AND INSTALLING/REPLACING LEFT OR RIGHT TOE ARM

**WARNING:** High-voltage system - danger to life

- Observe SAFETY INFORMATION for handling electric vehicles.

**NOTE:** If the toe arm is detached from the rear axle support/wheel carrier, it is necessary after installation to carry out a wheel alignment. See ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION or ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD) .

**Necessary preliminary tasks:**

- Remove REAR WHEEL .

Release spring strut shock absorber at wheel carrier.

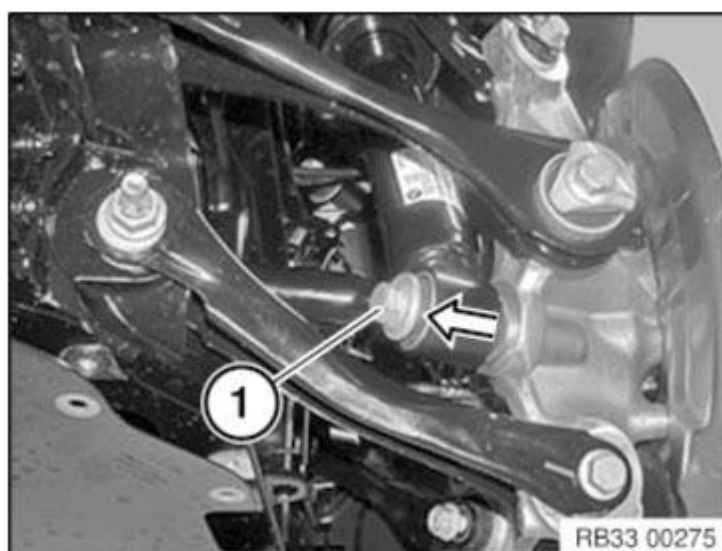
Tightening torque, 33 52 3AZ .

Release spring strut shock absorber from wheel carrier.

**IMPORTANT:** The wheel carrier is preloaded and moves up toward the normal position when the shock absorber is released.

*Installation note:*

Recut thread in wheel carrier.



**Fig. 33: Removing Wheel Carrier Spring Strut Shock Absorber Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

Slacken nut (2).

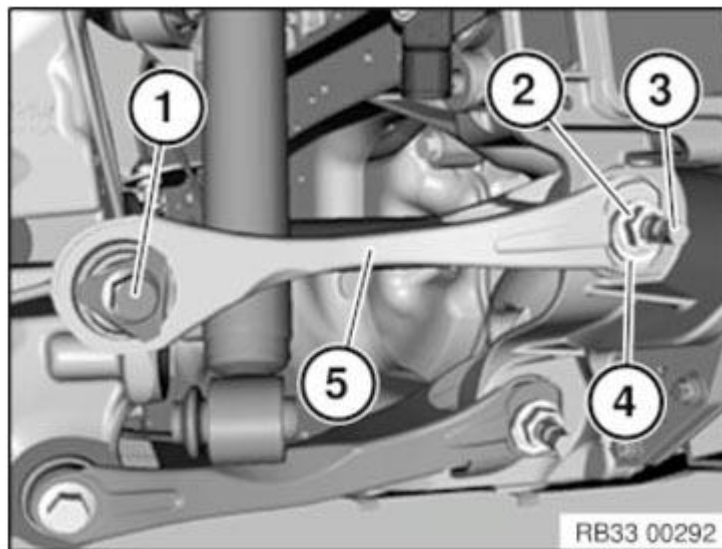
Unscrew bolt (3).



Remove track control arm (5).

*Installation note:*

Replace screw (1), nut (2), screw (3) and eccentric washer (4).



**Fig. 34: Identifying Track Control Arm, Eccentric Washer, Screws And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: You must observe the installation sequence and installation notes!

Failure to comply with these instructions may result in serious damage to the threads of the wheel carrier!

**Do not use an impact screwdriver!**

**Installation sequence:**

Firstly insert toe arm in axle support and do not screw!

Position new screw (1) on wheel carrier **by hand** .

- Twist toe arm a little so that screw (1) can be screwed in by hand without tension!

Insert new screw (3) into axle support.

Connect new eccentric washer (4) and screw on new nut (2).

**Only apply tightening force to both screw connections in normal position.**

Tightening torque [33 32 8AZ](#) .

Tightening torque [33 32 7AZ](#) .

**After installation:**

- Carry out wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

**33 32 076 REMOVING AND INSTALLING/REPLACING TOP LEFT WISHBONE**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**Necessary preliminary tasks:**

- Remove REAR WHEEL .
- Vehicles with range extender: Remove ENGINE COMPARTMENT FAN .
- Remove rear part of WHEEL ARCH PANEL AT REAR .

Release screw (1) from spring strut shock absorber on wheel carrier.

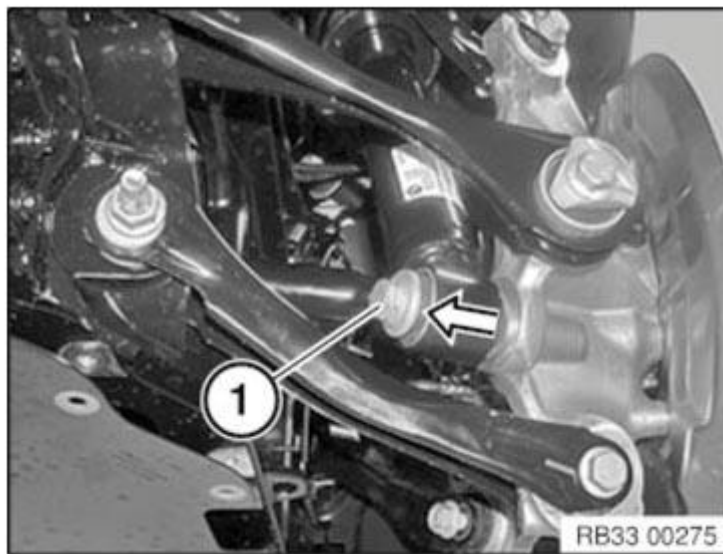
Tightening torque 33 52 3AZ .

Release spring strut shock absorber from wheel carrier.

**IMPORTANT:** The wheel carrier is preloaded and moves up toward the normal position when the shock absorber is released.

*Installation note:*

Recut thread on wheel carrier.

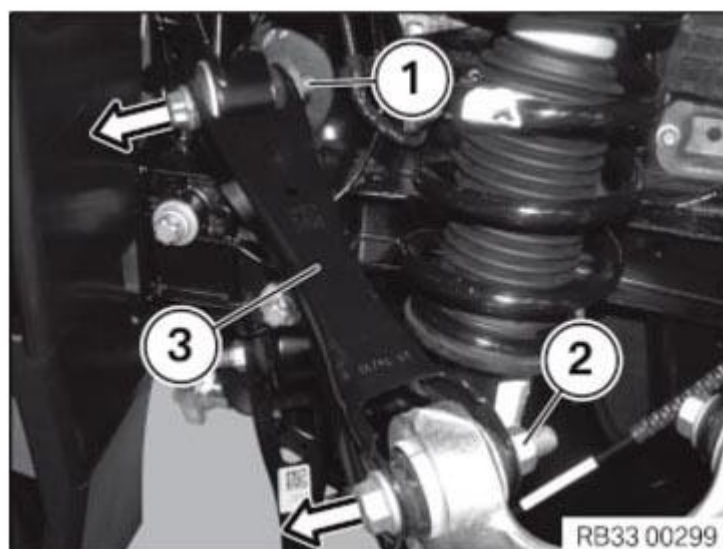


**Fig. 35: Removing Spring Strut Shock Absorber Screw**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** From 02/2014 on, the nuts (1) and (2) are fixed tightly to the wishbone.

The screw connections are loosened and tightened via the screws.



**Fig. 36: Removing Wishbone Nuts**

Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque [33 32 5AZ](#) .

Slacken nut (2).

Tightening torque [33 32 6AZ](#) .

Unscrew bolts.

Remove wishbone (3).

*Installation note:*

Up to build date 02/2014: Replace nuts and screws.

Version from 02/2014: Replace screws.

Tighten wishbone in normal position.

*Installation note:*

**Adjusting normal position:**

**NOTE:** Spring strut shock absorber must not be installed yet.

Push wheel carrier up to dimension A with workshop jack.

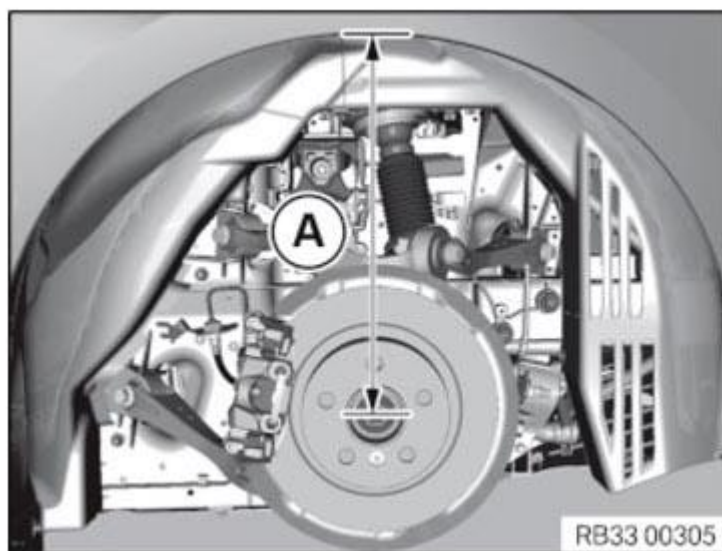
Dimension A = middle of wheel hub to upper edge of wheel arch

**Conventional chassis and suspension:**

A = 408 mm

**Threaded chassis (Japan):**

A = 378 mm



**Fig. 37: Identifying Wheel Hub Middle And Wheel Arch Upper Edge Dimension**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Replacement only: Carry out wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

**Necessary preliminary tasks:**

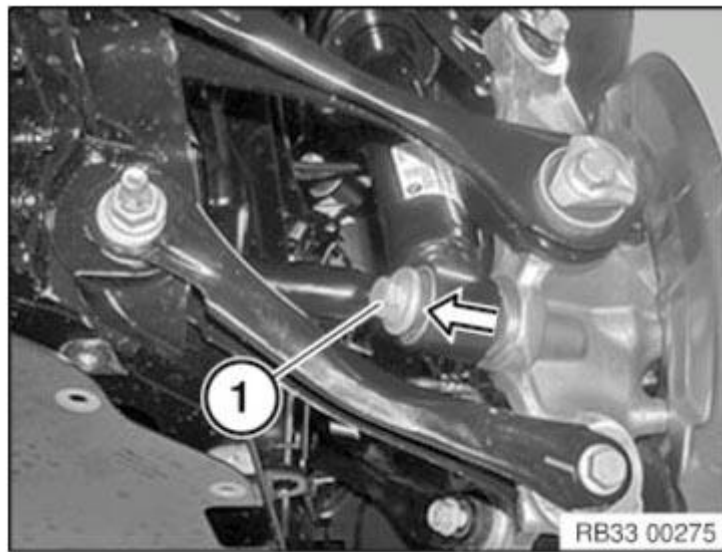
- Remove [REAR WHEEL](#) .

Release spring strut shock absorber at wheel carrier.

Tightening torque, [33 52 3AZ](#) .

Release spring strut shock absorber from wheel carrier.

**IMPORTANT:** The wheel carrier is preloaded and moves up toward the normal position when the shock absorber is released.



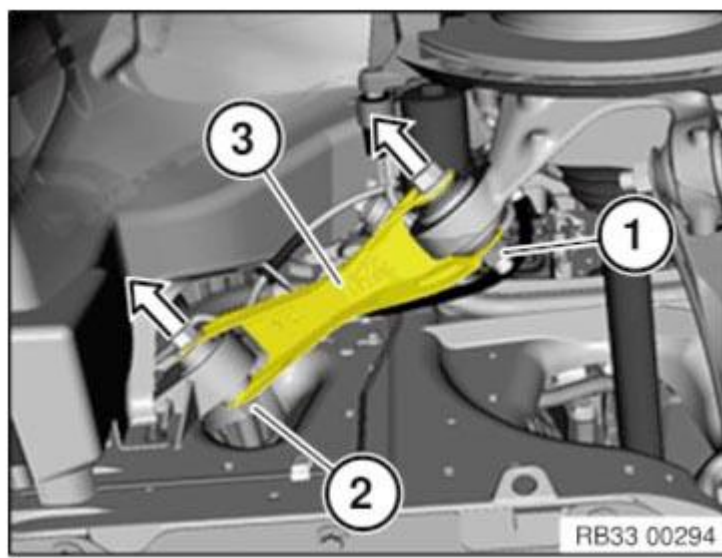
**Fig. 38: Removing Wheel Carrier Spring Strut Shock Absorber Screw**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Recut thread in wheel carrier.

**NOTE:** From 02/2014 on, the nuts (1) and (2) are fixed tightly to the wishbone.

The screw connections are loosened and tightened via the screws.



**Fig. 39: Removing Trailing Arm Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slacken nut (1).

Tightening torque [33 32 2AZ](#) .

Pull out screw.

Slacken nut (2).

Tightening torque [33 32 1AZ](#) .

Pull out screw.

Remove trailing arm (3).

*Installation note:*

Up to build date 02/2014: Replace nuts and screws.

Version from 02/2014: Replace screws.

The trailing arm must be installed with the opening (U-section) facing downward!

Note direction of insertion of screw.

Tighten screw connections in [NORMAL POSITION](#) .

*Installation note:*

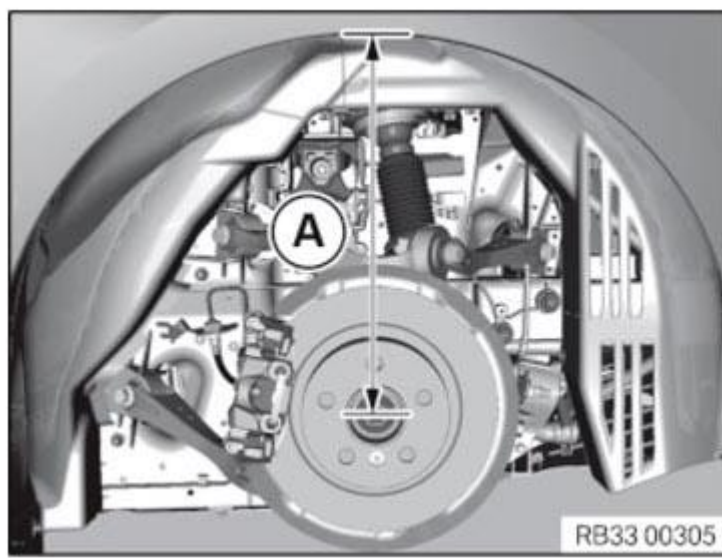
**Adjusting normal position:**

**NOTE:** Spring strut shock absorber may still not be screwed with the wheel carrier.

Push wheel carrier up to dimension A with workshop jack.

Dimension A = middle of wheel hub to upper edge of wheel arch

**Conventional chassis and suspension:**



**Fig. 40: Identifying Wheel Hub Middle And Wheel Arch Upper Edge Dimension**  
Courtesy of BMW OF NORTH AMERICA, INC.

A = 408 mm

**Threaded chassis (Japan):**

A = 378 mm

### **33 32 268 REPLACING RUBBER MOUNT FOR CAMBER CONTROL ARM IN REAR AXLE MODULE**

**Special tools required:**

- [2 355 442](#)
- [2 355 439](#)
- [2 355 246](#)
- [2 355 436](#)
- [2 355 435](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**IMPORTANT:** It is absolutely essential to make sure that the rubber mount in the rear axle module is only replaced four times.

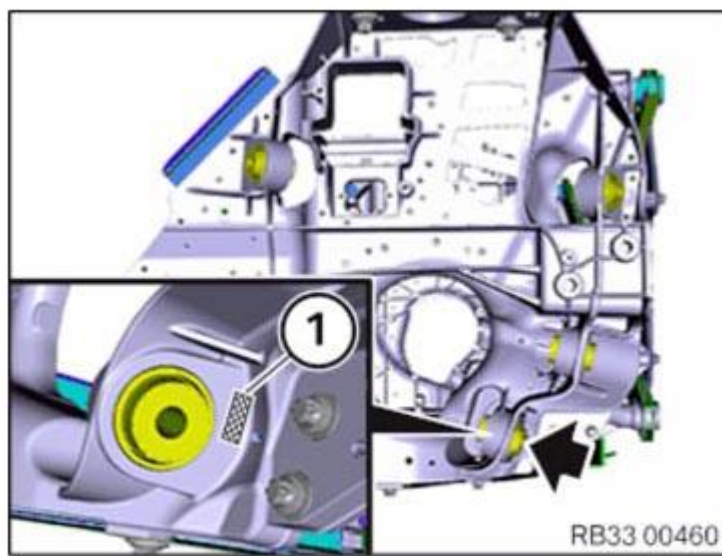
**Necessary preliminary work:**

- Remove [CAMBER ARM](#).

**IMPORTANT:** If the hatched area (1) on the rear axle module already has four identifying punch marks, the rear axle module must be replaced.

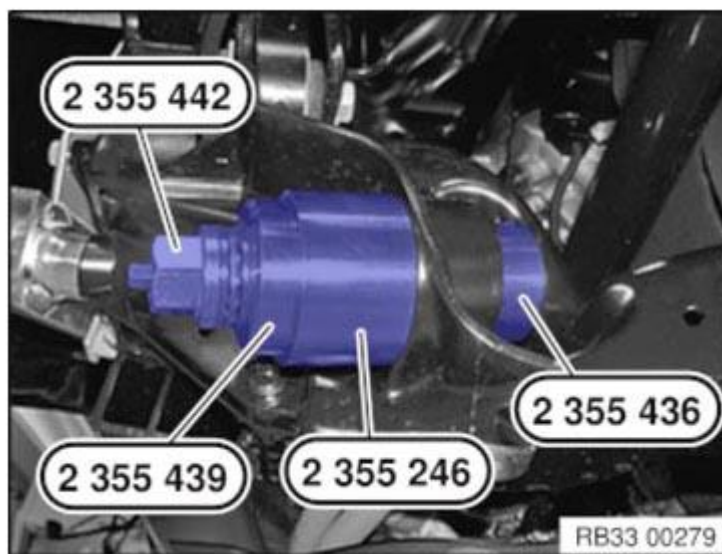
Mark the rear axle module by means of a punch mark in the hatched area (1).





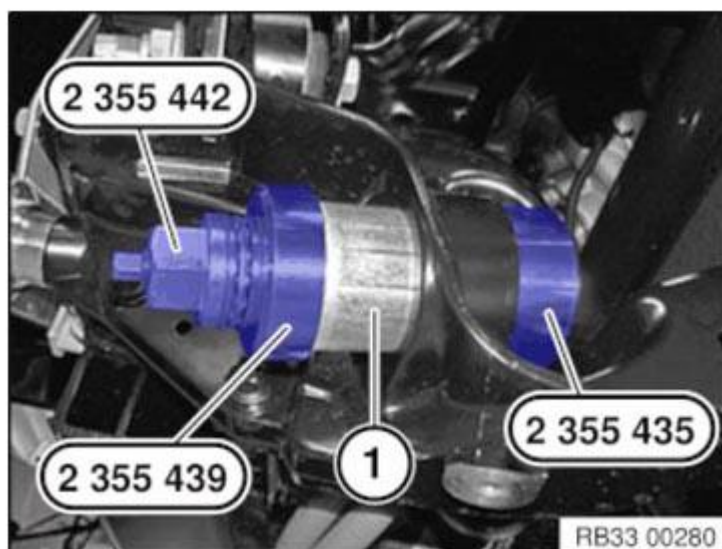
**Fig. 41: Identifying Rear Axle Module Hatched Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out rubber mount with special tools [2 355 442](#) , [2 355 439](#) , [2 355 246](#) and [2 355 436](#) .



**Fig. 42: Removing Rubber Mounts Using Special Tools**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install rubber mount (1) with special tools [2 355 442](#) , [2 355 439](#) , and [2 355 435](#) to the limit position.



**Fig. 43: Installing Rubber Mounts Using Special Tools**  
Courtesy of BMW OF NORTH AMERICA, INC.

After installation:

- Carry out wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#).

### 33 32 256 REPLACING RUBBER MOUNT FOR CAMBER CONTROL ARM IN WHEEL CARRIER

Special tools required:

- [2 355 442](#)
- [2 355 440](#)
- [2 355 246](#)
- [2 355 436](#)
- [2 355 435](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

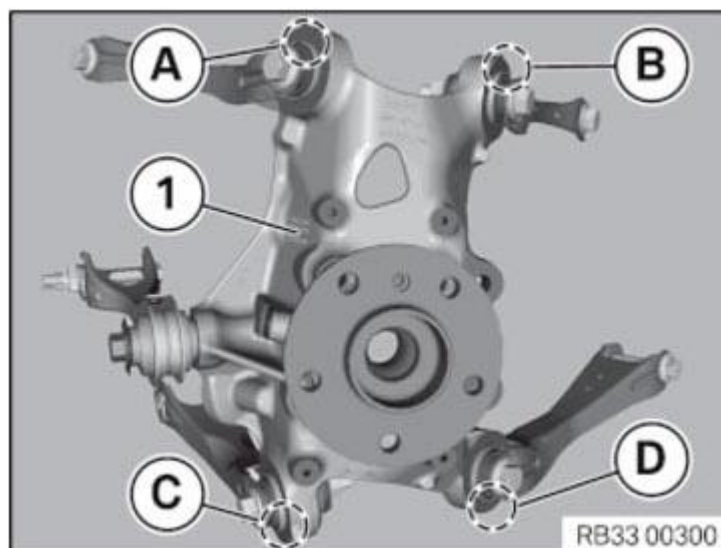
IMPORTANT: Note that the rubber mounts in the wheel carrier may only be changed once.

Necessary preliminary tasks:

- Remove [CAMBER ARM](#).

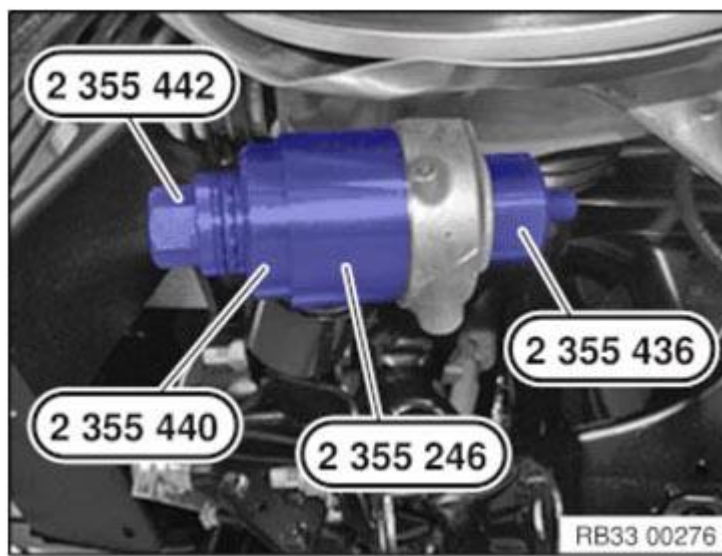
IMPORTANT: If the wheel carrier already features an identification mark with a center punch in area (C), it is necessary to replace the wheel carrier (1).

Mark wheel carrier (1) with a punch mark in area (C) (outer end face, 90° to direction of arm).



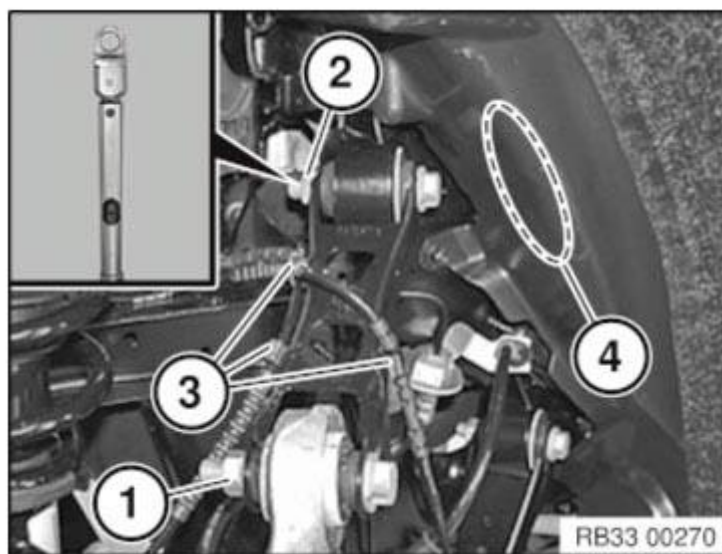
**Fig. 44: Identifying Wheel Carrier Punch Areas**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out rubber mount with special tools [2 355 442](#) , [2 355 440](#) , [2 355 246](#) and [2 355 436](#) .



**Fig. 45: Removing Rubber Mount Using Special Tools**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Install rubber mount (1) with special tools [2 355 442](#) , [2 355 440](#) , and [2 355 435](#) to the limit position.



**Fig. 46: Identifying Wheel Speed Sensor Holder, Nuts And Wheel Arch Cover Marked Area**  
 Courtesy of BMW OF NORTH AMERICA, INC.

After installation:

- Carry out wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#) .

**33 32 262 REPLACING RUBBER MOUNT FOR CONTROL ARM IN REAR AXLE MODULE**

Special tools required:

- [2 355 442](#)
- [2 355 246](#)
- [2 355 439](#)
- [2 355 436](#)
- [2 355 435](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

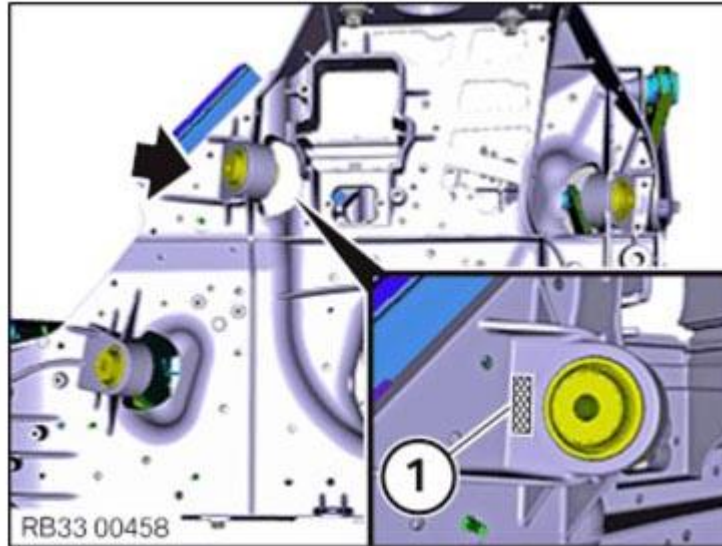
**IMPORTANT:** It is absolutely essential to make sure that the rubber mount in the rear axle module is only replaced four times.

**Necessary preliminary work:**

- Remove **CONTROL ARM**.
- Remove **REAR WHEEL ARCH PANEL** (front section only).

**IMPORTANT:** If the hatched area (1) on the rear axle module already has four identifying punch marks, the rear axle module must be replaced.

Mark the rear axle module by means of a punch mark in the hatched area (1).



**Fig. 47: Identifying Rear Axle Module Hatched Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out rubber joint with special tools [2 355 442](#) , [2 355 246](#) , [2 355 439](#) and [2 355 436](#) .



**Fig. 48: Removing Rubber Joint Using Special Tools**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install new rubber joint (1) with special tools [2 355 442](#) , [2 355 439](#) and [2 355 435](#) to the limit position.





**Fig. 49: Installing Rubber Mount Using Special Tools**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**33 32 250 REPLACING RUBBER MOUNT FOR CONTROL ARM IN WHEEL CARRIER**

Special tools required:

- [2 355 442](#)
- [2 355 441](#)
- [2 355 246](#)
- [2 355 438](#)
- [2 355 626](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

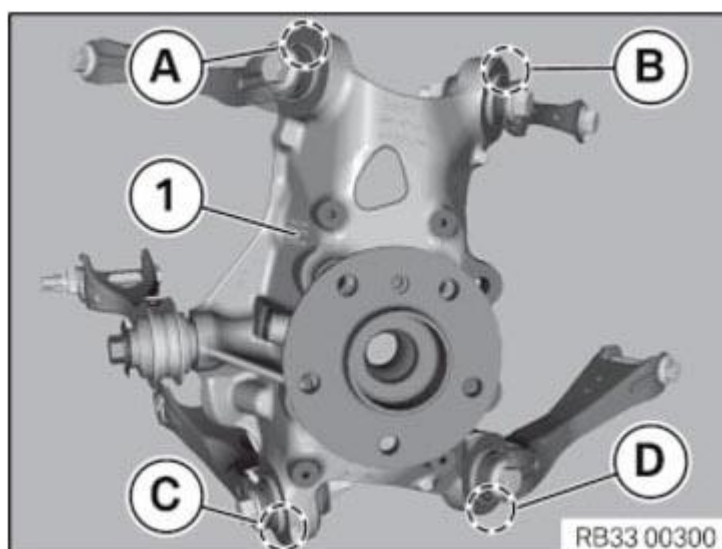
IMPORTANT: Note that the rubber mounts in the wheel carrier may only be changed once.

Necessary preliminary tasks:

- Remove [CONTROL ARM](#).

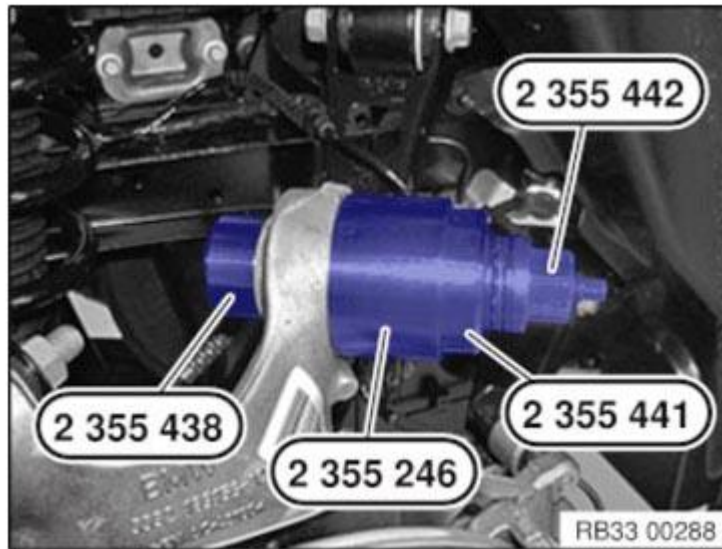
IMPORTANT: The wheel carrier must be replaced if an identification made by using a center punch is present on the wheel carrier in area (B)!

Mark wheel carrier by using a punch mark at area (B) (outer end face, 90° to steering direction).



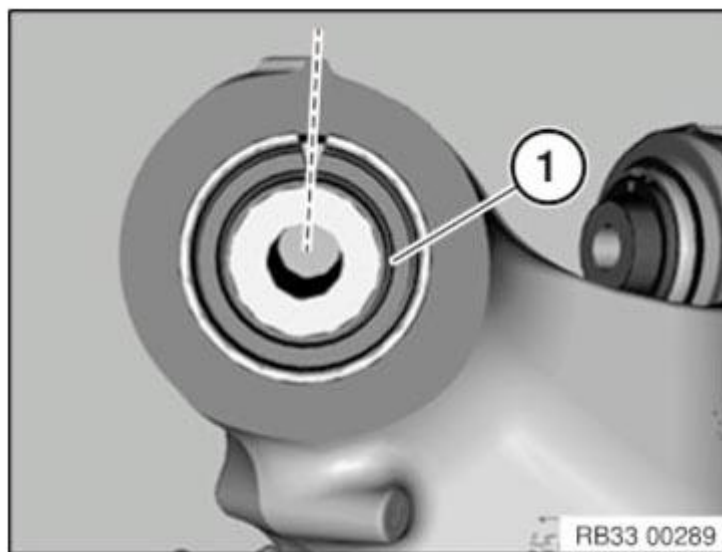
**Fig. 50: Identifying Wheel Carrier Punch Areas**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out rubber mount with special tools [2 355 442](#) , [2 355 441](#) , [2 355 246](#) and [2 355 438](#) .



**Fig. 51: Removing Rubber Mount Using Special Tools**  
Courtesy of BMW OF NORTH AMERICA, INC.

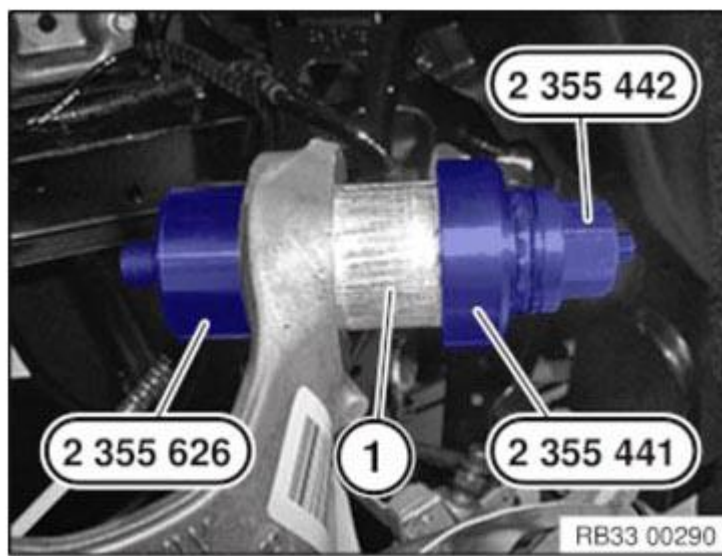
Align rubber mount (1).



**Fig. 52: Identifying Rubber Mount Alignment**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install rubber mount (1) with special tools [2 355 442](#) , [2 355 441](#) , and [2 355 626](#) to the limit position.





**Fig. 53: Installing Rubber Mount Using Special Tools**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### 33 32 264 REPLACING RUBBER MOUNT FOR LEFT WISHBONE IN REAR AXLE MODULE

**Special tools required:**

- [2 355 442](#)
- [2 355 439](#)
- [2 355 246](#)
- [2 355 436](#)
- [2 355 435](#)

**WARNING:** High-voltage system - danger to life

- Observe the [SAFETY INFORMATION](#) for working with electric vehicles.

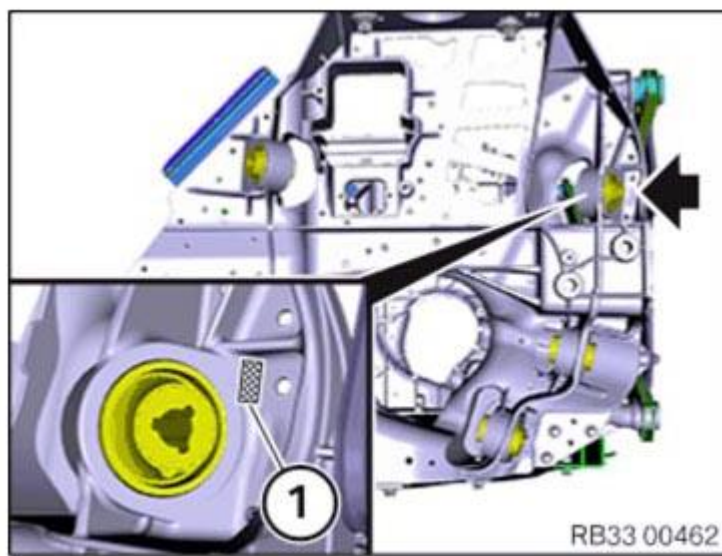
**IMPORTANT:** It is absolutely essential to make sure that the rubber mount in the rear axle module is only replaced four times.

**Necessary preliminary work:**

- Vehicles with range extender: Remove [ENGINE COMPARTMENT FAN](#) .
- Remove rear part of [WHEEL ARCH PANEL AT REAR](#) .
- Remove [WISHBONE](#).

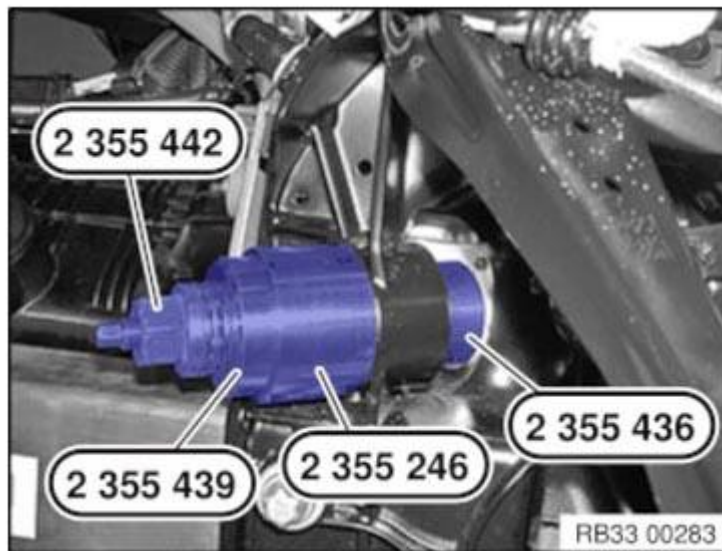
**IMPORTANT:** If the hatched area (1) on the rear axle module already has four identifying punch marks, the rear axle module must be replaced.

Mark the rear axle module by means of a punch mark in the hatched area (1).



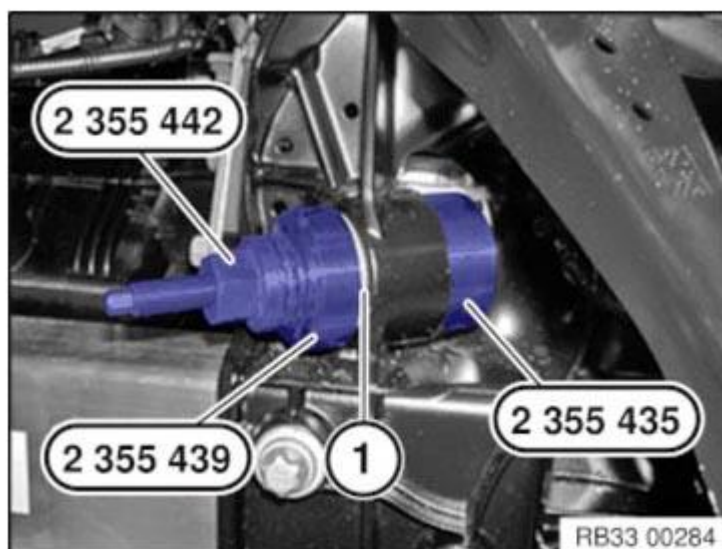
**Fig. 54: Identifying Rear Axle Module Hatched Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out rubber mount with special tools [2 355 442](#) , [2 355 439](#) , [2 355 246](#) and [2 355 436](#) .



**Fig. 55: Removing Rubber Mount Using Special Tools**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install rubber mount (1) with special tools [2 355 442](#) , [2 355 439](#) , and [2 355 435](#) to the limit position.



### **33 32 265 REPLACING RUBBER MOUNT FOR RIGHT WISHBONE IN REAR AXLE MODULE**

**Special tools required:**

- [2 355 442](#)
- [2 355 439](#)
- [2 355 246](#)
- [2 355 436](#)
- [2 355 435](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

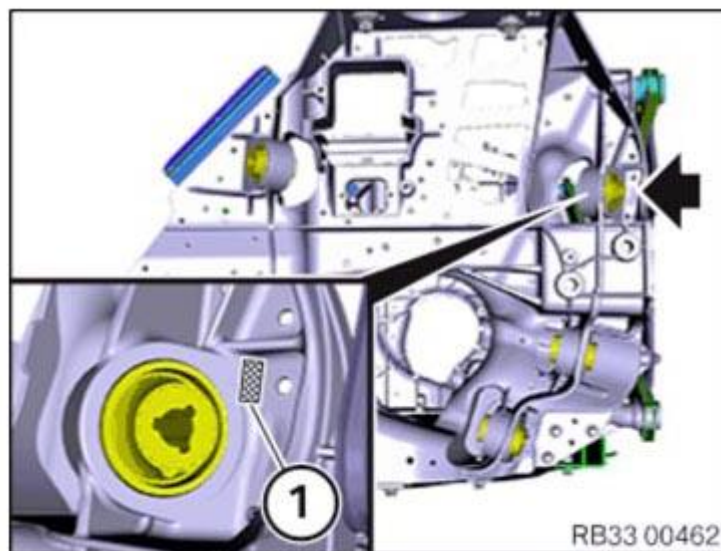
**IMPORTANT:** It is absolutely essential to make sure that the rubber mount in the rear axle module is only replaced four times.

**Necessary preliminary work:**

- Remove rear section of [REAR WHEEL ARCH PANEL](#) .
- Remove [WISHBONE](#).

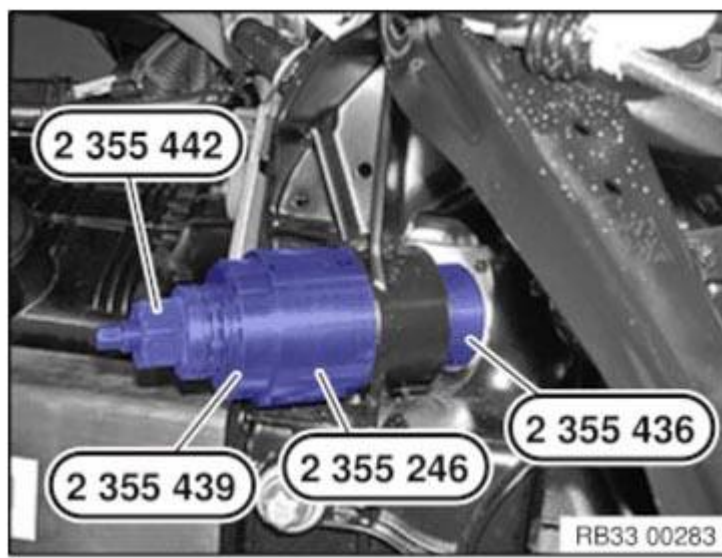
**IMPORTANT:** If the hatched area (1) on the rear axle module already has four identifying punch marks, the rear axle module must be replaced.

Mark the rear axle module by means of a punch mark in the hatched area (1).



**Fig. 57: Identifying Rear Axle Module Hatched Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

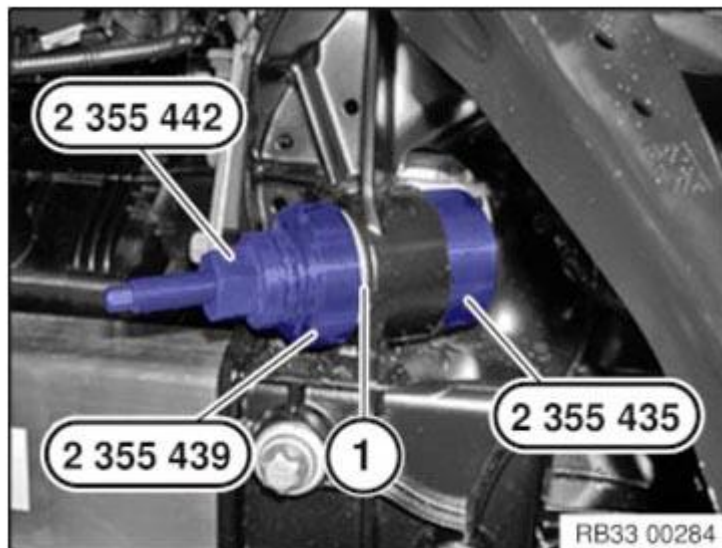
Pull out rubber mount with special tools [2 355 442](#) , [2 355 439](#) , [2 355 246](#) and [2 355 436](#) .



**Fig. 58: Removing Rubber Mount Using Special Tools**

Courtesy of BMW OF NORTH AMERICA, INC.

Pull on new rubber mount (1) with special tools [2 355 442](#) , [2 355 439](#) and [2 355 435](#) up to limit position.



**Fig. 59: Pulling Rubber Mount Using Special Tools**

Courtesy of BMW OF NORTH AMERICA, INC.

### **33 32 266 REPLACING RUBBER MOUNT FOR TRACK CONTROL ARM IN REAR AXLE MODULE**

Special tools required:

- [2 355 442](#)
- [2 355 439](#)
- 2 355 346
- [2 355 436](#)
- [2 355 435](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**IMPORTANT:** It is absolutely essential to make sure that the rubber mount in the rear axle module is only replaced four times.

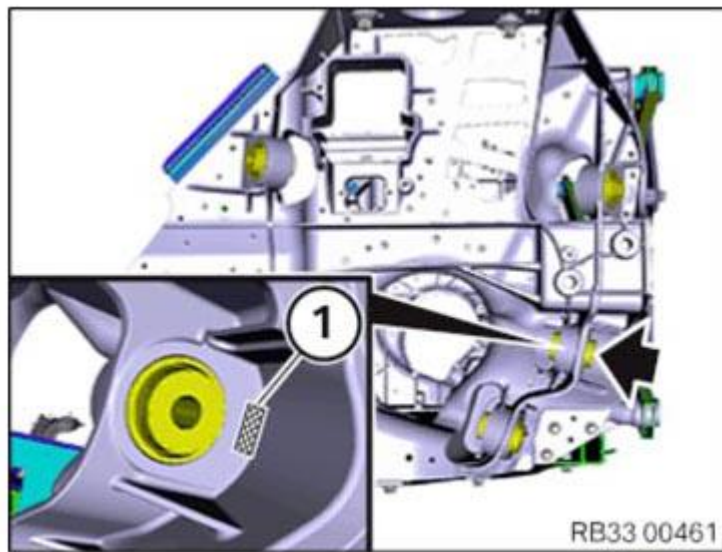


**Necessary preliminary work:**

- Remove **TRACK CONTROL ARM**.

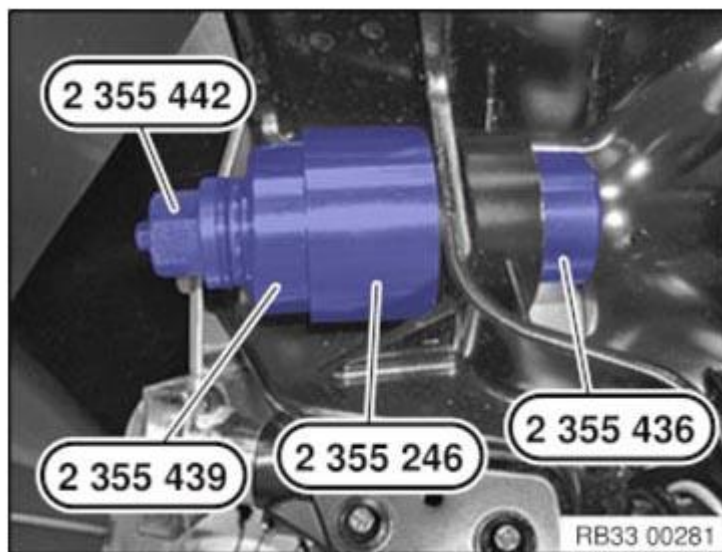
**IMPORTANT:** If the hatched area (1) on the rear axle module already has four identifying punch marks, the rear axle module must be replaced.

Mark the rear axle module by means of a punch mark in the hatched area (1).



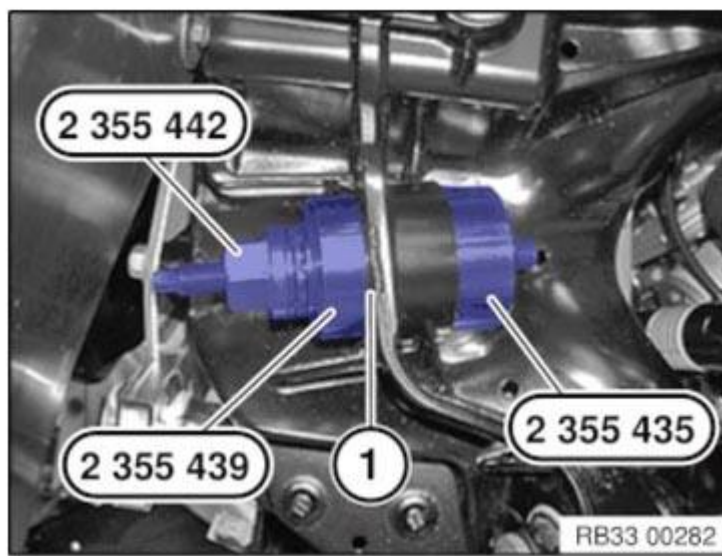
**Fig. 60: Identifying Rear Axle Module Track Control Arm Hatched Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out rubber mount with special tools [2 355 442](#) , [2 355 439](#) , 2 355 346 and [2 355 436](#) .



**Fig. 61: Removing Rubber Mount Using Special Tools**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install rubber mount (1) with special tools [2 355 442](#) , [2 355 439](#) , and [2 355 435](#) to the limit position.



**Fig. 62: Installing Rubber Mount Using Special Tools**  
 Courtesy of BMW OF NORTH AMERICA, INC.

After installation:

- Carry out wheel alignment procedure. See [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#).

### 33 32 260 REPLACING RUBBER MOUNT FOR TRAILING ARM IN REAR AXLE MODULE

**Special tools required:**

- [2 355 442](#)
- [2 355 246](#)
- [2 355 439](#)
- [2 355 436](#)
- [2 355 435](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**IMPORTANT:** It is absolutely essential to make sure that the rubber mount in the rear axle module is only replaced four times.

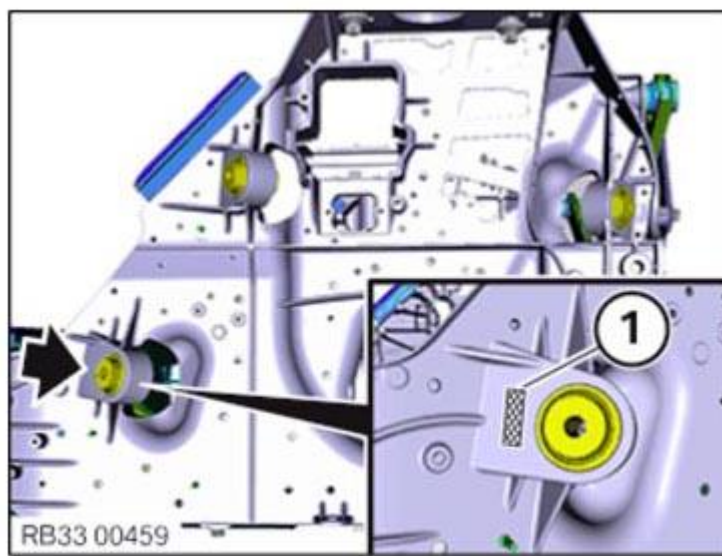
**Necessary preliminary work:**

- Remove [TRAILING ARM](#).
- Remove [REAR WHEEL ARCH PANEL](#) (front section only).

**IMPORTANT:** If the hatched area (1) on the rear axle module already has four identifying punch marks, the rear axle module must be replaced.

Mark the rear axle module by means of a punch mark in the hatched area (1).





**Fig. 63: Identifying Rear Axle Module Trailing Arm Hatched Area**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull out rubber mount with special tools [2 355 442](#) , [2 355 246](#) , [2 355 439](#) and [2 355 436](#) .



**Fig. 64: Pulling Rubber Mount Using Special Tools**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Pull on new rubber mount (1) with special tools [2 355 442](#) , [2 355 439](#) and [2 355 435](#) up to limit position.



### 33 32 255 REPLACING RUBBER MOUNT FOR TRAILING ARM IN WHEEL CARRIER

Special tools required:

- [2 355 442](#)
- [2 355 440](#)
- [2 355 246](#)
- [2 355 436](#)
- [2 355 435](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

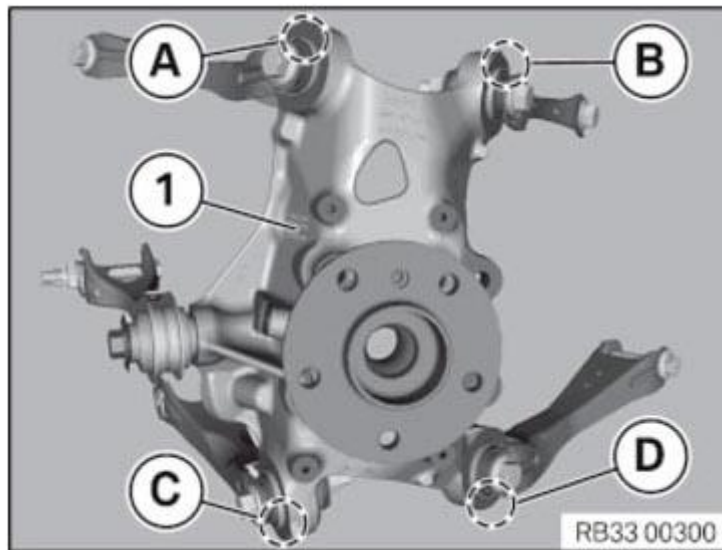
IMPORTANT: Note that the rubber mounts in the wheel carrier may only be changed once.

Necessary preliminary tasks:

- Remove [TRAILING ARM](#).

IMPORTANT: If the wheel carrier already features an identification mark with a center punch in area (D), it is necessary to replace the wheel carrier.

Mark wheel carrier with a punch mark in area (D) (outer end face, 90° to direction of arm).



**Fig. 66: Identifying Wheel Carrier Punch Areas**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull out rubber mount with special tools [2 355 442](#) , [2 355 440](#) , [2 355 246](#) and [2 355 436](#) .



**Fig. 67: Removing Rubber Mount Using Special Tools**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Install rubber mount (1) with special tools [2 355 442](#) , [2 355 440](#) , and [2 355 435](#) to the limit position.



**Fig. 68: Pulling Rubber Mount Using Special Tools**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **33 32 251 REPLACING RUBBER MOUNT FOR WISHBONE IN WHEEL CARRIER**

Special tools required:

- [2 355 442](#)
- [2 355 441](#)
- [2 355 246](#)
- [2 355 438](#)
- [2 355 626](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

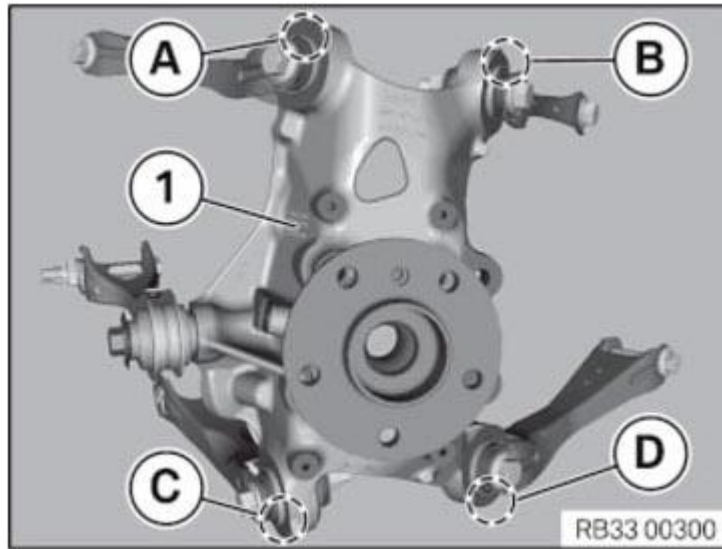
IMPORTANT: Note that the rubber mounts in the wheel carrier may only be changed once.

Necessary preliminary tasks:

- Remove wishbone. See [REPLACING TOP LEFT WISHBONE](#) or [REPLACING TOP RIGHT WISHBONE](#).

**IMPORTANT:** If the wheel carrier already features an identification mark with a center punch in area (A), it is necessary to replace the wheel carrier.

Mark wheel carrier with a punch mark in area (A) (outer end face, 90° to direction of arm).



**Fig. 69: Identifying Wheel Carrier Punch Areas**  
Courtesy of BMW OF NORTH AMERICA, INC.

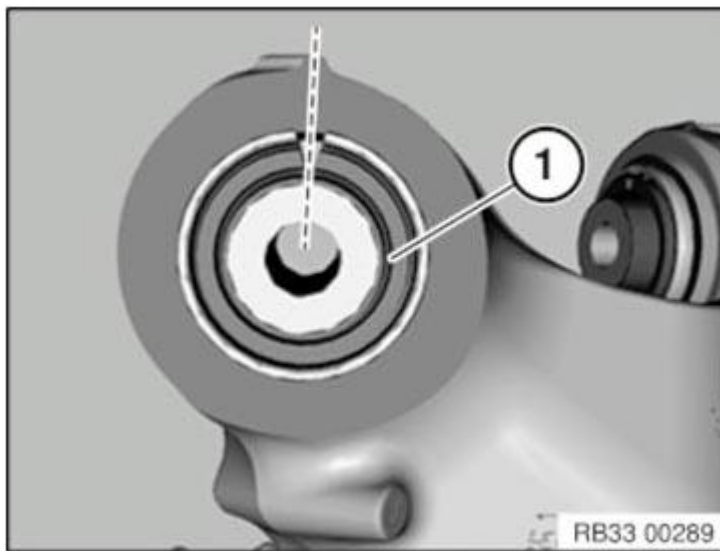
Pull out rubber mount with special tools [2 355 442](#) , [2 355 441](#) , [2 355 246](#) and [2 355 438](#) .



**Fig. 70: Pulling Rubber Mount Using Special Tools**  
Courtesy of BMW OF NORTH AMERICA, INC.

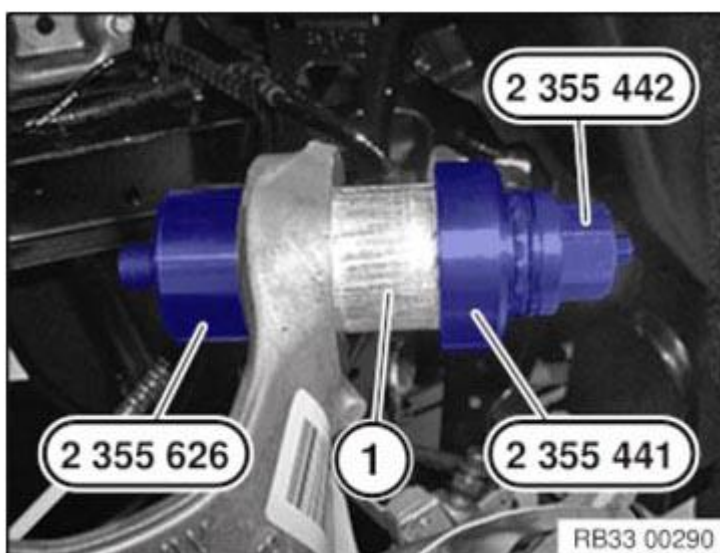
Align rubber mount (1).





**Fig. 71: Identifying Rubber Mount Alignment**  
Courtesy of BMW OF NORTH AMERICA, INC.

Install rubber mount (1) with special tools [2 355 442](#) , [2 355 441](#) , and [2 355 626](#) to the limit position.



**Fig. 72: Installing Rubber Mount Using Special Tools**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **33 41 151 REMOVING AND INSTALLING/REPLACING WHEEL BEARING OF REAR AXLE SHAFT ON THE LEFT OR RIGHT**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

Necessary preliminary tasks:

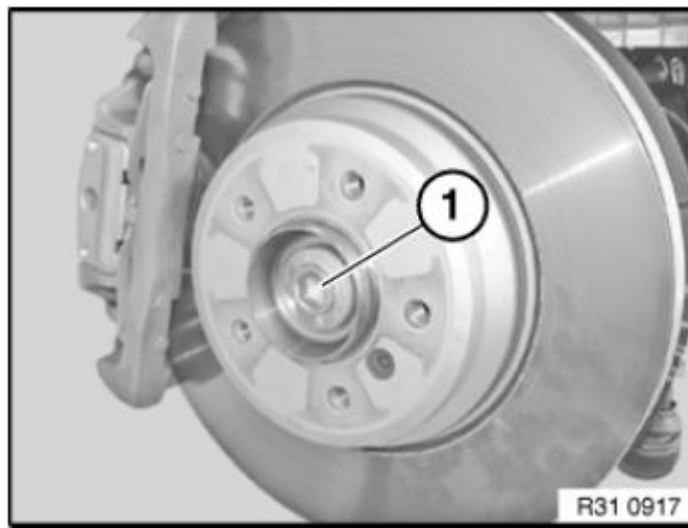
- Remove [REAR WHEEL](#) .

Release collar bolt (1), press brake pedal to floor for this purpose.

Tightening torque [33 41 1AZ](#) .

*Installation note:*

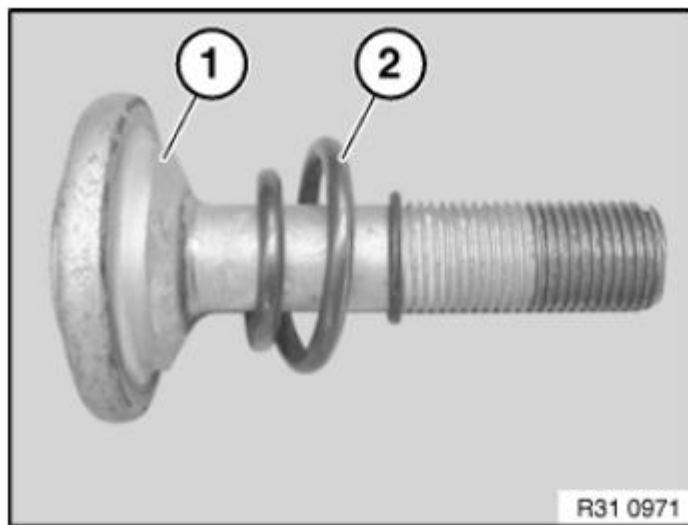
Replace screw.



**Fig. 73: Identifying Left Output Shaft Collar Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

- Replace collar bolt (1) and compression spring (2).
- Pay attention to installation position of compression spring (2).
- Keep collar bolt and spur gearing of wheel bearing/output shaft clean and free from grease
- **Follow installation note of the spur gearing.**



**Fig. 74: Identifying Collar Bolt And Compression Spring**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Remove **BRAKE DISC** .

Loosen screws (1).

Tightening torque **33 41 2AZ** .

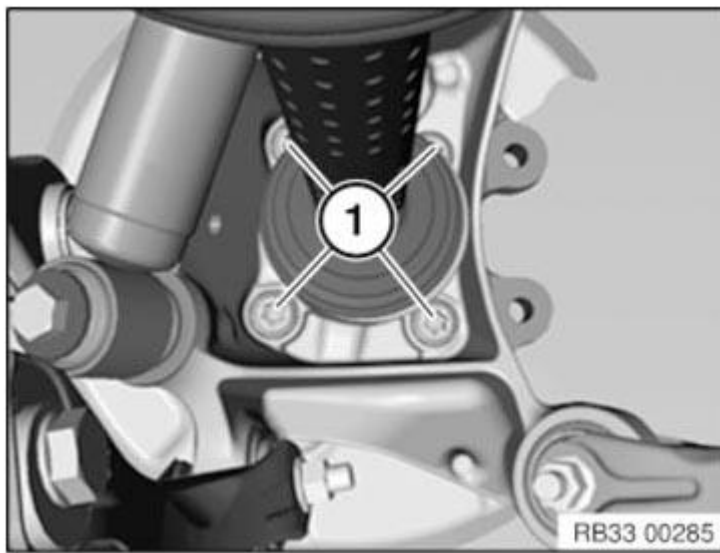
Remove wheel bearing.

*Installation note:*

**IMPORTANT:** Consider the assignment of wheel bearing - collar bolt! It is possible that wheel bearing with thread M12x1.5 or M12x1.25 has been installed.

Replace screws (1).

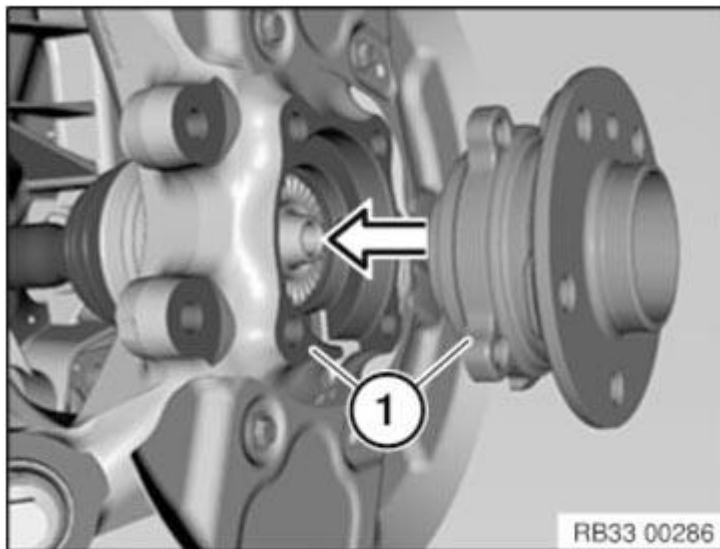




**Fig. 75: Identifying Rear Axle Shaft Wheel Bearing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Keep contact surfaces (1) of wheel bearing and wheel carrier clean and free from oil and grease.



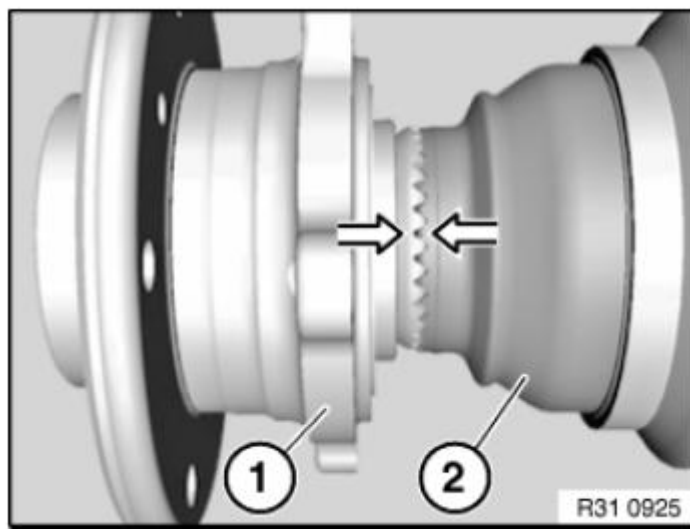
**Fig. 76: Installing Wheel Bearing And Wheel Carrier**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Note on installation for spur gearing must be observed without fail!

*Installation note:*

- Spur gearing of wheel bearing (1) and output shaft (2) must be installed form fit (tooth in tooth position)!
- Tighten collar bolt and compression spring manually.
- Check whether spur gearing is locked tooth in tooth by reciprocally rotating wheel hub/output shaft.
- Once a form fit has been ensured, tighten to final torque.

Tightening torque [33 41 1AZ](#) .



**Fig. 77: Locking Wheel Bearing And Output Shaft**  
 Courtesy of BMW OF NORTH AMERICA, INC.

## SHOCK ABSORBER

### 33 52 100 REMOVING AND INSTALLING REAR LEFT OR RIGHT SPRING STRUT

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**Necessary preliminary tasks:**

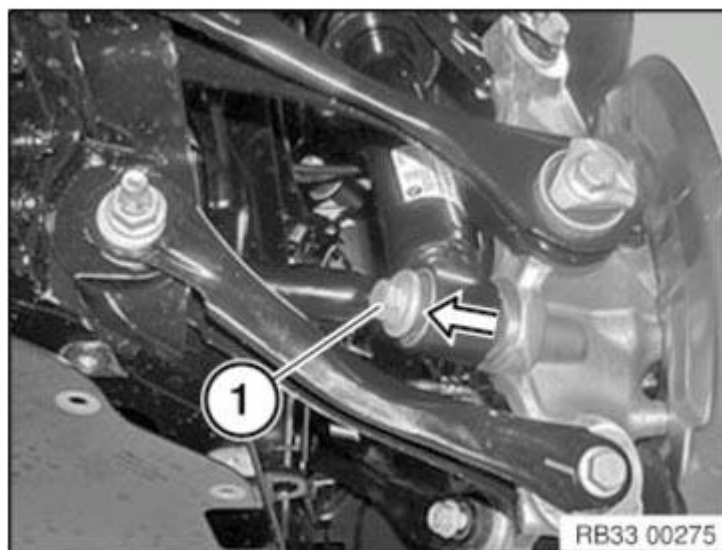
- Remove **REAR WHEEL** .

Release screw (1) from spring strut shock absorber on wheel carrier.

Tightening torque **33 52 3AZ** .

Release spring strut shock absorber from wheel carrier.

**IMPORTANT:** The wheel carrier is preloaded and moves up toward the normal position when the shock absorber is released.



**Fig. 78: Removing Spring Strut Shock Absorber Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Recut thread on wheel carrier.

Secure spring strut against falling down.

Release screws (1) from support bearing.

Tightening torque [33 52 1AZ](#) .



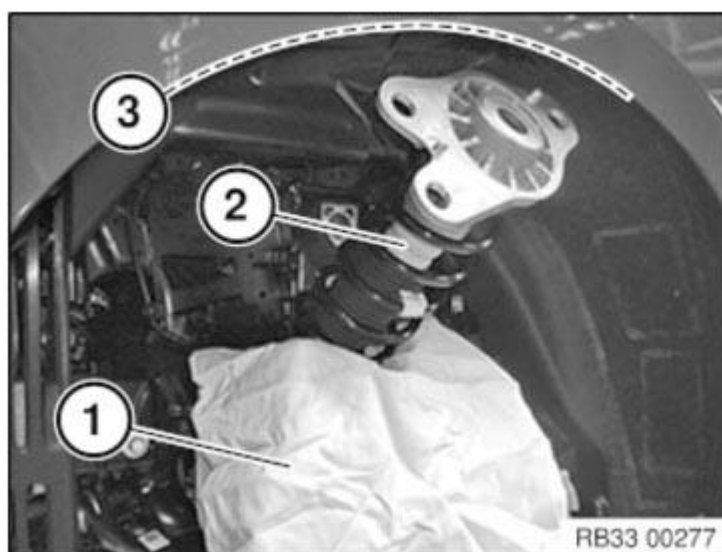
**Fig. 79: Identifying Spring Strut Support Bearing Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Risk of damage!

To prevent surface damage to the components, cover the wheel carrier with a cloth (1) when removing and installing.

When removing and installing, ensure that there is sufficient space between the support bearing and body (3).

Remove spring strut shock absorber (2).



**Fig. 80: Covering Wheel Carrier Using Cloth**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: Before tightening screw connection, check that spring strut shock absorber pin is correctly positioned in wheel carrier.

## Special tools required:

- 31 3 340
- 31 3 341
- 31 3 357
- [2 355 965](#)
- [2 355 966](#)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**WARNING:** Before using the special tool 31 3 340 take care to read through the Owner's Handbook!  
All the safety precautions and instructions contained in the Owner's Handbook must be strictly observed!  
Failure to observe these safety precautions and instructions increases the risk of serious physical injury, damage to your health and damage to property and equipment!

1. Prior to each use, check the special tools for defects, modifications and operational reliability.
2. Damaged/modified special tools must not be used!
3. No changes or modifications may be made to the special tools!
4. These special tools are intended solely for the purpose of tightening and relieving cylindrical and tapered suspension springs.
5. Keep special tools dry, clean and (down to the spindle) free from grease.
6. Impact screwdrivers are prohibited!
7. Do not compress coil spring to full extent.

IMPORTANT:

IMPORTANT: • When replacing the spring strut, replace the auxiliary damper as well!

## Necessary preliminary tasks:

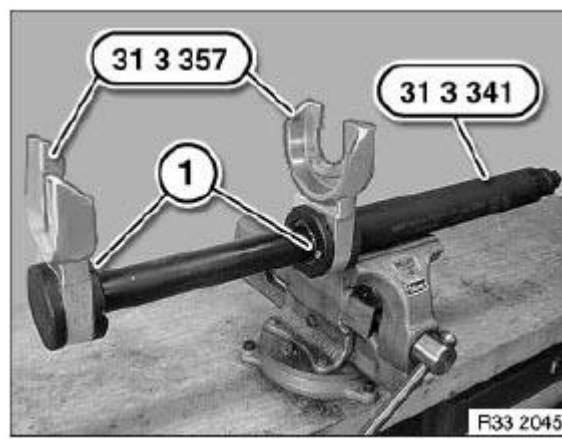
- Remove [REAR SPRING STRUT SHOCK ABSORBER UNIT](#).

## Removing:

Clamp special tool 31 3 341 in vice.

Fit special tools 31 3 357 from above on special tool 31 3 341 until locking pins (1) can be felt and heard to snap into place.

Check seating of special tools 31 3 357 and, if necessary, correct.

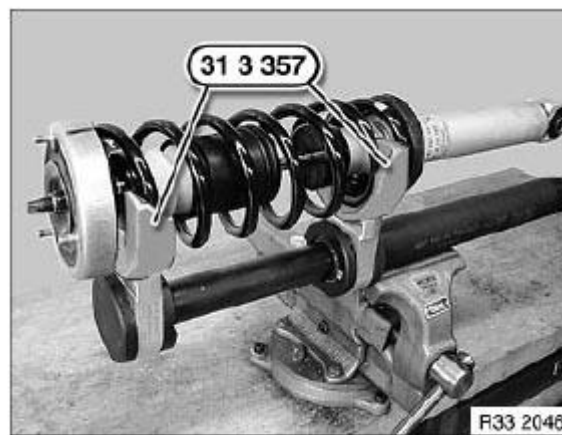


**Fig. 81: Fitting Special Tools (31 3 357) And (31 3 341)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Clean coil spring to remove all coarse dirt and mount on special tools 31 3 357.

**WARNING:** Coils of coil spring must be located completely in recesses of special tools 31 3 357!  
Do not compress coil spring to full extent.

Compress coil spring until stress on piston rod is relieved.



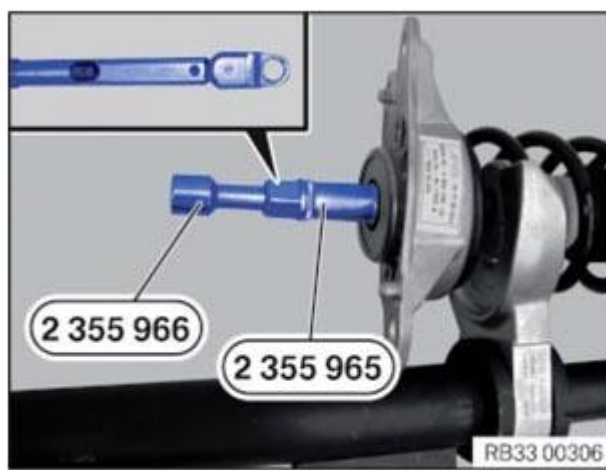
**Fig. 82: Accommodating Coil Spring Using Special Tools (31 3 357)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release nut by means of special tools [2 355 965](#) and [2 355 966](#) .

Remove spring pad with dust boot.

Impact screwdrivers are prohibited!

**Risk of damage inside the shock absorber!**



**Fig. 83: Removing Spring Strut Shock Absorber Nut Using Special Tools (2 355 965) And (2 355 966)**

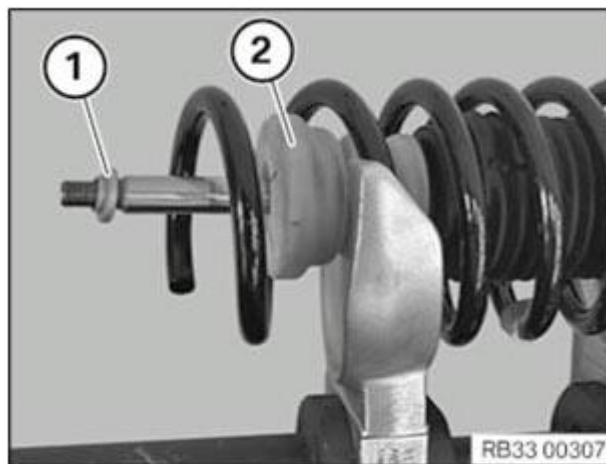
Courtesy of BMW OF NORTH AMERICA, INC.

Remove conical ring (1) from spring strut shock absorber.

Remove auxiliary damper (2) and protective tube, check for damage and replace if necessary.

Remove shock absorber sideways from the tensioned coil spring.

**NOTE:** When replacing the spring strut, replace the auxiliary damper (2) as well.



**Fig. 84: Identifying Conical Ring And Auxiliary Damper**

Courtesy of BMW OF NORTH AMERICA, INC.

Relieve tension on coil spring and remove from special tools 31 3 357.



**Fig. 85: Identifying Coil Spring And Special Tool (31 3 357)**

Courtesy of BMW OF NORTH AMERICA, INC.

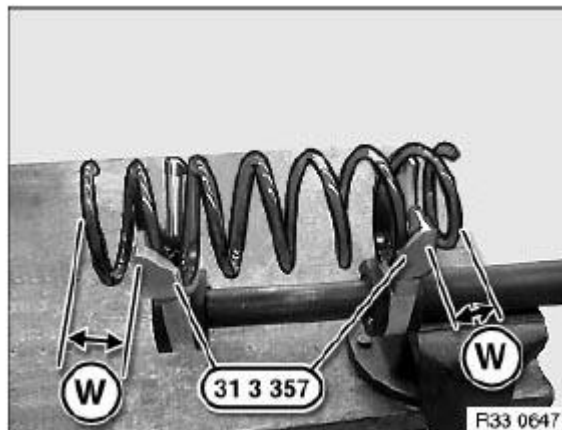


## Assembly:

Accommodate coil spring with special tools 31 3 357 in such a way that both ends of coil spring are approx. one coil (W) outside of special tools 31 3 357.

**WARNING:** Do not compress coil spring to full extent.  
Coils of coil spring must be located completely in recesses of special tools 31 3 357!

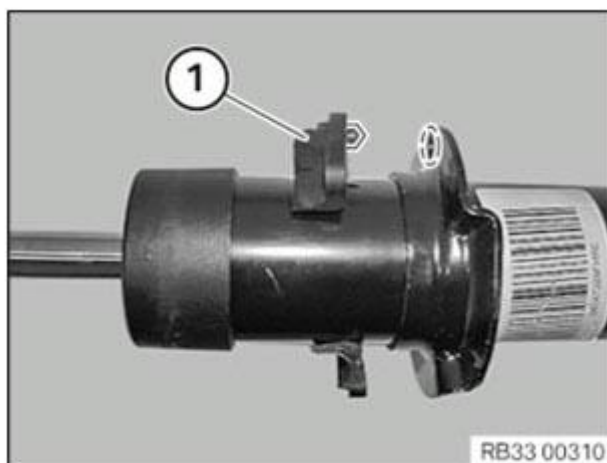
Tension coil spring.



**Fig. 86: Accommodating Coil Spring Using Special Tool (31 3 357)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check bottom spring pad (1) and replace if necessary.

Mount spring pad.

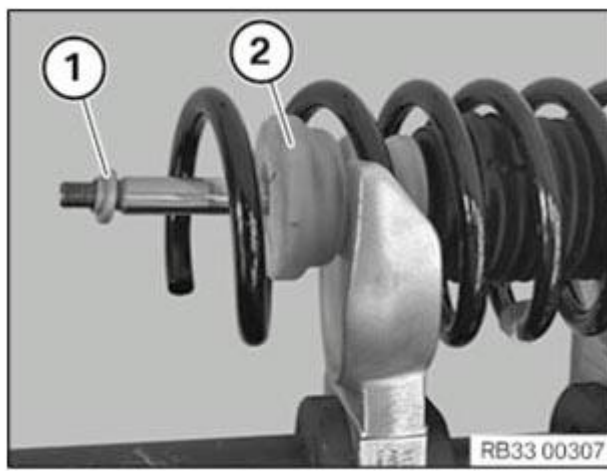


**Fig. 87: Identifying Bottom Spring Pad**  
Courtesy of BMW OF NORTH AMERICA, INC.

Insert spring strut shock absorber into tensioned coil spring.

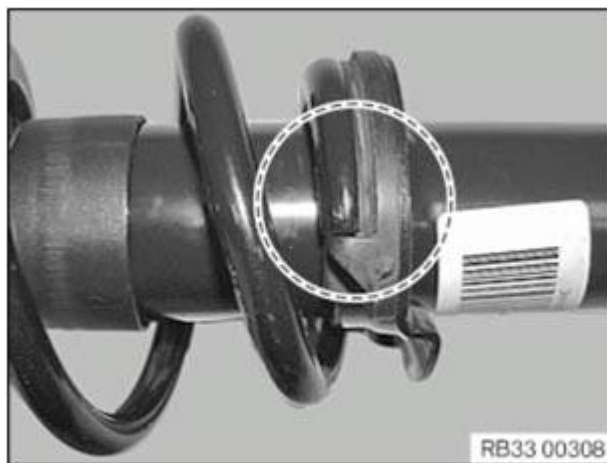
Attach auxiliary damper (2) with protective tube to spring strut shock absorber.

Attach conical ring (1).



**Fig. 88: Identifying Conical Ring And Auxiliary Damper**  
Courtesy of BMW OF NORTH AMERICA, INC.

Lower end of coil spring must rest on stop of spring pad!



**Fig. 89: Identifying Coil Spring Lower End And Spring Pad Stop**  
Courtesy of BMW OF NORTH AMERICA, INC.

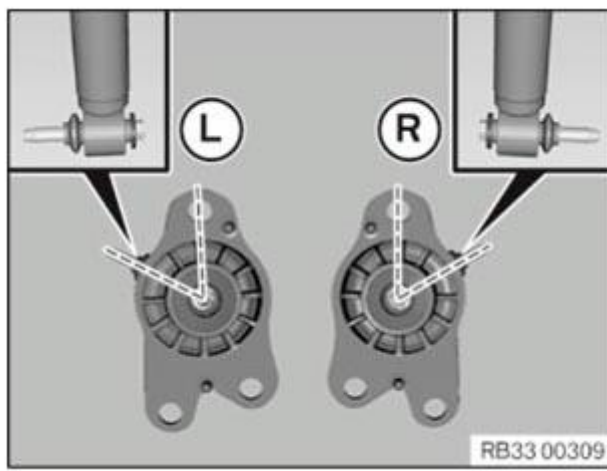
Attach spring pad to end of coil spring and align.



**Fig. 90: Checking Top Spring Pad Positioning**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check support bearing for damage, replace if necessary.

Place support bearing on spring strut shock absorber and align.



**Fig. 91: Aligning Support Bearing And Spring Strut**  
 Courtesy of BMW OF NORTH AMERICA, INC.

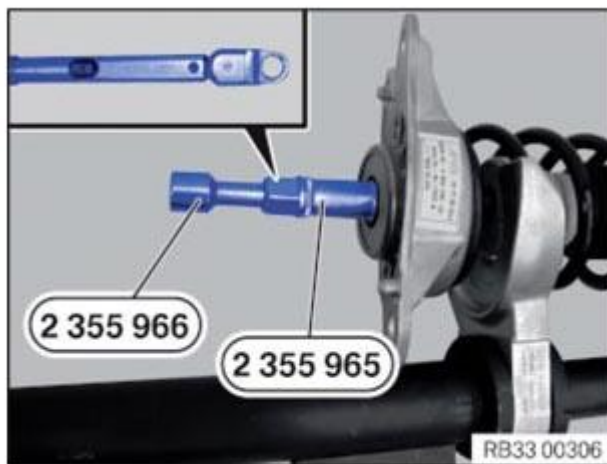
Replace nut and tighten by means of the special tools [2 355 965](#) and [2 355 966](#) .

Tightening torque [33 52 2AZ](#) .

Relieve tension on coil spring.

Impact screwdrivers are prohibited!

**Risk of damage inside the shock absorber!**



**Fig. 92: Removing Spring Strut Shock Absorber Nut Using Special Tools (2 355 965) And (2 355 966)**

Courtesy of BMW OF NORTH AMERICA, INC.

**33 52 161 REPLACING REAR LEFT OR RIGHT SUPPORT BEARING FOR SPRING STRUT SHOCK ABSORBER**

*Installation note:*

1. All screws, nuts, bolts and hose clamps removed during the repair must be replaced.
2. Retaining elements on chassis and suspension and steering parts must be replaced.

**NOTE:** Procedure is described in [REPLACING REAR LEFT OR RIGHT SPRING STRUT SHOCK ABSORBER](#).

**SPRINGS WITH SUSPENSION**

**33 53 000 REMOVING AND INSTALLING/REPLACING REAR LEFT OR RIGHT COIL SPRING**

**IMPORTANT:** Both coil springs on the relevant axle must be replaced in the event of corrosion breakage.

The spring pads at the top and bottom must also be replaced when replacing the coil springs.

Avoid damaging the coil spring coating.

The coil spring is allocated in the BMW parts catalogue according to the vehicle identification number (VIN) and the optional equipment of the particular vehicle.

**NOTE:** Procedure is described in **REPLACING REAR LEFT OR RIGHT SPRING STRUT SHOCK ABSORBER**.

**After installation:**

- Check **HEADLIGHT ADJUSTMENT** , correct if necessary.
-

[Back To Article](#)

## SUSPENSION

### Rear Axle - Special Tools - All I3 Models - i3

## REAR AXLE

### 2156277 ADAPTER AM

**NOTE:** Adapter N4 (Ã~ 39mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 1: Identifying Adapter (2156277)**

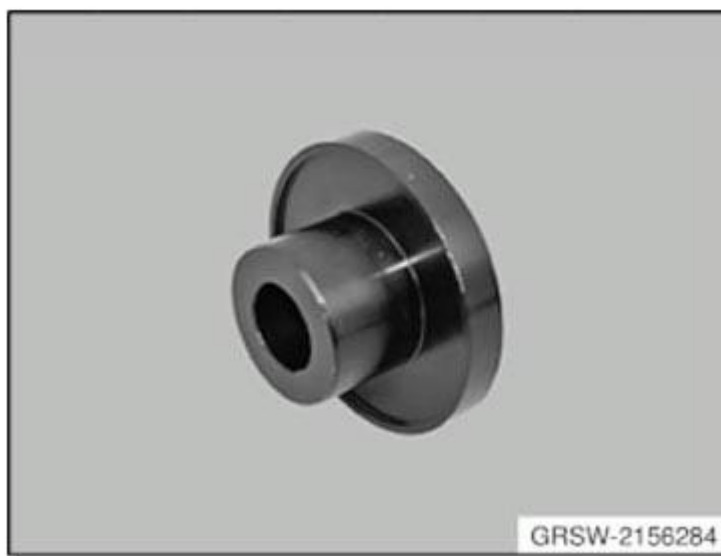
Courtesy of BMW OF NORTH AMERICA, INC.

### 2156284 ADAPTER AM

**NOTE:** Adapter P1 (Ã~ 45/85mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 2: Identifying Adapter (2156284).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156286 ADAPTER AM**

**NOTE:** Adapter R5 (M24/Ä~ 59/70mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 3: Identifying Adapter (2156286).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159724 ADAPTER AM**

**NOTE:** Adapter R1 (M24/Ä~ 77/82mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)





**Fig. 4: Identifying Adapter (2159724).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159722 ADAPTER AM**

**NOTE:** Adapter M6 (Ã~ 102/113mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 5: Identifying Adapter (2159722).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156287 ADAPTER AM**

**NOTE:** Adapter R4 (M24/Ã~ 64/75mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 6: Identifying Adapter (2156287).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159723 ADAPTER AM**

**NOTE:** Adapter M2 (Ã 88mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 7: Identifying Adapter (2159723).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156257 ADAPTER AM**

**NOTE:** Adapter G2 (M24x1.5/M20) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 8: Identifying Adapter (2156257).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156278 ADAPTER AM**

**NOTE:** Adapter N3 (Ã~ 42mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 9: Identifying Adapter (2156278).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2348436 ADAPTER AM**

**NOTE:** Adapter R8 (M24/Ã~ 74/83mm) in connection with adapter kit F03 (81642348804) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 02 13 (900)



**Fig. 10: Identifying Adapter (2348436)**

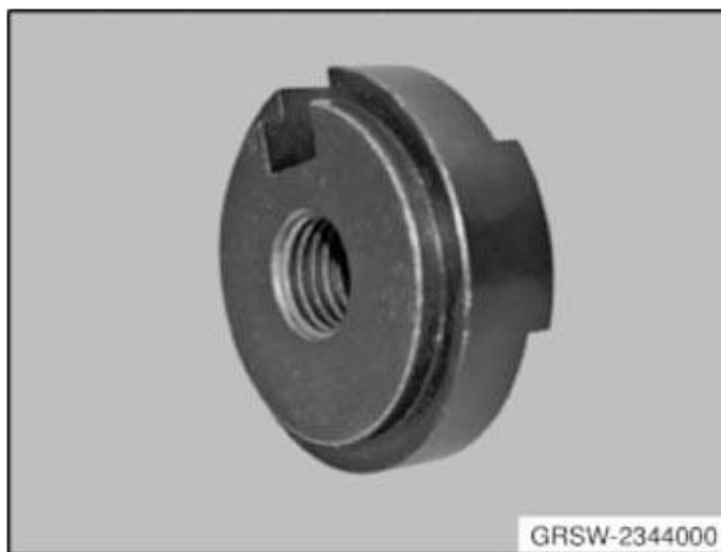
Courtesy of BMW OF NORTH AMERICA, INC.

**2344000 ADAPTER AM**

**NOTE:** Adapter R6 (M24/Ä~ 63/75mm) in connection with adapter kit F30 (84mm wheel bearings) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 09 12 (873)



**Fig. 11: Identifying Adapter (2344000)**

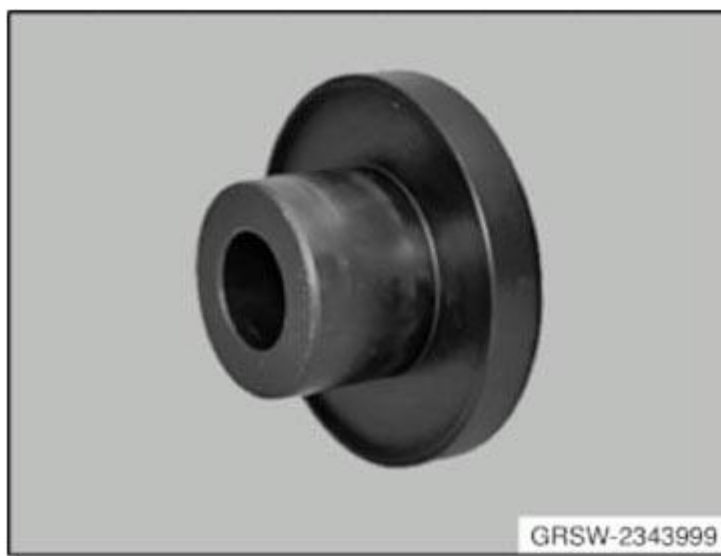
Courtesy of BMW OF NORTH AMERICA, INC.

**2343999 ADAPTER AM**

**NOTE:** Adapter P5 (Ä~ 45/82.5mm) in connection with wheel bearing adapter kit F30 (84mm, no longer in Catalogue) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 09 12 (873)



**Fig. 12: Identifying Adapter (2343999).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2348432 ADAPTER AM**

**NOTE:** Adapter P6 (1 1/2" 51/89mm) in connection with adapter kit F03 (81 64 2 348 804) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 02 13 (900)



**Fig. 13: Identifying Adapter (2348432).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2348434 ADAPTER AM**

**NOTE:** Adapter R7 (M24 1 1/2" 87/95mm) in connection with adapter kit F03 (81 64 2 348 804) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 02 13 (900)



**Fig. 14: Identifying Adapter (2348434).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156253 ADAPTER AM**

**NOTE:** Adapter B1 in connection with adapter kit 1 (BMW), (81 64 2 155 745) and MINI adapter kit (81 64 2 294 517), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 15: Identifying Adapter (2156253).**

Courtesy of BMW OF NORTH AMERICA, INC.

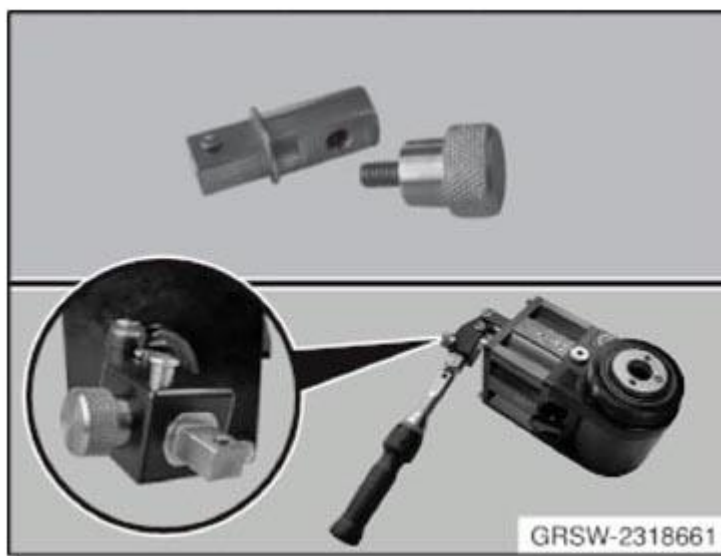
**2318661 ADAPTER AM**

**NOTE:** Adapter Z1 to attach torque wrench. Used in connection with hydraulic cylinder, (81642156246), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 04 12 (797)





**Fig. 16: Identifying Adapter (2318661).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156276 ADAPTER AM**

**NOTE:** Adapter M3 (Ã~ 102mm) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 06 09 (544)



**Fig. 17: Identifying Adapter (2156276).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156256 ADAPTER AM**

**NOTE:** Adapter G3 (M27x1.5/M20) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 18: Identifying Adapter (2156256).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2348435 ADAPTER AM**

**NOTE:** Adapter M8 for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



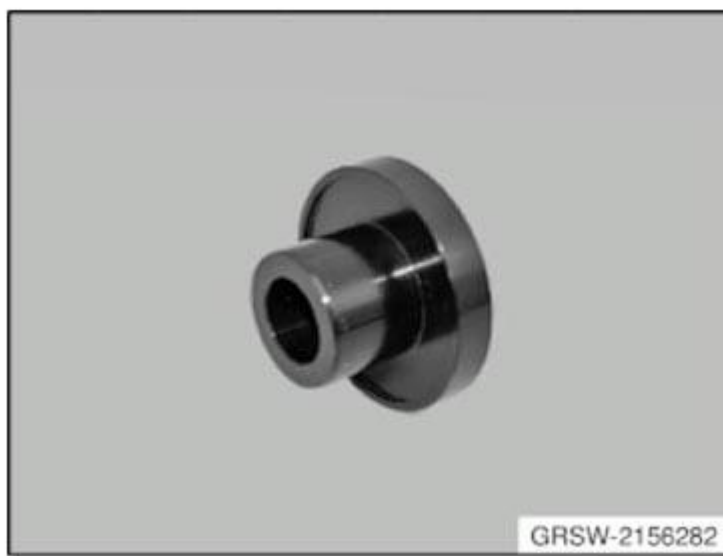
**Fig. 19: Identifying Adapter (2348435).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156282 ADAPTER AM**

**NOTE:** Adapter P3 (Ã~ 39/72mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 20: Identifying Adapter (2156282).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156260 ADAPTER AM**

**NOTE:** Adapter E2 (M24) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 21: Identifying Adapter (2156260).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156275 ADAPTER AM**

**NOTE:** Adapter M4 (Ã~ 96mm) in connection with adapter kit 2 (BMW), (81642155746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 22: Identifying Adapter (2156275).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2348431 ADAPTER AM**

**NOTE:** Adapter N5 (1.5" ~ 51mm) in connection with adapter kit F03 (81642348804) for installation and removal of wheel bearings, propeller shafts and drive shafts.

SI number

08 02 13 (900)



**Fig. 23: Identifying Adapter (2348431).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2159720 ADAPTER AM**

**NOTE:** Adapter G1 (M22x1.5/M20) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 24: Identifying Adapter (2159720).**

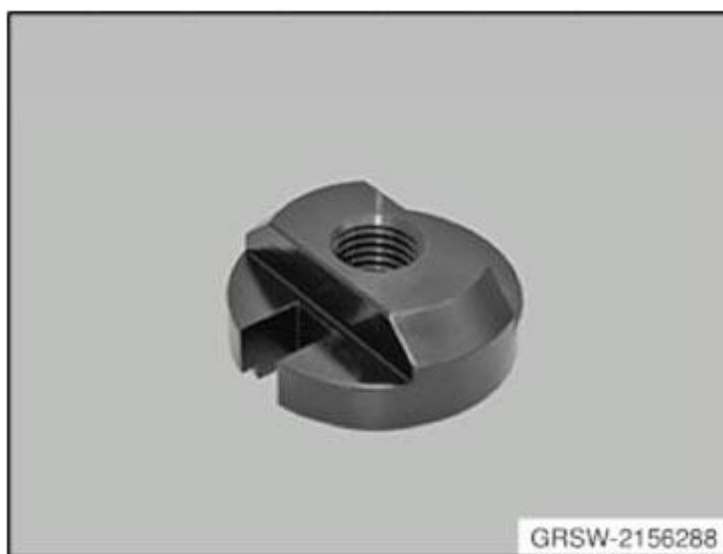
Courtesy of BMW OF NORTH AMERICA, INC.

### **2156288 ADAPTER AM**

**NOTE:** Adapter R3 (M24/Ã~ 69/79mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

#### **SI number**

08 06 09 (544)



**Fig. 25: Identifying Adapter (2156288).**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2357222 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic in combination with 83 30 2 357 221 for mounting engine I01 onto mobile major assembly table lift MHT 1200 81 22 2 184 136, is required 2 times

#### **Storage Location**

Individual

#### **SI number**

01 22 13 (988)



**Fig. 26: Identifying Adapter (2357222).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156280 ADAPTER AM**

**NOTE:** Adapter N1 (Ã~ 49mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 27: Identifying Adapter (2156280).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156279 ADAPTER AM**

**NOTE:** Adapter N2 (Ã~ 45mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)





**Fig. 28: Identifying Adapter (2156279).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2159721 ADAPTER AM**

**NOTE:** Adapter M1 (Ã~ 100/101mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 29: Identifying Adapter (2159721).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156273 ADAPTER AM**

**NOTE:** Adapter M5 (Ã~ 90mm) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 30: Identifying Adapter (2156273).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2159985 ADAPTER AM**

**NOTE:** Adapter H2 (tooth finder) in combination with adapter kit 1 BMW (81 64 2 155 745) for removal and installation of wheel bearings, output shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 31: Identifying Adapter (2159985).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156289 ADAPTER AM**

**NOTE:** Adapter R2 (M24 tapered) in connection with adapter kit 2 (BMW), (81 64 2 155 746), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 32: Identifying Adapter (2156289).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156285 ADAPTER AM**

**NOTE:** Adapter P2 (Ã~ 49/90mm) in connection with adapter kit 2 (BMW) and adapter kit 3 RR for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 33: Identifying Adapter (2156285).**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355626 BRACE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic contour-graphic silhouette foil is included in the delivery specification.

**Storage Location**

B36

**SI number**

01 13 13 (968)



**Fig. 34: Identifying Brace (2355626)**

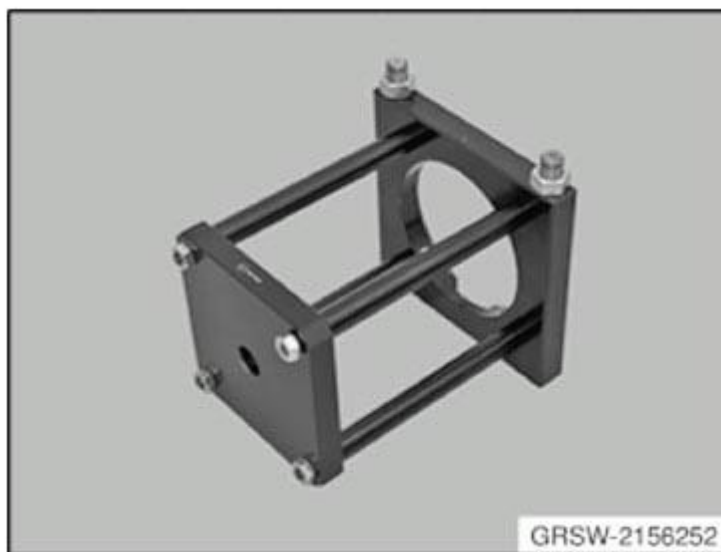
Courtesy of BMW OF NORTH AMERICA, INC.

**2156252 DEVICE AM**

**NOTE:** Device A1 in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 35: Identifying Device (2156252)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156258 HOLDING SLEEVE AM**

**NOTE:** Sleeve E1 (M24) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 36: Identifying Holding Sleeve (2156258)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156254 HOLDING SLEEVE AM**

**NOTE:** Sleeve C1 in connection with adapter kit 1 (BMW), (81 64 2 155 745) and MINI adapter kit (81 64 2 294 517), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 37: Identifying Holding Sleeve (2156254)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2159986 HOLDING SLEEVE AM**

**NOTE:** Sleeve H1 (removing gear finding component) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 38: Identifying Holding Sleeve (2159986)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355246 HOLDING SLEEVE MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic contour-graphic silhouette foil is included in the delivery specification.

**Storage Location**

B36

**SI number**

01 13 13 (968)



**Fig. 39: Identifying Holding Sleeve (2355246)**  
Courtesy of BMW OF NORTH AMERICA, INC.

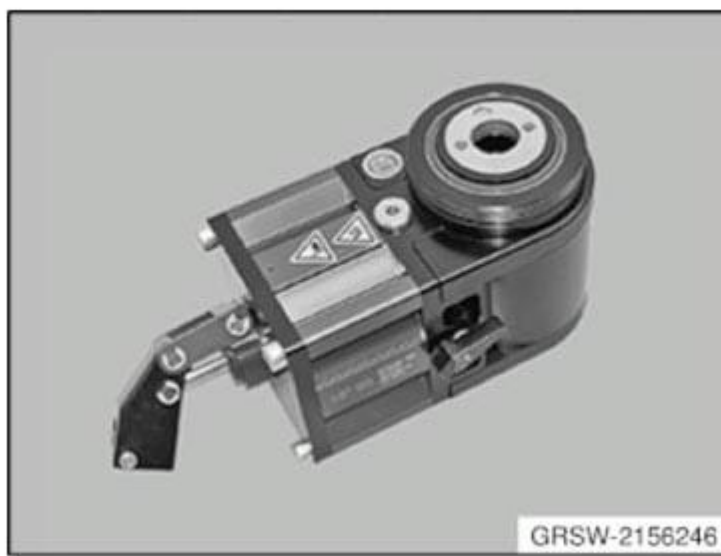
**2156246 HYDRAULIC CYLINDERS AM**

**NOTE:** Hydraulic cylinder (hydraulic actuator) in connection with lever, (81 64 2 156 247), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)





**Fig. 40: Identifying Hydraulic Cylinders (2156246)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156247 LEVER AM**

**NOTE:** Lever in connection with hydraulic cylinder (hydraulic actuator), (81 64 2 156 246), for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 41: Identifying Lever (2156247)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2208574 NUT AM**

**NOTE:** TR18 nuts for removing and installing the rubber mount on the rear axle support. Contained in threaded spindle set 81642208573. TR18 nuts cannot be ordered separately.

**SI number**

08 06 10 (658)



**Fig. 42: Identifying Nut (2208574)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2159983 SCREW AM**

**NOTE:** Screws K1 (M12x1.5) for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 43: Identifying Screw (2159983)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2159984 SCREW AM**

**NOTE:** Screws K2 (M14x1.5) for removal and installation of wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 44: Identifying Screw (2159984)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355965 SOCKET WRENCH INSERT MINIMUM SET: MECHANICAL TOOLS**

**NOTE:** Applies to: BMW i Aftersales Basic socket wrench SW16 to release and tighten the spring strut shock absorber on the screw connections of the support bearing of the rear axle.

**Storage Location**

C35

**SI number**

01 47 13 (037)



**Fig. 45: Identifying Socket Wrench Insert (2355965)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355966 SOCKET WRENCH INSERT MINIMUM SET: MECHANICAL TOOLS**

**NOTE:** Applies to: BMW i Aftersales Basic contour-graphic silhouette foil is included in the delivery specification.

**Storage Location**

C35

SI number

01 47 13 (037)



**Fig. 46: Identifying Socket Wrench Insert (2355966)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2208575 SPINDLE AM**

**NOTE:** M12 threaded spindles for removing and installing the rubber mount on the rear axle support. Contained in threaded spindle set 81642208573. Threaded spindles M12 cannot be ordered separately.

SI number

08 06 10 (658)



**Fig. 47: Identifying Spindle (2208575)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2156271 SPINDLE AM**

**NOTE:** Spindle F1 (M24/425 mm) in connection with adapter kit 1 (BMW), (81 64 2 155 745), for removal and installation of wheel bearings, propeller shafts drive flanges.

SI number

08 06 09 (544)



**Fig. 48: Identifying Spindle (2156271)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2156262 SPINDLE AM**

**NOTE:** Spindle F3 (M24/270mm) in connection with adapter kit 1 (BMW), (81 64 2 155 745) and MINI adapter kit (81 64 2 294 517) for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 06 09 (544)



**Fig. 49: Identifying Spindle (2156262)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2208577 SPINDLE AM**

**NOTE:** M18 threaded spindles for removing and installing the rubber mount on the rear axle support. Contained in threaded spindle set 81642208573. Threaded spindles M18 cannot be ordered separately.

**SI number**

08 06 10 (658)



**Fig. 50: Identifying Spindle (2208577)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2156270 SPINDLE AM**

**NOTE:** Spindle F2 (M20/M24/355mm) in connection with adapter kit 1 (BMW), (81 64 2 155 745), and MINI adapter kit, (81 64 2 294 517), for removal and installation of wheel bearings, propeller shafts and drive flanges.

#### **SI number**

08 06 09 (544)



**Fig. 51: Identifying Spindle (2156270)**

Courtesy of BMW OF NORTH AMERICA, INC.

### **2355442 SPINDLE MINIMUM SET: MECHANICAL TOOLS**

**NOTE:** Applies to: BMW i Aftersales Basic silhouette foil is included in the delivery specification.

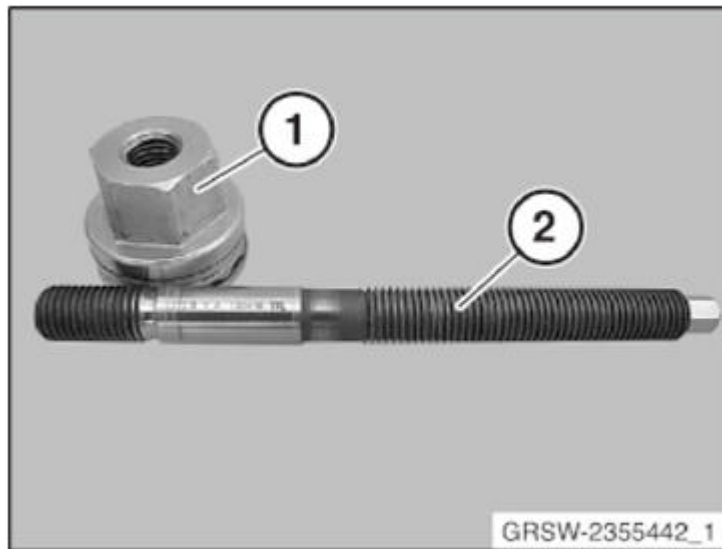
#### **Storage Location**

A36

B36

#### **SI number**





**Fig. 52: Identifying Spindle (2355442).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355443 TENSIONING STRAP MINIMUM SET: MECHANICAL TOOLS AM**

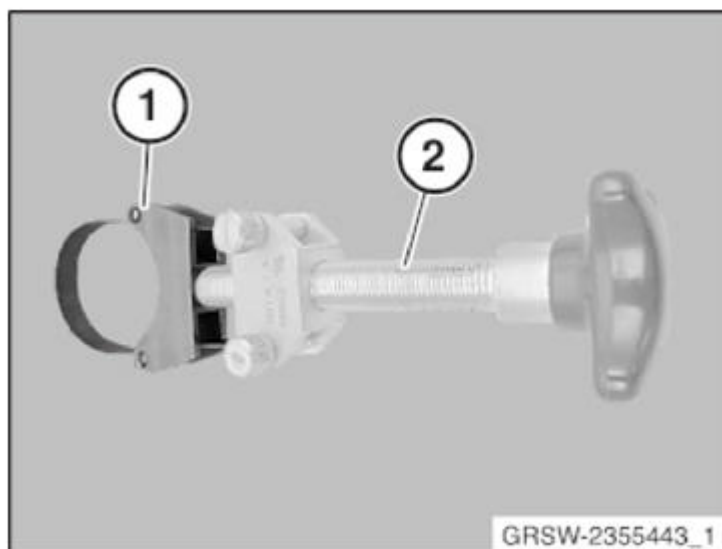
**NOTE:** Applies to: BMW i Aftersales Basic silhouette foil is included in the delivery specification.

**Storage Location**

B36

**SI number**

01 13 13 (968)



**Fig. 53: Identifying Tensioning Strap (2355443).**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2344011 TOOL AM**

**NOTE:** Tool (wheel hub grinder) for cleaning the connection of the wheel rim (wheel contact face) to the wheel hub.

**SI number**

08 08 12 (872)



**Fig. 54: Identifying Tool (2344011)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2155746 TOOL SET AM**

**NOTE:** Adapter kit 2 (BMW), (BMW-specific adapters), for installation and removal of wheel bearings, propeller shafts and drive shafts.

**SI number**

08 12 14 (155)

Consisting of:

1 = 2159721

14 = 2159722

18 = 2156282

17 = 2156283

19 = 2156290

2 = 2159723

16 = 2156275

15 = 2156273

13 = 2156280



**Fig. 55: Identifying Tool Set (2155746)**

**Courtesy of BMW OF NORTH AMERICA, INC.**

12 = 2156279

11 = 2156278

10 = 2156277

3 = 2156285

4 = 2159724

5 = 2156289

6 = 2156288

7 = 2156287

8 = 2156286

9 = 2156284

**2155745 TOOL SET AM**

**NOTE:** Wheel bearing adapter kit 1 (BMW), (spindles and tensioning nuts) for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 12 14 (155)

Consisting of:

15 = 2156262

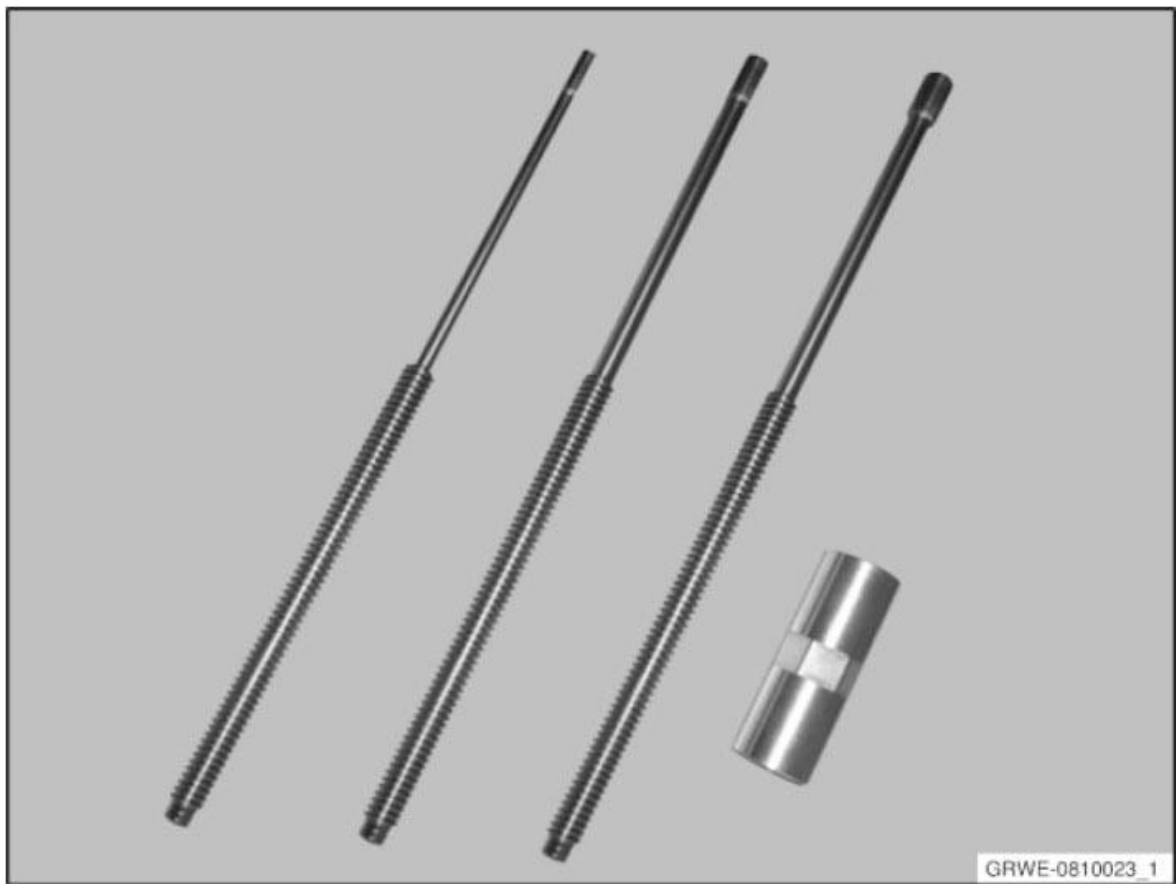
- 14 = 2159720
- 13 = 2156257
- 12 = 2156256
- 11 = 2318476
- 10 = 2159986
- 9 = 2159985
- 1 = 2156252



**Fig. 56: Identifying Tool Set (2155745)**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

- 2 = 2156253
- 3 = 2156254
- 4 = 2156255
- 5 = 2156258
- 6 = 2156260
- 7 = 2156265
- 8 = 2156271
- 16 = 2156270

**2208573 TOOL SET AM**



**Fig. 57: Identifying Tool Set (2208573)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Threaded spindle set for removing and installing the rubber mount on the rear axle support.

**SI number**

08 06 10 (658)

Consisting of:

4 = 2208574

3 = 2208575

2 = 2208576

1 = 2208577

**2155744 TOOL SET AM**



**Fig. 58: Identifying Tool Set (2155744)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Hydraulic unit (basic unit) for removal and installation of wheel bearings, propeller shafts and drive flanges.

**SI number**

08 12 14 (155)

Consisting of:

2 = 2156247

1 = 2156246

**2355438 WASHER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic silhouette foil is included in the delivery specification.

**Storage Location**

A36

**SI number**

01 13 13 (968)





**Fig. 59: Identifying Washer (2355438)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355435 WASHER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic silhouette foil is included in the delivery specification.

**Storage Location**

A36

**SI number**

01 13 13 (968)



**Fig. 60: Identifying Washer (2355435)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355440 WASHER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic silhouette foil is included in the delivery specification.

**Storage Location**

B36

**SI number**



**Fig. 61: Identifying Washer (2355440)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355439 WASHER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic silhouette foil is included in the delivery specification.

**Storage Location**

A36

**SI number**

01 13 13 (968)



**Fig. 62: Identifying Washer (2355439)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2355436 WASHER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic silhouette foil is included in the delivery specification.

**Storage Location**

B36

**SI number**

01 13 13 (968)



**Fig. 63: Identifying Washer (2355436)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2355441 WASHER MINIMUM SET: MECHANICAL TOOLS AM**

**NOTE:** Applies to: BMW i Aftersales Basic silhouette foil is included in the delivery specification.

**Storage Location**

A36

B36

**SI number**

01 13 13 (968)



**Fig. 64: Identifying Washer (2355441)**

Courtesy of BMW OF NORTH AMERICA, INC.

**2156255 WASHER AM**

**NOTE:** Contact disc D1 in connection with adapter kit 1 (BMW), (81 64 2 155 745) and MINI adapter kit (81 64 2 294 517), for removal and installation of

wheel bearings, propeller shafts and drive flanges.

SI number

08 06 09 (544)



**Fig. 65: Identifying Washer (2156255)**  
Courtesy of BMW OF NORTH AMERICA, INC.

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## SUSPENSION

### Rear Axle - Technical Data - All I3 Models - i3

## GENERAL - TRACK WIDTH

### 33 00 GENERAL - TRACK WIDTH I01 SERIES

#### GENERAL - TRACK WIDTH I01 SERIES SPECIFICATION

Track width for normal position and rim offset (ET)	Â	Â
Standard suspension		
-ET 43	mm	1576
-ET 53	mm	1556

## GENERAL - TRACK WIDTH, JAPANESE VERSION

### 33 00 GENERAL - TRACK WIDTH I01 JAPANESE VERSION

#### GENERAL - TRACK WIDTH I01 JAPANESE VERSION SPECIFICATION

Track width for normal position and rim offset (ET)	Â	Â
Standard suspension		
-ET 43	mm	1582
-ET 53	mm	1562

## REAR AXLE - RIDE HEIGHT

### 33 00 REAR AXLE - RIDE HEIGHT I01

#### REAR AXLE - RIDE HEIGHT I01 SPECIFICATION

Ride height in normal position (attach tape measure to bottom middle of rim flange and measure to lower edge of wheel arch)		Â
Tolerance ride height in <ul style="list-style-type: none"> <li><b>NORMAL POSITION</b> max. Â±10 mm</li> <li><b>DESIGN POSITION</b> max. Â±2 mm</li> </ul>		Â
Difference ride height between left/right in <ul style="list-style-type: none"> <li><b>NORMAL POSITION</b> 10 mm</li> <li><b>DESIGN POSITION</b> 2 mm</li> </ul>		Â
Standard suspension	Â	Â
19" wheel rim	mm	667
20" wheel rim	mm	680
Standard suspension Japan	Â	Â
19" wheel rim	mm	638
20" rim	mm	651

## SUSPENSION

### Rear Axle - Tightening Torques - All I3 Models - i3

## DRIVE MODULE

### 41 11 DRIVE MODULE

#### TIGHTENING TORQUE SPECIFICATION - DRIVE MODULE

Â	Type	Thread	Tightening specifications	Dimension
1AZ Strut, horizontal to drive module	I01	Screw, M10	Â	56 Nm
	I01	Screw, M8	Â	28 Nm
2AZ Cross member, rear to drive module	I01	M10 screw	Â	56 Nm
3AZ Drive module to body	I01	M12 screw	Â	108 Nm
4AZ Rear end strut to drive module	I01	M10 screw	Renew screw. Jointing torque Angle of rotation	56 Nm 90 Â°
	I01	Screw, M8	Â	28 Nm
5AZ Dome strut to cast spring strut dome/bulkhead	I01	M10 screw	Â	56 Nm
6AZ Grounding cable to blind rivet nut	I01	M8	Â	15 Nm
7AZ Grounding cable to blind rivet nut	I01/I12	M10	Â	17 Nm
8AZ Reinforcement of side member to side member	I01	M6 thread cutting	Â	4 Nm
9AZ Reinforcement of side member to side member/strut brace	I01	M12x1.5	Â	100 Nm
10AZ Strut brace to side member	I01	M12x1.5	Â	100 Nm
11AZ Side sill reinforcement to Drive module	I01	M12x1.5x23	Renew screw.	108 Nm

## SPRING STRUT SHOCK ABSORBER

### 33 52 SPRING STRUT SHOCK ABSORBER

#### TIGHTENING TORQUE SPECIFICATION - SPRING STRUT SHOCK ABSORBER

Â	Type	Thread	Tightening specifications	Dimension
1AZ Nut and locknut/self-locking nut	I01	M12	Replace screws. Jointing torque Angle of rotation	100 Nm 90 Â°
2AZ Support bearing to spring strut shock absorber	I01	M10	Replace nut.	38 Nm
3AZ Spring strut shock absorber to wheel carrier	I01	M14	Â	165 Nm
4AZ Lock nut for coilover (Japan chassis and suspension)	I01	Â	Â	59 Nm

## TRAILING ARMS AND STRUTS

### 33 32 TRAILING ARMS AND STRUTS

#### TIGHTENING TORQUE SPECIFICATION - TRAILING ARMS AND STRUTS

Â	Type	Thread	Tightening specifications	Dimension



Â	Type	Thread	Tightening specifications	Dimension
1AZ Trailing arm to rear axle support	I01	M12	Up to 02/2014: Replace screw and nut. From 02/2014: Replace screw. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> . Jointing torque Angle of rotation	100 Nm 90 Â°
2AZ Trailing arm to wheel carrier	I01	M12	Up to 02/2014: Replace screw and nut. From 02/2014: Replace screw. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> . Jointing torque Angle of rotation	100 Nm 90 Â°
3AZ Control arm on rear axle module	I01	M12	Replace screw and nut. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> . Jointing torque Angle of rotation	100 Nm 90 Â°
4AZ Guide arm to wheel carrier	I01	M12	Replace screw and nut. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> . Jointing torque Angle of rotation	100 Nm 90 Â°
5AZ Wishbone on rear axle module	I01	M12	Up to 02/2014: Replace screw and nut. From 02/2014: Replace screw. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> . Jointing torque Angle of rotation	100 Nm 90 Â°
6AZ Wishbone to wheel carrier	I01	M12	Up to 02/2014: Replace screw and nut. From 02/2014: Replace screw. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> . Jointing torque Angle of rotation	100 Nm 90 Â°
7AZ Track control arm on rear axle module	I01	M14	Replace screw, eccentric washer and nut. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> .	165 Nm
8AZ Toe arm to wheel carrier	I01	M12	Replace screw. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> . Jointing torque Angle of rotation	100 Nm 90 Â°
9AZ Camber control arm on rear axle module	I01	M14	Replace screw, eccentric washer and nut. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> .	165 Nm
10AZ Camber arm to wheel carrier	I01	M12	Replace screw and nut. <b><u>TIGHTEN DOWN IN NORMAL POSITION</u></b> . Jointing torque Angle of rotation	100 Nm 90 Â°

## WHEEL BEARINGS

**TIGHTENING TORQUE SPECIFICATION - WHEEL BEARINGS**

Â	Type	Thread	Tightening specifications	Dimension
1AZ Drive flange hub to output shaft	I01	M16	Replace screw. Jointing torque Angle of rotation	210 Nm 90 Â°
2AZ Wheel bearing to wheel carrier  IMPORTANT: Pay attention to the allocation of wheel bearing screws.	I01	M12x1.5	Replace screws. Jointing torque Angle of rotation	80 Nm 90 Â°
		M12x1.25	Replace screws. Jointing torque Angle of rotation	120 Nm 90 Â°

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## SUSPENSION

### Rear Axle Operating Fluids

## APPROVED FINAL DRIVE OILS FOR FRONT AND REAR AXLE FINAL DRIVES

### HYPOID OILS FOR FINAL DRIVE WITHOUT DISC-TYPE LIMITED-SLIP DIFFERENTIAL

Exception: E30/325iX differential with viscous self-locking differential.

Up to model year 07/2011:

Trade name	BMW part number China	BMW part number Rest of the world	Container size
	BMW Synthetics OSP	33 11 7 695 240	1000 ml
BMW Synthetics OSP	83 22 9 407 768		60-liter barrel
	BMW Synthetics OSP	83 22 2 148 570	12x1 liter

As of model year 07/2011:

Hypoid Axle Oil G1 (BOT448) (for all rear axle differentials apart from M vehicles)	83 22 2 295 532 3 x 500 ml
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Trade name	Manufacturer/Supplier
AGIP HLX	Agip
Aral transmission oil BS	Aral
Castrol SAF-X0	Castrol
Castrol Syntrax Longlife 75W-90	Castrol
Castrol Syntrax B 75W-85	Castrol
Dearon BHS	DEA
FINA PONTONIC MS	Fina
FINA PONTONIC MX	Fina
Veedol SAF 66	Veedol
Mobil Gearlube VS 600	Mobil
BP Energear SHX	BP
VALVOLINE SynPower Gear Oil GL-5 Society of Automotive Engineers 75W-90	Valvoline
TRANSELF BM 75W--90	Elf
Shell transmission oil OLS-BMW	Shell
Westfalen Fugo BMO	Westfalen AG
MOTUL HYPO SYNT	Motul
Avia Hypoid 75W--90 EP	AVIA
Esso transmission oil NLS 75W--90	Esso
Fuchs TITAN Gear H 75W--90	Fuchs
Wintershall gear fluid BOS	Schmierstoffraffinerie Salzbergen GmbH
TOTAL Transmission ALD Society of Automotive Engineers 75W-90	

**NOTE:** The above oils satisfy the demands required of lifetime oils.

Oil change intervals are given in the vehicle-specific inspection sheets.

**Before opening the container, "mix" the transmission oil to distribute the additives evenly through the oil.**

**General information about final-drive transmission oils**

Final-drive and hypoid transmission oil must fulfil the following requirements for handling high loads as arise at the tooth flanks of the hypoid gear:

- high load-carrying capacity
- high degree of immunity from seizure
- good protection against wear
- optimum frictional behavior and temperature stability
- compatibility with sealing materials
- resistance to ageing

A brand-name hypoid transmission oil already possesses these and other characteristics thanks to its high concentration of EP agents (EP = Extreme Pressure).

**Oil additives**

All final drives are designed in such a way that there is absolutely no need to use oil additives. BMW is totally against the use of such additives. We will also accept no liability for any consequences resulting from the use of additives.

**HYPOID OILS FOR FINAL DRIVE UNIT WITH DISC-TYPE LIMITED SLIP DIFFERENTIAL (M MODELS AND WITH SA209 SELF-LOCKING DIFFERENTIAL)**

As well as for final drive unit with electro-hydraulic limited-slip differential

**Standard version: 1 Series: E82/M Coupe**

**Standard version: 3-Series: E90/M3, E92/M3, E93/M3**

Trade name	BMW part number China	BMW part number Rest of the world	Container size
BMW differential oil SAF-XJ + FM Booster	83 21 2 155 243	83 22 2 282 583	3x500 ml

<b>Standard version: 3-Series:</b>	<b>Z3M, Z3 with SA209, E36 with SA209, E36/M3, E46/M3, E85/M Roadster, E86/M Coupe, F80/M3, F82/M4 Coupe, F83/M4 Convertible</b>	
<b>Standard version: 5-Series:</b>	<b>E34/M5, E39/M5, E60/M5, E61/M5, F10/M5</b>	
<b>Standard version: 6-Series:</b>	<b>E63/M6, E64/M6, F06/M6, F12/M6, F13/M6</b>	
Trade name	BMW part number Rest of the world	Container size
BMW MSP/A synthetic differential oil	83 22 9 405 462	1000 ml (Trade Unit)
BMW MSP/A synthetic differential oil	83 22 2 365 988	12x1 liter
BMW MSP/A synthetic differential oil	83 22 9 407 871	208-liter barrel

Specific Hypoid oils released by name

Trade name	Manufacturer/Supplier
Castrol SAF-XJ	Castrol
Castrol Syntrax Limited Slip 75W-140	Castrol
MOTUL HYPO SYNT LS	Motul
Mobil transmission oil VS 500	Mobil

Trade name	Manufacturer/Supplier
Aral transmission oil BS-LSX	Aral
BP Energear SHX-ZR	BP
Avia Hypoid 75W--140 LSX	AVIA
Agip HLZ	Agip
FINA PONTONIC MLK	Fina
Shell transmission oil ZLS-BMW	Shell
Wintershall gear fluid BMS Plus	Schmierstoffraffinerie Salzbergen GmbH
Westfalen Fugo BMS	Westfalen AG

**NOTE:** The above oils satisfy the demands required of lifetime oils.

Oil change intervals are given in the vehicle-specific inspection sheets.

Before opening the container, "mix" the transmission oil to distribute the additives evenly through the oil.

### General information about final-drive transmission oils

Final-drive and hypoid transmission oil must fulfil the following requirements for handling high loads as arise at the tooth flanks of the hypoid gear:

- high load-carrying capacity
- high degree of immunity from seizure
- good protection against wear
- optimum frictional behavior and temperature stability
- compatibility with sealing materials
- resistance to ageing

A brand-name hypoid transmission oil already possesses these and other characteristics thanks to its high concentration of EP agents (EP = Extreme Pressure).

### Oil additives

All final drives are designed in such a way that there is absolutely no need to use oil additives. BMW is totally against the use of such additives. We will also accept no liability for any consequences resulting from the use of additives.

## FINAL-DRIVE GEAR OILS FOR BMW M1 MOTORSPORT COUPE

In the BMW M1, the final drive is integrated into the manual transmission and is lubricated by the same oil. The following oil specifications apply:

During the breaking-in phase or after replacing the final drive (the first 1, 000 km (approx. 620 miles), use of the following oils is approved:

Trade name	Manufacturer/Supplier
Fuchs Renogear H 90	Fuchs
Veedol Multigear AX	Veedol

After this period, only manual-transmission gear oils that comply with specification SAE 80 MIL-L-2105 A or API-GL 4 may be used.

These manual-transmission gear oils are available from the parts sales department:

Trade name	BMW part number	Container size
Manual transmission oil	81 22 9 407 052	20-liter canister
Manual transmission oil	81 22 9 407 053	50-liter barrel
Manual transmission oil	81 22 9 407 178	205-liter barrel

**NOTE:** Oil-change intervals and rules to be followed when breaking can be found in the maintenance documentation or the Repair Instructions of the model in question.

### General information about final-drive transmission oils

Final-drive and hypoid transmission oil must fulfil the following requirements for handling high loads as arise at the tooth flanks of the hypoid gear:

- high load-carrying capacity
- high degree of immunity from seizure
- good protection against wear
- optimum frictional behavior and temperature stability
- compatibility with sealing materials
- resistance to ageing

A brand-name hypoid transmission oil already possesses these and other characteristics thanks to its high concentration of EP agents (EP = Extreme Pressure).

### Oil additives

All final drives are designed in such a way that there is absolutely no need to use oil additives. BMW is totally against the use of such additives. We will also accept no liability for any consequences resulting from the use of additives.

### **HYPOID OILS FOR DIFFERENTIAL X5/X6 REAR AXLE TRANSVERSE MOMENT DISTRIBUTION (QMVH TRANSMISSION)**

**Standard equipment: Series X6 - E71; X5M - F85; X6M - F86**

**Optional equipment: Series X5 - E70, F15, F16**

Trade name	BMW part number China	BMW part number Rest of the world	Container size
	Basic transmission, center: BMW final drive oil SAF-XO	33 11 7 695 240	1000 ml
Variable ratio transmission left/right: BMW final drive oil SAF-Carbon Mod.	83 12 0 446 012	83 12 0 445 832	3 x 500 ml

**NOTE:** For capacities for rear axle differential, see Technical data.

### General information about final-drive transmission oils

Final-drive and hypoid transmission oil must fulfil the following requirements for handling high loads as arise at the tooth flanks of the hypoid gear:

- high load-carrying capacity
- high degree of immunity from seizure
- good protection against wear
- optimum frictional behavior and temperature stability
- compatibility with sealing materials
- resistance to ageing

A brand-name hypoid transmission oil already possesses these and other characteristics thanks to its high concentration of EP agents (EP = Extreme Pressure).



## Oil additives

All final drives are designed in such a way that there is absolutely no need to use oil additives. BMW is totally against the use of such additives. We will also accept no liability for any consequences resulting from the use of additives.

## GREASE FOR FLANGE NUT AND INPUT FLANGE, GLUE FOR THREADS OF FLANGE NUT

The following grease should be used for greasing the contact surfaces of the flange nut to the bearing inner ring and to the insert nut, and for greasing the face of the drive flange.

The Drei Bond glue is to be used for the threads of the flange nut.

Trade name	BMW part number	Container size
Castrol Optitemp HAT LF1	83 23 0 417 754	50g tube
Drei Bond adhesive, type 1385	83 19 0 417 376	50g tube

## OUTPUT SHAFTS

The joints of the output shafts are lubricated for life and therefore maintenance-free. If repairs are carried out, the amount of joint grease required is enclosed in the "Repair kit, gaiter".

## WHEEL BEARINGS

### TAPER ROLLER BEARING

High-temperature multipurpose grease is used to grease the taper roller bearing.

Grease filling in the wheel hub 50 g and in the wheel hub protective cap 20 g per wheel.

Trade name	BMW part number
BMW part number	83 23 9 407 845

The wheel hub protective caps must always be replaced and glued into the wheel hubs during installation with the following adhesive.

Trade name	BMW part number
Loctite No. 638	81 22 9 407 420

### ANGULAR-CONTACT BALL BEARING UNIT

Bearing unit lubricated for life, cannot be dismantled, no re-greasing possible.

### Grooved ball bearing (rear axle) E12, E21, E23, E24 up to mod. 5.82

Trade name	BMW part number
Shell Retinax EP 2	83 23 9 407 845

## SEALANTS - DIFFERENTIAL HOUSING FINAL DRIVE COVERS AND HOUSING

On 735i/iL, 750iL, M6 and M5 (E28) models, the attaching bolts are to be installed with Hylogrip/Loctite 270 (green) thread sealant (former BMW Part No. 81 22 9 400 086).

Wurth Part No. 8932700

Loctite Part No. 21438

**All Models**

Resealing Final drive Cover can be obtained via Applied Industrial Technologies

Order item number 39246 (Loctite 5970 300ml)

## TRANSMISSION OIL FOR ELECTRIC VEHICLES

<b>Model series:I12</b>			
<b>Trade name</b>	<b>Transmission:</b>	<b>BMW part number</b>	<b>Container size</b>
ATF 6	GA6F21AW	83 22 2 355 599	1000 ml
BMW i TF	GE2I12GK	83 22 2 365 760	1000 ml

<b>Series : E82 e; M12, I01, I01 Range extender</b>			
<b>Trade name</b>	<b>Gearbox:</b>	<b>BMW part number</b>	<b>Container size</b>
Hypoid Axle Oil G1	GE1B100H; GE1E84H; GE1B130H; GE1B131H	83 22 2 295 532	3 x 500 ml

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## SUSPENSION

### Steering And Wheel Alignment - Repair - I3 Hybrid & Plug-In - i3\_I01

## SAFETY AND GENERAL INFORMATION

### (72 00... SAFETY REGULATIONS FOR HANDLING COMPONENTS WITH GAS GENERATORS)

**It is essential to comply with the regulations as specified in the law relating to the use of explosives when working on airbag units and seat belt tensioners.**

Airbags, seat belt tensioners etc. are pyrotechnical objects. Pyrotechnical objects are assigned to different danger classes on the basis of the quantity of propellant that they contain. The assignment can be ascertained from the identification marking on the product:

#### *Attention!*

Failure to comply with the warning notices and repair instructions for gas generator components can cause accidental deployment and result in injury and vehicle damage!

This applies in particular to the following components:

- Airbag modules (driver's/front passenger airbags, side airbags)
- Seat belt tensioner
- Head airbag
- Active knee protection
- Active head restraint
- Safety battery terminal

#### 1. Regulations

The regulations quoted in the following refer to the Federal Republic of Germany.

In all other countries, the relevant legislation and regulations must be observed in each case. Country-specific legal regulations that go beyond this information or court decisions based thereon must be followed in each case or given precedence over these regulations.

- Pyrotechnical restraint systems are subject to danger class PT1
- Gas generators are pyrotechnical objects belonging to danger class T1

Handling, transporting and storing non-fired gas generators are subject to the "Explosive Materials Act" (law relating to the use of explosives dated 13/09/1976).

The relevant trade supervisory authority must be notified at least 2 weeks before pyrotechnical objects are handled for the first time. In this process, notify the person responsible at the relevant authority (e.g. dealership owner, holder of general power of attorney, technical supervisor) in writing. A certificate of qualification, i.e. specific training, is not required for the person responsible.

#### 2. Dismantling and installation

- Checking and installation work must be carried out by professionally trained personnel only.
- Work on airbag system components must only ever be carried out with a disconnected vehicle battery, covered negative terminal and disconnected plug connection of the cable leading to the gas generator. Observe the specified waiting period if merely the vehicle battery is disconnected:

- 30 min. for vehicles up to 9/93
- 1 min. for vehicles from 9/93 onward
- In the event of breaks in work, a component with a gas generator that has been removed must be secured against access by other persons.
- Individual components must never be repaired. Instead, always replace them.
- Do not treat airbag system components with cleaning agents or grease.
- Components of the airbag system must not be exposed to temperatures in excess of 75 °C.
- Airbag system components, including electronic diagnostic components, which have been dropped from heights in excess of 0.5 m must not be reinstalled in the vehicles.
- Do not remove components of the airbag system from the original packaging until immediately before they are to be installed in the vehicle.
- Before installing, subject components such as housing, connector pins, etc. of the airbag system (including diagnosis electronics) to a visual inspection for damage and replace if necessary.
- Airbag system components may only be electrically tested while they are installed and only with the diagnosis system.
- **Danger of injury:** The airbag module may only be set down with the airbag itself facing *upwards*. Otherwise the gas generator may be propelled upwards upon potential ignition of the gas generator.
- Do not point the ignition squib of a gas generator at other persons.
- Components with gas generators must not be fired while they are removed. They must be disposed of by special disposal companies or returned in the packaging of the new parts.
- When carrying out straightening and welding work with an electric welder:
  - Disconnect the vehicle battery
  - Cover negative terminal (post)
- Avoid all contact with the skin when removing a fired airbag module - wear gloves. Wash with water after contact with the skin.

### 3. Transport

- Components with gas generators must be sent off in the packaging of the new components.

### 4. Storage

- Observe the regulations of the relevant trade supervisory authority and the applicable national regulations.

## 32 00... ADDITIONAL WORK FOR CAMBER CORRECTION

**NOTE:** The camber adjustment is performed only with the replacement of the swivel bearing. There are 3 different swivel bearings for this!

IMPORTANT: Changes in axle geometry caused by accidents must under no circumstances be rectified by camber adjustment!

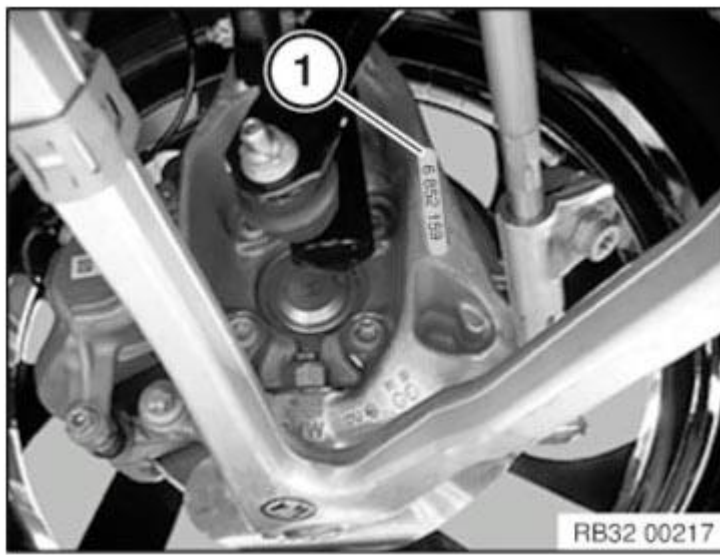
**NOTE:** The swivel bearing may only be replaced if the camber is outside the specified tolerance after toe adjustment.

Necessary preliminary tasks:

Adjust **TOE-IN**.

Check camber values; if necessary, replace **SWIVEL BEARING** with over- or under-dimension variant.

**NOTE:** Camber correction swivel bearings can only be identified from the BMW part number (1).



**Fig. 1: Locating BMW Part Number**

Courtesy of BMW OF NORTH AMERICA, INC.

Version	BMW part number
Standard	6 852 159/160
+ 30'	6 859 113/114
- 30'	6 859 115/116

These camber correction swivel bearings are used to correct the camber values by 30 minutes. To be used only if the tolerance values are exceeded or undershot!

**After Installation note:**

- Check directional stability of car; if necessary, repeat **TOE-IN** adjustment

**32 00 620 ADJUSTING REAR AXLE**

**NOTE:** A camber change always means a toe change as well. The camber must therefore be adjusted first.

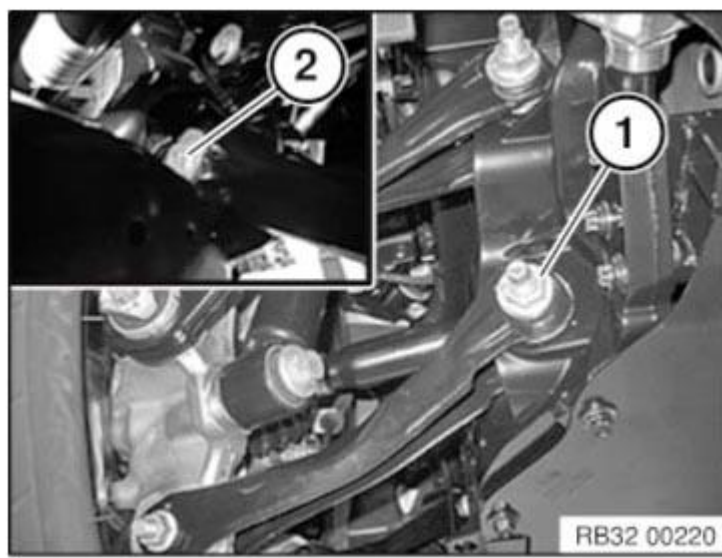
**Adjusting camber:**

Replace nut (1) and apply 5 Nm.

Turn eccentric bolt (2) to adjust camber to setpoint value.

Tighten nut (1) giving counter support to eccentric bolt (2) at same time.

Tightening torque **33 32 9AZ** .



**Fig. 2: Identifying Camber Nut And Eccentric Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

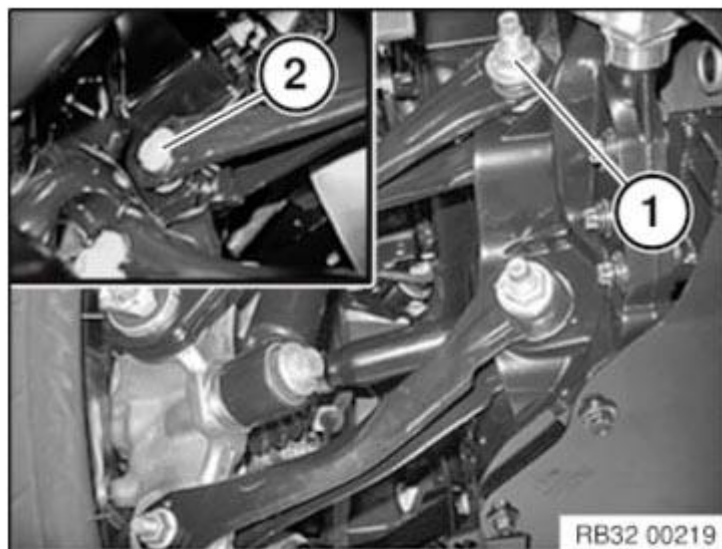
**Adjusting toe:**

Replace nut (1) and apply 5 Nm.

Turn eccentric bolt (2) to adjust toe to setpoint value.

Tighten nut (1) giving counter support to eccentric bolt (2) at same time.

Tightening torque [33 32 7AZ](#) .



**Fig. 3: Identifying Toe Nut And Eccentric Bolt**  
Courtesy of BMW OF NORTH AMERICA, INC.

**32 00 601 ADJUSTING TOE-IN ON FRONT AXLE**

**IMPORTANT:** Changes in axle geometry caused by accidents must under no circumstances be rectified by camber adjustment!

**NOTE:** Camber and toe-in influence each other. Adjust the toe-in first in order to simplify the adjustment procedure.

The camber adjustment is performed only with the replacement of the swivel bearing. There are various swivel bearings (+/-30') for this purpose.



-> See also [ADDITIONAL WORK FOR CAMBER CORRECTION](#).

Bring wheels to straight-ahead position or move the steering wheel to straight-ahead position and secure with a steering wheel lock.

### **Adjust toe-in:**

Clean thread on track rod.

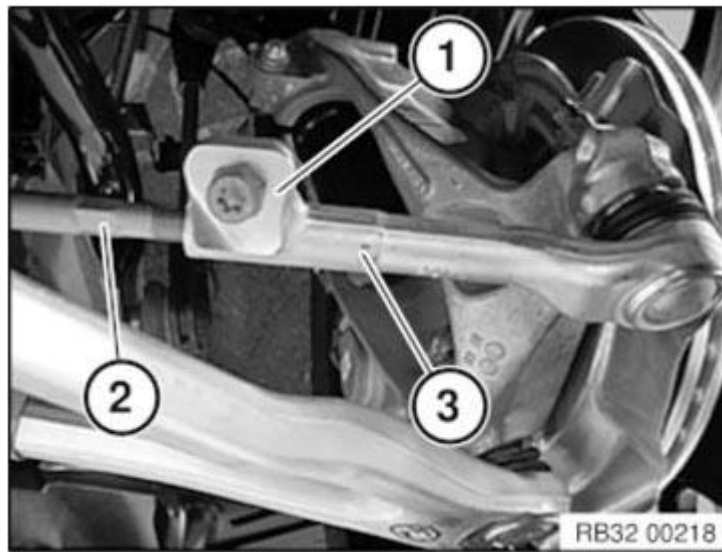
Slacken bolt (1).

Twist track rod (2) to adjust toe-in to setpoint value, if necessary counterhold track rod end (3).

Tighten screw (2).

Tightening torque [32 21 2AZ](#) .

If necessary, correct installation position of gaiter.

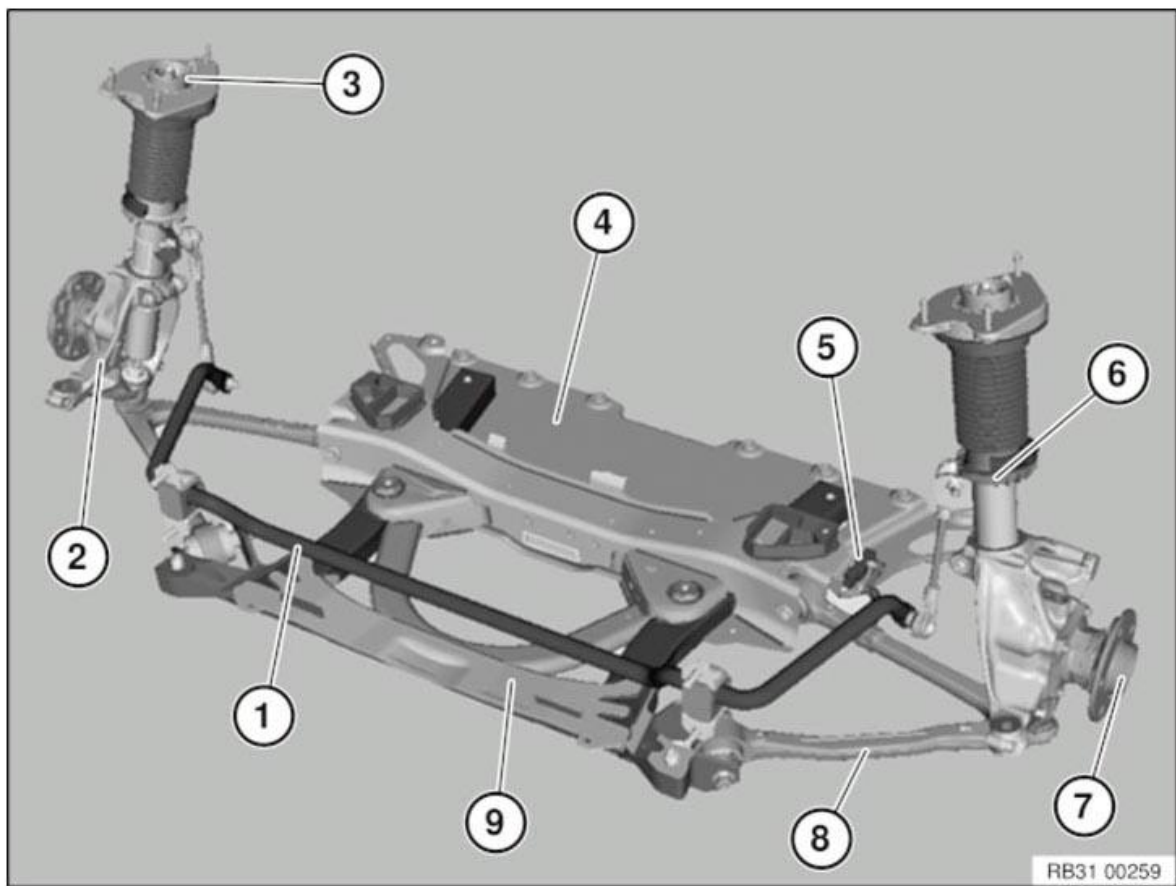


**Fig. 4: Identifying Toe-In Bolt, Track Rod And Track Rod End**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **After Installation note:**

- Check directional stability of vehicle; if necessary, repeat toe-in adjustment

**31 00... FRONT AXLE + STEERING REPAIR WORK REQUIRING SUBSEQUENT WHEEL ALIGNMENT CHECK**



**Fig. 5: Identifying Front Axle And Steering Wheel Alignment Components**  
 Courtesy of BMW OF NORTH AMERICA, INC.

A wheel/chassis alignment check must be carried out after the following work:

**Release the following screw connections:**

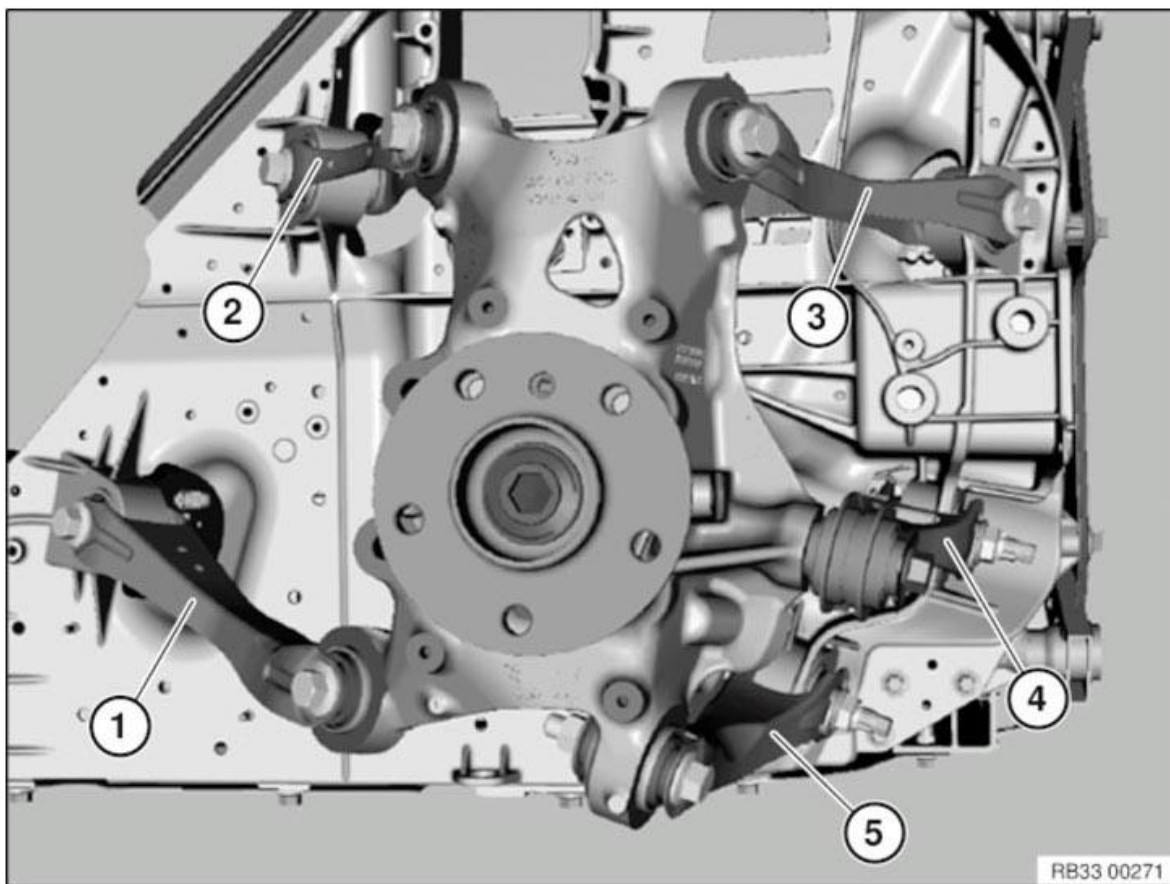
- Steering box to front axle carrier
- Lower wishbone to front axle carrier
- Track rod end to track rod

**Replace the following components:**

- EPS steering box
- Front axle support
- Wishbone
- Track rod end
- Track rod
- Swivel bearing

Refer to **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)**.

**33 00... REAR AXLE REPAIR WORK REQUIRING SUBSEQUENT WHEEL ALIGNMENT CHECK**



**Fig. 6: Identifying Rear Axle Wheel Alignment Components**  
 Courtesy of BMW OF NORTH AMERICA, INC.

A wheel/chassis alignment check must be carried out after the following work:

- **Release the following screw connection:**
  - Track control arm on rear axle module (4)
  - Toe arm to wheel carrier (4)
  - Camber control arm on rear axle module (5)
  - Camber arm to wheel carrier (5)
- **Replacement of following parts:**
  - Rubber mount for track control arm (4) in rear axle module
  - Rubber mount for camber control arm (5) in rear axle module
  - Toe arm (4)
  - Toe arm (5)
  - Control arm (2)
  - Wishbone (3)
  - Wheel carrier

Refer to **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)**.

### **32 00... NOTES ON STEERING GEAR/STEERING COLUMN/STEERING SHAFT REPLACEMENT FOLLOWING ACCIDENT DAMAGE**

#### **Steering gear facts:**

In the event of accidents or driving conditions similar to accidents, shock-like loads can cause different types of damage to steering boxes. When a steering box is externally undamaged, it is sometimes only possible to identify damage with great difficulty and with great effort. However, damage of this nature poses an unacceptable risk to the vehicle which can result in failure of the steering system.

Because of the disproportionate amount of effort involved, it is generally not sensible to check thoroughly all the individual components of the steering box and as an alternative it is necessary to take into account other components which can be checked more easily.

### **Steering gear procedure:**

The steering box must be replaced if one or more of the following points apply:

- A. Visible or noticeable damage to the steering box
  - Version with electric steering box (EPS): Examine in particular the control unit with all plug connections for damage and hairline cracks.
- B. Unacceptable torque increase and jamming when the steering box is turned from lock to lock (without hydraulic/electrical assistance)
- C. Fire damage
- D. Damage, permanent deformation or fractures to:
  - Wheel rims in the event of a negative result from the wheel alignment check
  - Spring struts, steering stubs, wheel carriers
  - Wishbones
  - Struts or trailing links or anti-roll bar with this function
  - Body-side screwing/attachment points for wheel guide/control components
  - Front axle support
  - Drop arm
  - Track rods
  - Steering box fixtures
  - Steering column

A crooked steering wheel, clear deviation of the camber values/toe values and noise when cranking the steering can be additional indications for the damages/deformations listed here!

**NOTE:**        **If the steering box replacement work which is required for safety reasons is refused by the customer or an insurance company for cost reasons, a memorandum to that effect must be drawn up and countersigned by the party bearing the costs of the accident repair.**

### **Actual situation of the steering column and steering shaft:**

In the event of accidents or driving conditions similar to accidents, shock-like loads can cause different types of damage to the steering shaft and steering column. In case no external damaged of the steering column and the steering shaft can be noticed, it is sometimes only possible to identify damage with great difficulty and with great effort.

### **Procedure for steering column and steering shaft:**

The steering column and steering shaft must be replaced if one or more of the following points apply:

- Visible or noticeable damage, deformation or breakage of the steering column or steering shaft
- Damage, permanent deformation or breakage of the track rod
- Unacceptable torque increase and jamming when the steering column is cranked from limit position to limit position (without hydraulic/electrical assistance)
- Permissible tolerances exceeded after wheel adjustment and wheel alignment (include alignment record with invoice/report if necessary)
- Positive check for activated crash system of the steering column
- If no damage is visible on the steering column, the mechanical steering column must be checked for an activated crash system:
  1. Open steering column lock
  2. Pull steering wheel out towards the driver (towards the body) until the physical limit position is reached, but do not use excessive force

3. Push steering wheel towards engine compartment (approx. 20-30 mm away from body) into the comfort position and lock

If no end stop is present when pulling out the steering column or the gaiter of the steering column shroud has tension, the crash system has activated and the steering column is to be renewed.

**NOTE:** If the steering column/steering shaft replacement work which is required for safety reasons is rejected by the customer or an insurance company for cost reasons, a memorandum to that effect must be drawn up and countersigned by the party bearing the costs of the accident repair.

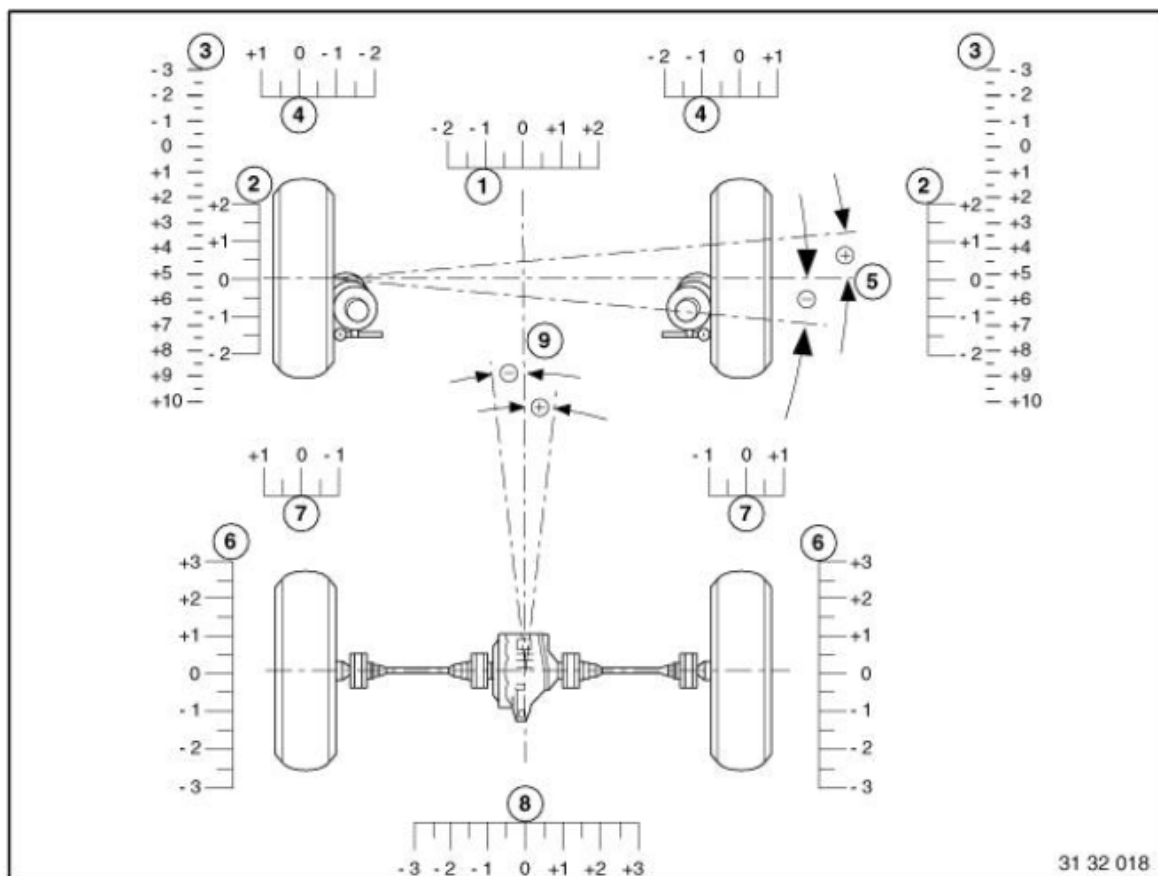
**Attention!**

The vehicle's operating licence will be invalidated whenever the function of any of its safety components is compromised!

This guideline is binding for all accident repairs to BMW, MINI and Rolls Royce vehicles!

**32 00... DESCRIPTION OF FRONT AXLE AND WHEEL ALIGNMENT**

General overview:



- |   |                             |
|---|-----------------------------|
| 1. Toe  | 5. Wheel misalignment       |
| 2. Camber                                     | 6. Camber                   |
| 3. Caster (with 10° or 20° wheel lock)        | 7. Rear-wheel position      |
| 4. Toe angle difference (with 20° wheel lock) | 8. Toe                      |
|   | 9. Geometrical driving axis |

**Fig. 7: Identifying General Chassis And Suspension Definitions**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Toe angle difference:

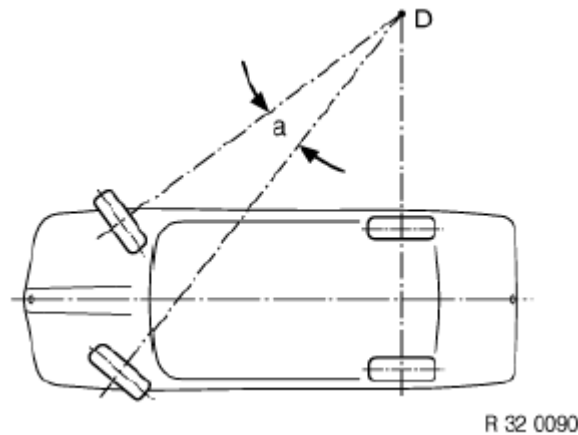
**a** = Toe difference angle

**D** = Center point of operating circle

The toe angle difference is the angle adjustment of the inner cornering wheel relative to the outer cornering wheel when negotiating a curve. Steering is designed in such a way that angular position of wheels changes as steering lock progresses.

A correctly adjusted toe angle difference produces equal values for left and right lock with consideration of factory tolerances.

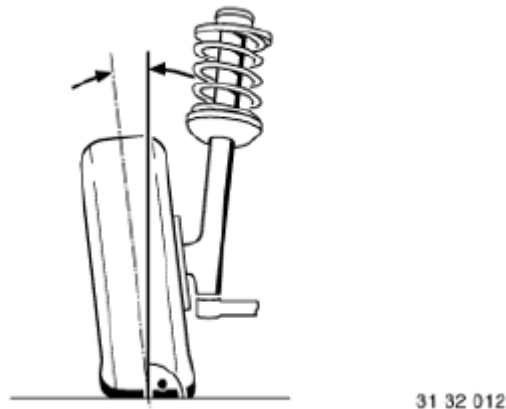
Toe angle difference provides information on corresponding operation of steering trapezoid for left or right steering lock from center position.



**Fig. 8: Identifying Toe-Differential Angle**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Camber:**

This is the inclination of the wheel from the perpendicular.



**Fig. 9: Identifying Camber**  
Courtesy of BMW OF NORTH AMERICA, INC.

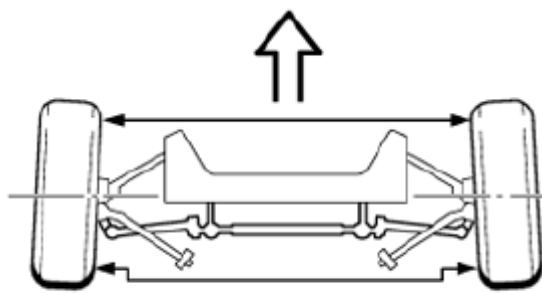
**Toe:**

This is the reduction in distance of front of front wheels to rear of front wheels. The toe-in prevents the wheels from moving apart during driving and thus:

- the wheels from vibrating and grinding
- excessive tire wear
- excessive strain on the steering linkage and its links/joints
- heavy vehicle steering

Measurement is performed in "straight-ahead mode".





31 32 010

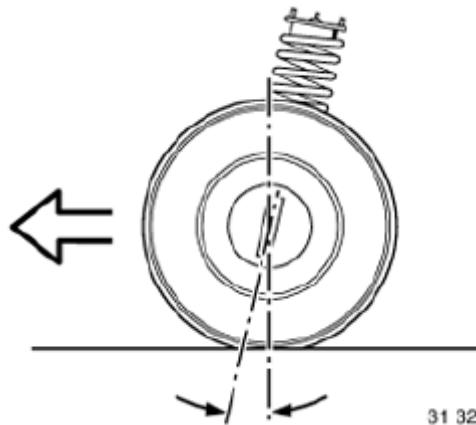
**Fig. 10: Identifying Toe-In**

Courtesy of BMW OF NORTH AMERICA, INC.

**Caster:**

This is the inclination of the kingpin in the direction of travel viewed from the side. The line through the center point of the spring strut support bearing and the control arm ball joint corresponds to the "kingpin".

Thanks to caster, wheels are pulled and not pushed. In a similar manner to king pin inclination, when driving in curves or around corners, returning forces are reproduced to help return wheels to straight-ahead position.



31 32 014

**Fig. 11: Identifying Caster**

Courtesy of BMW OF NORTH AMERICA, INC.

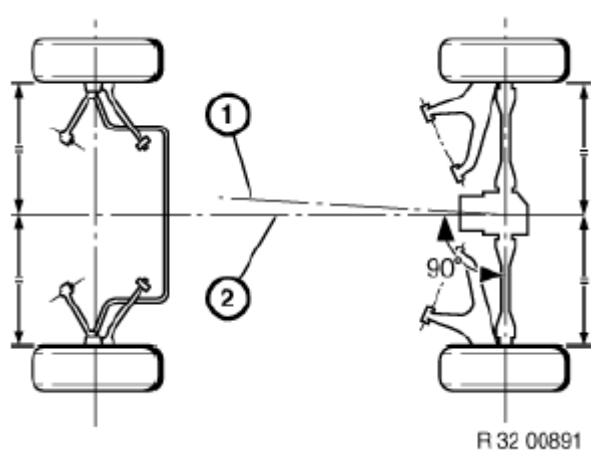
**Geometrical driving axis (1):**

This is the angle bisector from the total rear-wheel toe.

Front-wheel measurements are taken in reference to this axis.

**Symmetrical axis (2):**

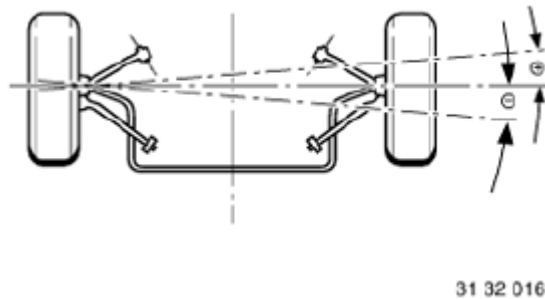
This is the center line running through front and rear axles.



**Fig. 12: Identifying Geometrical Driving Axis And Symmetrical Axis**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Wheel misalignment:**

This is the angle by which one front wheel is displaced more towards front or rear than the other front wheel. The wheel offset angle is positive when the right wheel is displaced towards the front and negative when it is displaced towards the rear.

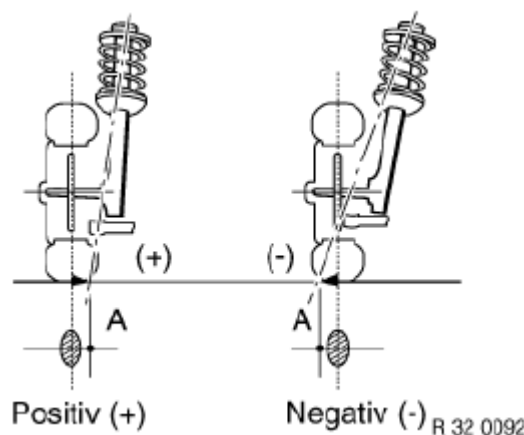


**Fig. 13: Identifying Wheel Displacement Angle**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**Kingpin offset/scrub radius:**

This is the distance from the center of the wheel contact face to the intersection point of the kingpin extension. The line through the center point of the spring strut support bearing and the control arm ball joint corresponds to the "kingpin".

The scrub radius is influenced by camber, kingpin angle and wheel offset of the wheel rim.



**Fig. 14: Identifying Kingpin Offset**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**32 00 150 KDS CHASSIS/WHEEL ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION**

Carry out wheel alignment with DIN load **only** :

- IMPORTANT:**
- If the technical prerequisites for alignment with ride height input are not fulfilled
  - If the vehicle in question is a damaged vehicle

**NOTE:**

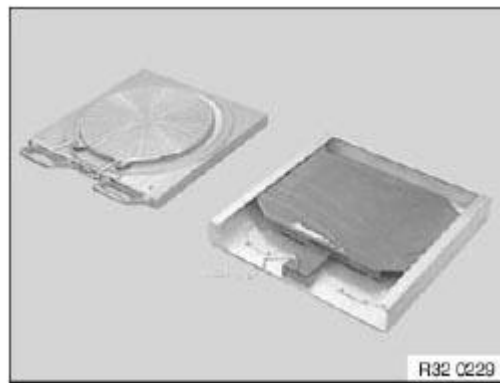
- Read and comply with **GENERAL INFORMATION AND DEFINITIONS**.
- Update **KDS DATA STATES**
- Check compliance with **TEST CONDITIONS**, repair vehicle if necessary.
- If necessary, prepare vehicle hoist.
- Drive vehicle onto vehicle hoist.

**NOTE:**

The front and rear wheels must be positioned centrally on the rotary and sliding plates.

**NOTE:**

Rotary plates may vary from illustration depending on the manufacturer!



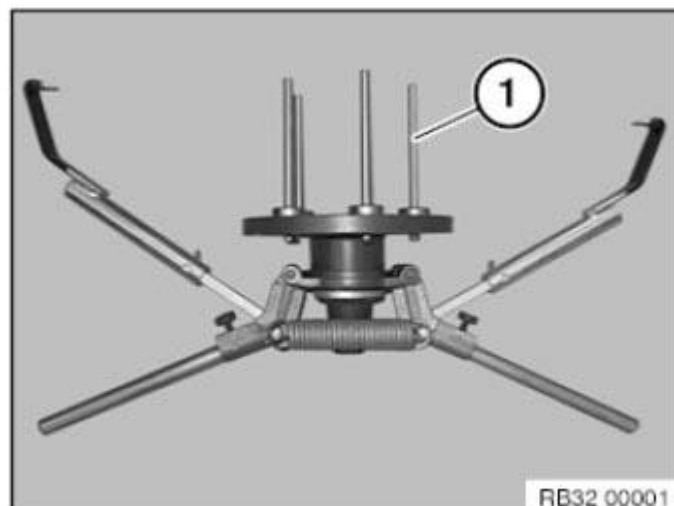
**Fig. 15: Identifying Rotary And Sliding Plates**

Courtesy of BMW OF NORTH AMERICA, INC.

Attach pickup/ride height marks to vehicle (observe specifications from the various equipment manufacturers).

Use only quick connectors with poly control pins (1).

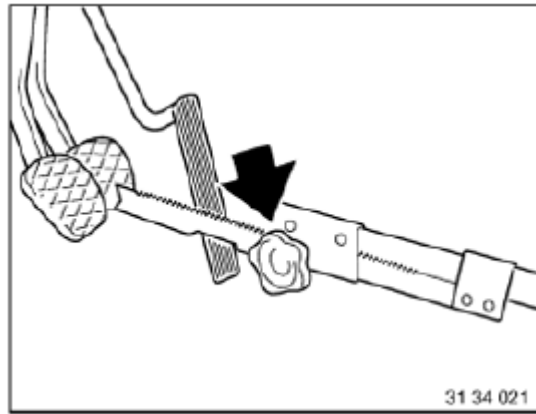
**IMPORTANT:** Due to excessive measuring inaccuracy, other quick-clamping units are not permitted!  
Graphic of KDS II pickup



**Fig. 16: Identifying Poly Control Pins**

Courtesy of BMW OF NORTH AMERICA, INC.

- Enter customer and vehicle data
- Identify chassis version and select vehicle
- Enter tire inflation pressure and tread depth
- Move **VEHICLE INTO DESIGN POSITION**
- Install brake tensioner.



**Fig. 17: Securing Brake Pedal With Pedal Support**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Remove locking pins from both rotary and sliding plates.
- Perform input measurement in accordance with equipment manufacturer's instructions.
- If necessary, adjust front axle and rear axle
- Perform output measurement in accordance with equipment manufacturer's instructions.
- Save and print out test record.
- Insert locking pins into both rotary and sliding plates
- Remove chassis/wheel alignment system

### **32 00... Test conditions for chassis/wheel alignment check**

Observe the following test conditions prior to the chassis/wheel alignment check:

1. Only BMW approved wheel and tire combinations may be installed on the vehicle
2. Correct tread depth. The tread depth for each axle may differ from left to right by max. 1-2 mm.
3. Correct tire pressure (see label on vehicle).
4. All chassis and suspension components must be technically OK.
5. Condition of suspension and shock absorbers OK: Visually inspect for breakage, etc.

### **32 00... KDS data statuses**

**NOTE:** Applies to HunterÂ® KDS wheel alignment systems.

Setpoint values for wheel alignment are not published.

The current setpoint values for this specific shop equipment can be obtained via BMW.

### **32 00 155 KDS WHEEL ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT WITHOUT VEHICLE LOAD**

Do not perform wheel alignment with the vehicle unladen.

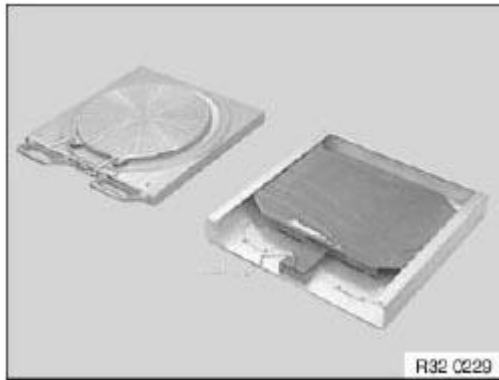
- IMPORTANT:**
- If the technical prerequisites for alignment with ride height input are not fulfilled
  - If the vehicle in question is a damaged vehicle

**NOTE:**

- Read and comply with **GENERAL INFORMATION AND DEFINITIONS**.
- Update **KDS DATA STATES**
- Check compliance with **TEST CONDITIONS**, repair vehicle if necessary.
- If necessary, prepare vehicle hoist.
- Drive vehicle onto vehicle hoist.

**NOTE:** The front and rear wheels must be positioned centrally on the rotary and sliding plates.

**NOTE:** Rotary plates may vary from illustration depending on the manufacturer!

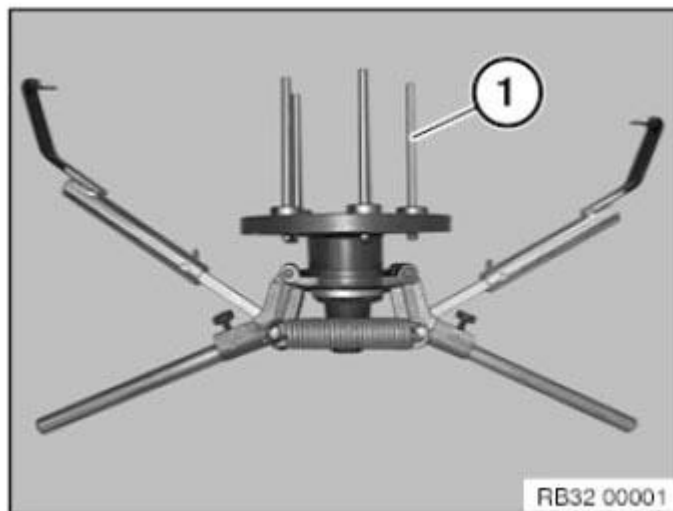


**Fig. 18: Identifying Rotary And Sliding Plates**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Attach pickup/ride height marks to vehicle (observe specifications from the various equipment manufacturers).

Use only quick connectors with poly control pins (1).

**IMPORTANT:** Due to excessive measuring inaccuracy, other quick-clamping units are not permitted!  
 Illustration of KDSII pick-up!

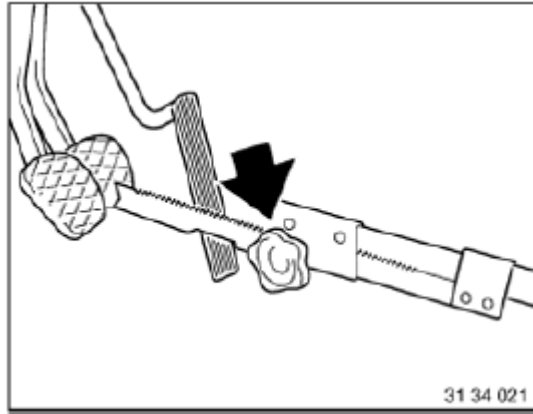


**Fig. 19: Identifying Poly Control Pins**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- Enter customer and vehicle data
- Identify chassis version and select vehicle
- Enter tire inflation pressure and tread depth
- Measure **VEHICLE RIDE HEIGHT** with tape measure (only Beissbarth KDSII wheel alignment equipment)

If the ride height is outside the tolerance range (+40/-20 mm), load or unload vehicle accordingly to adjust the vehicle in this ride-height window

- Install brake tensioner.

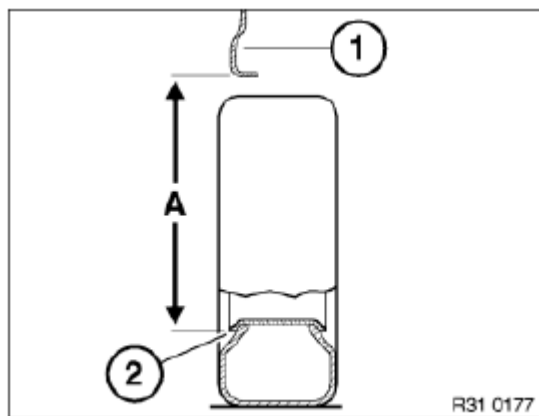


**Fig. 20: Securing Brake Pedal With Pedal Support**  
Courtesy of BMW OF NORTH AMERICA, INC.

- Remove locking pins from both rotary and sliding plates.
- Perform input measurement in accordance with equipment manufacturer's instructions.
- If necessary, adjust front axle and rear axle
- Perform output measurement in accordance with equipment manufacturer's instructions.
- Save and print out test record.
- Insert locking pins into both rotary and sliding plates
- Remove chassis/wheel alignment system

### **31 33... MEASURING VEHICLE RIDE HEIGHT**

Determine actual ride height (A) - to do so, attach tape measure to rim flange (2) at bottom middle and measure to wheel arch lower edge (1).



**Fig. 21: Identifying Actual Ride Height**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **32 00... MOVING VEHICLE INTO DESIGN POSITION**

**Necessary preliminary work:**

- Move **VEHICLE INTO NORMAL POSITION**
- Add/distribute weights in area of spring struts until the vehicle ride height is within the tolerance (refer to **FRONT AXLE - RIDE HEIGHT** and **REAR AXLE - RIDE HEIGHT** ).

Measure **VEHICLE RIDE HEIGHT** .



### Necessary preliminary work:

- Check compliance with **TEST CONDITIONS**, repair vehicle if necessary.
- Check vehicle interior and luggage compartment (incl. spare wheel well) for load, unload vehicle if necessary
- Introduce **DIN LOAD** into vehicle

## MECHANICAL STEERING GEAR

### (32 00... NOTES ON STEERING GEAR/STEERING COLUMN/STEERING SHAFT REPLACEMENT FOLLOWING ACCIDENT DAMAGE)

#### Steering gear facts:

In the event of accidents or driving conditions similar to accidents, shock-like loads can cause different types of damage to steering boxes. When a steering box is externally undamaged, it is sometimes only possible to identify damage with great difficulty and with great effort. However, damage of this nature poses an unacceptable risk to the vehicle which can result in failure of the steering system.

Because of the disproportionate amount of effort involved, it is generally not sensible to check thoroughly all the individual components of the steering box and as an alternative it is necessary to take into account other components which can be checked more easily.

#### Steering gear procedure:

The steering box must be replaced if one or more of the following points apply:

- A. Visible or noticeable damage to the steering box
  - Version with electric steering box (EPS): Examine in particular the control unit with all plug connections for damage and hairline cracks.
- B. Unacceptable torque increase and jamming when the steering box is turned from lock to lock (without hydraulic/electrical assistance)
- C. Fire damage
- D. Damage, permanent deformation or fractures to:
  - Wheel rims in the event of a negative result from the wheel alignment check
  - Spring struts, steering stubs, wheel carriers
  - Wishbones
  - Struts or trailing links or anti-roll bar with this function
  - Body-side screwing/attachment points for wheel guide/control components
  - Front axle support
  - Drop arm
  - Track rods
  - Steering box fixtures
  - Steering column

A crooked steering wheel, clear deviation of the camber values/toe values and noise when cranking the steering can be additional indications for the damages/deformations listed here!

**NOTE:** If the steering box replacement work which is required for safety reasons is refused by the customer or an insurance company for cost reasons, a memorandum to that effect must be drawn up and countersigned by the party bearing the costs of the accident repair.

#### Actual situation of the steering column and steering shaft:

In the event of accidents or driving conditions similar to accidents, shock-like loads can cause different types of damage to the steering shaft and steering column. In case no external damaged of the steering column and the steering shaft can be noticed, it is sometimes only possible to identify damage with great difficulty and with great effort.

### **Procedure for steering column and steering shaft:**

The steering column and steering shaft must be replaced if one or more of the following points apply:

- Visible or noticeable damage, deformation or breakage of the steering column or steering shaft
- Damage, permanent deformation or breakage of the track rod
- Unacceptable torque increase and jamming when the steering column is cranked from limit position to limit position (without hydraulic/electrical assistance)
- Permissible tolerances exceeded after wheel adjustment and wheel alignment (include alignment record with invoice/report if necessary)
- Positive check for activated crash system of the steering column
- If no damage is visible on the steering column, the mechanical steering column must be checked for an activated crash system:
  1. Open steering column lock
  2. Pull steering wheel out towards the driver (towards the body) until the physical limit position is reached, but do not use excessive force
  3. Push steering wheel towards engine compartment (approx. 20-30 mm away from body) into the comfort position and lock

If no end stop is present when pulling out the steering column or the gaiter of the steering column shroud has tension, the crash system has activated and the steering column is to be renewed.

**NOTE:** If the steering column/steering shaft replacement work which is required for safety reasons is rejected by the customer or an insurance company for cost reasons, a memorandum to that effect must be drawn up and countersigned by the party bearing the costs of the accident repair.

### ***Attention!***

The vehicle's operating licence will be invalidated whenever the function of any of its safety components is compromised!

This guideline is binding for all accident repairs to BMW, MINI and Rolls Royce vehicles!

## **32 11 100 REPLACING GAITER FOR STEERING BOX ON LEFT OR RIGHT**

**WARNING:** High-voltage system - danger to life

- Observe **SAFETY INFORMATION** for handling electric vehicles.

**IMPORTANT:** The steering box must be replaced if the polished surface of the rack is damaged (e.g. by corrosion)!

### **Necessary preliminary tasks:**

- Remove **TRACK ROD END**.

Clean track rod.

Release **EAR CLAMP** (1) and band clamp (2).

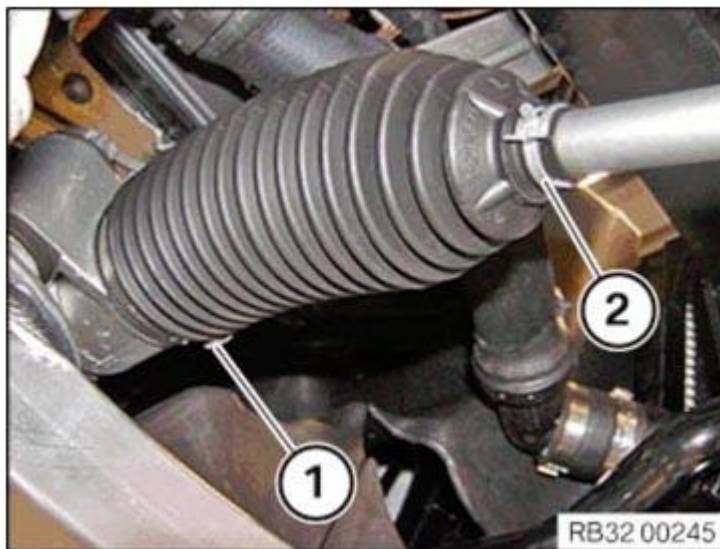
Detach gaiter from track rod.

*Installation note:*

Clean rack and check surface for damage (e.g. by corrosion).

Clean track rod and apply grease to taper.

- This ensures that the gaiter is not rotated when the track rod is rotated.



**Fig. 22: Identifying Track Rod Ear And Band Clamps**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Carry out wheel alignment procedure. Refer to **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)**.

**32 41... Instructions for removing and installing ear clips**

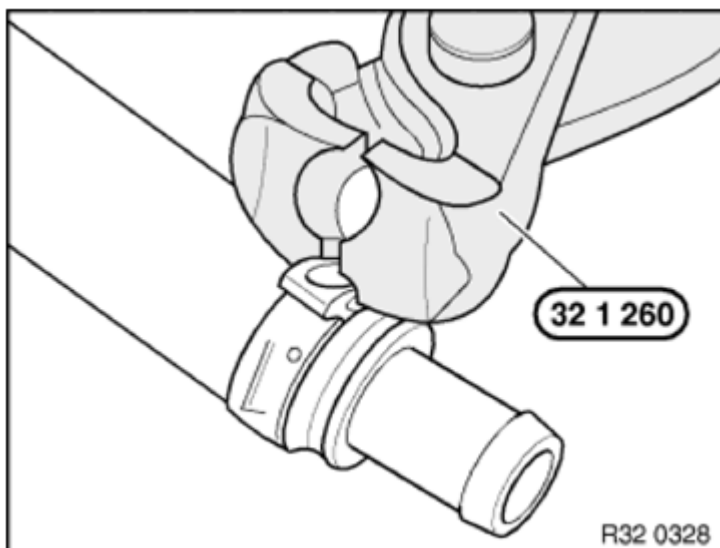
**Special tools required:**

- 32 1 260

**NOTE:** The work steps are show on assorted components.

**Ear clip must always be replaced.**

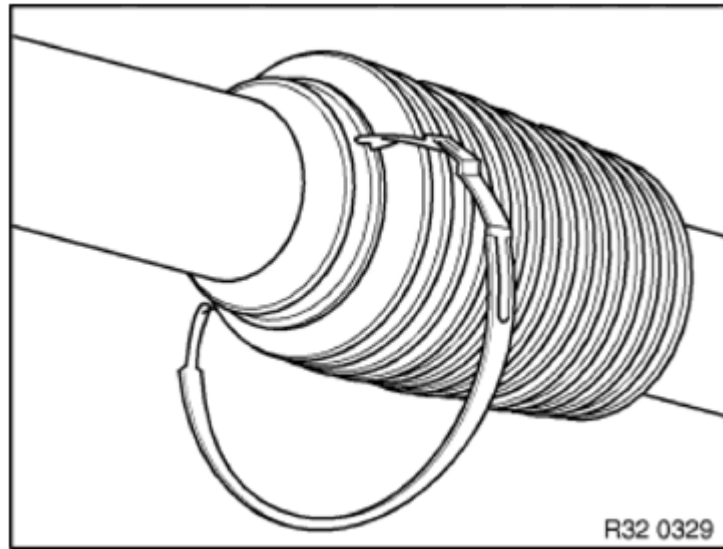
To remove an ear clip, place special tool 32 1 260 at right angles to ear and cut ear open.



**Fig. 23: Removing Ear Clip**

Courtesy of BMW OF NORTH AMERICA, INC.

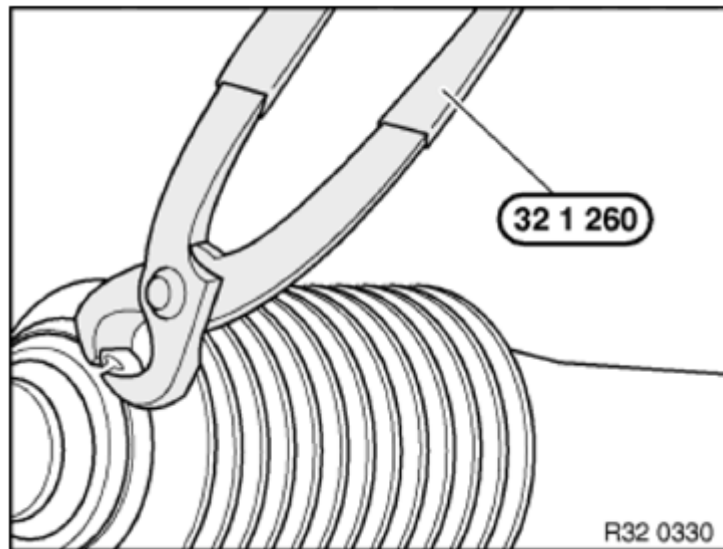
The ear clip can be fitted not only axially but also radially after the hook fastener has been opened.



**Fig. 24: Identifying Ear Clip**

Courtesy of BMW OF NORTH AMERICA, INC.

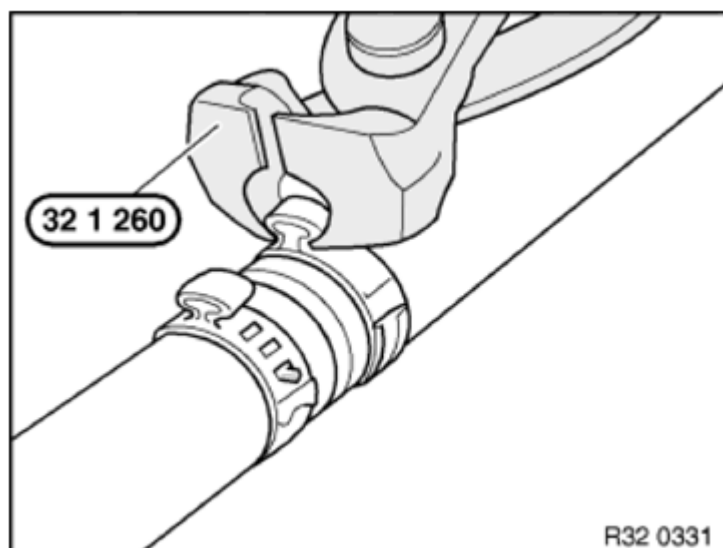
Attach hook fastener and press ear together with special tool 32 1 260.



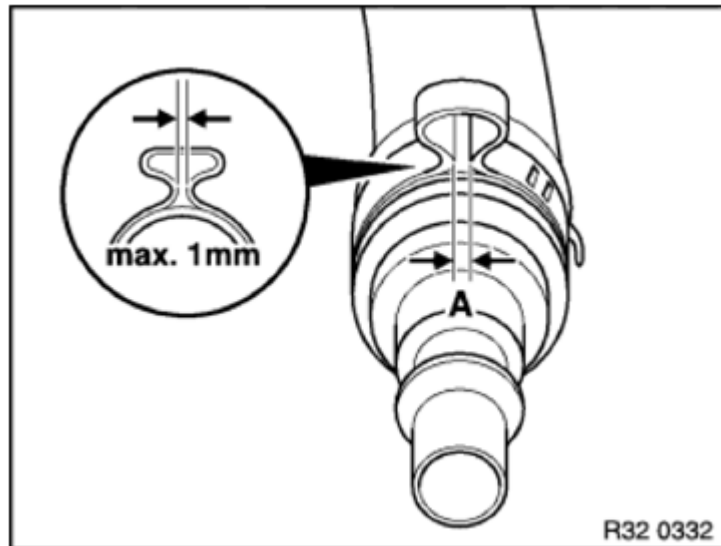
**Fig. 25: Pressing Ear Together With Special Tool**

Courtesy of BMW OF NORTH AMERICA, INC.

The diagonal cutting pliers of special tool 32 1 260 can be used in areas which are difficult to access.



IMPORTANT: Gap (A) max. 1 mm!



**Fig. 27: Checking Ear Clip Gap**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **STEERING GEAR WITH SERVO UNIT**

### **(32 00... NOTES ON STEERING GEAR/STEERING COLUMN/STEERING SHAFT REPLACEMENT FOLLOWING ACCIDENT DAMAGE)**

#### **Steering gear facts:**

In the event of accidents or driving conditions similar to accidents, shock-like loads can cause different types of damage to steering boxes. When a steering box is externally undamaged, it is sometimes only possible to identify damage with great difficulty and with great effort. However, damage of this nature poses an unacceptable risk to the vehicle which can result in failure of the steering system.

Because of the disproportionate amount of effort involved, it is generally not sensible to check thoroughly all the individual components of the steering box and as an alternative it is necessary to take into account other components which can be checked more easily.

#### **Steering gear procedure:**

The steering box must be replaced if one or more of the following points apply:

- A. Visible or noticeable damage to the steering box
  - Version with electric steering box (EPS): Examine in particular the control unit with all plug connections for damage and hairline cracks.
- B. Unacceptable torque increase and jamming when the steering box is turned from lock to lock (without hydraulic/electrical assistance)
- C. Fire damage
- D. Damage, permanent deformation or fractures to:
  - Wheel rims in the event of a negative result from the wheel alignment check
  - Spring struts, steering stubs, wheel carriers
  - Wishbones
  - Struts or trailing links or anti-roll bar with this function
  - Body-side screwing/attachment points for wheel guide/control components
  - Front axle support
  - Drop arm

- Track rods
- Steering box fixtures
- Steering column

A crooked steering wheel, clear deviation of the camber values/toe values and noise when cranking the steering can be additional indications for the damages/deformations listed here!

**NOTE:** If the steering box replacement work which is required for safety reasons is refused by the customer or an insurance company for cost reasons, a memorandum to that effect must be drawn up and countersigned by the party bearing the costs of the accident repair.

#### **Actual situation of the steering column and steering shaft:**

In the event of accidents or driving conditions similar to accidents, shock-like loads can cause different types of damage to the steering shaft and steering column. In case no external damaged of the steering column and the steering shaft can be noticed, it is sometimes only possible to identify damage with great difficulty and with great effort.

#### **Procedure for steering column and steering shaft:**

The steering column and steering shaft must be replaced if one or more of the following points apply:

- Visible or noticeable damage, deformation or breakage of the steering column or steering shaft
- Damage, permanent deformation or breakage of the track rod
- Unacceptable torque increase and jamming when the steering column is cranked from limit position to limit position (without hydraulic/electrical assistance)
- Permissible tolerances exceeded after wheel adjustment and wheel alignment (include alignment record with invoice/report if necessary)
- Positive check for activated crash system of the steering column
- If no damage is visible on the steering column, the mechanical steering column must be checked for an activated crash system:
  1. Open steering column lock
  2. Pull steering wheel out towards the driver (towards the body) until the physical limit position is reached, but do not use excessive force
  3. Push steering wheel towards engine compartment (approx. 20-30 mm away from body) into the comfort position and lock

If no end stop is present when pulling out the steering column or the gaiter of the steering column shroud has tension, the crash system has activated and the steering column is to be renewed.

**NOTE:** If the steering column/steering shaft replacement work which is required for safety reasons is rejected by the customer or an insurance company for cost reasons, a memorandum to that effect must be drawn up and countersigned by the party bearing the costs of the accident repair.

#### ***Attention!***

The vehicle's operating licence will be invalidated whenever the function of any of its safety components is compromised!

This guideline is binding for all accident repairs to BMW, MINI and Rolls Royce vehicles!

### **32 10... TEACHING IN END STOP SOFTWARE FOR ELECTRIC STEERING GEAR (EPS)**

**NOTE:** The end stop software must be taught in:

- after the steering gear is replaced
- after programming/coding



Connect vehicle to BMW diagnosis system.

Select and perform end stop under Service functions.

### 32 13 572 REPLACE ELECTRICAL STEERING BOX (EPS)

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

#### Connecting line:

IMPORTANT: In the event of moisture/corrosion inside the two plug connections, check the insulation of the connecting line. If the insulation reveals any noticeable/striking features, partial replacement will be necessary. Otherwise it will be sufficient to replace the contacts or connector housing.

**NOTE:** In a warranty case you must always provide a fault memory printout, even where there is no fault entry, with the defective part.

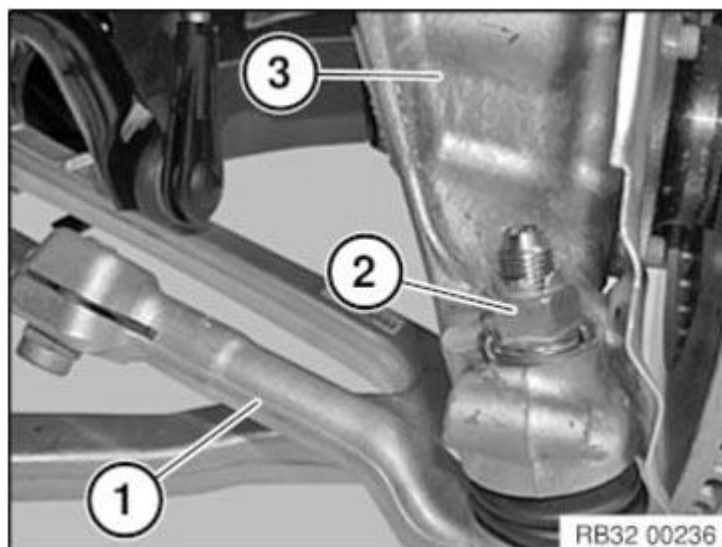
IMPORTANT: Do not turn the steering wheel once the steering shaft has been detached from the steering gear. If the lower section of the steering shaft is separated from the steering gear, the steering column switch cluster may be damaged when the steering wheel is turned.

#### Necessary preliminary tasks:

- Clamp off [BATTERY EARTH LEAD](#) .
- Remove [FRONT WHEELS](#) .
- Lower front axle. See [LOWERING/RAISING FRONT AXLE SUPPORT \(NO RANGE EXTENDER\)](#) or [LOWERING/RAISING FRONT AXLE SUPPORT \(WITH RANGE EXTENDER\)](#) .

IMPORTANT: Do not release track rod end from swivel bearing with impact tool. Rubber boot must not be damaged!

Release nuts (2) of track rods at swivel bearing (3).



**Fig. 28: Identifying Track Rod End, Swivel Bearing And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

- At the same time, counter support at the Torx socket.

Tightening torque [32 21 3AZ](#) .

Release track rod ends (1) from swivel bearing (3).

*Installation note:*

Keep track rod end to swivel bearing connection clean and free from oil and grease.

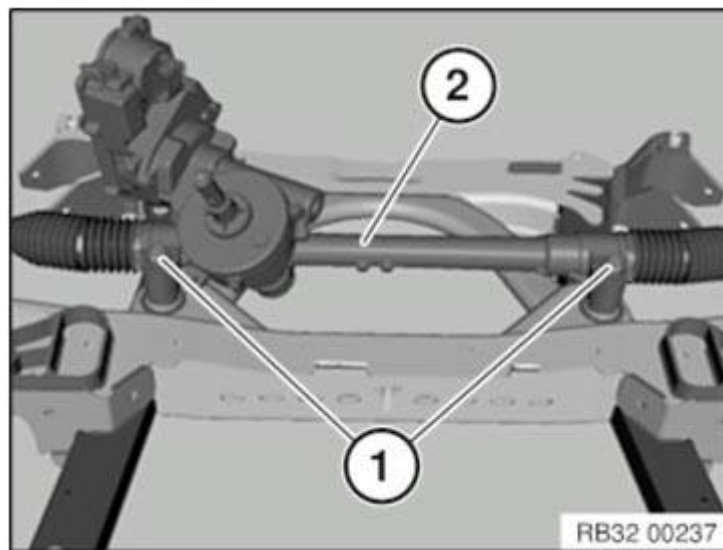
Replace nuts.

Loosen screws (1).

Tightening torque, [32 00 1AZ](#) .

Remove steering gear (2) to the left.

**IMPORTANT:** Risk of damage!  
Pay attention to connector housing on steering box while removing steering box!



**Fig. 29: Identifying Steering Gear And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace screws.

**IMPORTANT:** Protective cap of steering gear is filled with grease.  
A discharge of grease (1) is not faulty!



**Fig. 30: Locating Grease Discharge**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Remount **TRACK ROD END** on left and right.

Or check and replace if necessary!

**After installation:**

- Carry out **PROGRAMMING/ENCODING** .
- Turn steering wheel in both directions to the limit position. The airbag indicator light must not light up in the process.
- Teach in **END STOP SOFTWARE**.
- Perform wheel alignment. Refer to **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)**.

## **STEERING ARMS, TIE RODS, STEERING DAMPER**

### **32 21 231 REPLACING (REMOVING AND INSTALLING) LEFT OR RIGHT TRACK ROD**

**Special tools required:**

- **2 287 009**

**IMPORTANT:** The steering box must be replaced if the polished surface of the rack is damaged (e.g. by corrosion)!

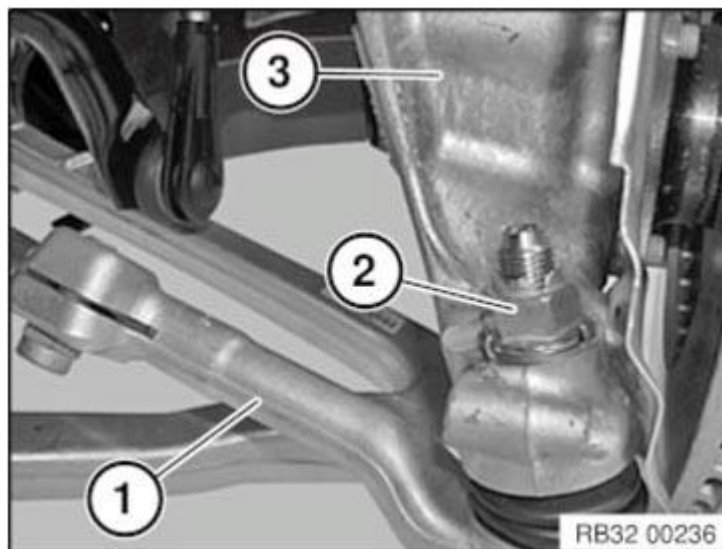
Slacken nut (2).

- If necessary, hold up at the Torx socket.

Tightening torque **32 21 3AZ** .

Remove track rod end (1) from swivel bearing (3).

*Installation note:*



**Fig. 31: Identifying Track Rod End, Swivel Bearing And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Keep track rod end to swivel bearing connection clean and free from oil and grease.

Replace self-locking nut.

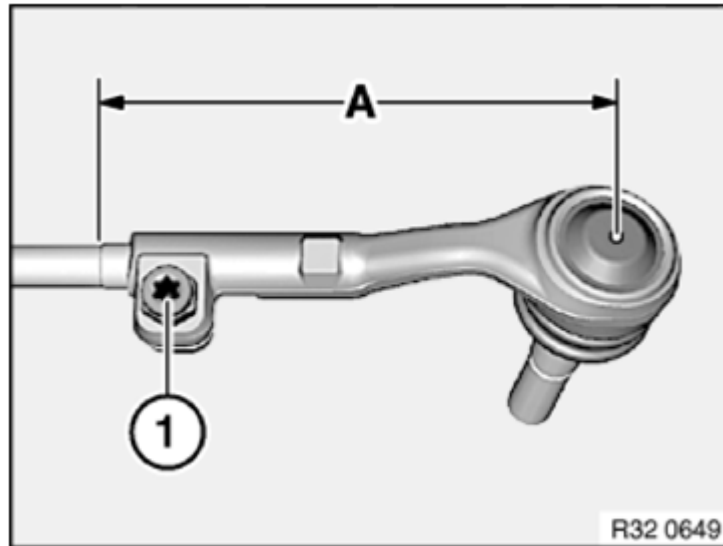
### Replacement only:

Determine dimension (A) to simplify following adjustment of front axle.

Slacken clamping bolt (1) and screw off track rod end.

Release ear clamp and band clamp of gaiter.

Detach gaiter from track rod.



**Fig. 32: Identifying Track Rod End Dimension**  
Courtesy of BMW OF NORTH AMERICA, INC.

#### *Installation note:*

Slide gaiter with ear clamp and band clamp on new track rod.

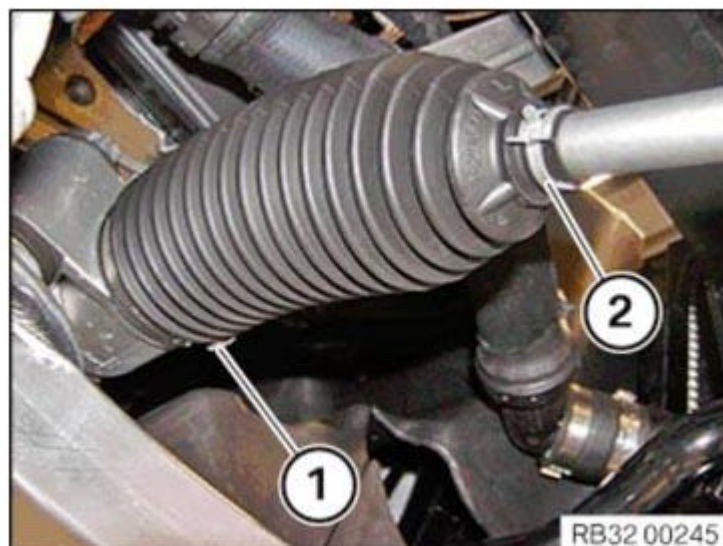
Screw in track rod end to dimension (A).

Tightening torque [32 21 2AZ](#) .

Clean track rod.

Release ear clamp (1) and band clamp (2).

Move gaiter on track rod until the square of the thrust bearing track rod is exposed.

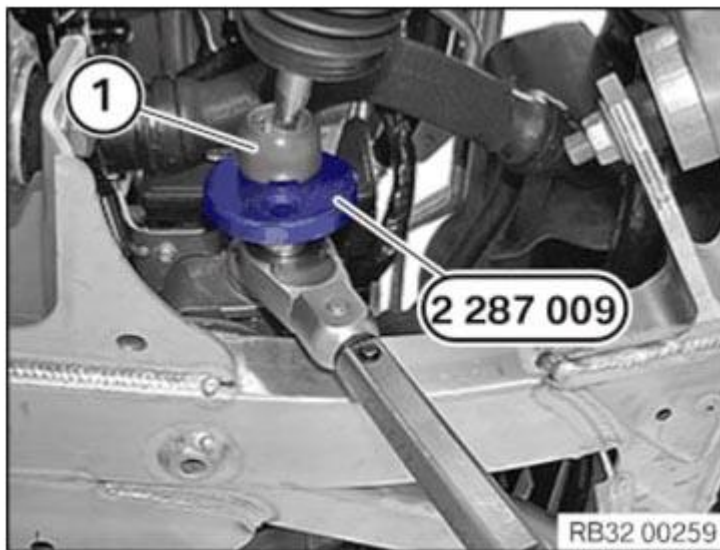


**Fig. 33: Identifying Track Rod Ear And Band Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

IMPORTANT: To avoid damage to rack and to suspension mounting, move rack in as far as possible.

Undo the joint (1) using special tools [2 287 009](#) at the steering box rack.

Tightening torque [32 21 1AZ](#) .



**Fig. 34: Removing Track Rod Joint Using Special Tool (2 287 009)**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Clean rack.

Check surface of rack for damage (e.g. corrosion).

**After installation:**

- Only if replacing/removing track rod end: Perform chassis/wheel alignment check. Refer to [ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION](#) or [ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT \(WITHOUT VEHICLE LOAD\)](#).

**32 21 151 REPLACING LEFT OR RIGHT TRACK ROD END**

**NOTE:** If the track rod end to track rod screw connection is released, it is necessary after reinstallation to carry out a wheel alignment check.

**Necessary preliminary tasks:**

- Remove [FRONT WHEEL](#) .

IMPORTANT: Do **not** release track rod end from swivel bearing with impact tool.  
Rubber boot of track rod end must not be damaged.

Slacken nut (2).

- If necessary, hold up at the Torx socket.

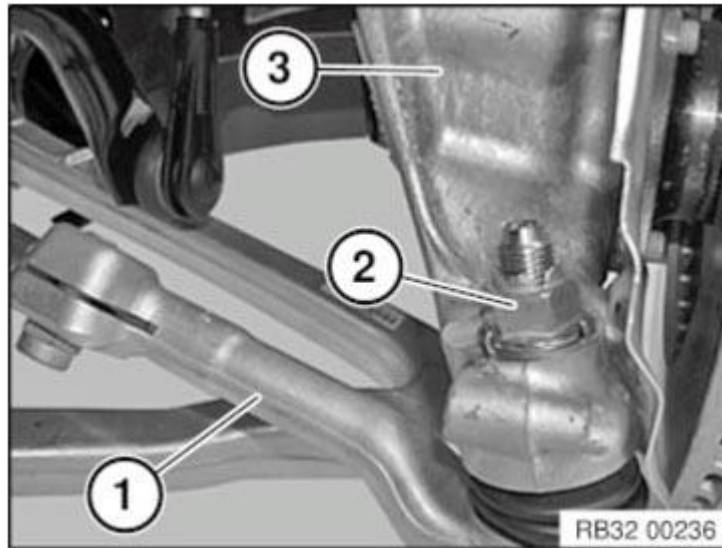
Tightening torque [32 21 3AZ](#) .

Remove track rod end (1) from swivel bearing (3).

*Installation note:*

Keep track rod end to swivel bearing connection clean and free from oil and grease.

Replace self-locking nut.



**Fig. 35: Identifying Track Rod End, Swivel Bearing And Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.

Determine dimension (A) to simplify following adjustment of front axle.

Slacken bolt (1).

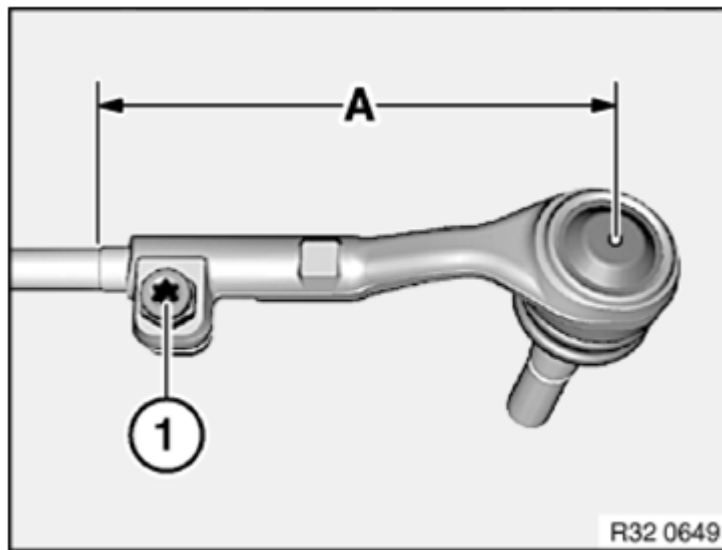
Tightening torque **32 21 2AZ** .

Unscrew track rod end.

- Counterhold track rod with open-end spanner if necessary.

*Installation note:*

Check **GAITER** for damage, replace if necessary.



**Fig. 36: Identifying Track Rod End Dimension**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw track rod end onto track rod to dimension (A).

**After installation:**



- Perform wheel alignment. Refer to **ALIGNMENT CHECK WITH VEHICLE LOAD UP TO DESIGN POSITION** or **ALIGNMENT CHECK WITH RIDE HEIGHT MEASUREMENT (WITHOUT VEHICLE LOAD)**.

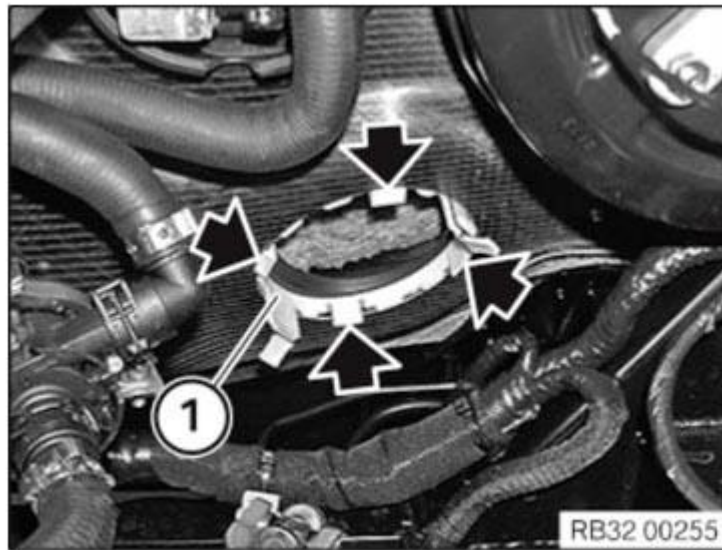
## STEERING COLUMN

### 32 31 107 REMOVING AND INSTALLING/REPLACING HOLDER FOR SLEEVE OF STEERING SHAFT

Necessary preliminary tasks:

- Remove **SLEEVE OF STEERING SHAFT**.
- Remove **LOWER STEERING SHAFT**.

Press retaining lugs and remove holder (1) to the inside.



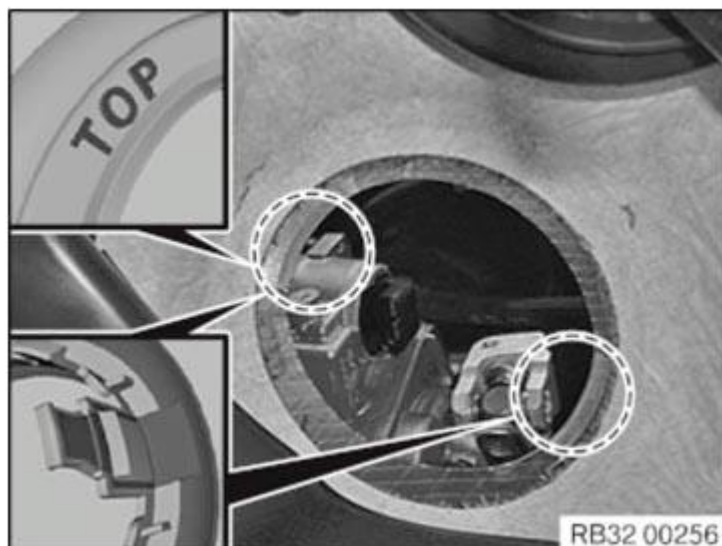
**Fig. 37: Locating Steering Shaft Sleeve Holder Retaining Lugs**  
 Courtesy of BMW OF NORTH AMERICA, INC.

From passenger compartment:

Align holder to bulkhead.

- "TOP" mark to the left and up.

Attach holder to bulkhead.



## **32 31 070 REMOVING AND INSTALLING/REPLACING LOWER SECTION OF STEERING SHAFT**

**IMPORTANT:** Do not turn the steering wheel once the steering shaft has been detached from the steering box/steering column! If the lower section of the steering shaft is separated from the steering box/steering column, the steering column switch cluster may be damaged when the steering wheel is turned.

### **Necessary preliminary tasks:**

- Remove **TRIM PANEL** for pedal mechanism.
- Move steering column in "top" and "retracted" position.
- Remove **FRONT LUGGAGE COMPARTMENT WELL** .

Release clamping bolt (1) on universal joint (steering gear).

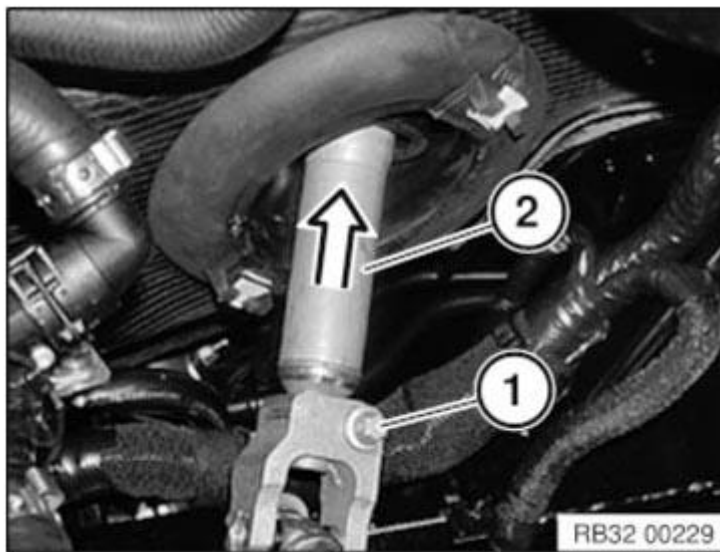
Tightening torque **32 31 3AZ** .

Release steering shaft (2) from universal joint and slide inwards.

### *Installation note:*

Clean screw threads to remove all remnants of screw locking adhesive.

Replace clamping bolt



**Fig. 39: Removing Steering Shaft From Universal Joint**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release clamping bolt (1) of steering shaft at steering column.

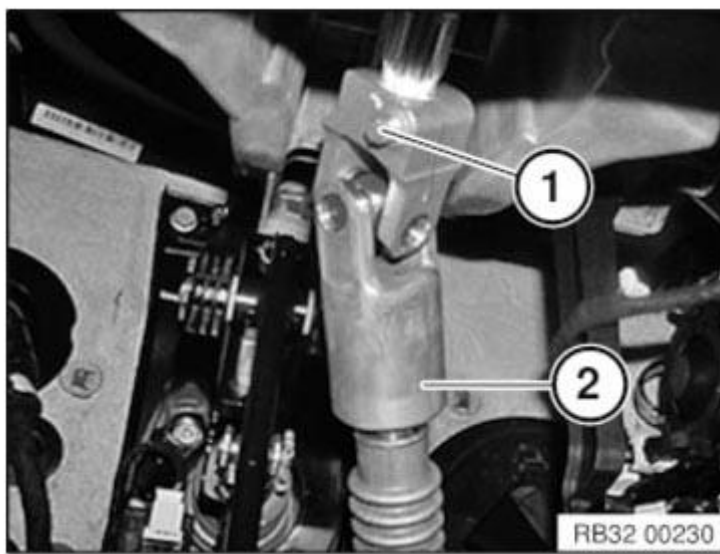
Tightening torque **32 31 4AZ** .

Release steering shaft from steering column.

Pull steering shaft into passenger compartment and remove.

### *Installation note:*

For reuse, clean threads to remove all remnants of screw locking adhesive.



**Fig. 40: Identifying Steering Shaft And Clamping Bolts**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

Replace clamping bolt

Counter-hold the steering shaft in the passenger compartment on the steering column when sliding the universal joint onto the steering column!

Connect steering spindle first to steering column and then to steering gear.

Clamping bolts must rest in groove of steering gear or steering column.

**After installation:**

- Turn steering wheel in both directions to the limit position. The airbag indicator light must not light up in the process.

**32 31 215 REMOVING AND INSTALLING/REPLACING DOUBLE PIVOT (UNIVERSAL JOINT) FOR STEERING SHAFT, BOTTOM**

**IMPORTANT:** Do not turn the steering wheel once the steering shaft has been detached from the steering box/steering column! If the lower section of the steering shaft is separated from the steering gear/steering column, the steering column switch cluster may be damaged when the steering wheel is turned!

**Necessary preliminary tasks:**

- Bring steering wheel in straight-ahead driving position and do not alter it during repair.
- Remove **FRONT LUGGAGE COMPARTMENT WELL** .

Release clamping screws (1).

Tightening torque **32 31 2AZ** .

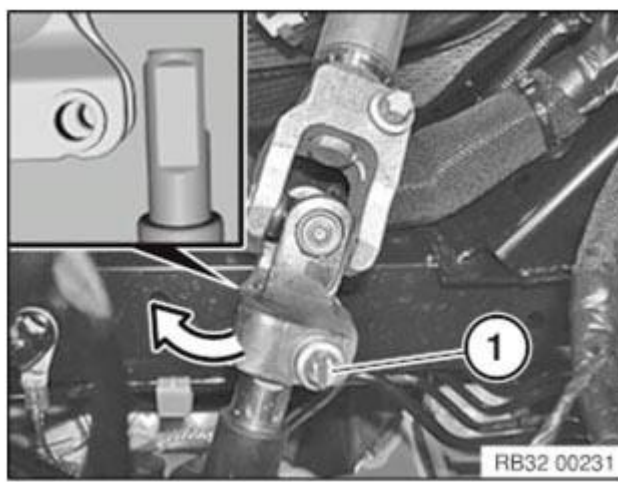
Swing out universal joint of steering gear.

*Installation note:*

Replace clamping bolt

For reuse of the universal joint, recut thread in the universal joint.

Universal joint can only be installed in one position.



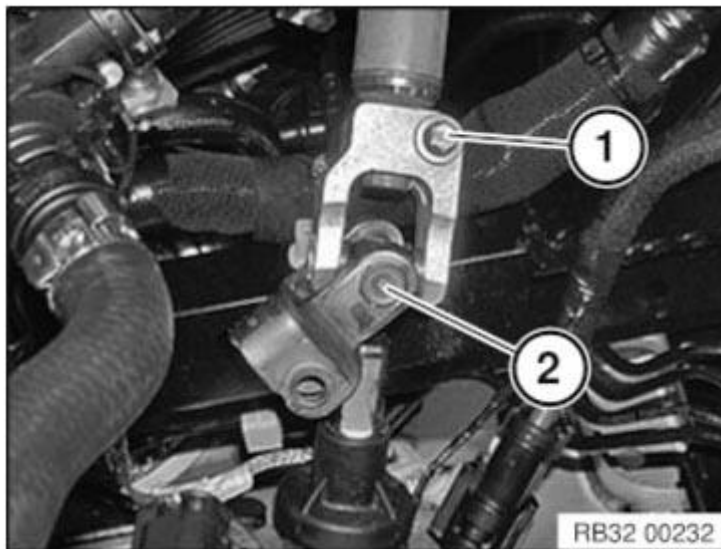
**Fig. 41: Removing Front Axle Support Clamping Bolt**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release clamping screws (1).

Tightening torque [32 31 3AZ](#) .

Pull universal joint (2) from steering shaft.

**IMPORTANT:** After disassembly of the universal joint, do not twist the steering gear and steering wheel.



**Fig. 42: Identifying Steering Shaft Universal Joint And Clamping Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Replace clamping bolt

For reuse of the universal joint, recut thread in the universal joint.

**After installation:**

- Turn steering wheel in both directions to the limit position. The airbag indicator light must not light up in the process.

**32 31 020 REMOVING AND INSTALLING/REPLACING LOWER SECTION OF STEERING COLUMN SHROUD**

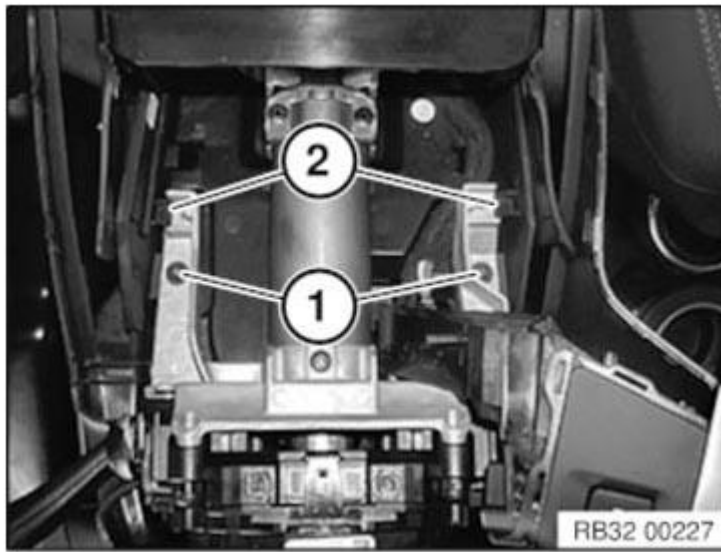
**Necessary preliminary tasks:**

- Remove **STEERING COLUMN SHROUD UPPER SECTION**.
- Move steering column in "top" and "extended" position.

Release screws (1).

Push retaining lugs (2) outward slightly.

Unclip steering column shroud in downward direction.



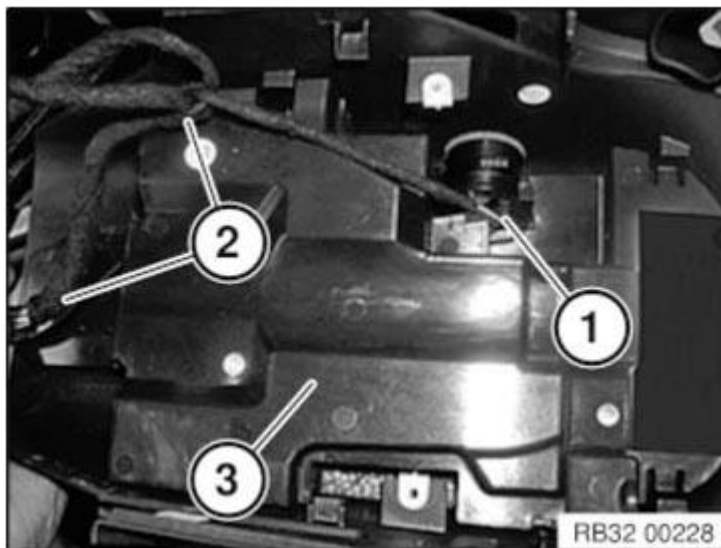
**Fig. 43: Identifying Steering Column Shroud Lower Section Screws And Retaining Lugs**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Tilt steering column shroud in downward direction.

Disconnect ring aerial connector (1).

Unclip wiring harness (2).

Remove steering column shroud lower section (3).



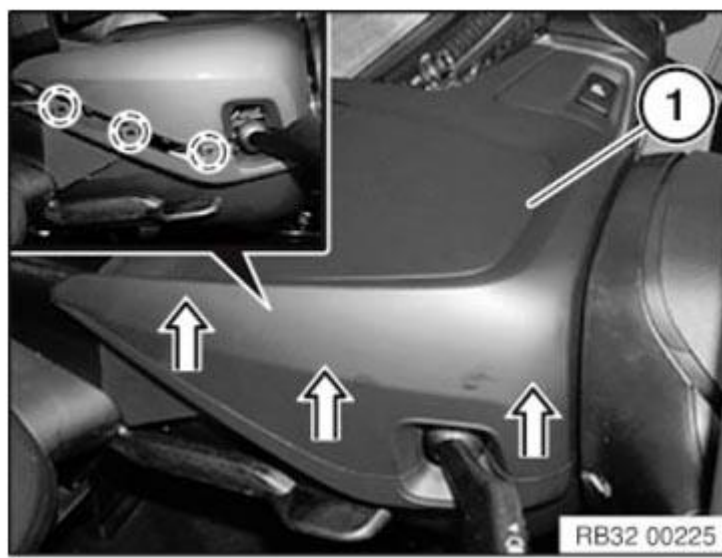
**Fig. 44: Identifying Ring Aerial Connector, Wiring Harness And Steering Column Shroud Lower Section**

Courtesy of BMW OF NORTH AMERICA, INC.

**32 31 003 REMOVING AND INSTALLING/REPLACING UPPER SECTION OF STEERING COLUMN SHROUD**

Carefully pull steering column shroud upper section (1) on the left upward and unclip.



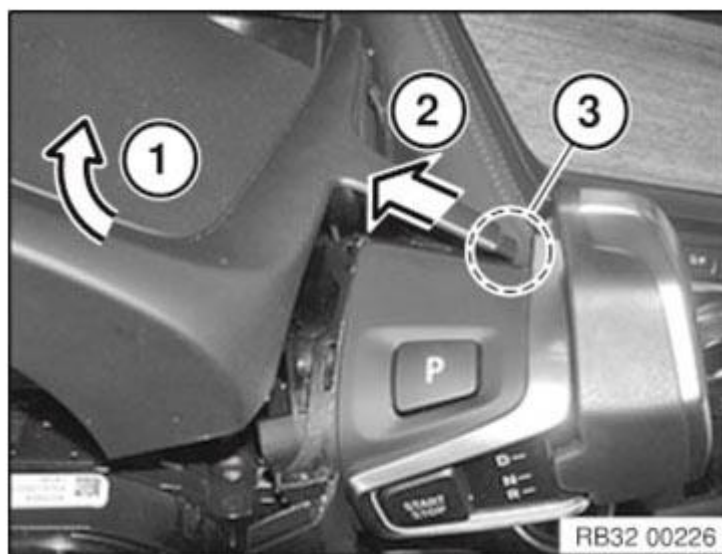


**Fig. 45: Removing Steering Column Shroud Upper Section**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Carefully unclip steering column shroud upper section on right (1).

Feed out steering column shroud upper section toward the left (2) from gear selector switch.

**NOTE:** When installing, ensure that trim panel on gear selector switch is correctly seated (3).



**Fig. 46: Removing Steering Column Shroud Upper Section From Gear Selector Switch**  
 Courtesy of BMW OF NORTH AMERICA, INC.

### **32 31 090 REMOVING AND REFITTING/REPLACING STEERING COLUMN**

**Necessary preliminary tasks:**

- Move steering column into "extended" position.
- Remove **STEERING COLUMN SHROUD**, bottom.
- Remove **TRIM PANEL FOR PEDAL MECHANISM** .
- Remove **STEERING COLUMN SWITCH CLUSTER** .
- Replacement only: Remove **GEAR SELECTOR SWITCH** .

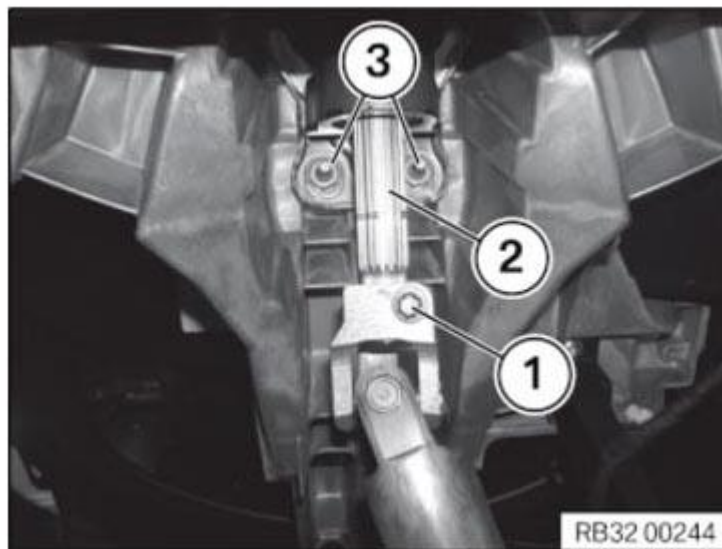
Release clamping bolt (1) on steering shaft at steering column (2), bottom.

Tightening torque **32 31 4AZ** .



Undo nuts (3) at bottom of steering column.

Tightening torque [32 31 1AZ](#) .

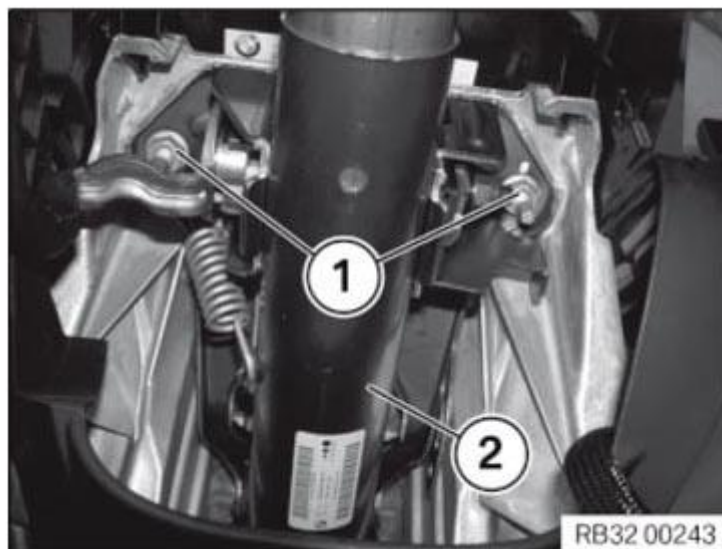


**Fig. 47: Identifying Clamping Bolt, Steering Column And Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

Secure steering column against falling out.

Undo nuts (1) at top of steering column.

Tightening torque [32 31 1AZ](#) .



**Fig. 48: Identifying Steering Column Nuts**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Turn steering wheel in both directions to the limit position. The airbag indicator light must not light up!

### **32 31 102 REPLACING STEERING SHAFT SLEEVE**

**WARNING:** High-voltage system - danger to life

- Observe [SAFETY INFORMATION](#) for handling electric vehicles.

IMPORTANT: Do not turn steering wheel/steering shaft or steering gear once the steering shaft has

been detached from the steering gear!

If the lower section of the steering shaft is separated from the steering gear, the steering column switch cluster may be damaged when the steering wheel is turned.

### **Necessary preliminary tasks:**

- Remove **FRONT LUGGAGE COMPARTMENT WELL** .

Release clamping bolt (1) on universal joint (steering gear).

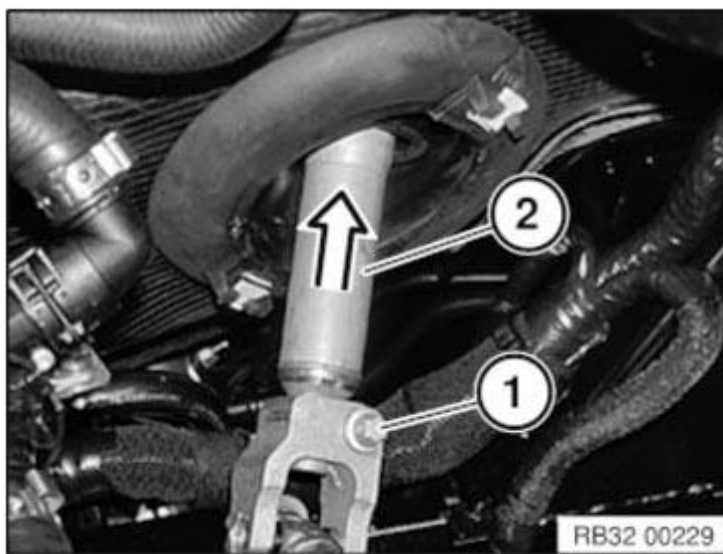
Tightening torque **32 31 3AZ** .

Release steering shaft (2) from universal joint and slide inwards.

*Installation note:*

Clean screw threads to remove all remnants of screw locking adhesive.

Replace clamping bolt



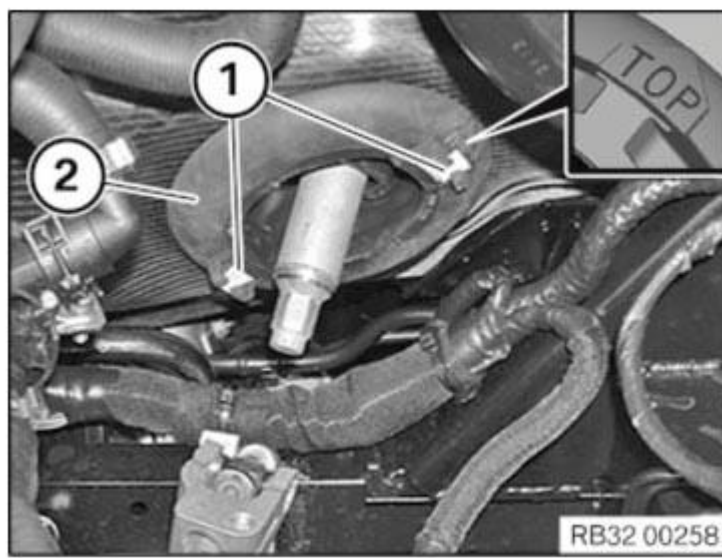
**Fig. 49: Removing Steering Shaft From Universal Joint**  
Courtesy of BMW OF NORTH AMERICA, INC.

Release retaining lugs (1) of retaining ring from sleeve (2).

Remove sleeve (2).

*Installation note:*

Check retaining lugs (1), **REPLACE RETAINING RING** if necessary.



**Fig. 50: Identifying Sleeve And Retaining Lugs**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

- Turn steering wheel in both directions to the limit position. The airbag indicator light must not light up in the process.

**STEERING WHEEL**

**32 33 000 REMOVING AND INSTALLING/REPLACING STEERING WHEEL**

**NOTE:** Wheel alignment is not necessary after the steering wheel has been removed and installed or replaced.

**Necessary preliminary work:**

- Remove **AIRBAG UNIT**

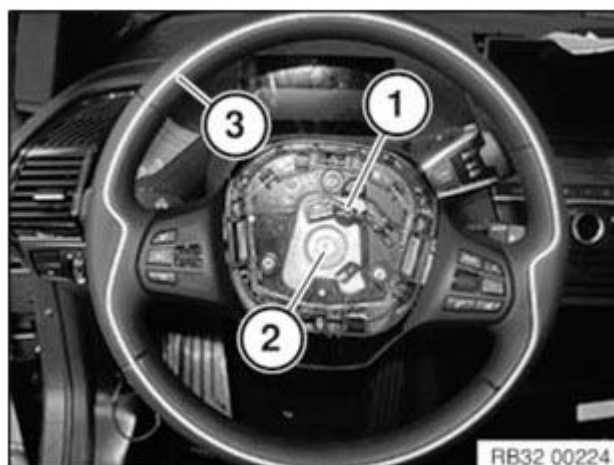
Move wheels/steering wheel into straight-ahead driving position.

Disconnect plug connection (1).

Release screw (2).

Tightening torque **32 33 1AZ** .

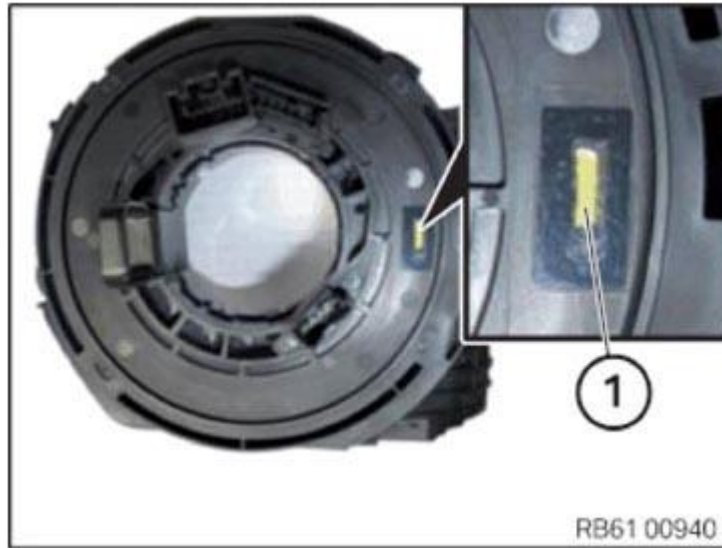
Remove steering wheel (3).



**Fig. 51: Identifying Steering Wheel, Plug Connection And Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:**

Do not twist the clock spring.  
Clock spring does not have a mechanical anti-twist lock.  
Check zero position of clock spring on steering column switch cluster.  
Zero position is correct only when yellow mark (1) is clearly visible!



**Fig. 52: Identifying Steering Column Switch Cluster Clock Spring Yellow Mark**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Align steering wheel by way of marking (1) to steering column marking (2) and attach.



**Fig. 53: Identifying Steering Wheel And Steering Column Marking**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **STEERING WHEEL AIRBAG UNIT**

### **(72 12... PROCEDURE AFTER AIRBAG DEPLOYMENT AS RESULT OF AN ACCIDENT)**

**Replace all components that were affected by the accident and check all others!**

Check and/or replace following components after airbag deployment:

- Components
  - Sensor B-pillar (left/right)
  - Sensor front door (left/right)
  - Sensor seat, Driver-/passenger's side
  - Airbag control unit, vehicle interior
  - Sensor, pedestrian protection

- Front sensor (engine compartment)
- Procedure
  - Inspect visually for mechanical damage (housing, plug connections). Replace damaged components.
  - Connect BMW diagnosis system
  - Read fault memory
  - Disconnect the vehicle battery and adhere to the waiting period (at least 30 seconds)
  - Inspect visually for mechanical damage
  - Rectify faults
  - Reconnect the vehicle battery and adhere to the waiting period (at least 10 seconds)
  - Delete fault memory
  - Switch off ignition and wait at least 2 minutes (no consumers may be switched on during this period such as interior light, radio, etc.)
  - Switch the ignition on (wait for at least 10 seconds)
  - Delete fault memory
  - If you cannot delete the fault memory: Replace the component that is causing the fault

*Replace the airbag control unit in the following cases only:*

- In the case of visible external damage
- In the case of a corresponding fault memory entry (airbag indicator light is illuminated)

*Cables and connectors*

- Components and procedure
  - Check cables and connectors for damage, replace if necessary.  
(e. g. corrosion, correct engagement, bent pin)

*Seat belt system*

- Components
  - Automatic reel
  - Seat belt tensioner
  - Seat belt height adjustment
  - Anchor fitting tensioner
  - Seat belt buckle
- Procedure
  - Check components, replace if necessary
  - Additional door lock: Check for foreign body, remove it if necessary.

*Seats*

- Components
  - Seat
  - Airbag module
  - Active head restraint
- Procedure
  - Check seats (functional check of seat mechanism), replace if necessary
  - Check seat connection
  - Replace gas generator of active head restraint

If the severity of the crash has not caused any other damage to the seat, only the triggered gas generator needs to be replaced.

External feature: The triggered head restraint is folded forwards and engaged.

The repair work can be carried out in the vehicle with the rear panel removed. The entire system can be pushed back into its original position and the new gas generator installed.

The gas generator can be replaced up to 5 times.

- Replace airbag module and seat cover with upholstery
- **Only I01** : If one of the following criteria is fulfilled, the backrest frame must be replaced!

(Part number of backrest frame: 52 10 7 388 646)

- Activated belt tensioner
- Activated end fitting pretensioner
- Outer cover unclipped by a side collision
- Outer cover ripped off by a side collision
- Faulty clip connection on outer cover caused by a side collision

#### *Driver's airbag*

- Components
  - Airbag module
  - Steering Wheel
  - Steering column (if damaged)
- Procedure
  - Check components, replace if necessary
  - Replace steering wheel

#### *Front-passenger airbag*

- Components
  - Airbag module
  - Dashboard trim panel (must be replaced!)
  - Supporting tube (if damaged)
- Procedure
  - Check components, replace if necessary

#### *Side airbag, front/rear*

- Components
  - Airbag module
  - Door trim panel
  - Door in white
  - Seat
- Procedure
  - Check components; replace if necessary

#### *Head airbag*

- Components
  - Airbag module
  - A-pillar trim panel
  - Roofliner
  - B-pillar trim panel (if damaged)
  - C-pillar trim panel (if damaged)
  - Connection/mount (on side frame)



- Procedure
  - Check components, replace if necessary

### *Knee airbag*

- Components
  - Trim panel (driver's side)
  - Lower section of glove box
  - Knee protection (Driver- and passenger's side)
- Procedure
  - Check components, replace if necessary

### *Knee protection*

- Components
  - Trim panel (driver's side)
  - Glove box incl. knee protection (passenger's side)
- Procedure
  - Check components for damage, replace if necessary
  - Check retaining elements

## **32 34 030 REMOVING AND INSTALLING/REPLACING AIRBAG UNIT**

**WARNING:** Observe the following instructions to avoid any risk of injury by the airbag unit.

- Comply with **SAFETY REGULATIONS** for handling components with gas generators.
- Do not exert any force on the airbag unit.
- Use only specified release tool for the airbag unit.

**NOTE:** Incorrect handling may result in triggering of the airbag unit and thereby cause serious injury.

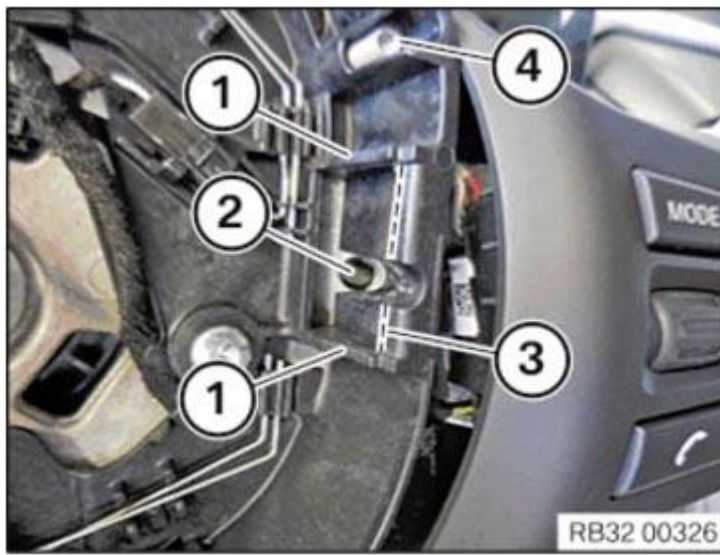
**IMPORTANT:** **STEERING WHEEL** must be replaced if airbag unit has been triggered!  
Follow **PROCEDURE AFTER AIRBAG DEPLOYMENT**.

### **Necessary preliminary tasks:**

- Clamp off **BATTERY EARTH LEAD** .

Depiction of the airbag locking point on the steering wheel:

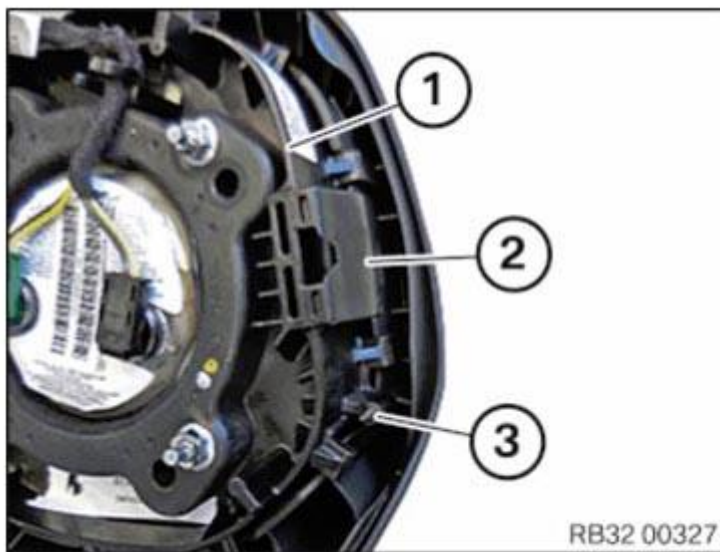
1. Guide for retaining hook
2. Hole for disassembly
3. Retaining hook
4. Steering wheel spring



**Fig. 54: Identifying Steering Wheel Airbag Locking Point Components**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Depiction of the airbag locking points on the airbag unit

1. Airbag unit
2. Retaining hook
3. Airbag spring groove



**Fig. 55: Identifying Airbag Unit, Retaining Hook And Airbag Spring Groove**  
 Courtesy of BMW OF NORTH AMERICA, INC.

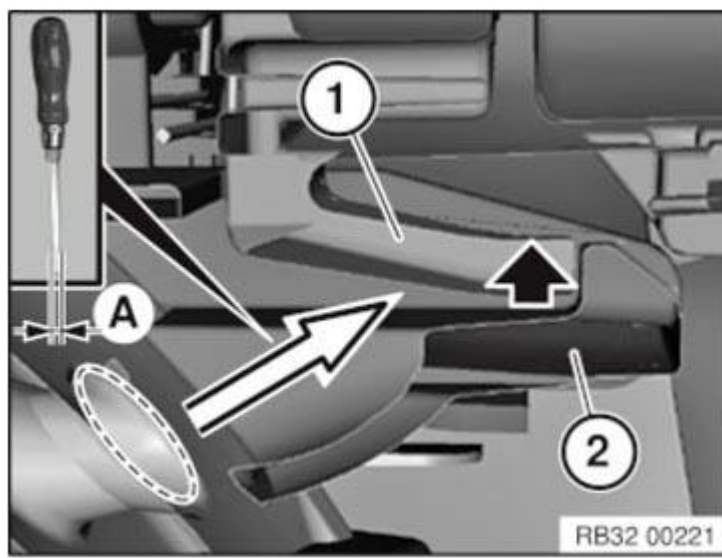
Sectional view of the steering wheel and the driver's airbag.

Measurement (A): approx. 6 - 6.5 mm.

1 = Retaining hook for airbag

2 = Retaining hook for steering wheel

White arrow = Position of the screwdriver



**Fig. 56: Steering Wheel And Driver Airbag Sectional View**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

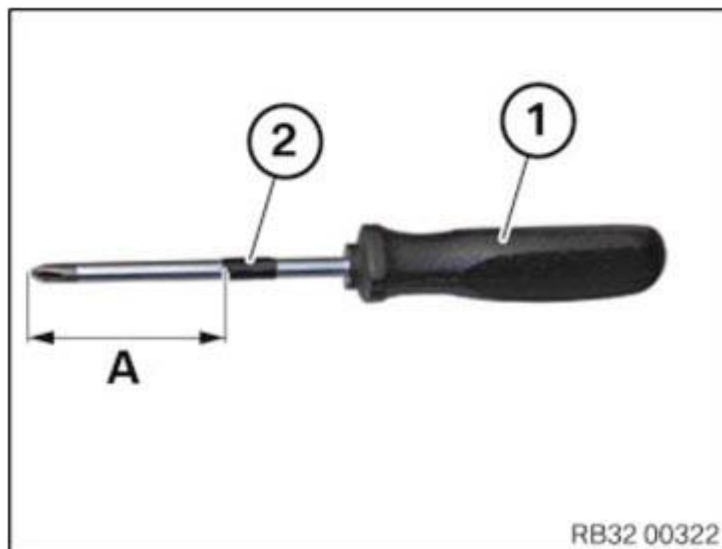
For unlocking the airbag unit, a phillips screwdriver (1), size 2, is required.

The shaft diameter must be 6 - 6.5 mm.

In order to avoid damage to the airbag, a maximum depth to which the screwdriver can be inserted into the disassembly opening must be marked on the screwdriver (1).

To do so, mark the dimension A on the screwdriver using insulating tape (2), for example.

Dimension A = 65 mm



**Fig. 57: Identifying Screwdriver Dimension Mark (A)**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

First remove the right side of the airbag unit.

Turn the steering wheel (1) until the disassembly opening on the rear of the steering wheel is aligned to the steering column release lever.

*Installation note:*

Carefully push airbag unit in direction of steering column shaft into steering wheel with uniform pressing force until airbag engages noticeably and audibly.



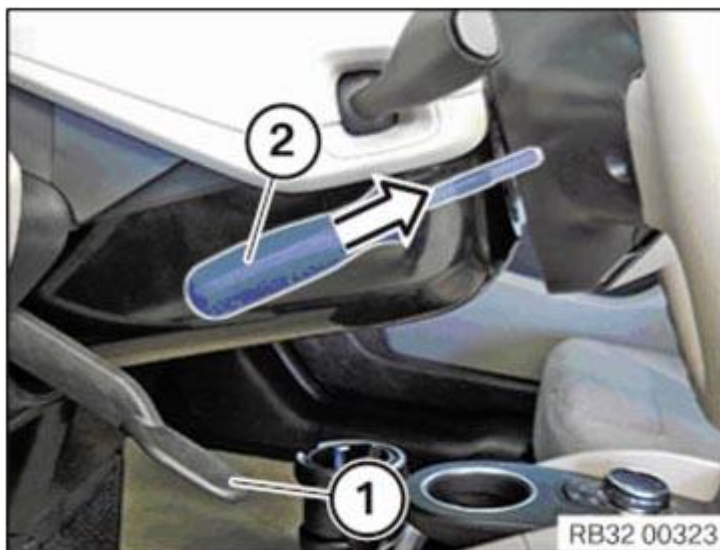
**Fig. 58: Turning Steering Wheel**

Courtesy of BMW OF NORTH AMERICA, INC.

Unlock the steering wheel release lever (1).

Align the phillips screwdriver tangentially to the steering column axis and insert it into the disassembly opening without rotating it, until the airbag unit is unlocked.

**IMPORTANT:** Risk of damage to the airbag unit.  
Do not exceed the earlier marked maximum insertion depth on the screwdriver.



**Fig. 59: Unlocking Steering Wheel Release Lever**

Courtesy of BMW OF NORTH AMERICA, INC.

Turn the steering wheel (1) until the left disassembly opening on the rear of the steering wheel is aligned to the steering column release lever.

**NOTE:** Hold the airbag module in position (arrow) in order to avoid a relocking of the right side of the airbag while unlocking the left side.



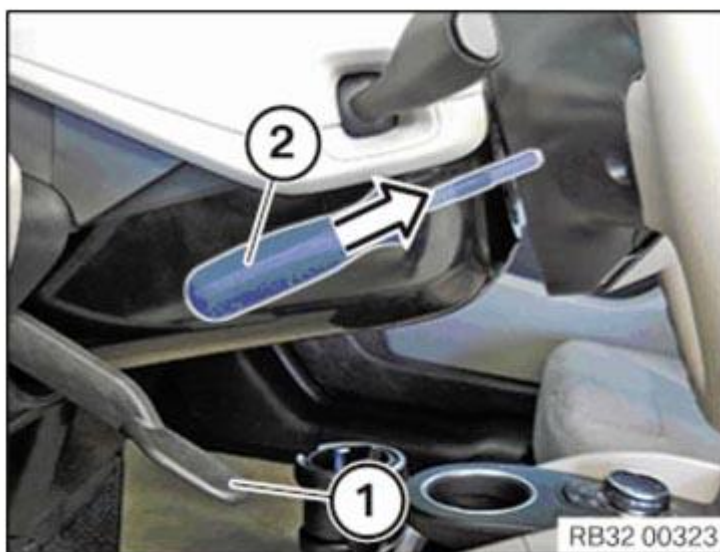
**Fig. 60: Turning Steering Wheel**

Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Risk of damage to the airbag unit.  
Do not exceed the earlier marked maximum insertion depth on the screwdriver.

Align the phillips screwdriver tangentially to the steering column axis and insert it into the disassembly opening without rotating it, until the airbag unit is unlocked.

- The airbag can be pulled out using a little force for support.



**Fig. 61: Unlocking Steering Wheel Release Lever**

Courtesy of BMW OF NORTH AMERICA, INC.

**WARNING:** Danger of injury!  
The airbag unit may only be set down with the airbag itself facing up .

Tilt airbag unit (2) to one side.

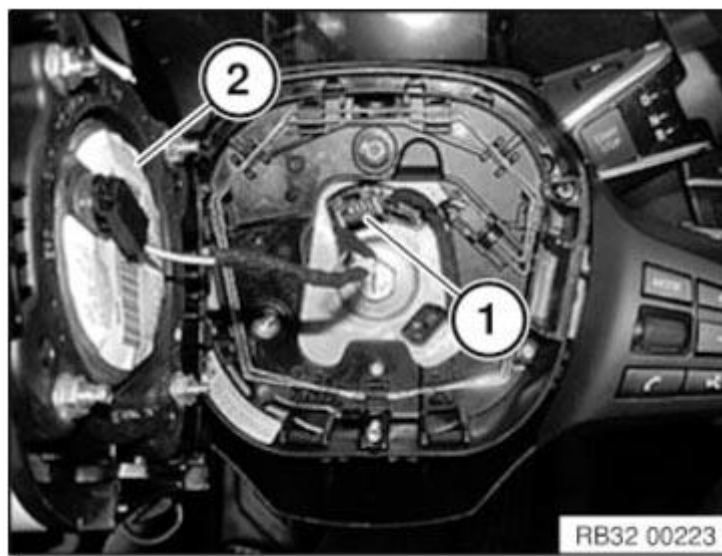
Disconnect plug connection (1).

Remove airbag unit (2).

*Installation note:*

Make sure electrical wiring is correctly positioned.





**Fig. 62: Identifying Airbag Unit And Plug Connection**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Position the airbag unit (1) on the steering wheel.

- While doing so, note that the retaining hooks of the airbag unit are fitted in the retaining hook guides on the steering wheel and the steering wheel springs are fitted in the spring grooves.

Push the airbag unit (1), carefully and with uniform pressing force, in the parallel direction of the steering column axis into the steering wheel, until the airbag engages both audibly and noticeably.



**Fig. 63: Identifying Airbag Unit Pressing Direction**  
Courtesy of BMW OF NORTH AMERICA, INC.

- **Attention!** If the retaining hooks engage one after the other, this leads to a flawed installation!

Check the functioning of the horn.

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[Back To Article](#)

## SUSPENSION

Steering And Wheel Alignment - Special Tools - All I3 Models - i3

### STEERING AND WHEEL ALIGNMENT

#### 321270 PLUG MINIMUM SET: MECHANICAL TOOLS AM

**NOTE:** (Plugs (set)) 27-piece, 3x per size - For sealing off hydraulic lines for brakes, steering etc.

#### Storage Location

Individual

#### SI number

01 14 01 (766)



**Fig. 1: Identifying Plug (321270)**

Courtesy of BMW OF NORTH AMERICA, INC.

#### 2287009 SOCKET WRENCH MINIMUM SET: MECHANICAL TOOLS

**NOTE:** Socket wrench with SW36 for joint on track rod. Applies to: BMW i Aftersales Basic contour-graphic silhouette foil is included in the delivery specification.

#### Storage Location

C35

#### SI number

01 55 13 (060)



**Fig. 2: Identifying Socket Wrench (2287009)**  
**Courtesy of BMW OF NORTH AMERICA, INC.**

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## SUSPENSION

### Steering And Wheel Alignment - Technical Data - All I3 Models - i3\_I01

## CHASSIS/WHEEL ALIGNMENT

### 32 00 CHASSIS/WHEEL ALIGNMENT - NORMAL POSITION I01

#### CHASSIS/WHEEL ALIGNMENT - NORMAL POSITION I01 SPECIFICATION

This data refers to vehicles that are <b style="color: green;">DOWN TO NORMAL POSITION</b>	°	Vehicle with complete equipment for normal operation with: 2 x 68 kg on front seats (seats in center position); 1 x 68 kg on rear seat (center); 1 x 21 kg in luggage compartment (center) and full fuel tank.
°	°	°

### 32 00 WHEEL ALIGNMENT I01 SERIES

#### WHEEL ALIGNMENT I01 SERIES SPECIFICATION

<b style="color: green;">OBSERVE TEST CONDITIONS !</b>	°	°
Front axle:	°	°
Total toe-in	°	0° 14' ± 12'
Total toe-in adjustment <sup>(1)</sup>	°	0° 14' ± 4'
Toe difference <sup>(2)</sup> single wheel between left/right	°	max. 12'
Camber (Difference between left/right maximum 30')	°	- 0° 20' ± 30'
Camber adjustment <sup>(1)</sup>	°	- 0° 20' ± 25'
Toe difference angle (difference between left/right max. 30')	°	2° 15'
Caster angle	°	(difference between left/right max. 30')
Front wheel offset	°	0° ± 15'
Maximum steering angle	°	°
- Inner cornering wheel	Ca. °	46° 00'
- Outer cornering wheel	Ca. °	35° 06'
Rear axle:	°	°
Total toe-in	°	0° 18' ± 12'
Total toe-in adjustment <sup>(1)</sup>	°	0° 18' ± 4'
Camber (difference between left/right max. 30')	°	-1° 40' ± 25'
Camber adjustment <sup>(1)</sup>	°	-1° 40' ± 5'
Geometrical driving axis	°	0° ± 12'
<p><b>NOTE:</b></p> <p>(1) To minimize adjusting errors (measuring inaccuracies), use a narrower tolerance for adjusting toe/camber.</p> <p><b>NOTE:</b></p> <p>(2) Toe difference front axle = criterion for steering wheel inclination</p>		°

## WHEEL ALIGNMENT, BMW, I01, JAPANESE VERSION

### 32 00 WHEEL ALIGNMENT I01 JAPANESE VERSION

**WHEEL ALIGNMENT I01 JAPANESE VERSION SPECIFICATION**

<b>OBSERVE TEST CONDITIONS !</b>	°	°
Front axle:	°	°
Total toe-in	°	0° 14' ± 12'
Total toe-in adjustment <sup>(1)</sup>	°	0° 14' ± 4'
Toe difference <sup>(2)</sup> single wheel between left/right	°	max. 12'
Camber (Difference between left/right maximum 30')	°	- 0° 53' ± 30'
Camber adjustment <sup>(1)</sup>	°	- 0° 53' ± 25'
Toe difference angle (difference between left/right max. 30')	°	2° 17'
Caster angle	°	(difference between left/right max. 30')
Front wheel offset	°	0° ± 15'
Maximum steering angle	°	°
- Inner cornering wheel	Ca. °	45° 30'
- Outer cornering wheel	Ca. °	34° 24'
Rear axle:	°	°
Total toe-in	°	0° 18' ± 12'
Total toe-in adjustment <sup>(1)</sup>	°	0° 18' ± 4'
Camber (difference between left/right max. 30')	°	-2° 15' ± 25'
Camber adjustment <sup>(1)</sup>	°	-2° 15' ± 5'
Geometrical driving axis	°	0° ± 12'
<p><b>NOTE:</b></p> <p>(1) To minimize adjusting errors (measuring inaccuracies), use a narrower tolerance for adjusting toe/camber.</p> <p><b>NOTE:</b></p> <p>(2) Toe difference front axle = criterion for steering wheel inclination</p>		°

## SUSPENSION

### Steering And Wheel Alignment - Tightening Torques - All I3 Models - i3\_I01

## DROP ARM

### 32 21 DROP ARM

#### TIGHTENING TORQUE SPECIFICATION - DROP ARM

Â	Type	Thread	Tightening specifications	Dimension
1AZ Track rod to rack	I01	Â	Â	71 Nm
2AZ Track rod end to track rod	I01	Â	Â	32 Nm
3AZ Track rod end to swivel bearing	I01	M14	Replace nut.	175 Nm

## STEERING

### 32 00 STEERING

#### TIGHTENING TORQUE SPECIFICATION - STEERING

Â	Type	Thread	Tightening specifications	Dimension
1AZ Steering box to front axle carrier	I01	M12	Replace screws. Jointing torque Angle of rotation	96 Nm 45 Â°
2AZ Ground strap to steering gear	I01	M6	Â	8 Nm

## STEERING COLUMN

### 32 31 STEERING COLUMN

#### TIGHTENING TORQUE SPECIFICATION - STEERING COLUMN

Â	Type	Thread	Tightening specifications	Dimension
1AZ Steering column to support	I01	M8	Â	21 Nm
2AZ Universal joint to steering box	I01	M10	Recut screw thread. Replace clamping bolt No subsequent retorquing permitted!	28 Nm
3AZ Steering shaft to universal joint	I01	M10	Recut screw thread. Replace clamping bolt No subsequent retorquing permitted!	28 Nm
4AZ Steering shaft to steering column	I01	M8	Recut screw thread. Replace clamping bolt No subsequent retorquing permitted!	24 Nm

## STEERING WHEEL

### 32 33 STEERING WHEEL

#### TIGHTENING TORQUE SPECIFICATION - STEERING WHEEL

Â	Type	Thread	Tightening specifications	Dimension
1AZ Steering wheel to steering column	I01	M14	Â	66 Nm





## SUSPENSION

### Wheel And Tires - Repair - All I3 Models - i3

## WHEELS

### 36 10... NOTES FOR REPAIRING ALUMINUM RIMS

In general, the economic viability must be checked prior to the repair.

**It is possible to repair the following damage** (applies to cast aluminum rims labelled as AlSi7 AlSi11, AlSi12):

- Depth of the damage in the aluminum at maximum 1 mm
- Distance of the damage from the outer rim edge at maximum 50 mm
- Paintwork damage on the remaining wheel rim

**It is not possible to repair the following damage:**

- Deformation and cracks
- Polished, forged aluminum wheel rims are unsuitable for repair.

### 36 10 300 REMOVE OR INSTALL FRONT OR REAR WHEEL

**Special tools required:**

- [36 1 300](#)
- 81 25 2 344 011
- 36 1 335
- 36 1 010

**WARNING:** High-voltage system - danger to life

- Observe the [SAFETY INFORMATION](#) for working with electric vehicles.

The wheel is balanced electronically.

Observe safety information on raising the vehicle.

Adhere to the instructions on initializing the Run Flat Indicator (RPA).

**IMPORTANT:** During the installation of all four wheels (e.g. when changing from summer to winter wheels), the tire pressure must be checked!

Note the information on tolerance compensation for tire pressure control.

To avoid tire damage, advise the customer to check the tire pressure on a regular basis!

Observe the following procedure to prevent clamping errors and imbalance:

- Loosen the wheel studs.
- Wheel positioned with valve facing down.
- If several wheels are simultaneously removed, mark installation position of wheels on tires (e.g. with a piece of chalk).
- Mark out wheel to wheel hub.
- Mark out lockable wheel stud in relation to wheel.
- Loosen wheel bolts. Remove wheel.



**Fig. 1: Locating Wheel Bolts**

Courtesy of BMW OF NORTH AMERICA, INC.

**Some of the rim styling must be positioned in a certain direction!**

**IMPORTANT:** The assignment of left and right, or front and rear must be carried out using the BMW parts catalogue.



**Fig. 2: Positioning Wheel Rim**

Courtesy of BMW OF NORTH AMERICA, INC.

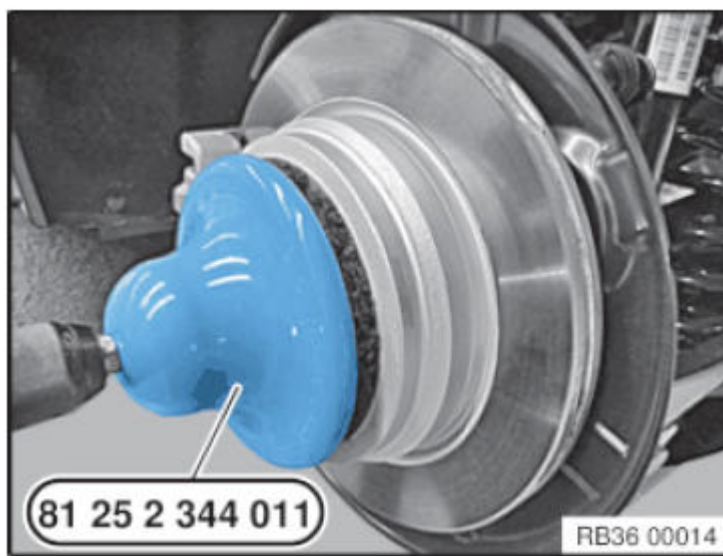
Contact surfaces between:

- IMPORTANT:**
- brake disc and wheel rim,
  - brake disc and wheel hub,

must be clean and free from grease.

Remove dirt, grease residues and corrosion from contact surface with a drill and special tool 81 25 2 344 011.

**IMPORTANT:** Do not operate special tool 81 25 2 344 011 with an impact screwdriver!



**Fig. 3: Identifying Special Tool (81 25 2 344 011)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Degrease the contact surface using universal cleaner.

**NOTE:** If there are grease residues in the area of the wheel stud hole, the brake disc must be removed and cleaned.

Remove dirt, grease residues and corrosion from contact surface (1) with a drill and special tool 81 25 2 344 011.

**IMPORTANT:** Do not operate special tool 81 25 2 344 011 with an impact screwdriver!



**Fig. 4: Identifying Special Tool (81 25 2 344 011)**  
Courtesy of BMW OF NORTH AMERICA, INC.

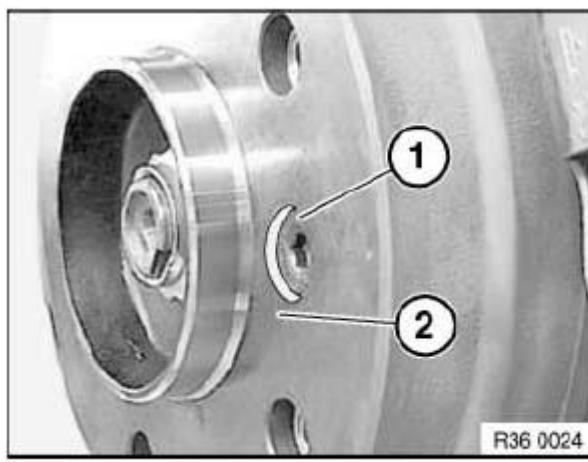
**NOTE:** Degrease the contact surface using universal cleaner.

Check brake disc retaining bolt (1) for tight fit.

**IMPORTANT:** Mounting bolt (1) must not under any circumstances protrude over contact surface (2) between brake disc and wheel rim.

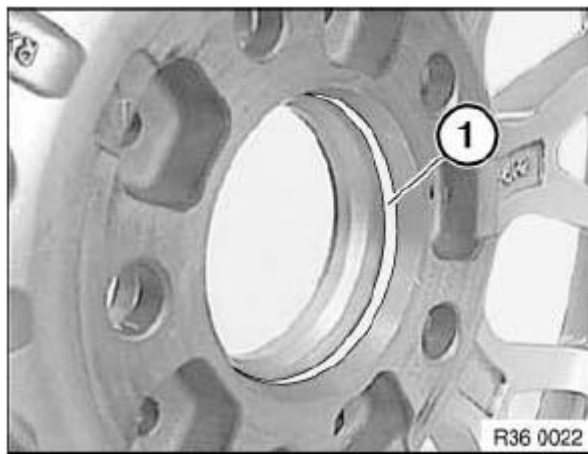
Tightening torque brake disc retaining bolt:

- Front axle [34 11 1AZ](#)
- Rear axle [34 21 1AZ](#)



**Fig. 5: Identifying Brake Disc Retaining Bolt And Contact Surface**  
Courtesy of BMW OF NORTH AMERICA, INC.

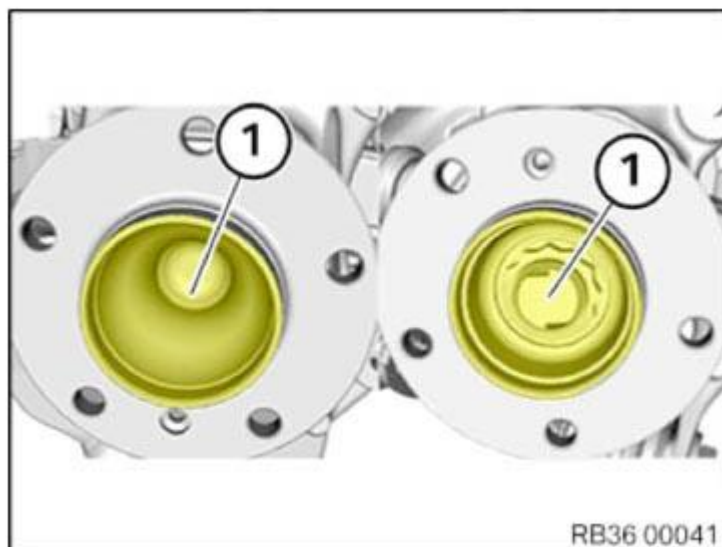
Apply a thin coat of **GREASE** to wheel centering (1) in wheel rim.



**Fig. 6: Identifying Wheel Centering In Wheel Rim**  
Courtesy of BMW OF NORTH AMERICA, INC.

Front and rear wheel hub in the area (1) is coated with thin layer of grease for the protection against corrosion.

Refer to **OPERATING FLUIDS**.



**Fig. 7: Identifying Front And Rear Wheel Hub Grease Applying Area**  
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** To release and tighten lockable wheel bolts, use a matching adapter from



**Fig. 8: Identifying BMW Adapters (36 1 300)**

Courtesy of BMW OF NORTH AMERICA, INC.

Clean wheel bolts and check threads for damage, renew if necessary.

Renew corroded wheel bolts.

IMPORTANT: Do not apply oil to wheel studs.

IMPORTANT: Under no circumstances use pneumatic or electric screwdrivers to screw in and tighten the wheel bolts.

The wheel rim must rest uniformly against the brake disc.

IMPORTANT: In the case of non-original BMW wheel studs/rims it may be necessary to retighten the wheel studs on account of setting properties.

**Tightening specifications:**

1. Screw in wheel bolts and evenly tighten crosswise by hand in order to center the wheel rim.
2. Tighten down wheel studs in crosswise sequence with a calibrated torque wrench to prescribed tightening torque [36 10 1AZ](#) .
3. Check all the wheel bolts in the same order or retighten to the prescribed tightening torque again.



**Fig. 9: Locating Wheel Bolts**

Courtesy of BMW OF NORTH AMERICA, INC.



**Special tools required:**

- 36 1 010
- 36 1 020

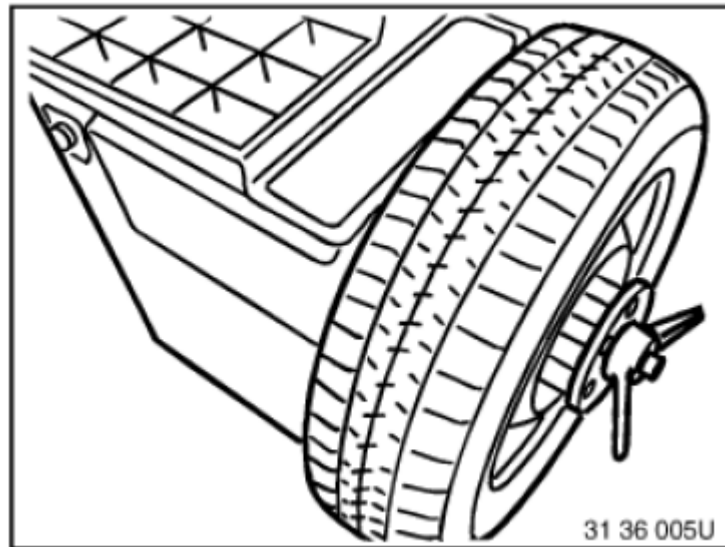
**Necessary preliminary tasks:**

- Remove wheel

IMPORTANT: Use only BMW-approved balance weights.

Remove any fitted balancing weights, stones in tread pattern and larger dirt contaminations.

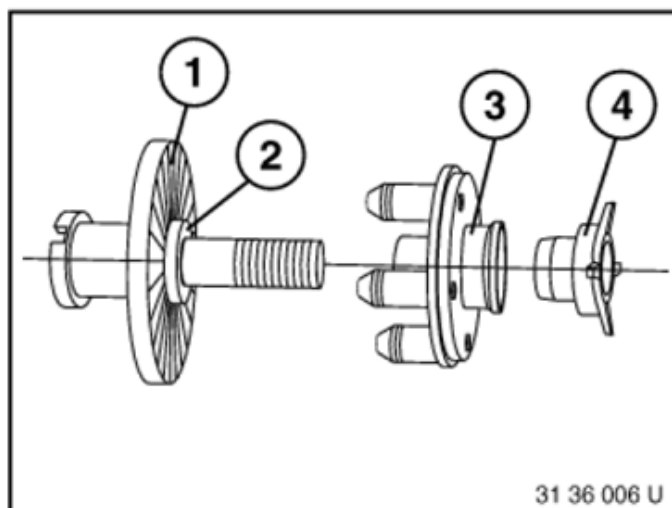
Check tire pressure and tire for condition, damage, flat spots (irregularities caused by e.g. parking of vehicle with tires which have run hot). If necessary, check wheel and tire for radial and lateral runout.



**Fig. 10: Installing Wheel In Balancing Machine**  
Courtesy of BMW OF NORTH AMERICA, INC.

Use BMW-approved wheel centering elements of relevant balancing machine manufacturers.

1. Basic flange
2. Wheel centering element
3. Type flange
4. Clamping nut



1. Basic flange
2. Wheel centering element
3. Type flange
4. Clamping nut

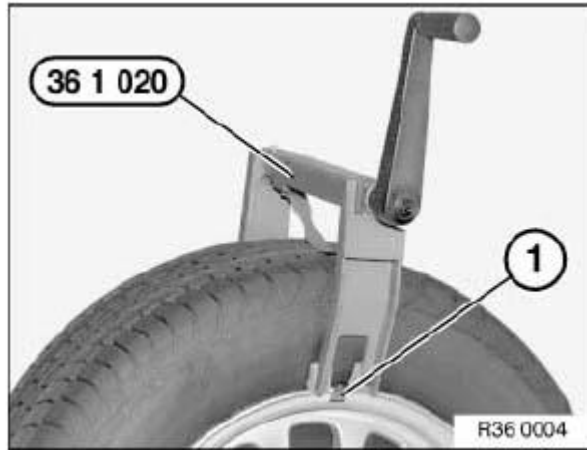
**Fig. 11: Identifying Basic Flange, Wheel Centering Element And Clamping Nut**  
Courtesy of BMW OF NORTH AMERICA, INC.



To avoid clamping errors, it will be necessary to fit the wheel on the balancing machine  
**IMPORTANT:** in the same way (e.g. valve facing down) as it is then fitted on the vehicle. Balance wheel in accordance with operating instructions of relevant balancing machine.

On light-alloy rims with distinctive J-shape rim flange, proceed as follows:

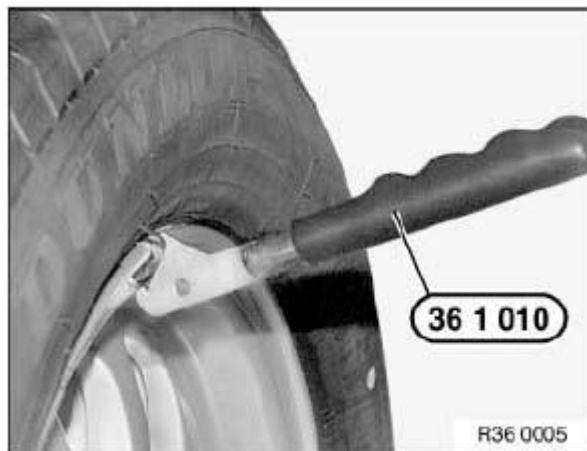
1. Gently force off tire sidewall with special tool 36 1 020 at appropriate point from rim flange.
2. Install retaining clip (1).
3. Remove special tool 36 1 020.



**Fig. 12: Pressing Off Tire Sidewall With Special Tool (36 1 020)**

Courtesy of BMW OF NORTH AMERICA, INC.

Raise retaining clip with special tool 36 1 010 Slide balance weight underneath and allow it to snap into place.



**Fig. 13: Raising Retaining Clip Using Special Tool (36 1 010)**

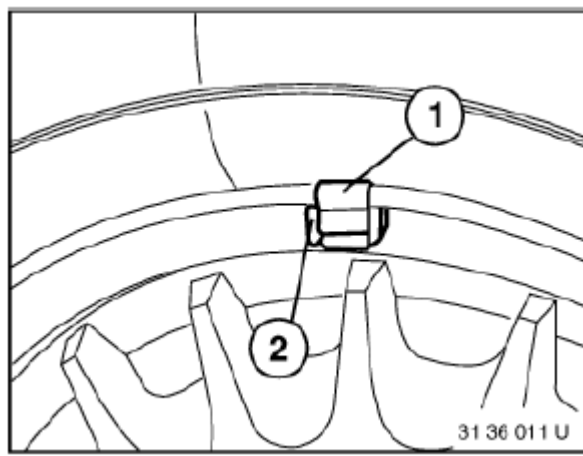
Courtesy of BMW OF NORTH AMERICA, INC.

Arrangement of balance weights for light-alloy rims with distinctive J-shape rim flanges.

1. Retaining spring
2. Balance weight

Adhesive weights must be used on all other light-alloy rims.

Max. imbalance per wheel.



**Fig. 14: Identifying Spring Retainer And Balance Weight**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** When using adhesive weights, proceed as follows:

1. Carefully remove any adhesive weights. Do not damage wheel rim when doing so.
2. Select suitable location for fitting.
3. Clean adhesive area thoroughly.

## **DISC WHEELS (RIMS)**

### **36 11 000 INITIALIZING RUN FLAT INDICATOR (RPA)**

**NOTE:** Checking the tire pressure is based on speed monitoring of the wheels in relation to each other. A tire puncture is detected and signalled by way of a deviation in specific speed ratios.  
The four tires mounted on the vehicle are monitored while the vehicle is driving.  
Initialization must be carried out in each case immediately after tire pressures have been corrected, after tires/wheels have been exchanged and after repair work to the air spring system.

**IMPORTANT:** The Run Flat Indicator does not function when the vehicle is driven with the compact spare wheel.

### **36 11 503 RDC RESETTING**

**NOTE:** RDC monitors the tire pressure in the four wheels.  
Each tire incorporates an Wheel electronics module, which constantly monitors the tire pressure.  
The system signals when the tire pressure drops in one or more tires.  
Resetting must be carried out in each case immediately after tire pressures have been corrected, after tires/wheels have been replaced and after repairs to the air spring system.

### **36 11 533 REMOVING AND INSTALLING/REPLACING WHEEL ELECTRONICS (RDCi)**

**Attention!**

Before removing and refitting, check which generation of wheel electronics is fitted!

If the wheel electronics have been removed, the complete valve must be replaced.

**NOTE:** The wheel electronics RDCi is installed as from 2013 and as from I01.

If a tire sealant has been used, replace the wheel electronics.

When a tire has been removed, do not clean the rim with installed wheel electronics with high-pressure cleaning equipment.

Before the installation of new wheel electronics with valve, thoroughly clean the valve bore of the wheel rim.

Do not treat wheel electronics with solvents, cleaning agents etc. If dirt contamination, wipe with a clean cloth only.

Do not clean wheel electronics with compressed air.

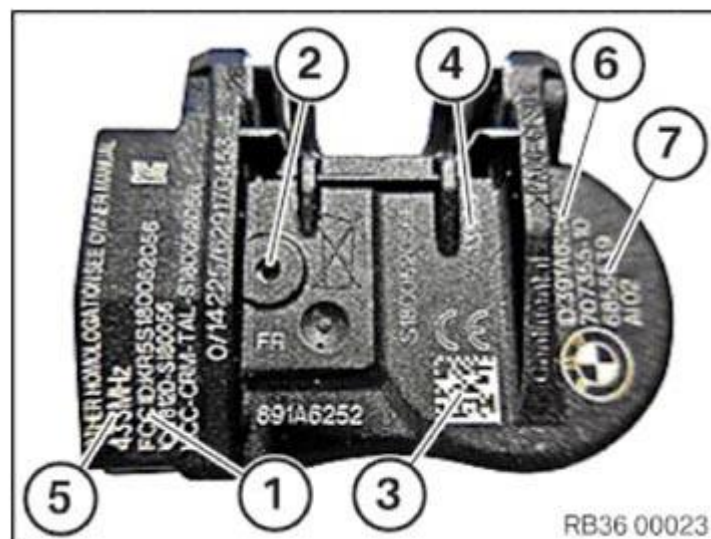
When tire sealant is used, the installed wheel electronics must necessarily be replaced.

### Necessary preliminary tasks:

- Remove tire

### Labelling of wheel electronics (RDCi)

1. FCC ID = radio authorization
2. Pressure sensor
3. Data Matrixcode
4. Production date of wheel electronics
5. Transmission frequency
6. Wheel electronics ID
7. BMW part number



**Fig. 15: Identifying Wheel Electronics Labeling (RDCi)**

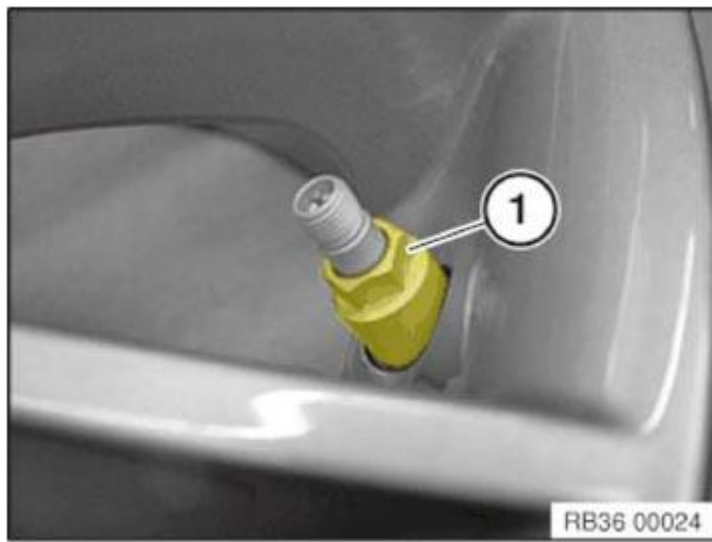
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** The following graphics only show removal and refitting of the RDCi wheel electronics.

### Removal:

#### Removing wheel electronics

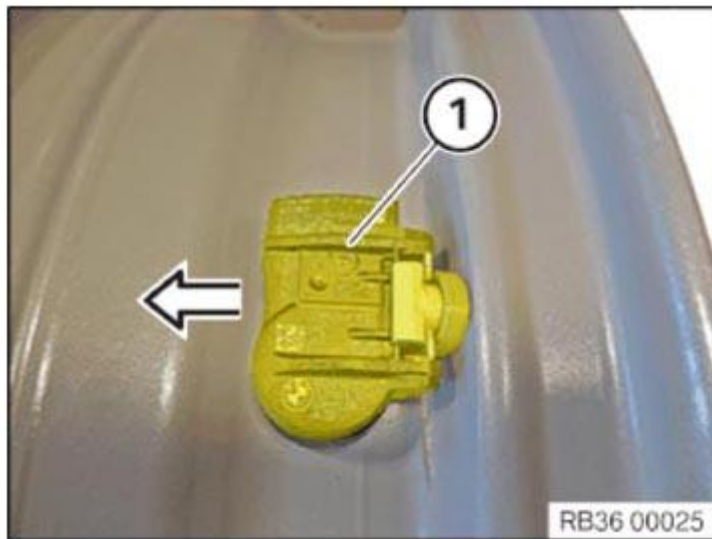
Release union nut (1).



**Fig. 16: Identifying Union Nut**

Courtesy of BMW OF NORTH AMERICA, INC.

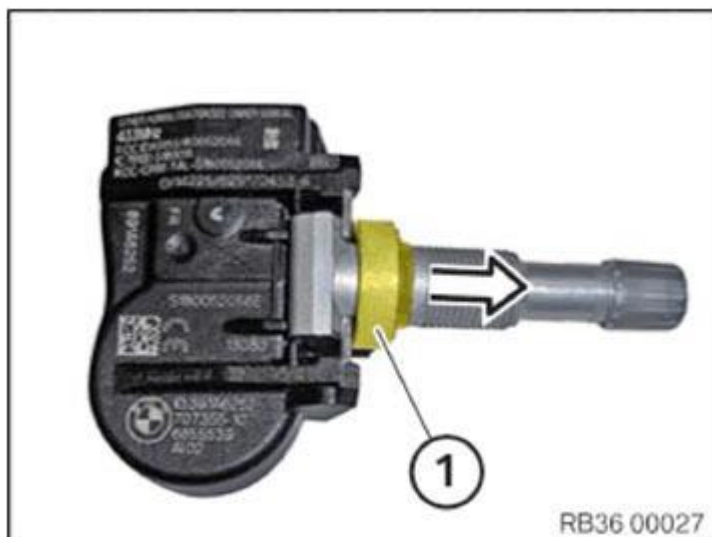
Remove wheel electronics and valve (1) from valve hole.



**Fig. 17: Removing Wheel Electronics And Valve From Valve Hole**

Courtesy of BMW OF NORTH AMERICA, INC.

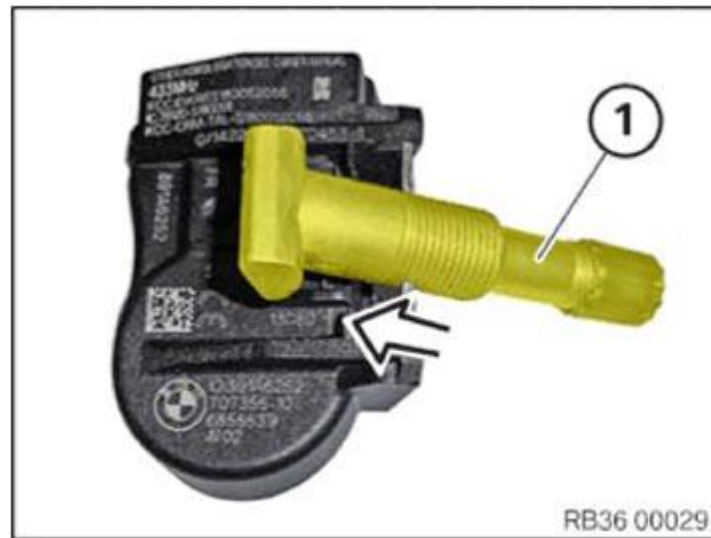
Detach sealing ring (1) in the direction of the arrow.



**Fig. 18: Detaching Sealing Ring**

Courtesy of BMW OF NORTH AMERICA, INC.

Feed valve insert (1) in the direction of the arrow out of wheel electronics.



**Fig. 19: Pulling Valve Insert Out Of Wheel Electronics**

Courtesy of BMW OF NORTH AMERICA, INC.

**Installation:**

**Attention!**

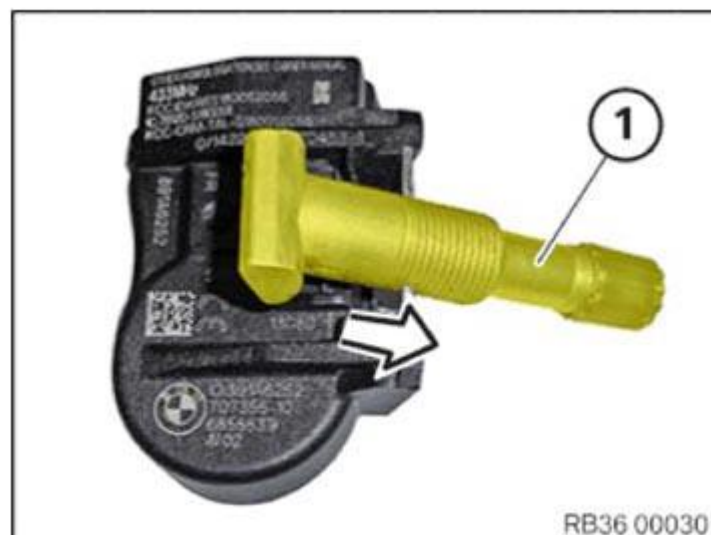
**The valve must be renewed!**

**Failure to replace the part leads to leaks!**

Before the installation of new wheel electronics with valve, thoroughly clean the valve bore of the wheel rim!

Also make sure that the valve bore has been deburred.

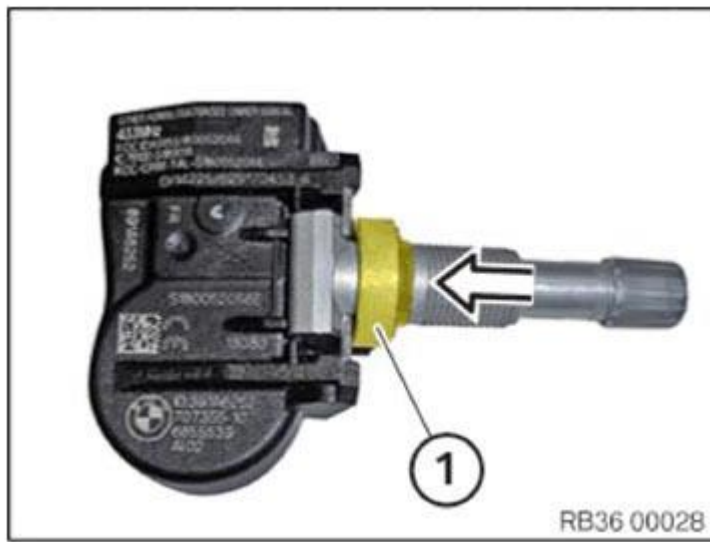
Insert valve insert (1) in the direction of the arrow into wheel electronics.



**Fig. 20: Inserting Valve Insert Into Wheel Electronics**

Courtesy of BMW OF NORTH AMERICA, INC.

Fit sealing ring (1) in the direction of the arrow.

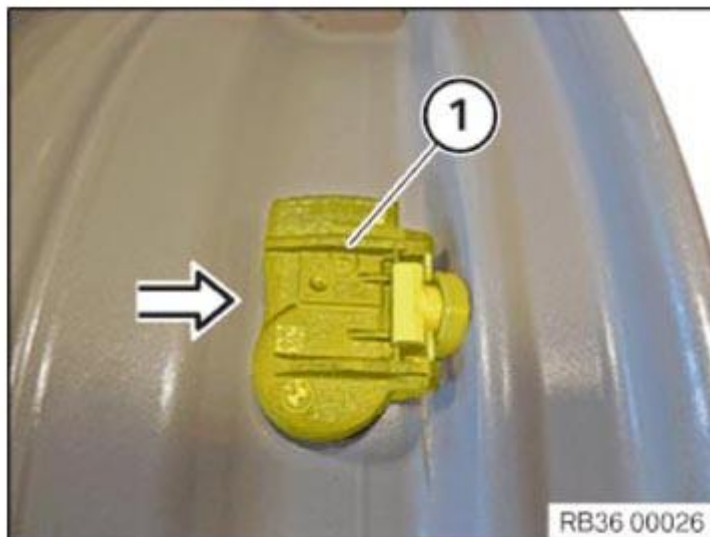


**Fig. 21: Installing Sealing Ring**

Courtesy of BMW OF NORTH AMERICA, INC.

Insert valve insert with wheel electronics (1) into cleaned valve bore.

Both outer feet on the underside of the wheel electronics module must be resting against the rim wall.



**Fig. 22: Inserting Valve Insert With Wheel Electronics**

Courtesy of BMW OF NORTH AMERICA, INC.

Screw on union nut (1) by hand as far as it will go.

Tighten union nut (1).

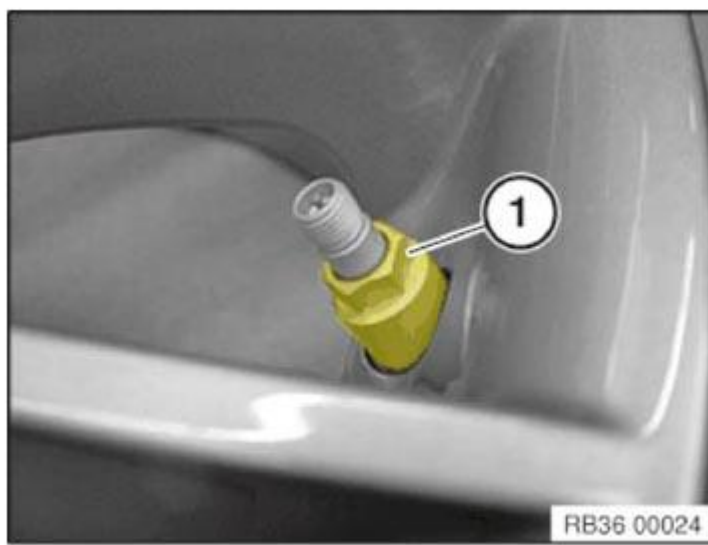
Tightening torque [36 11 1AZ](#) .

**Attention!**

Fixing must not under any circumstances be retightened!

The wheel electronics should still be resting evenly against the wheel rim after tightening.





**Fig. 23: Identifying Union Nut**

Courtesy of BMW OF NORTH AMERICA, INC.

**Required follow-up work:**

- Fit tire.

## **TIRES**

### **36 12... NOTES REGARDING TIRE/WHEEL EXCHANGE**

**General:**

- The tire size, manufacturer and tire tread must be the same on one axle
- To meet the BMW standards, the vehicle should be equipped with tires from the same manufacturer and with the same tire tread (tires approved by BMW) on all 4 wheels
- The difference in tire tread depth on one axle must not exceed 2 mm (control quality of suspension control systems and wheel alignment requirement)
- The tires with the higher tread depths must be mounted on the rear axle
- The DOT age difference must not exceed 4 years
- The tire pressure must be adjusted when the tires are exchanged
- Wheel exchange between the axles

The wheels may be exchanged between axles to achieve even abrasion. However, BMW does **not recommend** switching the front wheels to the rear or vice-versa.

**The wheel exchange may lead to the following customer complaints:**

- complaints regarding acoustics
- Risk of increased lane groove sensitivity

**Compliance with the following requirements is required when exchanging wheels between the axles:**

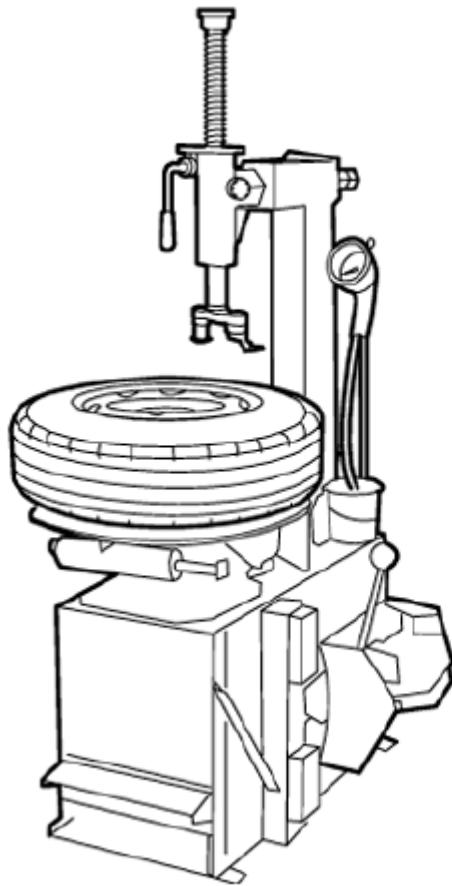
- Assess the wear pattern
- The tread difference between the front and rear wheels must not exceed a maximum of 2-3 mm
- Exchange the wheels between the axles every **5000 Km**

**Additionally for all-wheel drive vehicles:**

- The tire size, manufacturer and tire tread must be identical on all wheels; if mixed tires are fitted, different tire sizes are permissible.

- The tire tread difference between tires in all wheel positions must not exceed **2 mm** (normal quality of the wheel control systems and wheel alignment requirement)

### 36 12 001 REPLACING A TIRE



31 36 025 U

#### Fig. 24: Identifying Tire Replacing Machine

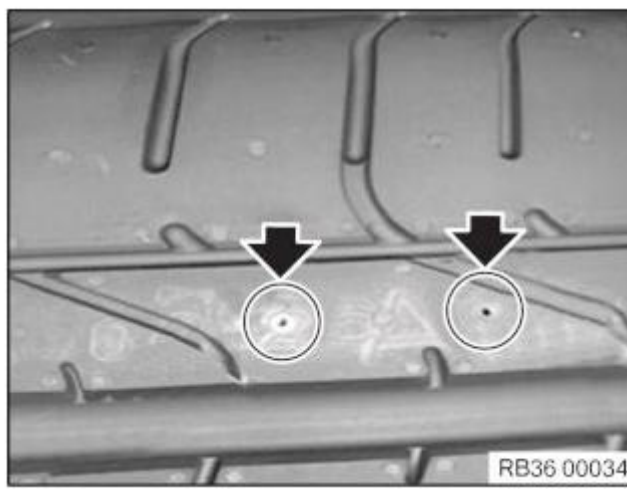
Courtesy of BMW OF NORTH AMERICA, INC.

Refer to the operating manual of the relevant fitting equipment manufacturer for details on how to fit the tire correctly. However, it is essential to make sure that the equipment is in proper working condition and there is no damage to the disc wheel or the tire.

**NOTE:** Comply with approved tires, tire sizes and optional equipment.  
Follow instructions on initializing run flat indicator:

- Run flat indicator (RPA)

IMPORTANT: **Pirelli tires can happen to have two little holes in the tread pattern!  
These two holes are production-related!  
The presence of these two little holes in the tread pattern does not represent a fault  
and does not affect the performance and the efficiency of the tires in any way!**

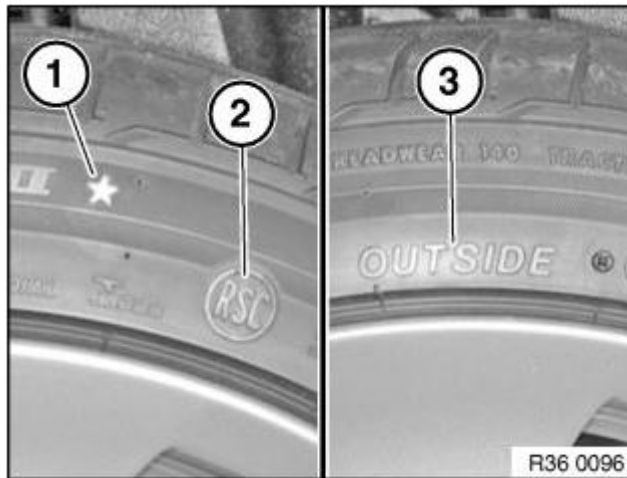


**Fig. 25: Locating Pirelli Tires Holes**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** Pay attention to different tire markings:

- Item (1) Marking denoting BMW-approved tires. Ensure that only BMW-approved tires are fitted.
- Item (2) RSC is the abbreviation for R unflat S ystem C omponent (runflat tires).
- Item (3) Outside. The tire must be fitted so that the wording Outside is always situated on the outside of the rim.



**Fig. 26: Identifying Tire Markings**

Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Many tires are directional!  
The arrow on the tire must point in the direction of travel for each wheel!

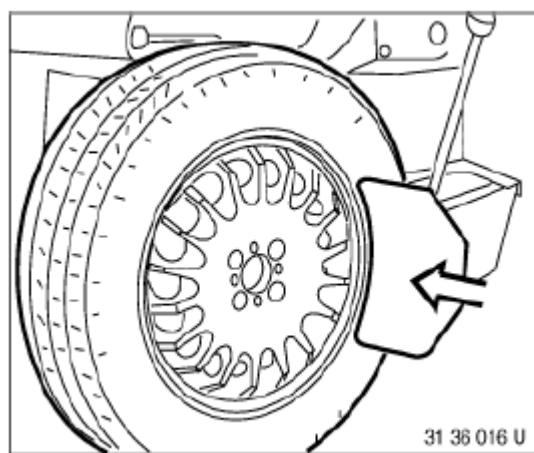
### **Models with M Mobility system**

If the tire was filled with the M-Mobility system after a puncture, it will be necessary before removal to drill an approx. 25 mm dia. hole in the side wall of the tire. Allow sealing compound to flow out through this bore and dispose of compound in compliance with environmental regulations. Clean disc wheel after removing tire.

Tire removal with a tire fitting machine:

Unscrew valve insert, discharge air, force off tire bead from rim flange with pressing-off tool of the device on outside and inside.

If tire beads are stuck, first release the tire with the pressing-off horn at several points of the wheel before actually pressing off, apply tire mounting paste between tire and rim flange and press off the tires completely.



**Fig. 27: Releasing Tire With Pressing-Off Horn**  
Courtesy of BMW OF NORTH AMERICA, INC.

Pull off balance weights on wheel rim and clean rim to remove large pieces of dirt.

Clamp wheel on tire fitting machine.

Narrow rim shoulder always faces upwards.

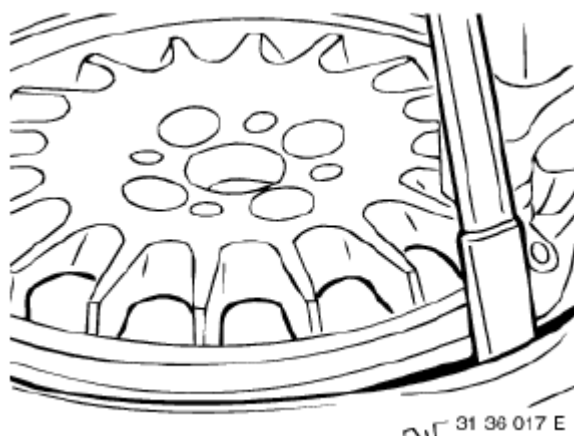
Vehicles with RDC:

**IMPORTANT:** To prevent the pressing-off horn from damaging the RDC wheel electronics, do not rest the pressing-off horn on both rim sides in the area of the valve.

Swing or fold mounting column into position and let it engage.

Adjust mounting head, pressing it on the rim edge fully, and turn down the lever for the clamp; normally the distance of the mounting head will set in automatically.

The valve should be approx. 15 cm to the right of the mounting head (so as to prevent the mounting lever from damaging the wheel electronics).



**Fig. 28: Raising Tire Bead With Tire Iron Over Mounting Finger**  
Courtesy of BMW OF NORTH AMERICA, INC.

Raise tire bead with mounting lever over mounting finger.

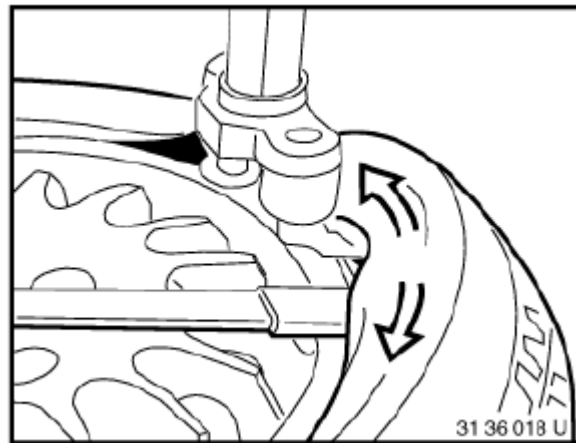
**NOTE:** On aluminum rims, it is best to use a mounting lever coated (either fully or partially) with heat-shrink tubing to prevent damage.

Let fitting machine run back a short distance (counter clockwise); tire bead will slip fully onto mounting finger.

Then let fitting machine run forward in stages (clockwise).

In so doing, always check whether the lower bead is fully resting in the well and allow the tire time to move.

If the bead clamps, stop the machine and let it run back slightly.



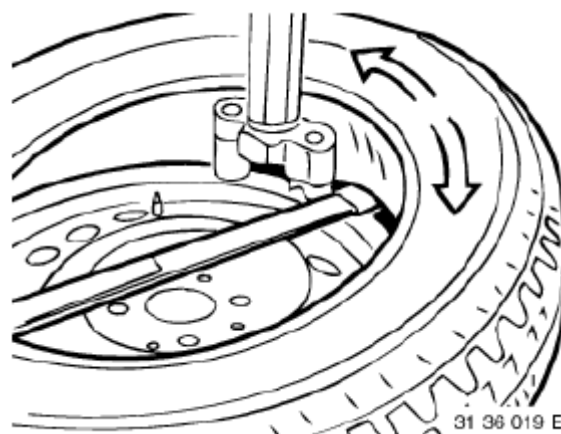
**Fig. 29: Running Fitting Machine**

Courtesy of BMW OF NORTH AMERICA, INC.

If the upper bead is pulled off the rim, also lift the bottom bead over the mounting finger with the tire iron.

Let machine run back a short distance again and then forward (clockwise) briefly until there is complete separation of the tire from the rim.

IMPORTANT: Vehicles with RDC:  
Tire bead must not press onto wheel electronics.



**Fig. 30: Lifting Bottom Bead Over Mounting Finger With Tire Iron**

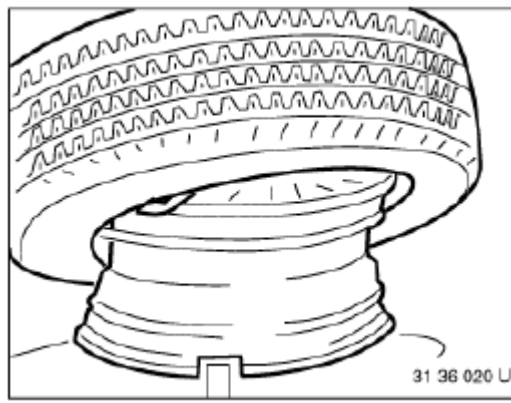
Courtesy of BMW OF NORTH AMERICA, INC.

Release lock and tilt back or swing away mounting column.

Unclamp and clean rim.

Replace valve.

Coat rim flange and tire beads with tire-fitting paste.



**Fig. 31: Releasing Lock**

Courtesy of BMW OF NORTH AMERICA, INC.

Vehicles with RDC:

When the wheel electronics are installed, the rim must not be cleaned with high-pressure cleaning equipment.

**IMPORTANT:** Visually inspect wheel electronics for external damage and check for tight fit; do not retighten screw and union nut. If one of the valve parts is loose, replace the entire valve. Keep wheel electronics free of tire mounting paste.

Clamp rim on fitting machine, valve must be located at  $180^{\circ}$  to mounting head.

Slide on tire with lower bead partially over rim flange.

Swing or tilt mounting pillar into position and lock.

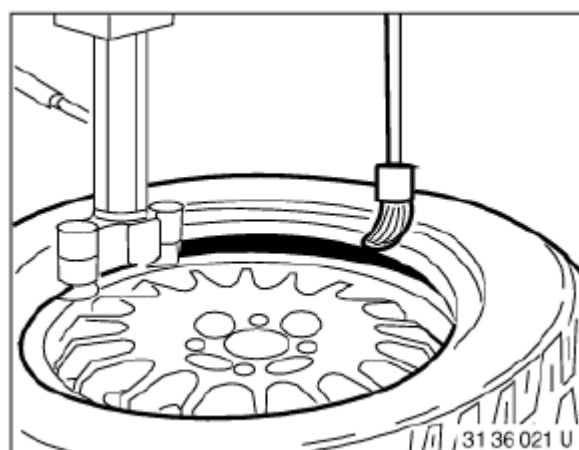
Check adjustment of mounting finger, readjusting if necessary, and clamp.

Press tire under mounting finger by hand.

Tire bead should seat in rollers next to mounting finger.

Let fitting machine run forward (clockwise) a short distance.

Lower tire bead will drop into well.



**Fig. 32: Tilting Mounting Pillar Into Position**

Courtesy of BMW OF NORTH AMERICA, INC.

**IMPORTANT:** Vehicles with RDC:

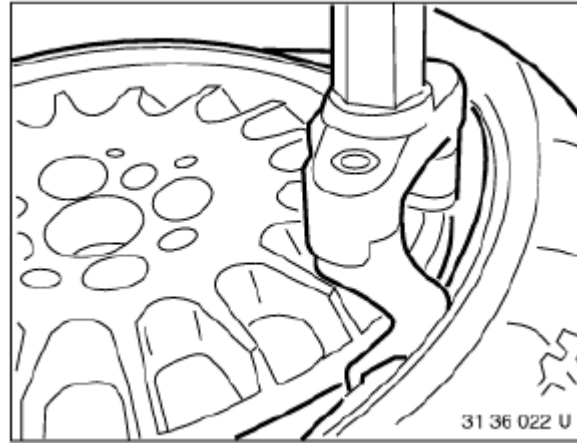
Fit lower tire bead so that no pressure forces are exerted on wheel electronics.

Turn wheel again into installation position so that valve is at  $180^{\circ}$  to mounting head.

Press upper tire bead under mounting finger. Tire bead should seat in rollers next to mounting finger.



IMPORTANT: Do not pinch or damage bead.

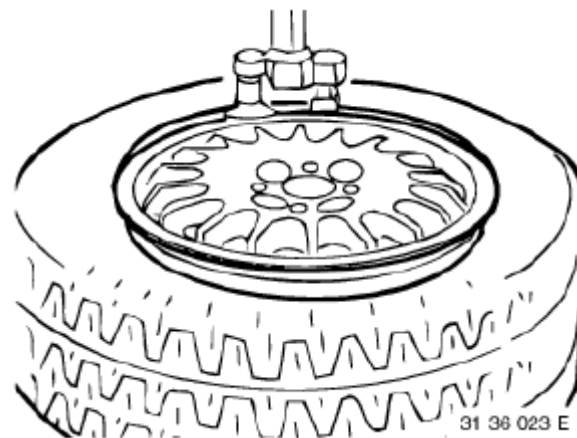


**Fig. 33: Pressing Upper Tire Bead Under Mounting Finger**  
Courtesy of BMW OF NORTH AMERICA, INC.

Operate fitting machine forwards (clockwise) little by little; while doing so, make sure the lower tire bead remains in the well.

IMPORTANT: Vehicles with RDC:  
Fit upper tire bead so that no pressure forces are exerted on wheel electronics.

Possibilities for safely mounting the wheel or incorporation in inflation apparatus  
IMPORTANT: should be utilized!  
Observe national/country-specific regulations.



**Fig. 34: Inflating Tire**  
Courtesy of BMW OF NORTH AMERICA, INC.

After mounting, first release clamping claws and then inflate tire (without valve).

Increase pressure up to 3.3 bar (330 kPa) in steps (jumping pressure).

If the tire bead does not slip on all round at the rim edge, do not increase pressure further but rather drain off air.

Press off tire bead again, coat rim flange again with tire mounting paste and pump up again to 3.3 bar. When the beads are resting properly on the rim shoulders, increase inflation pressure to max. 4.0 bar to "settle" the tire.

Screw in valve insert and correct tire pressure.

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## SUSPENSION

### Wheel And Tires - Tightening Torques - All I3 Models - i3

#### WHEEL RIMS

##### 36 11 WHEEL RIMS

#### TIGHTENING TORQUE SPECIFICATION - WHEEL RIMS

Á	Type	Thread	Tightening specifications	Value
1AZ Valve on disc wheel (RDCi)	I01/I12	WAF 11	Á	8 Nm

#### WHEELS

##### 36 10 WHEELS

#### TIGHTENING TORQUE SPECIFICATION - WHEELS

Á	Type	Thread	Tightening specifications	Dimension
1AZ Wheel bolt	I01/I12	M14x1.25	<ul style="list-style-type: none"><li>• Screw in the wheel bolts and evenly tighten by hand in a crosswise sequence in order to center the wheel rim.</li><li>• Tighten the wheel bolts to the specified tightening torque in a crosswise sequence using a calibrated torque wrench.</li><li>• Check all wheel bolts in the same sequence and retighten to the prescribed tightening torque if necessary.</li></ul>	140 Nm

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## SUSPENSION

### Wheels And Tires - Special Tools - All I3 Models - i3

## WHEELS WITH TIRES

### 361300 ADAPTER MINIMUM SET: MECHANICAL TOOLS AM

**NOTE:** (Wheel bolt adapter kit) For releasing and tightening wheel bolts.

#### Storage Location

Individual

#### SI number

01 27 04 (167)

Consisting of:

6 = 0495221 Wheel stud

**NOTE:** (Code 30) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

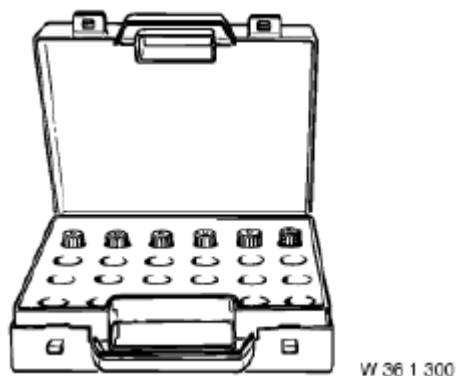
6 = 0495222 Wheel stud

**NOTE:** (Code 31) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495223 Wheel stud

**NOTE:** (Code 32) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495224 Wheel stud



**Fig. 1: Identifying Adapter (361300)**

Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** (Code 33) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495225 Wheel stud

**NOTE:** (Code 34) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495226 Wheel stud

**NOTE:** (Code 35) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495227 Wheel stud

**NOTE:** (Code 36) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495228 Wheel stud

**NOTE:** (Code 37) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495229 Wheel stud

**NOTE:** (Code 38) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495230 Wheel stud

**NOTE:** (Code 40) With centering bore. Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495231 Supplement

**NOTE:** Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).  
(Supplementary set for wheel bolt adapter kit 36 1 300) Consisting of: 36 1 323 Code 30 36 1 324 Code 31 36 1 325 Code 32 36 1 326 Code 33 36 1 327 Code 34 36 1 328 Code 35 36 1 329 Code 36 36 1 331 Code 37 36 1 332 Code 38 36 1 333 Code 40 36 1 336 Connection diagram label

6 = 0495232 Labels

**NOTE:** (Label) Connection diagram not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

6 = 0495233 Case

**NOTE:** s (Case) incl. connection diagram label. Not available individually.

2 = 0492519 Wheel stud

**NOTE:** (Code 11) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492520 Wheel stud

**NOTE:** (Code 12) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492521 Wheel stud

**NOTE:** (Code 13) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492522 Wheel stud

**NOTE:** (Code 14) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492523 Wheel stud

**NOTE:** (Code 16) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492524 Wheel stud

**NOTE:** (Code 17) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492525 Wheel stud

**NOTE:** (Code 18) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492526 Wheel stud

**NOTE:** (Code 19) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492527 Wheel stud

**NOTE:** (Code 20) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492528 Wheel stud

**NOTE:** (Code 31) 12/2004 Replaced by 36 1 324 (0 495 222) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492529 Wheel stud

**NOTE:** (Code 32) 12/2004 Replaced by 36 1 325 (0 495 223) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492530 Wheel stud

**NOTE:** (Code 33) 12/2004 Replaced by 36 1 326 (0 495 224) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492531 Wheel stud

**NOTE:** (Code 34) 12/2004 Replaced by 36 1 327 (0 495 225) Not available individually. Can only be ordered as part of the complete special tool set



83 30 0 492 518 (special tool number 36 1 300).

2 = 0492532 Wheel stud

**NOTE:** (Code 35) 12/2004 Replaced by 36 1 328 (0 495 226) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492533 Wheel stud

**NOTE:** (Code 36) 12/2004 Replaced by 36 1 329 (0 495 227) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492534 Wheel stud

**NOTE:** (Code 37) 12/2004 Replaced by 36 1 331 (0 495 228) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492535 Wheel stud

**NOTE:** (Code 38) 12/2004 Replaced by 36 1 332 (0 495 229) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492536 Wheel stud

**NOTE:** (Code 39) Code 30, 12/2004 Replaced by 36 1 323 (0 495 221) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

2 = 0492537 Wheel stud

**NOTE:** (Code 40) 12/2004 Replaced by 36 1 333 (0 495 230) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

10= 0493534 Wheel stud

**NOTE:** (Code 15) Not available individually. Can only be ordered as part of the complete special tool set 83 30 0 492 518 (special tool number 36 1 300).

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## SUSPENSION

### Wheels and Tires Operating Fluids

#### TIRE MOUNTING PASTE

BMW tyre fitting spray for Pax system (BMW part number 36 12 6 768 292)

BMW tyre mounting paste (81 22 0 433 046)

#### ANTI-CORROSION PASTE

Apply small amounts of Plastilube paste evenly around the centering cone of the alloy wheel rim and onto the contact areas of the brake hub.

Plastilube BMW Part No. 81 22 9 407 103.

#### GREASE FOR WHEEL-CENTRING SPIGOTS

Apply the following grease to the centring collar of the wheel hub to prevent corrosion between the rim and the wheel-centring spigots.

Tradename	BMW Part Number	Container size
Plastilube	81 22 9 407 103	4 cm <sup>3</sup> pad, 100 pce.

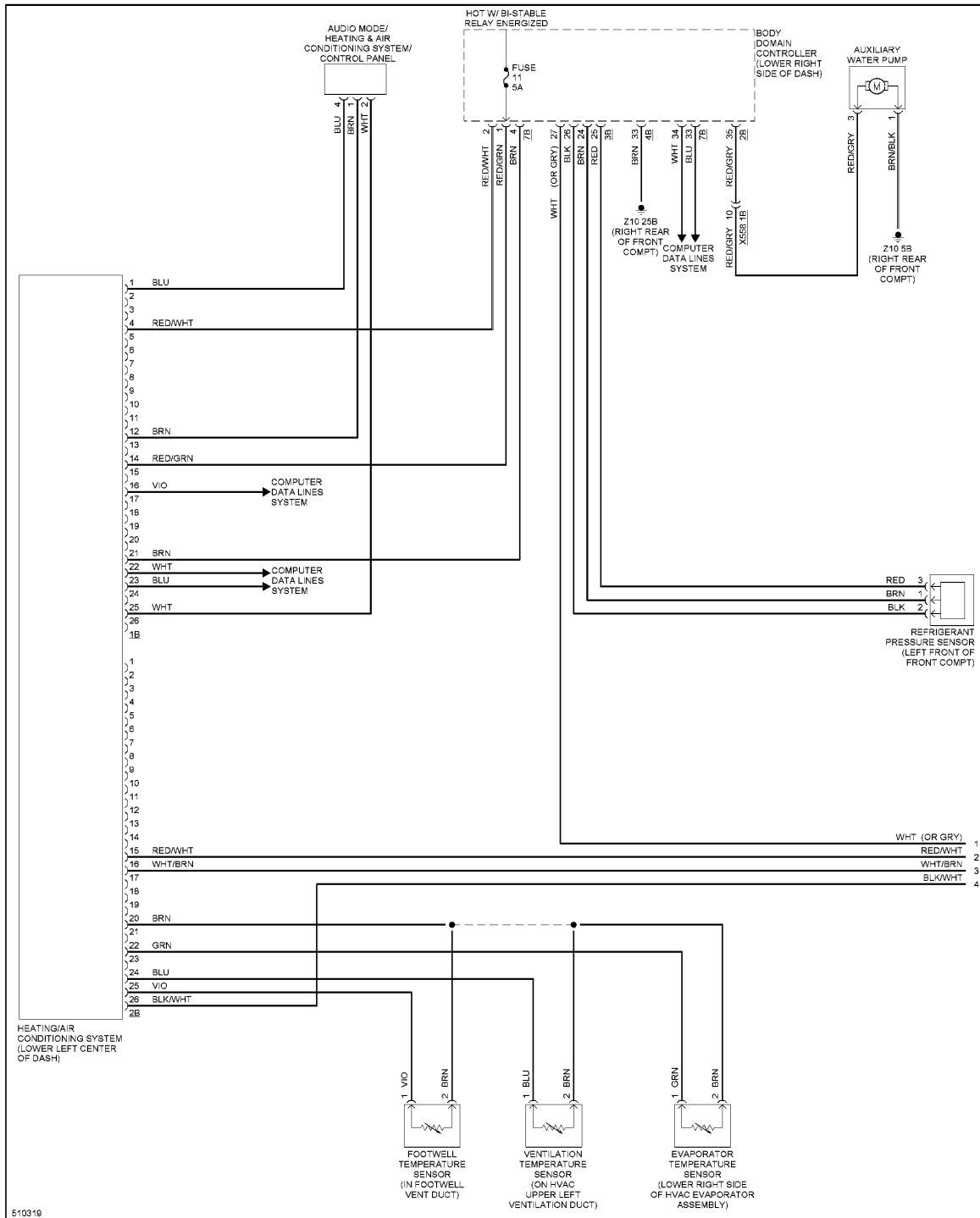
**IMPORTANT:** Do not coat the contact surface of the disc wheel, because this would adversely affect the frictional behaviour of wheel contact surfaces!

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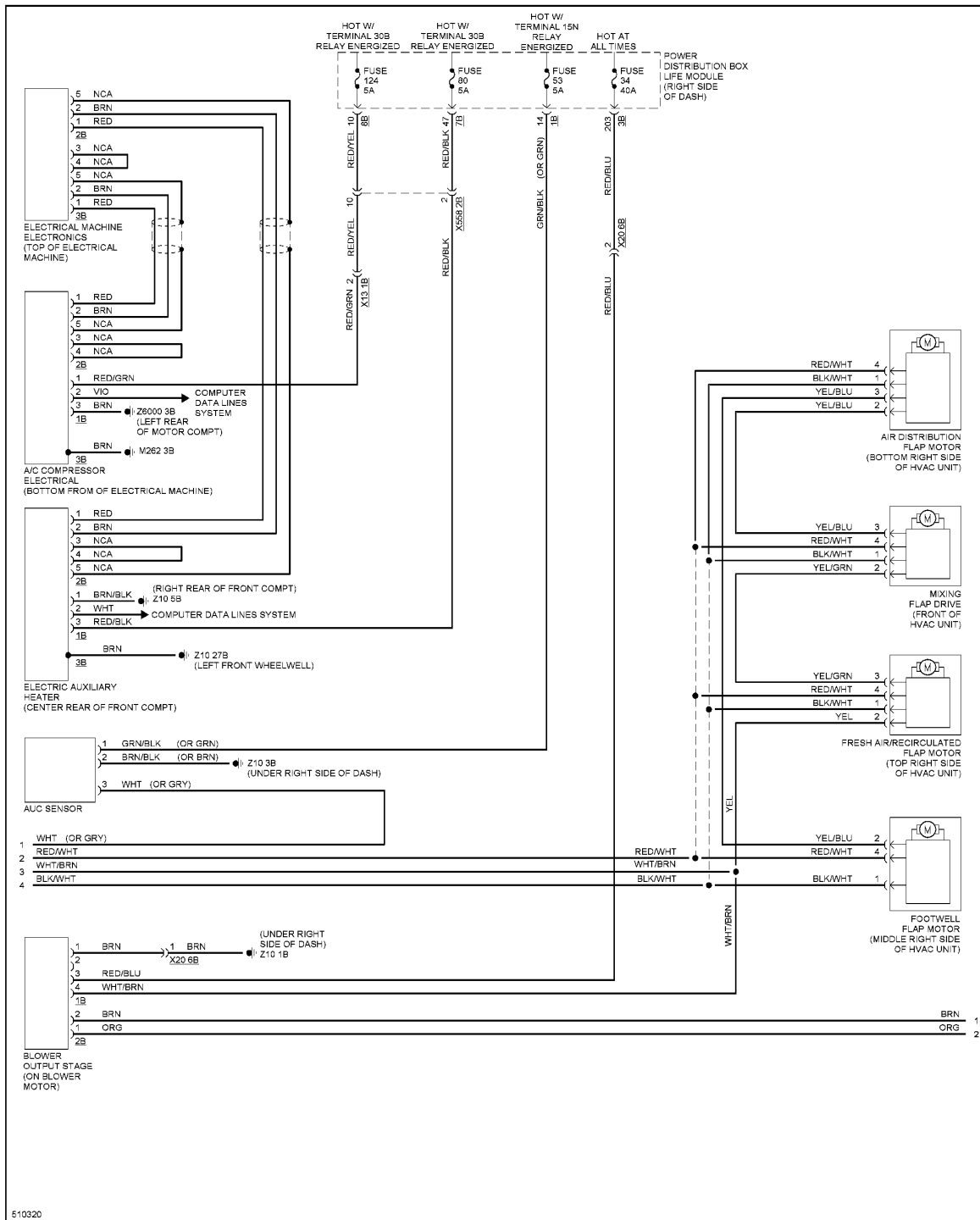
# 2016 SYSTEM WIRING DIAGRAMS

## BMW - i3

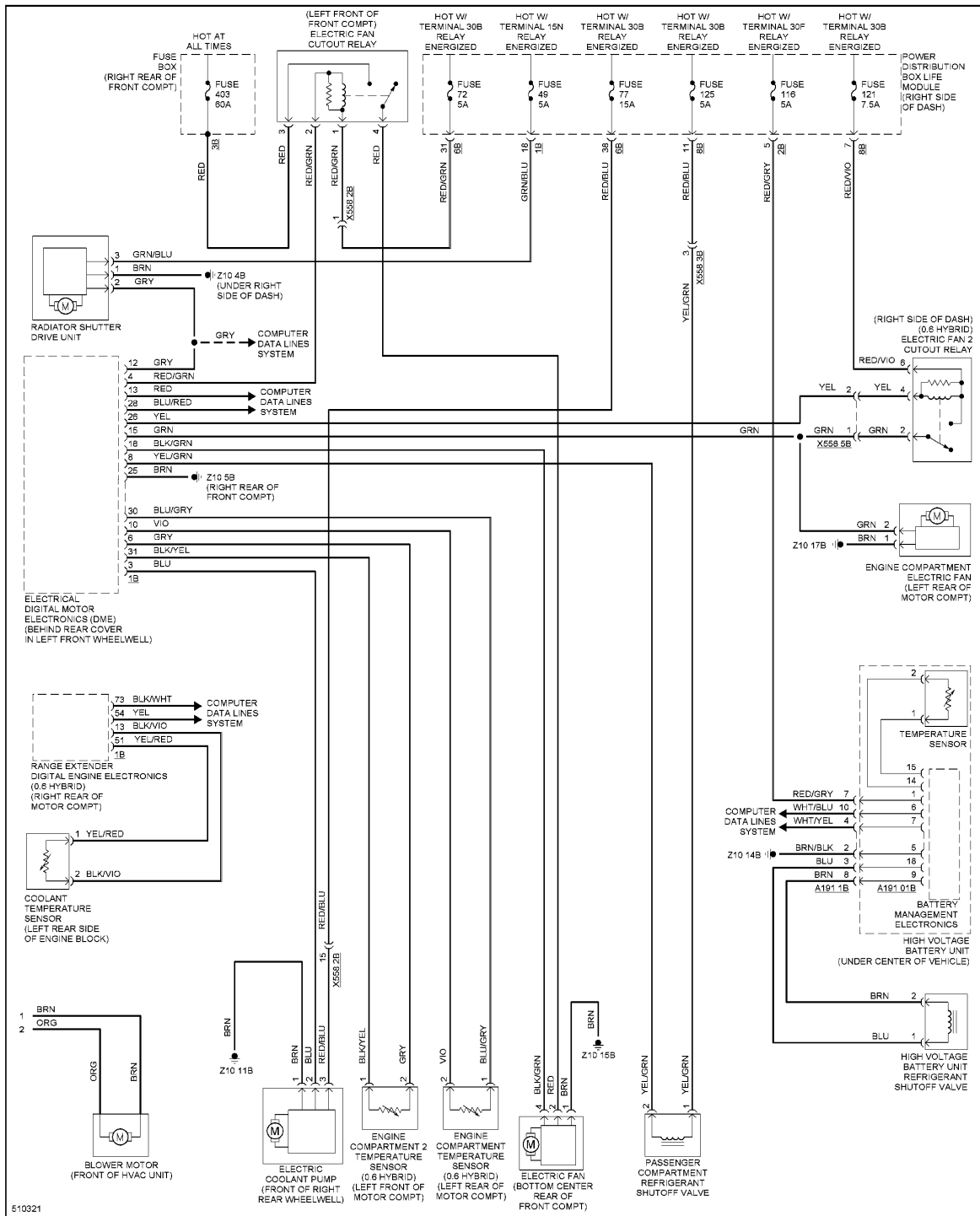
### AIR CONDITIONING



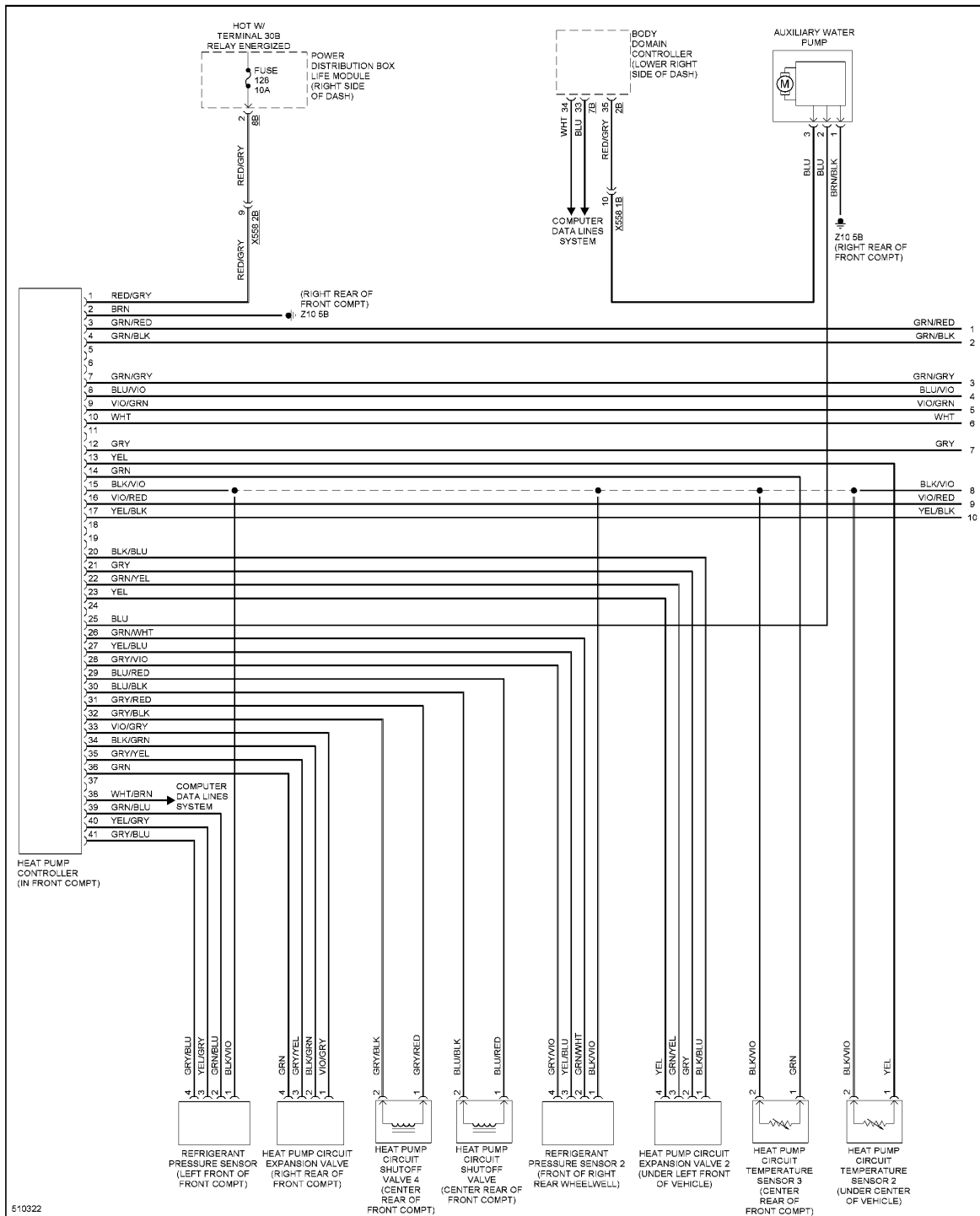
**Fig. 1: Automatic A/C Circuit (1 of 3)**



**Fig. 2: Automatic A/C Circuit (2 of 3)**

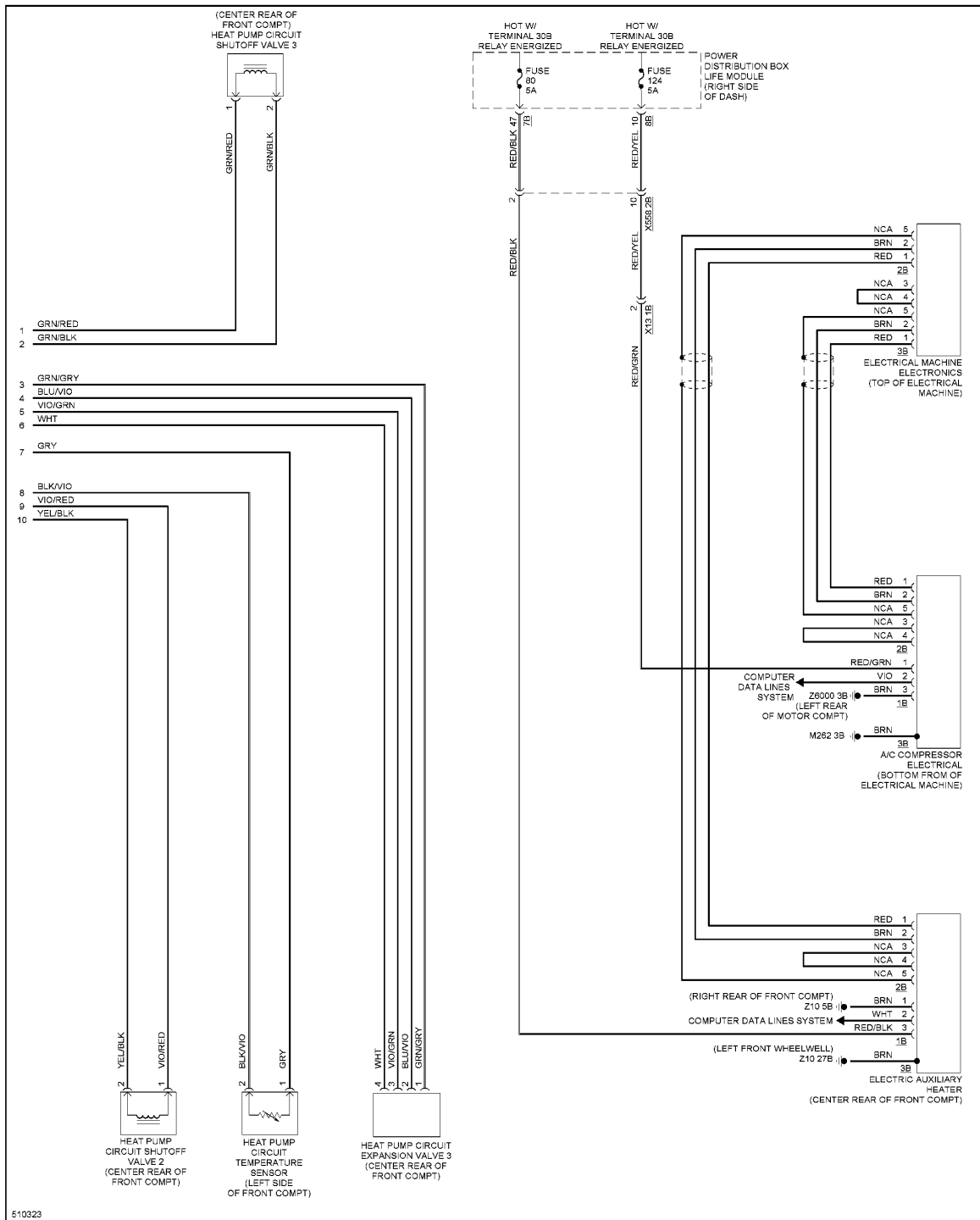


**Fig. 3: Automatic A/C Circuit (3 of 3)**



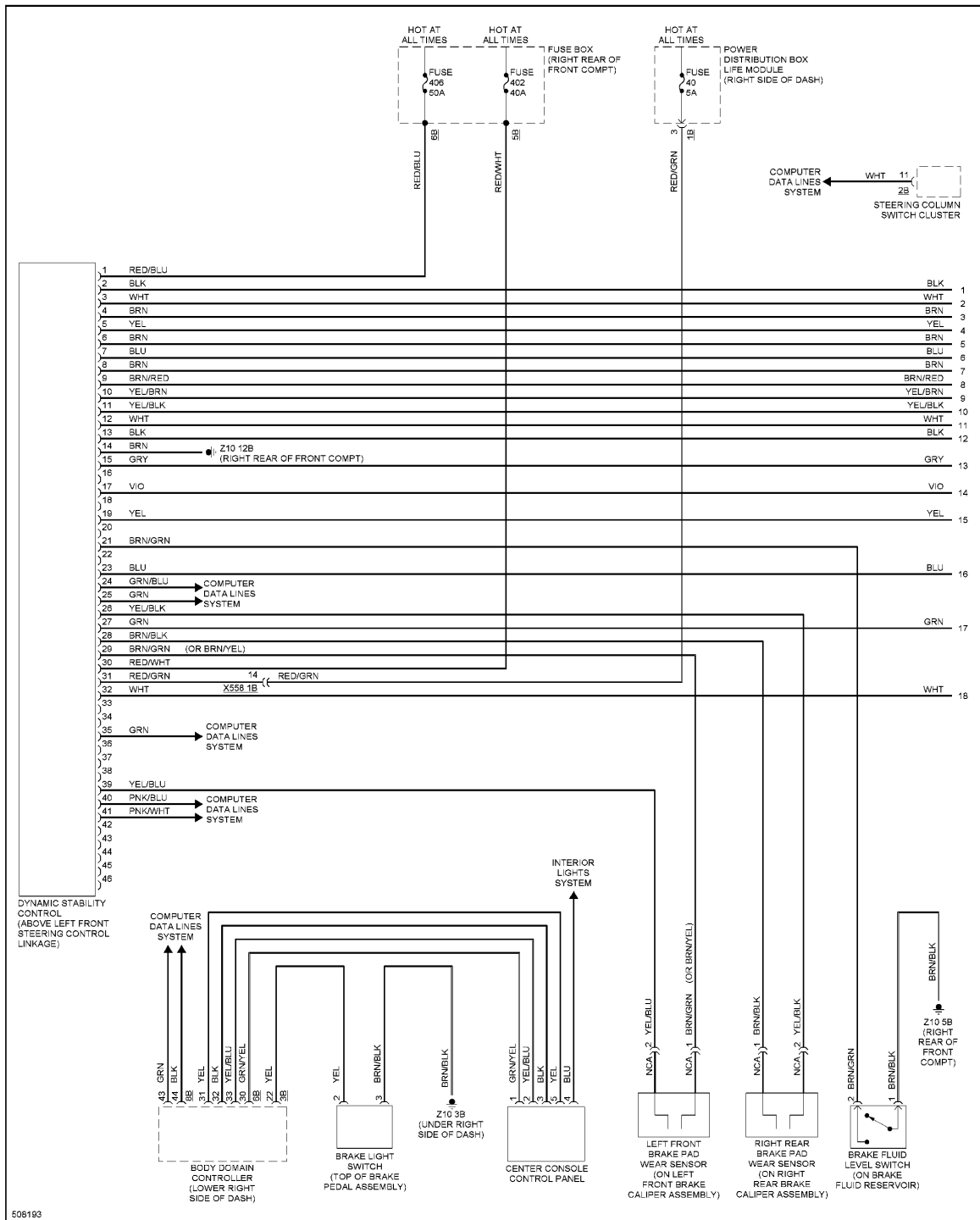
**Fig. 4: Heat Pump Circuit (1 of 2)**



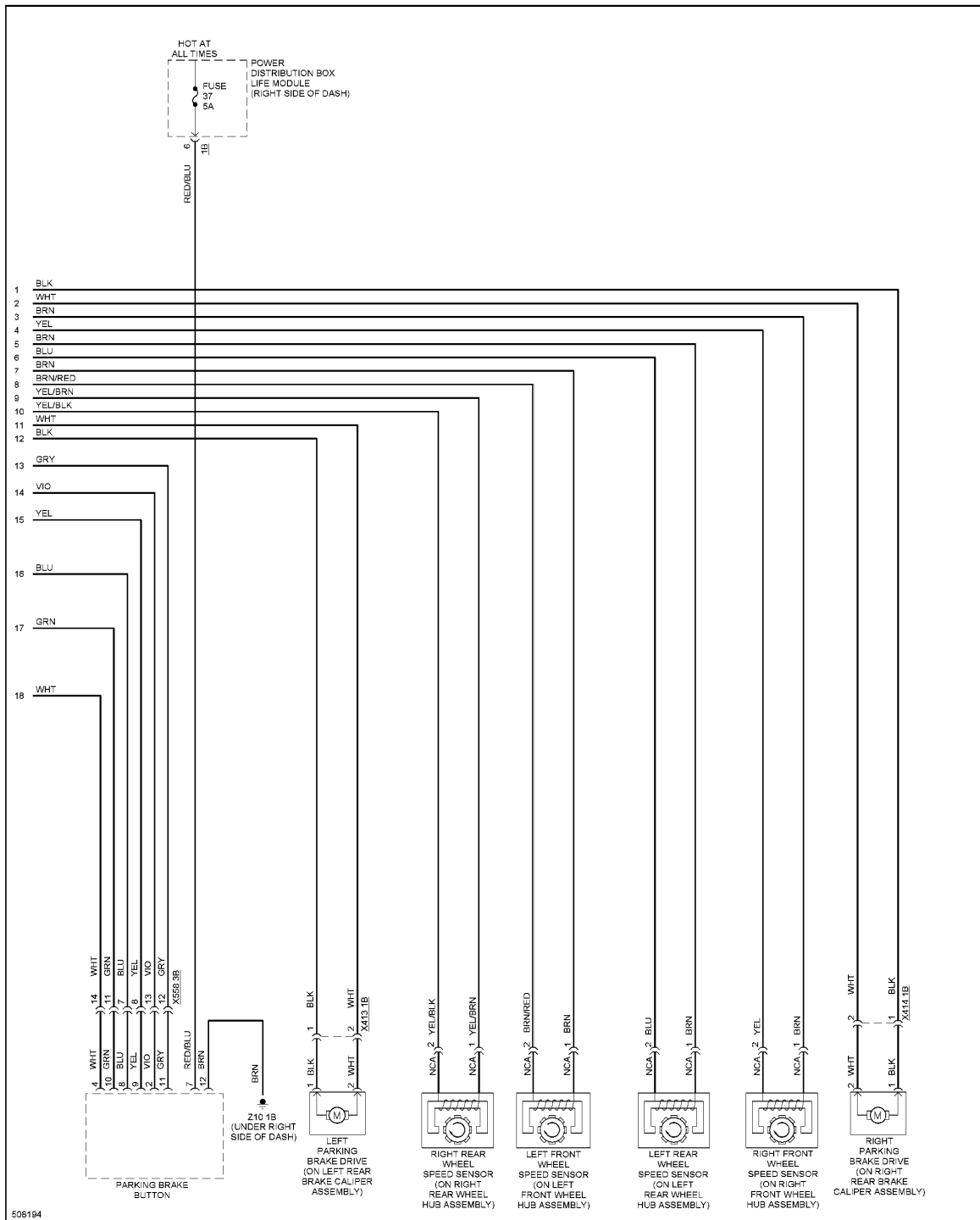


**Fig. 5: Heat Pump Circuit (2 of 2)**

**ANTI-LOCK BRAKES**

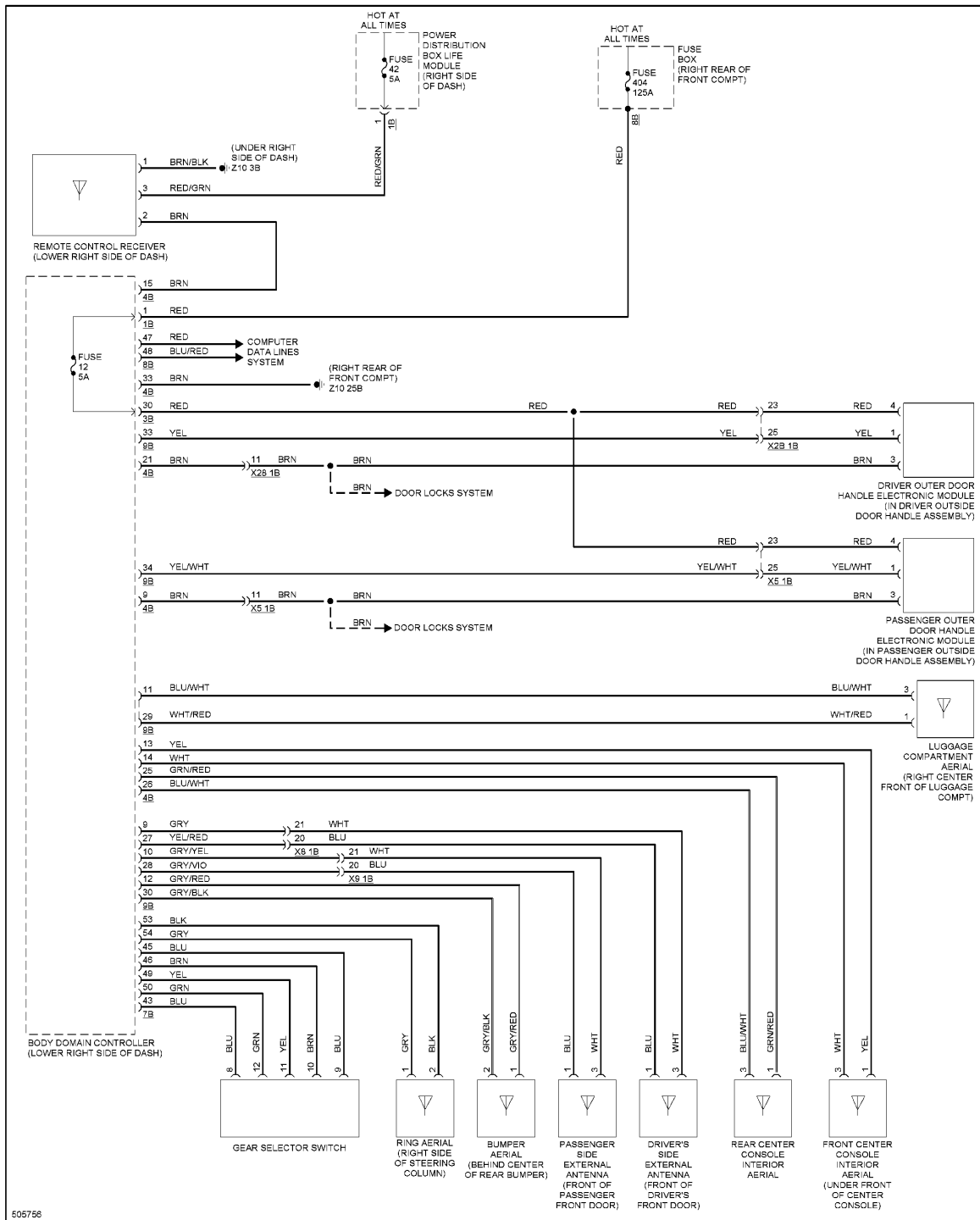


**Fig. 6: Anti-lock Brakes Circuit (1 of 2)**

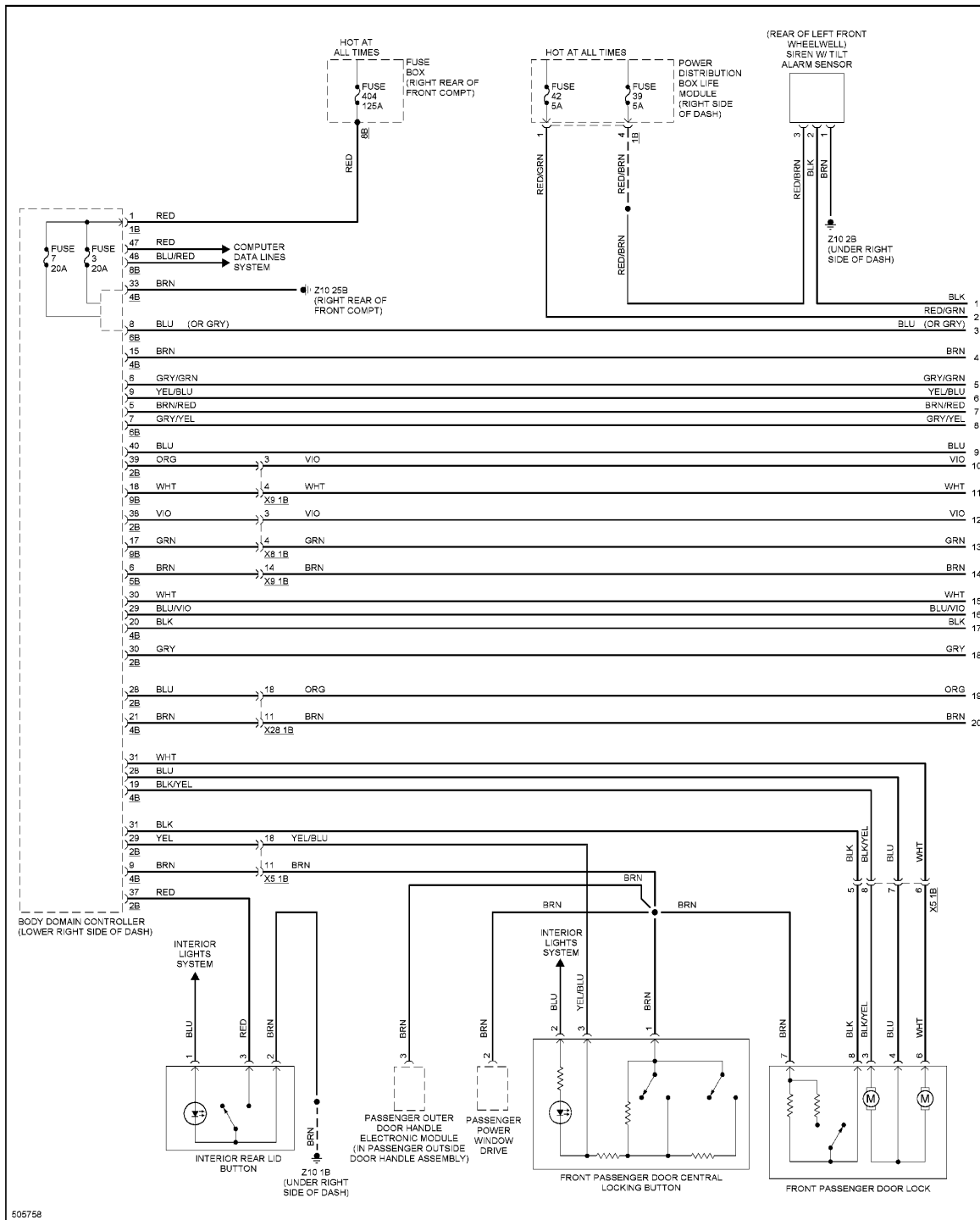


**Fig. 7: Anti-lock Brakes Circuit (2 of 2)**

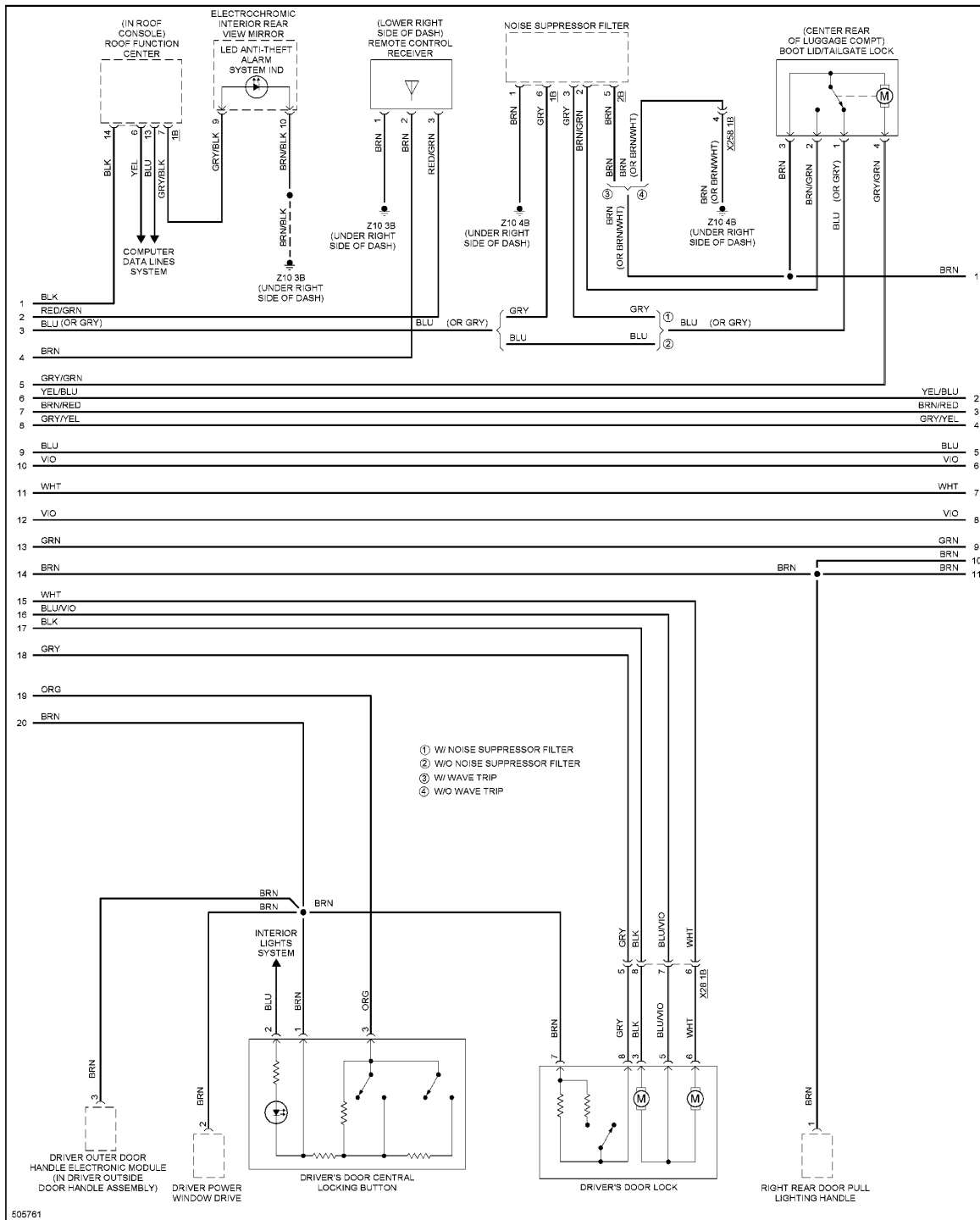
**ANTI-THEFT**



**Fig. 8: Access/Start Circuit**

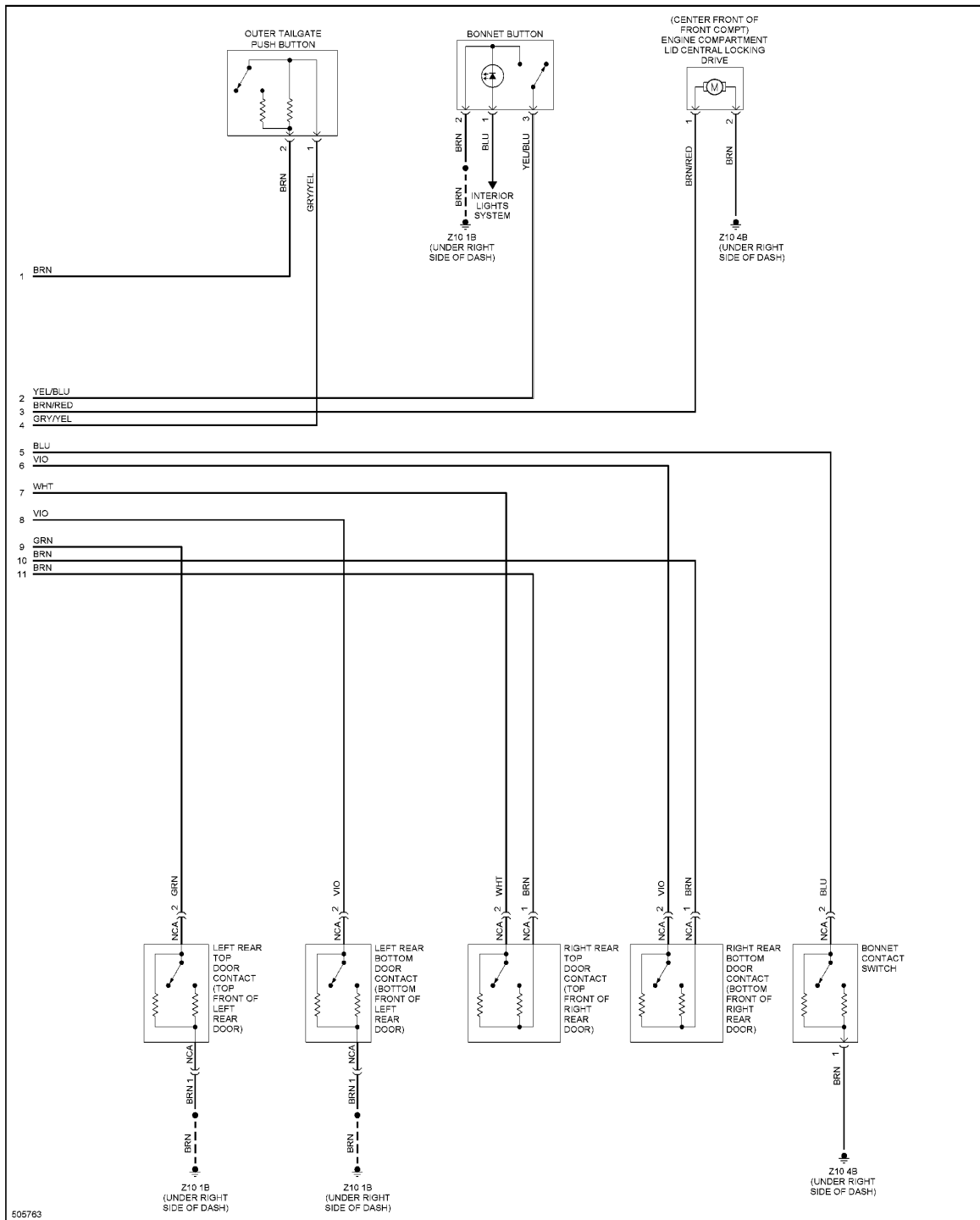


**Fig. 9: Anti-theft & Central Locking Circuit (1 of 3)**



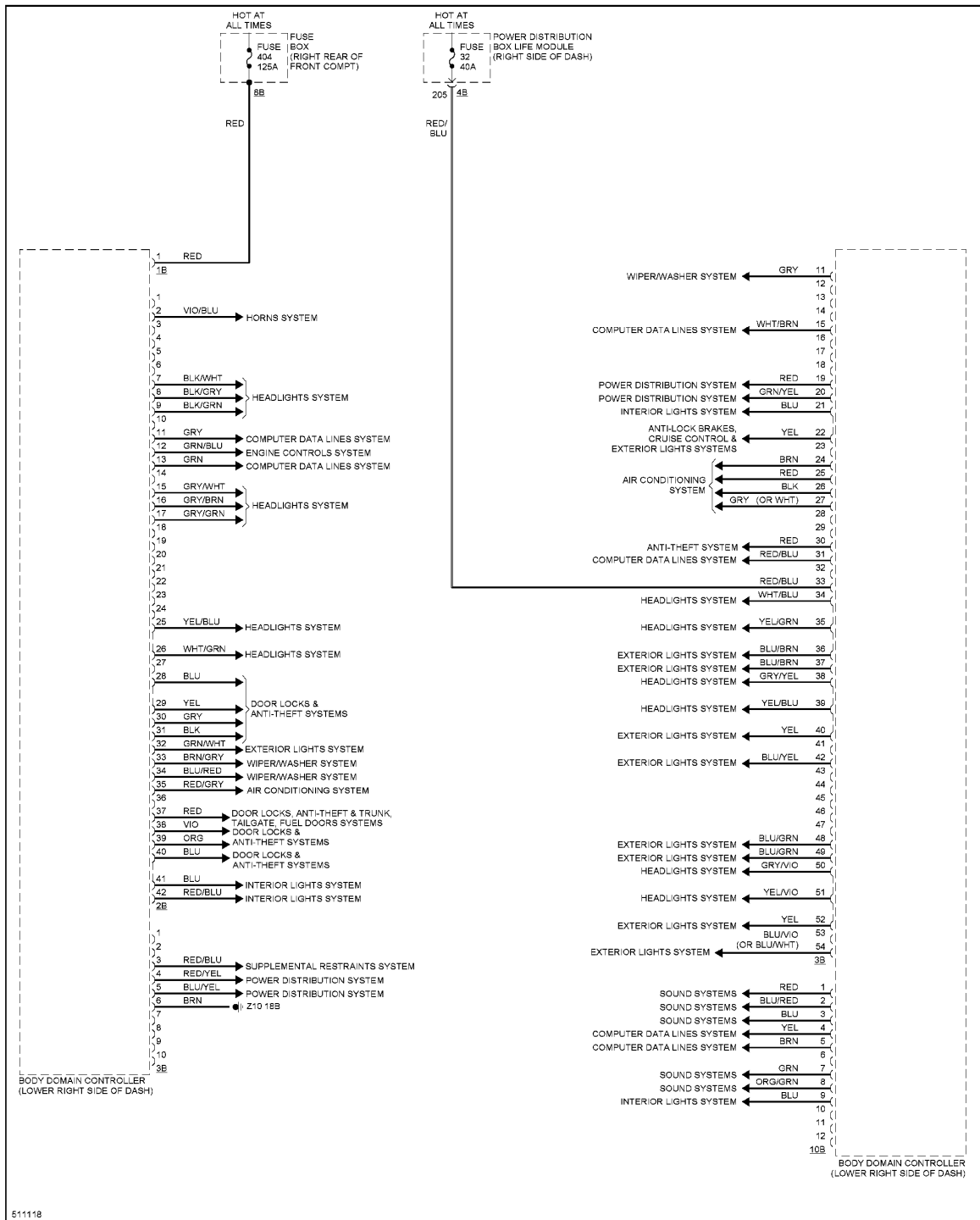
**Fig. 10: Anti-theft & Central Locking Circuit (2 of 3)**





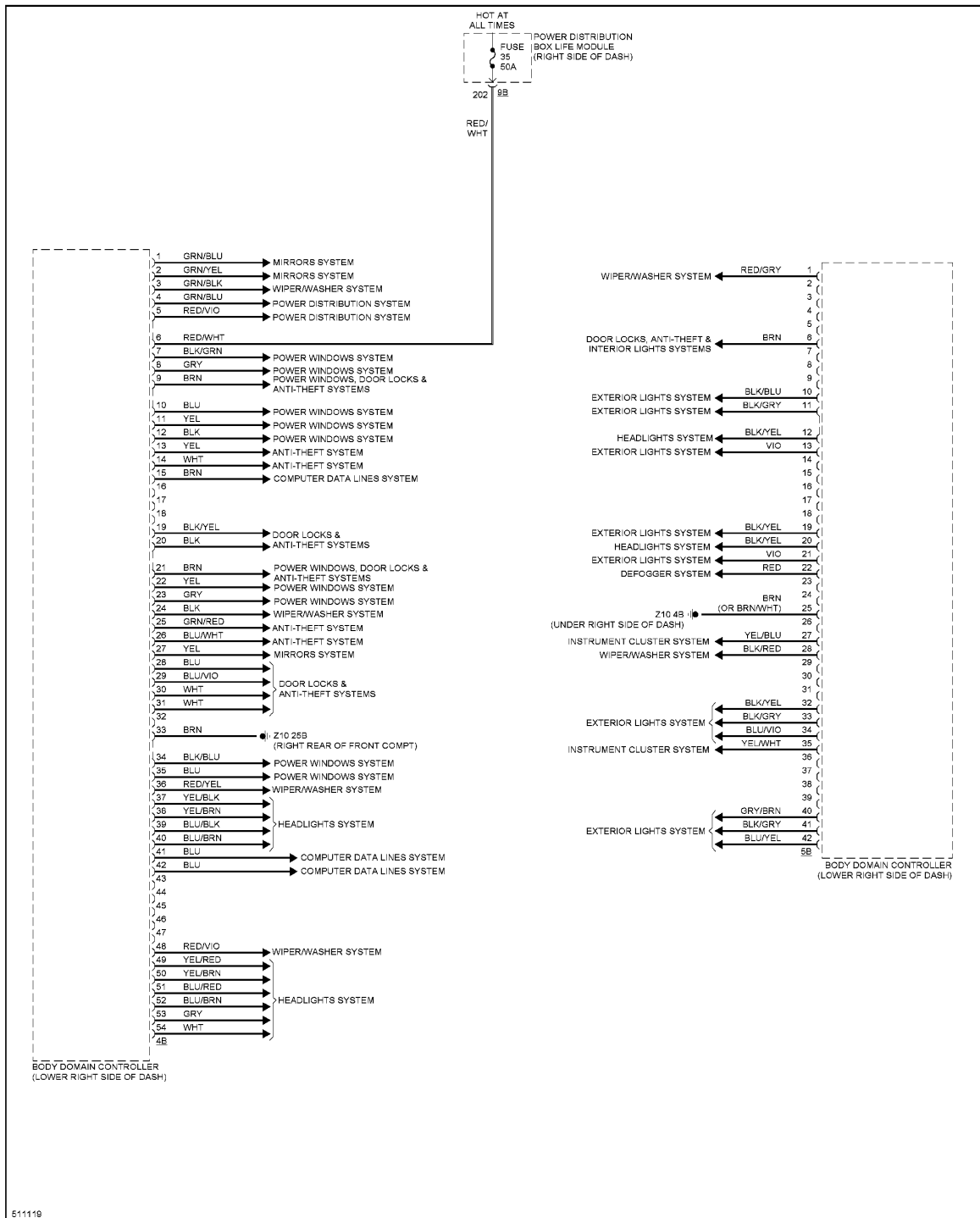
**Fig. 11: Anti-theft & Central Locking Circuit (3 of 3)**

## BODY CONTROL MODULES

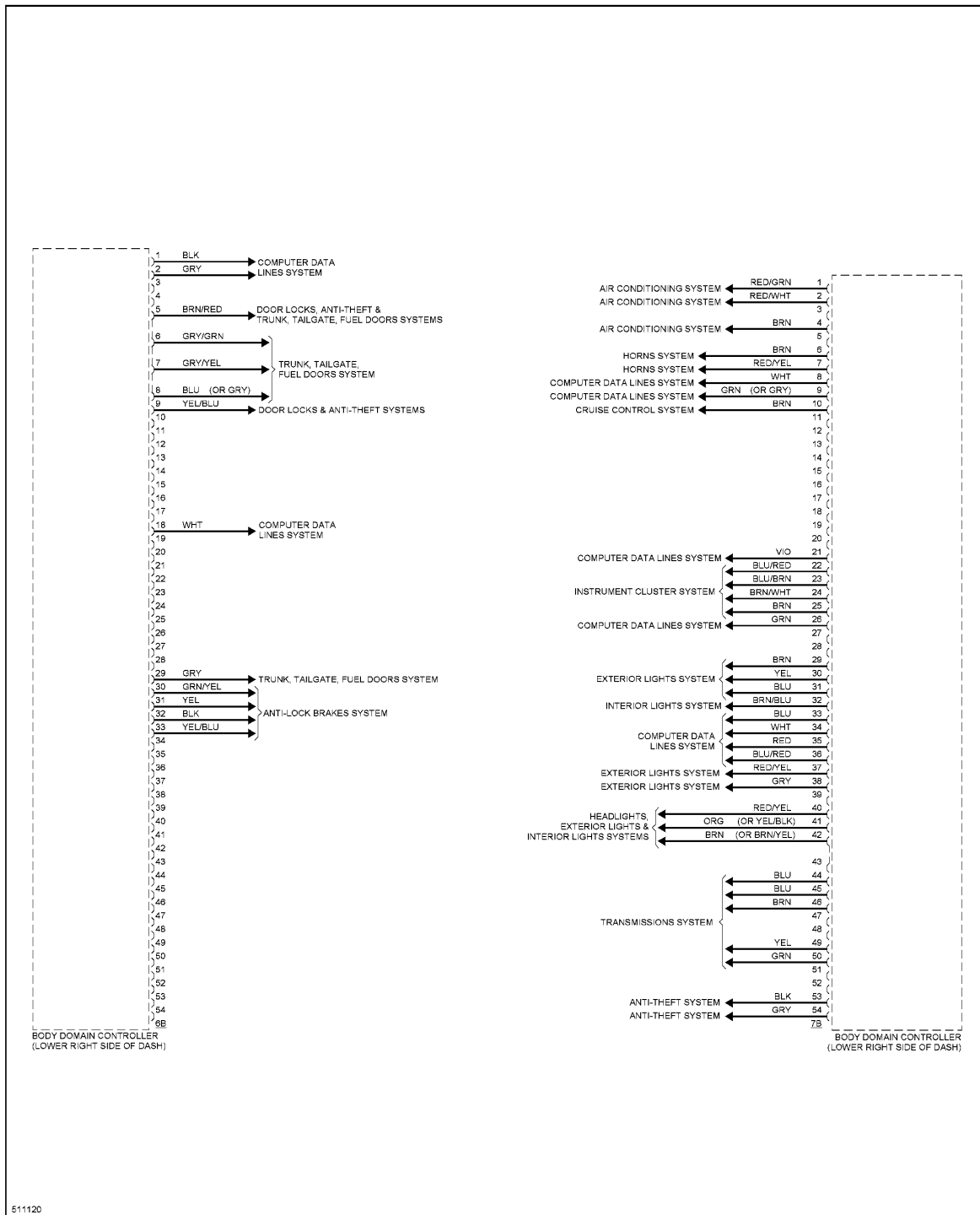


511118

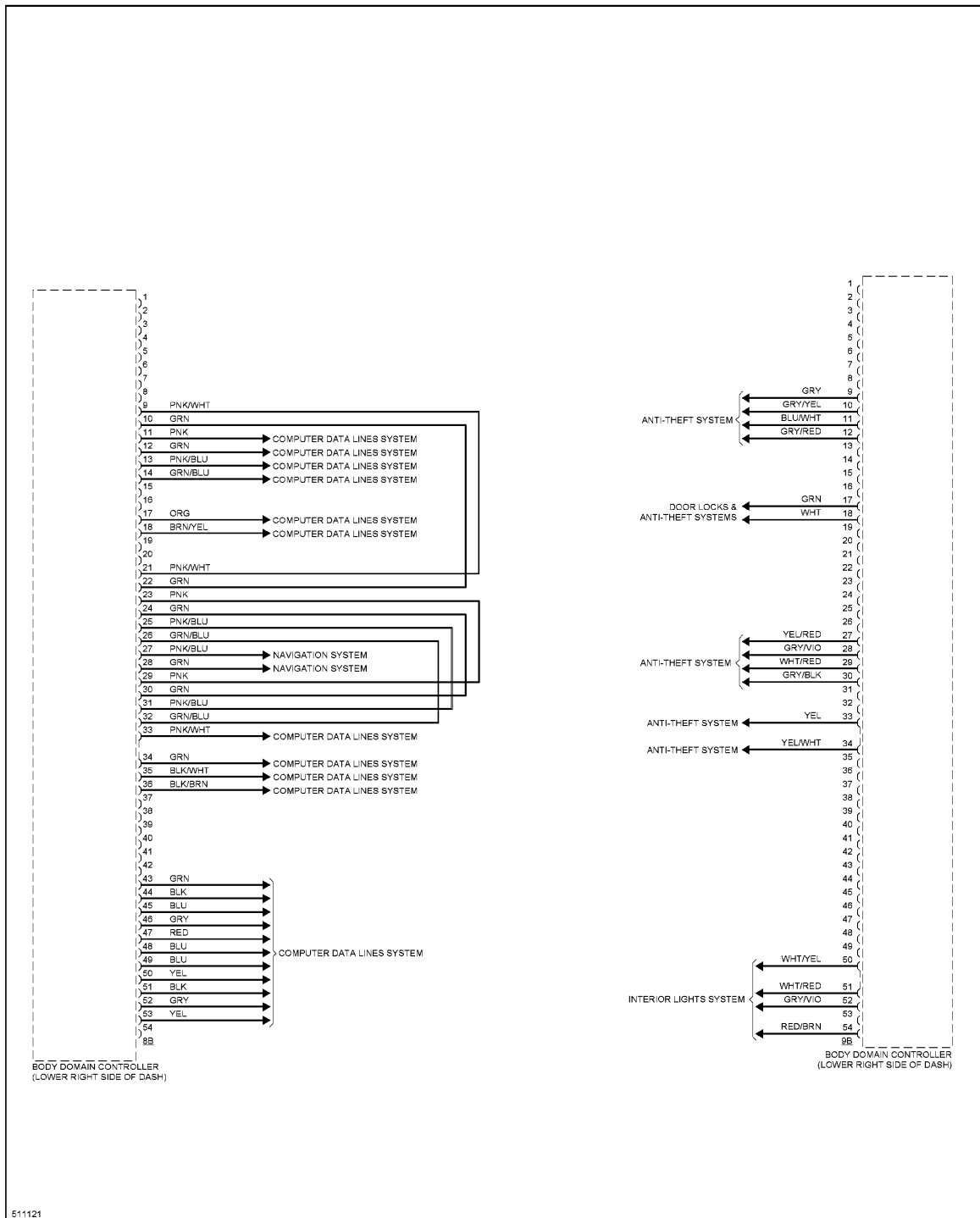
**Fig. 12: Body Control Modules Circuit (1 of 4)**



**Fig. 13: Body Control Modules Circuit (2 of 4)**

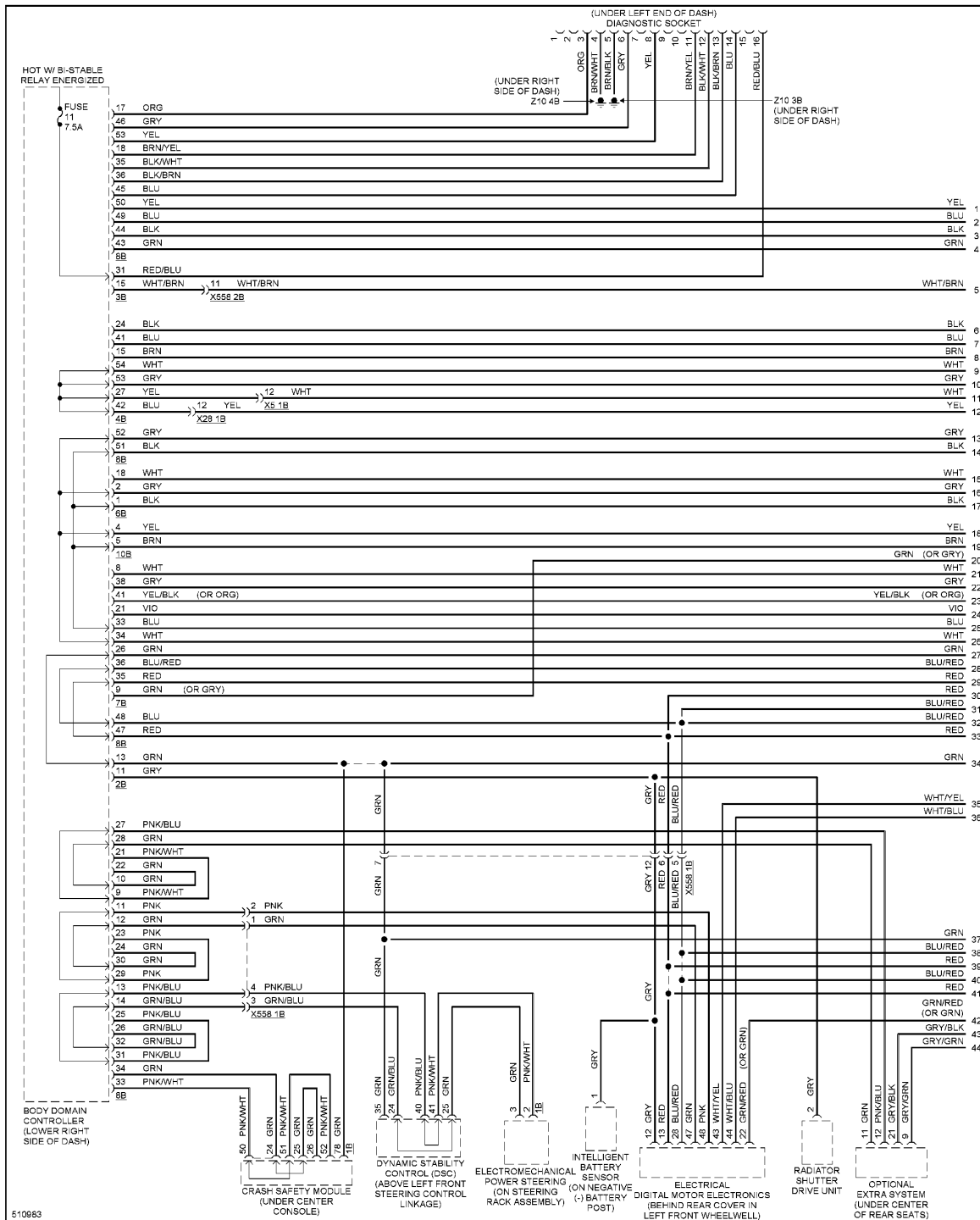


**Fig. 14: Body Control Modules Circuit (3 of 4)**



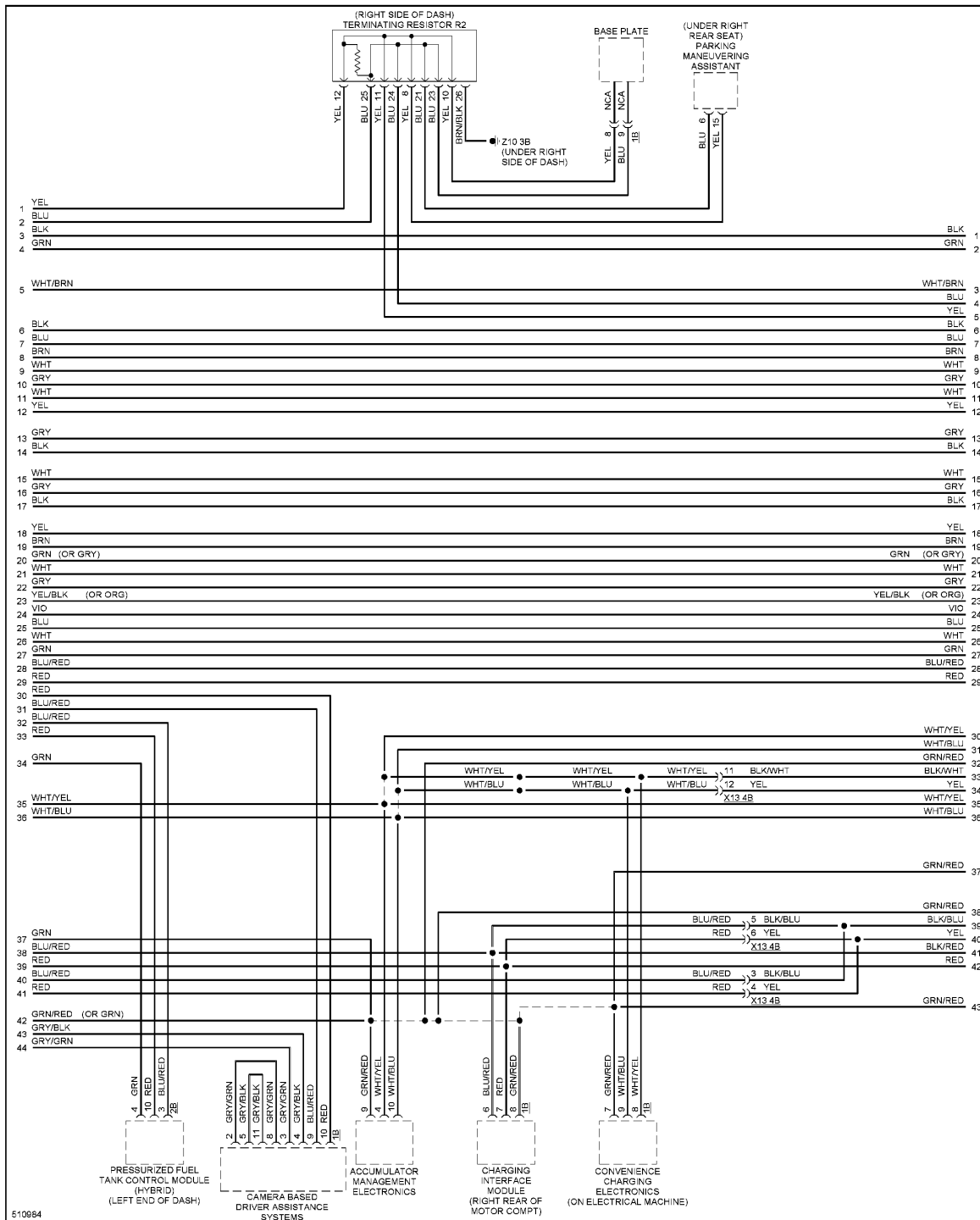
**Fig. 15: Body Control Modules Circuit (4 of 4)**

**COMPUTER DATA LINES**

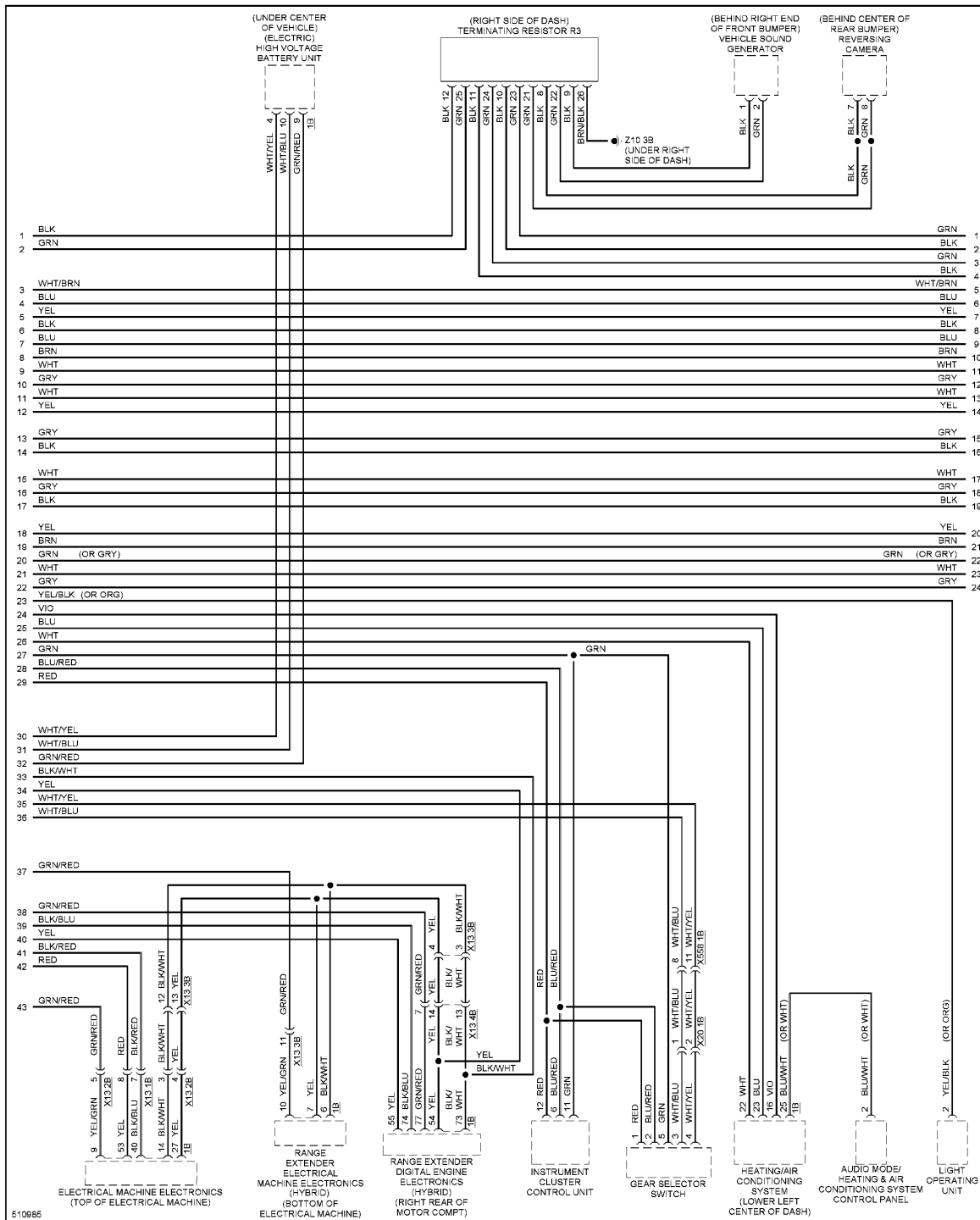


**Fig. 16: Computer Data Lines Circuit (1 of 5)**

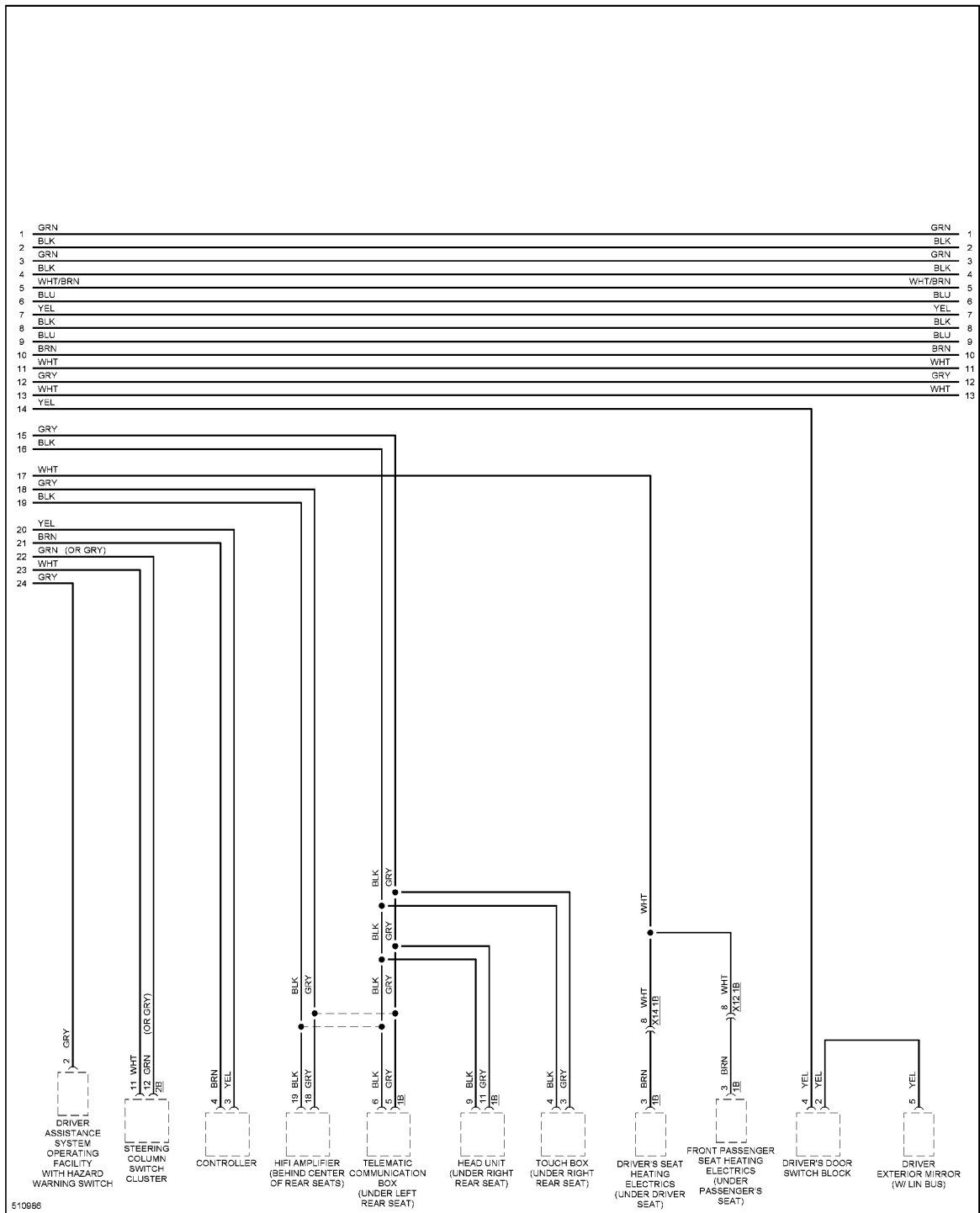




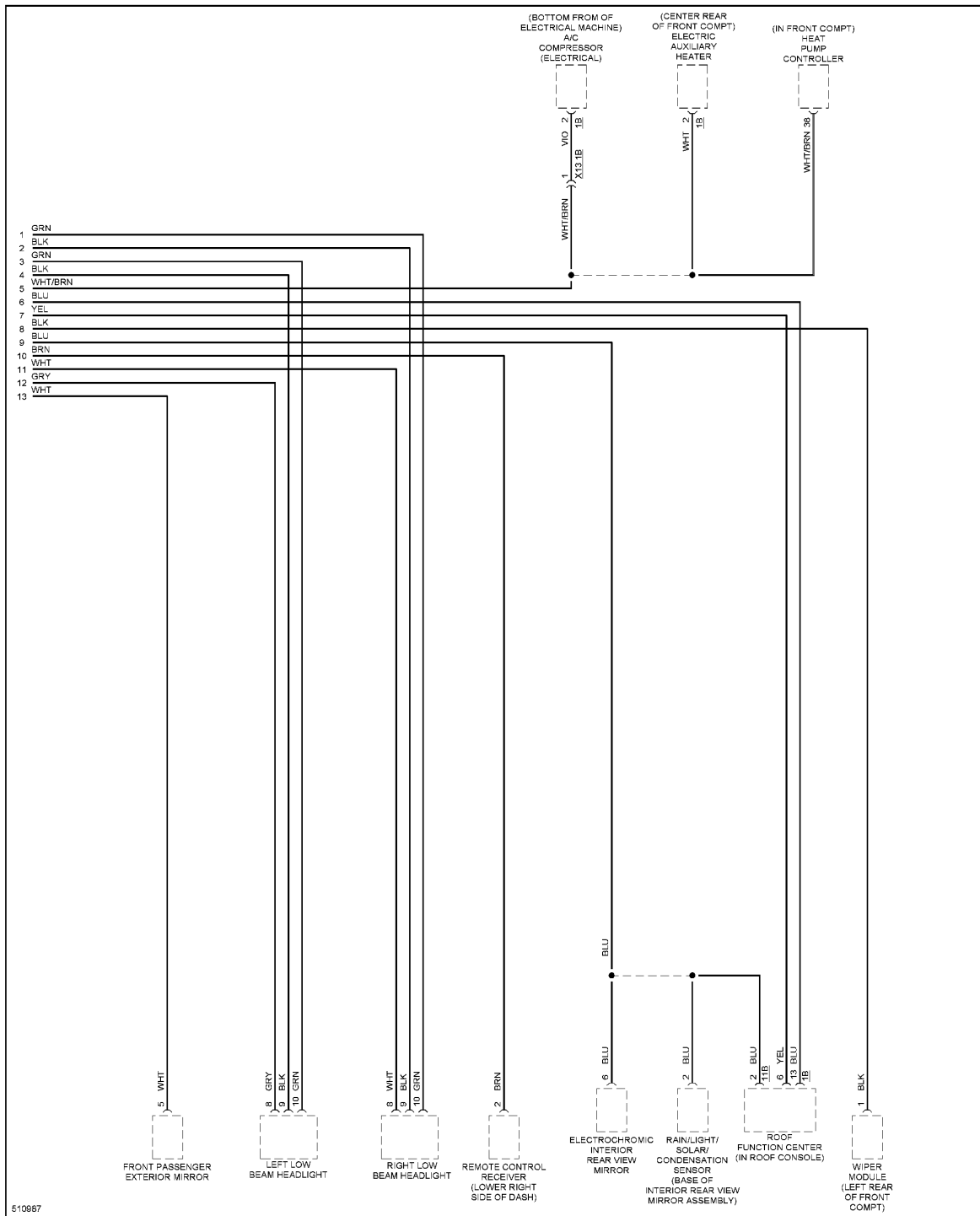
**Fig. 17: Computer Data Lines Circuit (2 of 5)**



**Fig. 18: Computer Data Lines Circuit (3 of 5)**

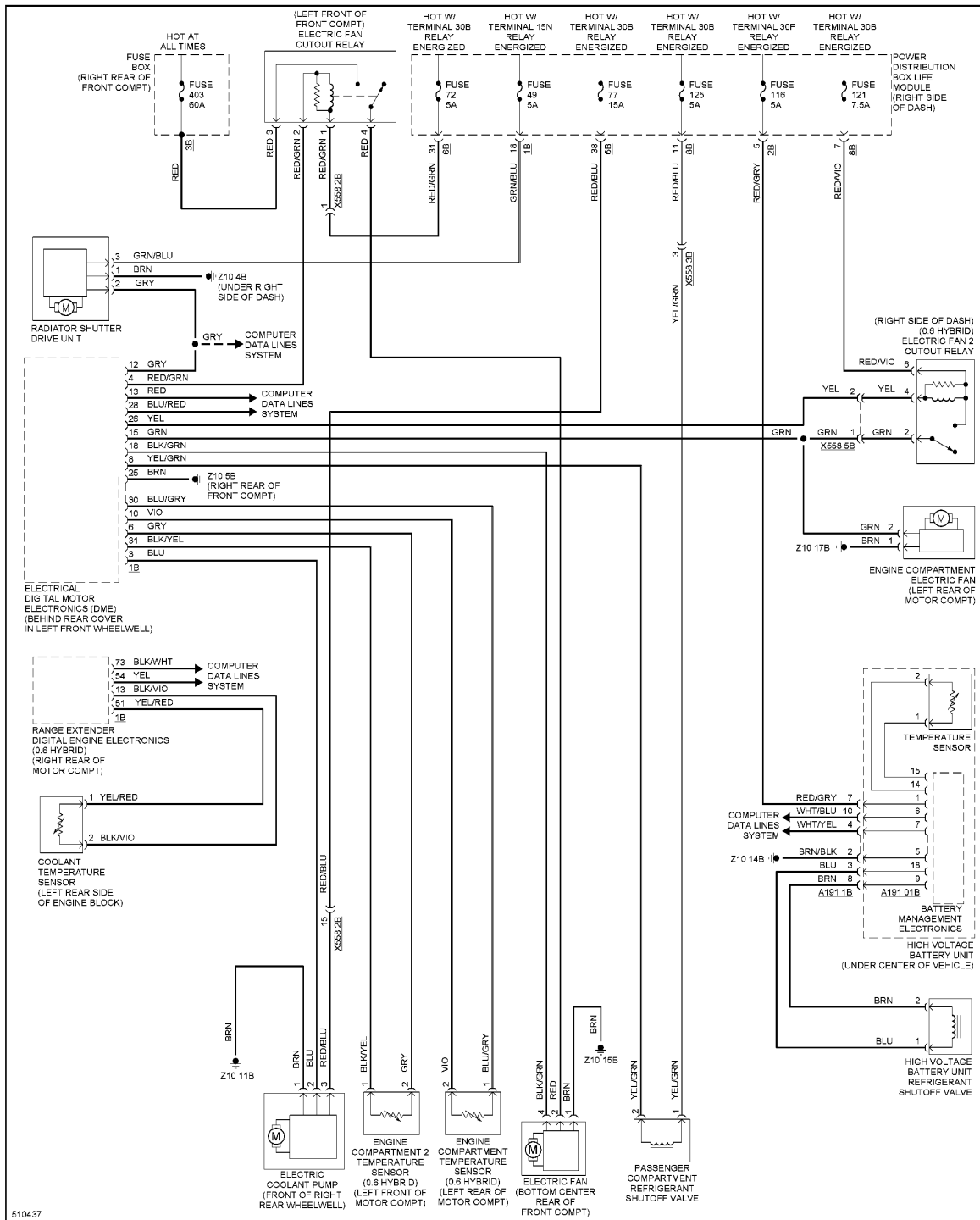


**Fig. 19: Computer Data Lines Circuit (4 of 5)**



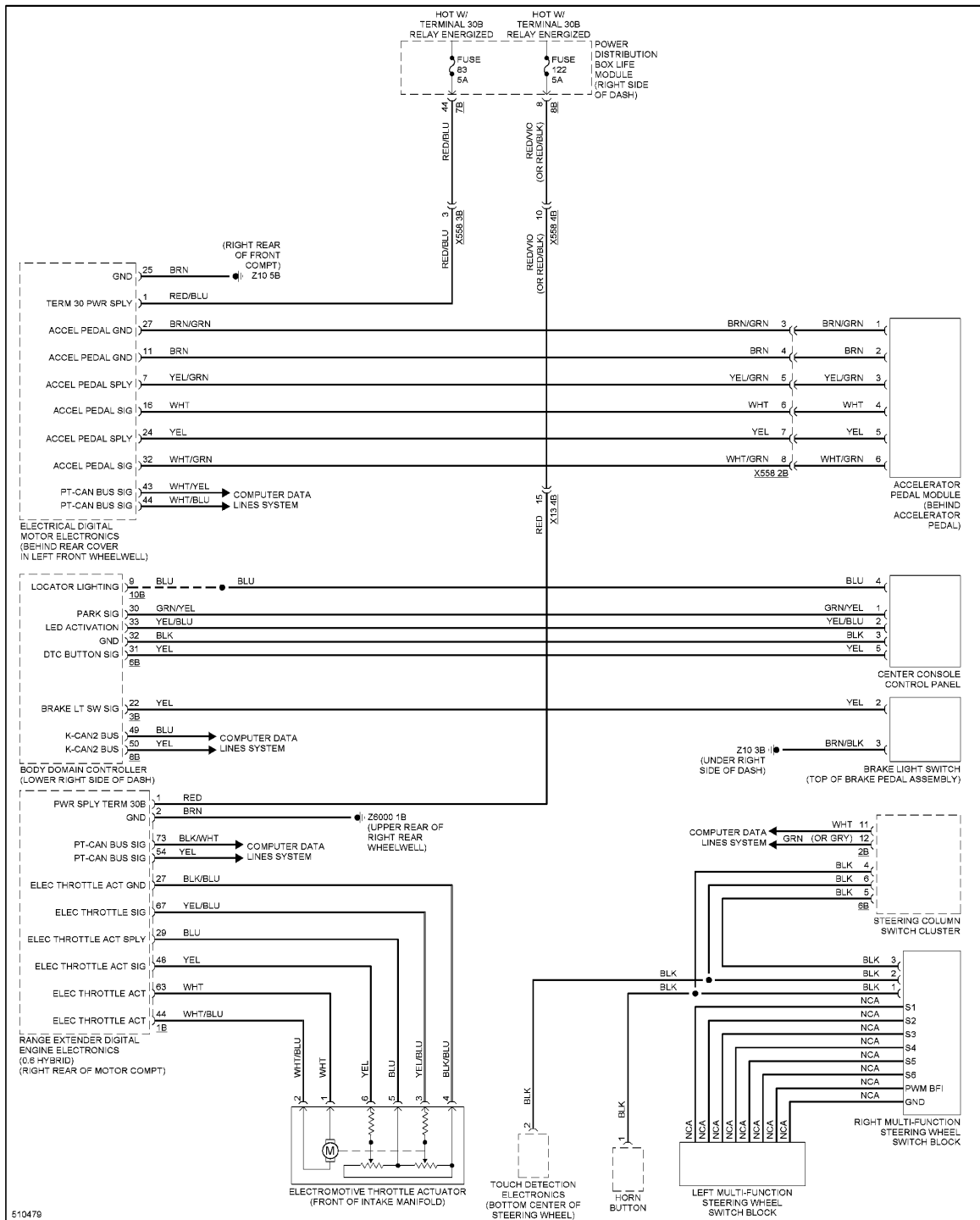
**Fig. 20: Computer Data Lines Circuit (5 of 5)**

## COOLING FAN



**Fig. 21: Cooling Fan Circuit**

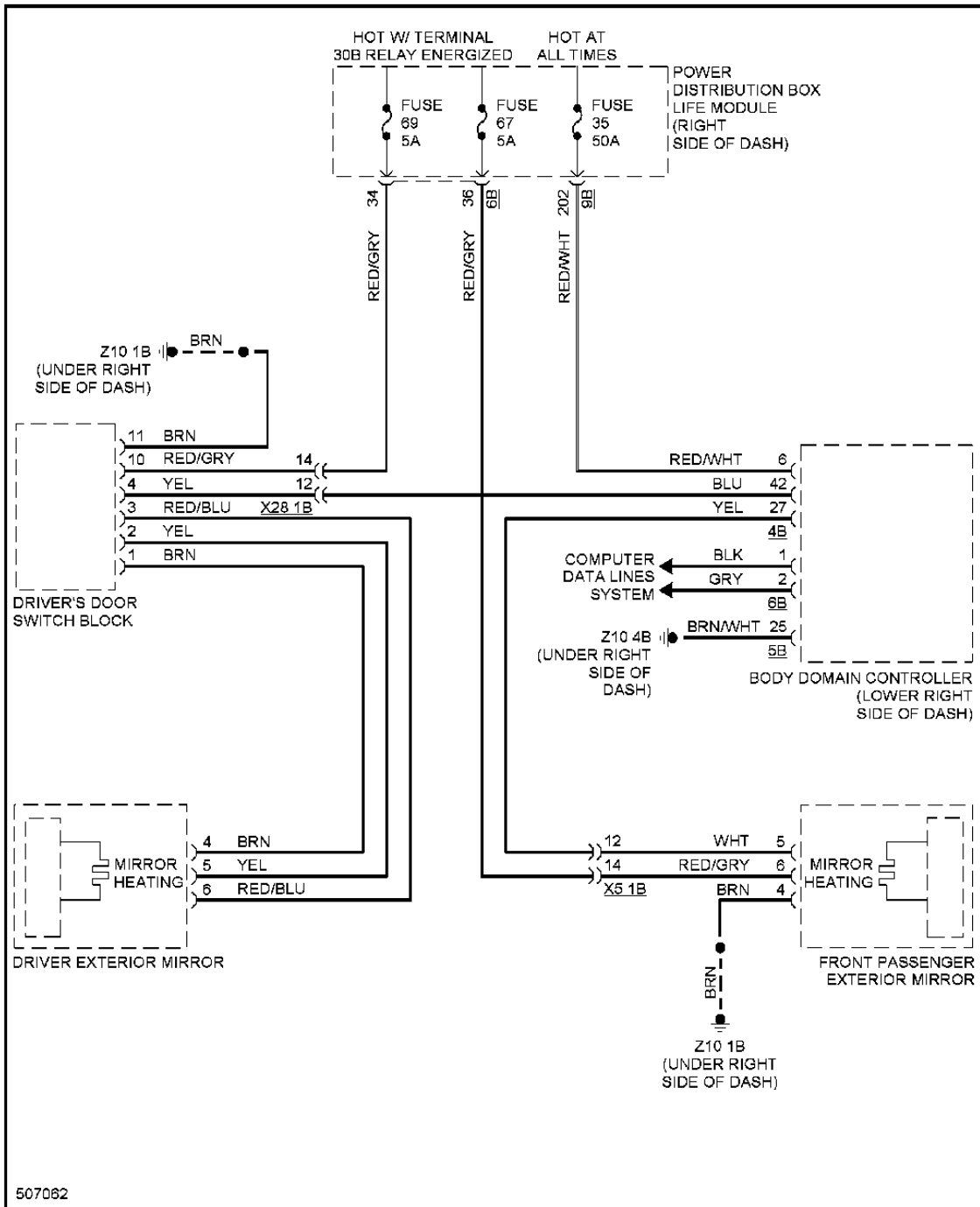
## CRUISE CONTROL



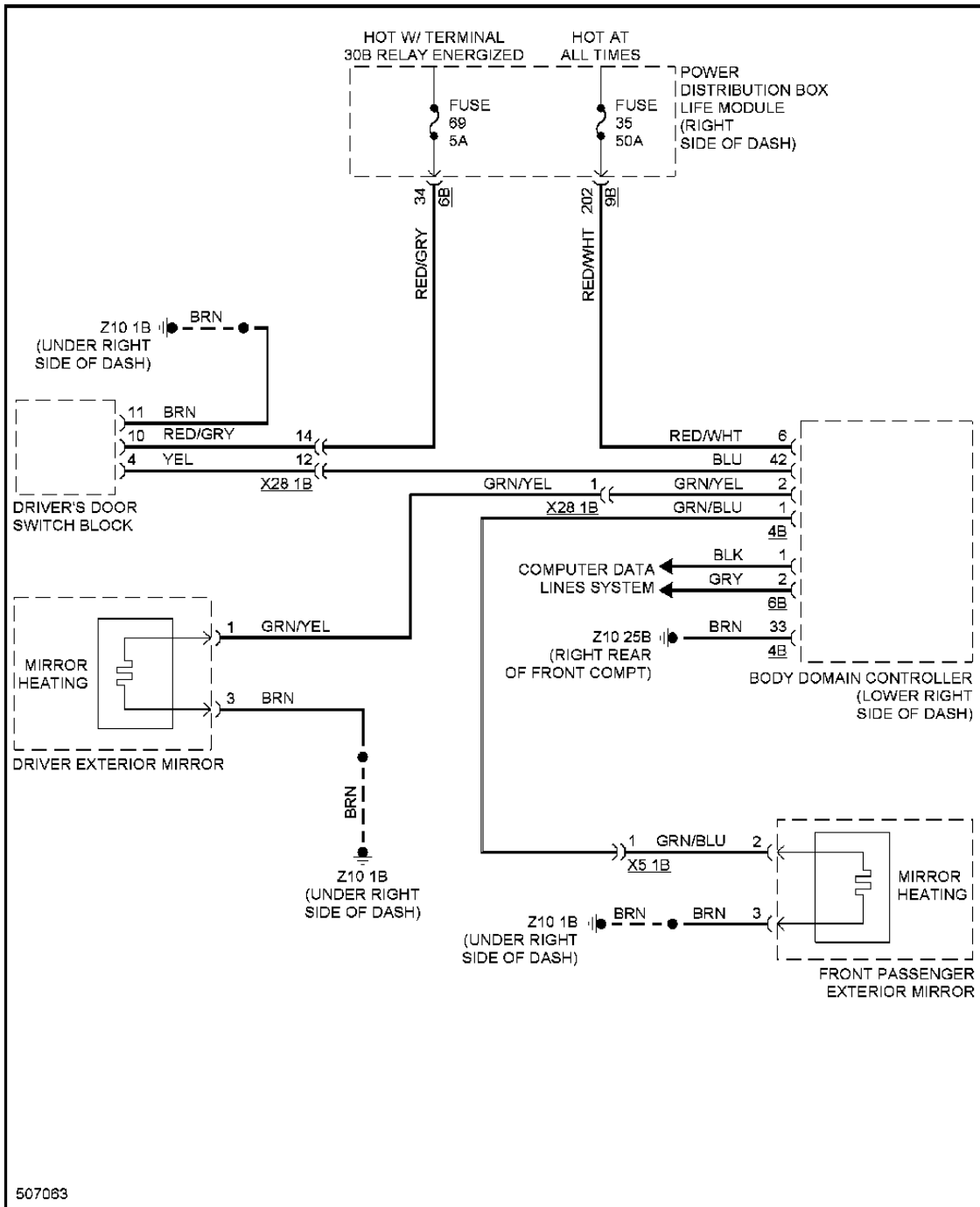
**Fig. 22: Cruise Control Circuit**

**DEFOGGERS**

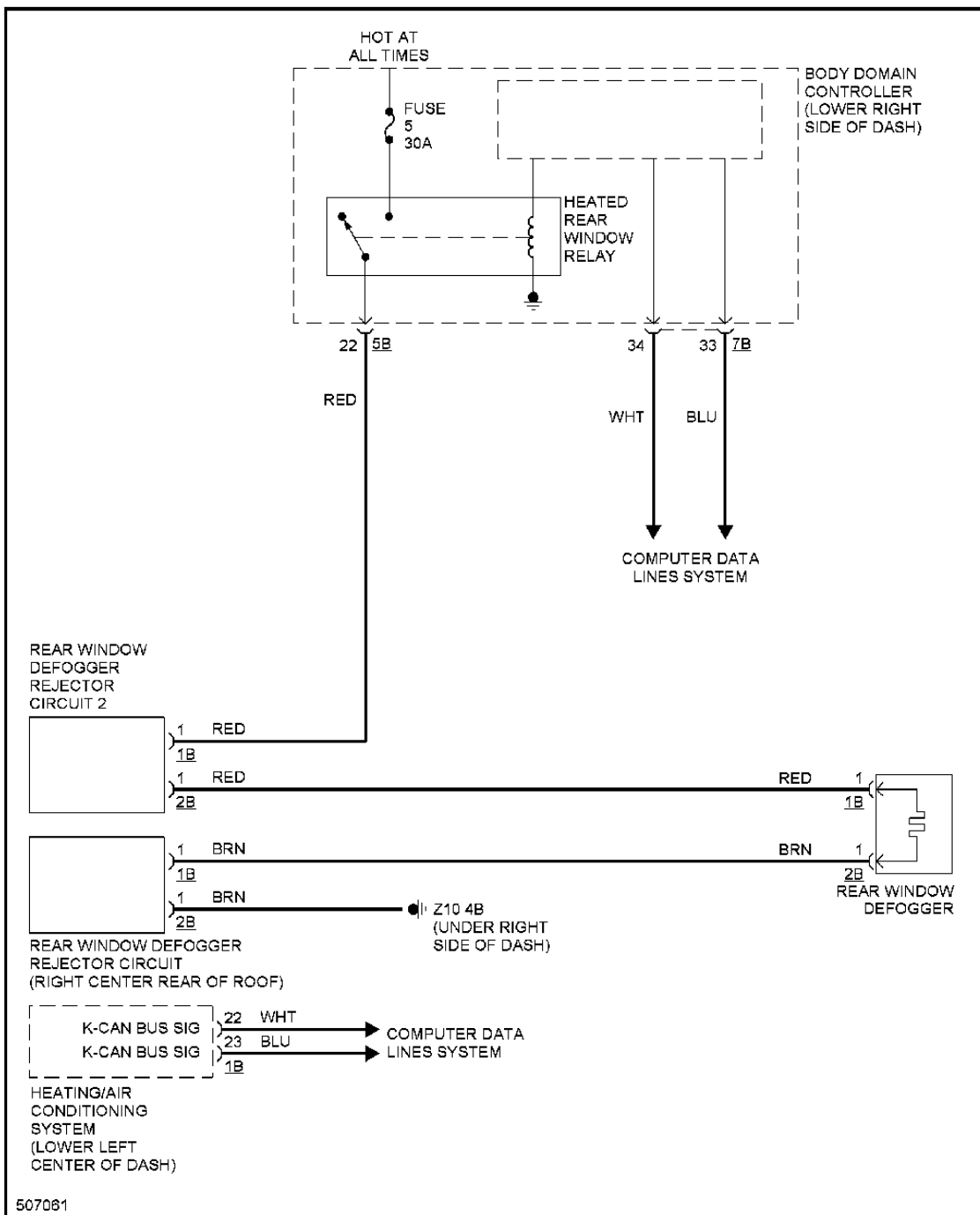




**Fig. 23: Heated Mirrors Circuit, W/ LIN Bus Function**

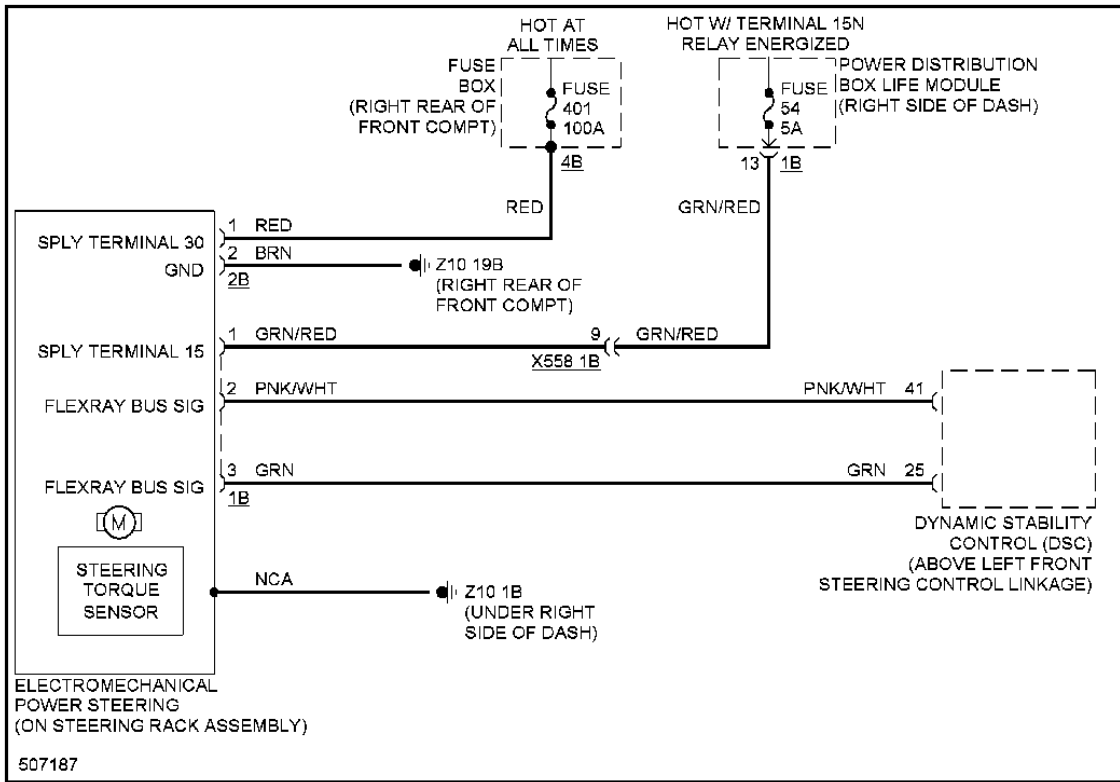


**Fig. 24: Heated Mirrors Circuit, W/O LIN Bus Function**



**Fig. 25: Rear Defogger Circuit**

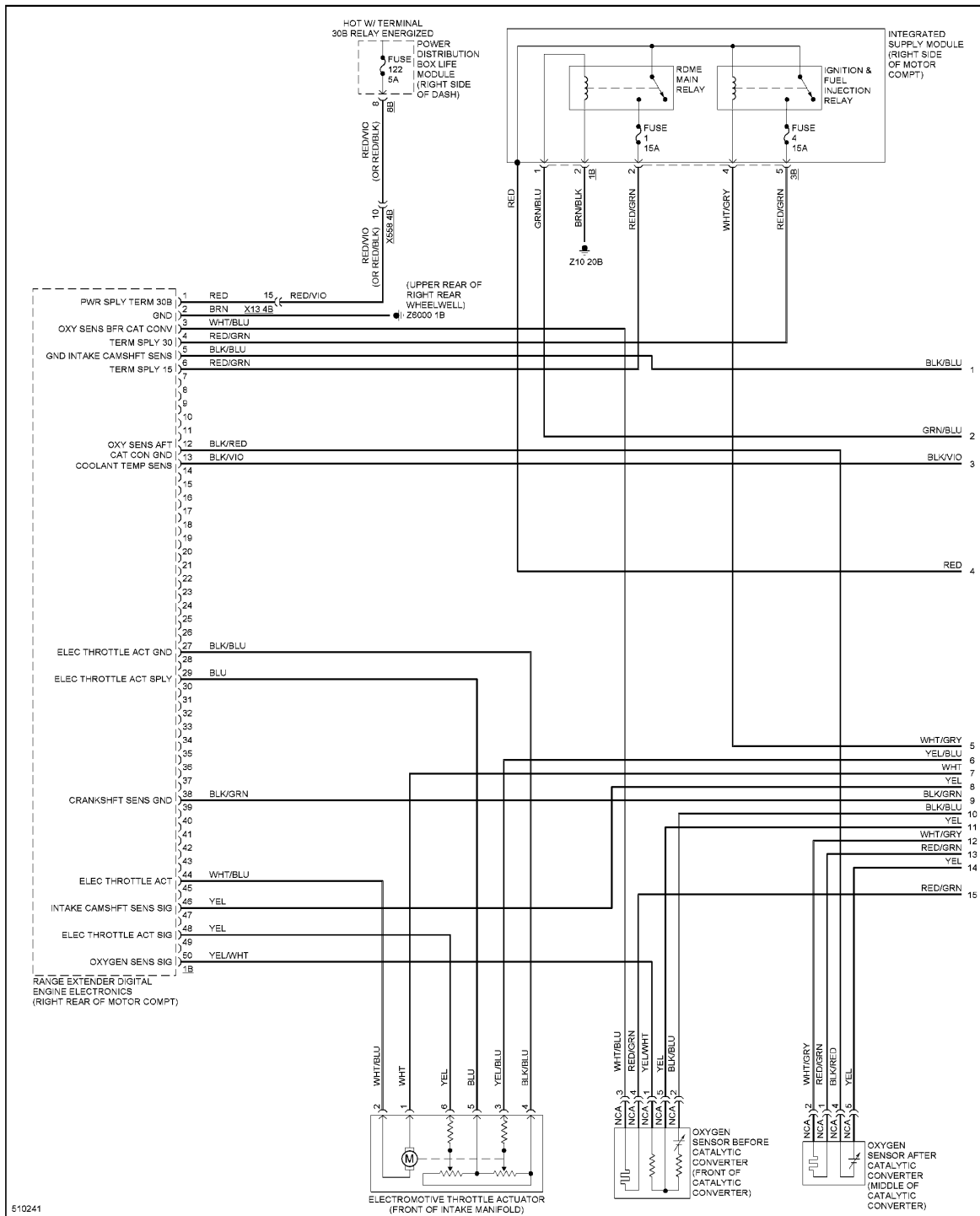
**ELECTRONIC POWER STEERING**



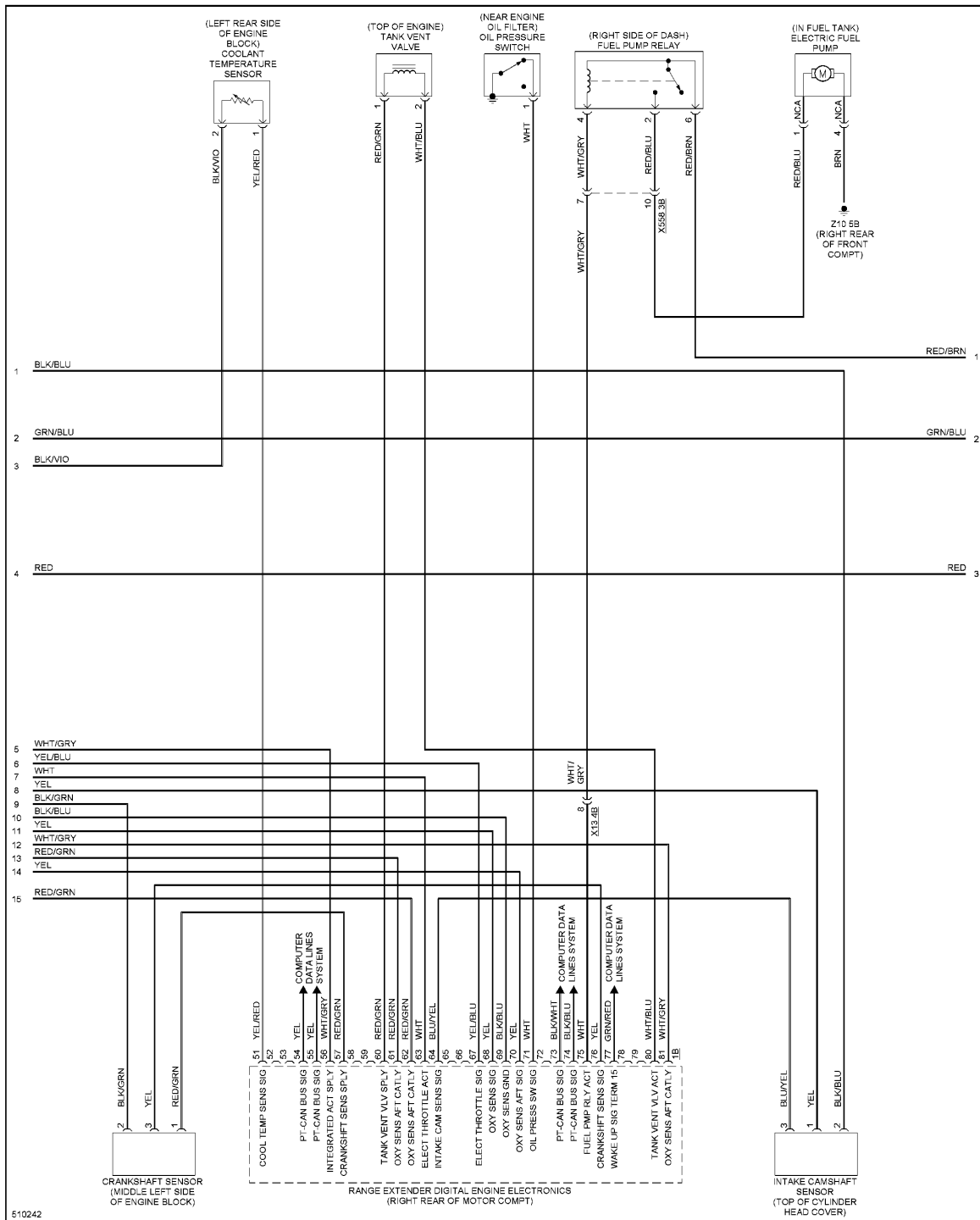
**Fig. 26: Electronic Power Steering Circuit**

## ENGINE PERFORMANCE

### 0.6L HYBRID

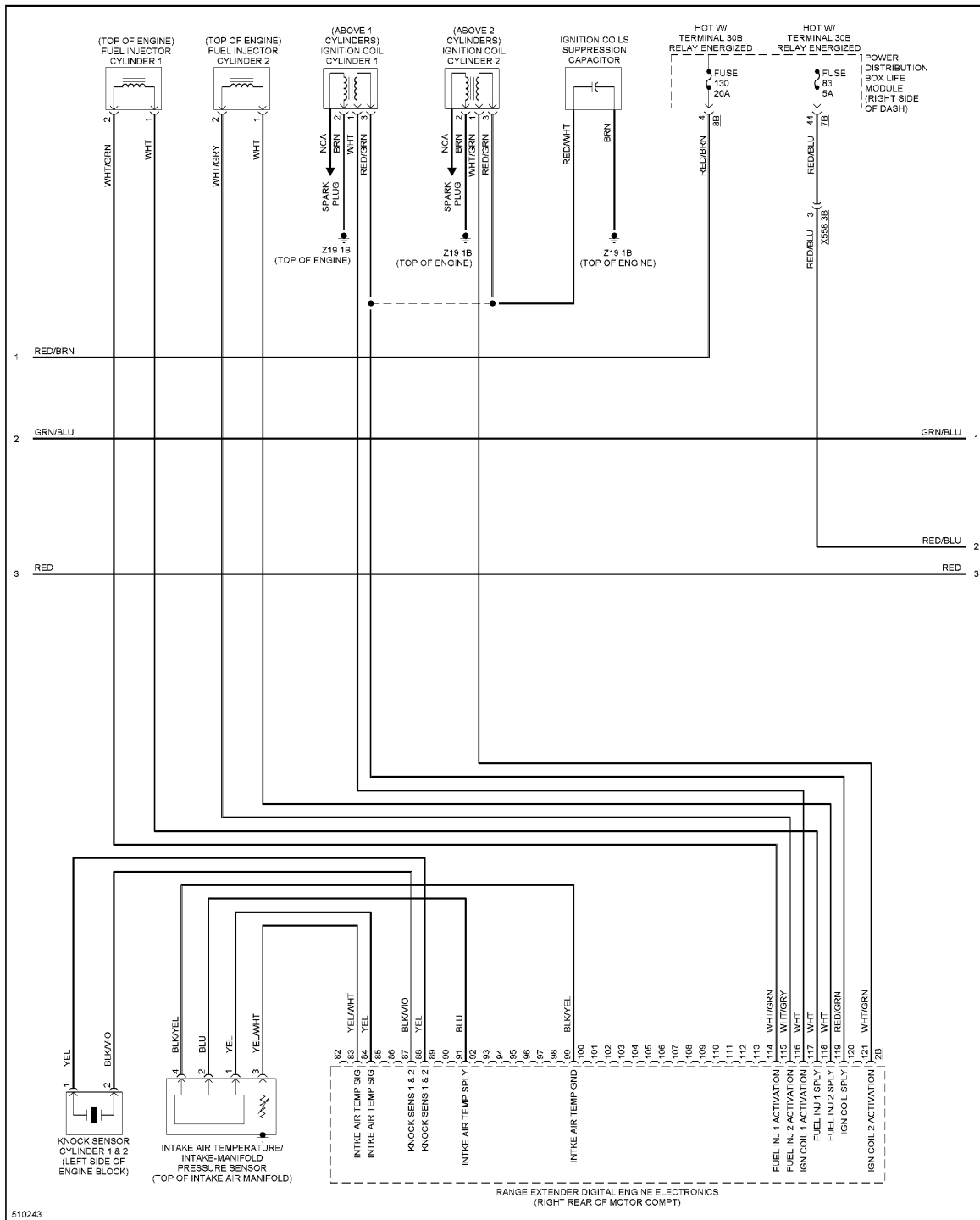


**Fig. 27: 0.6L Hybrid, Engine Performance Circuit (1 of 12)**

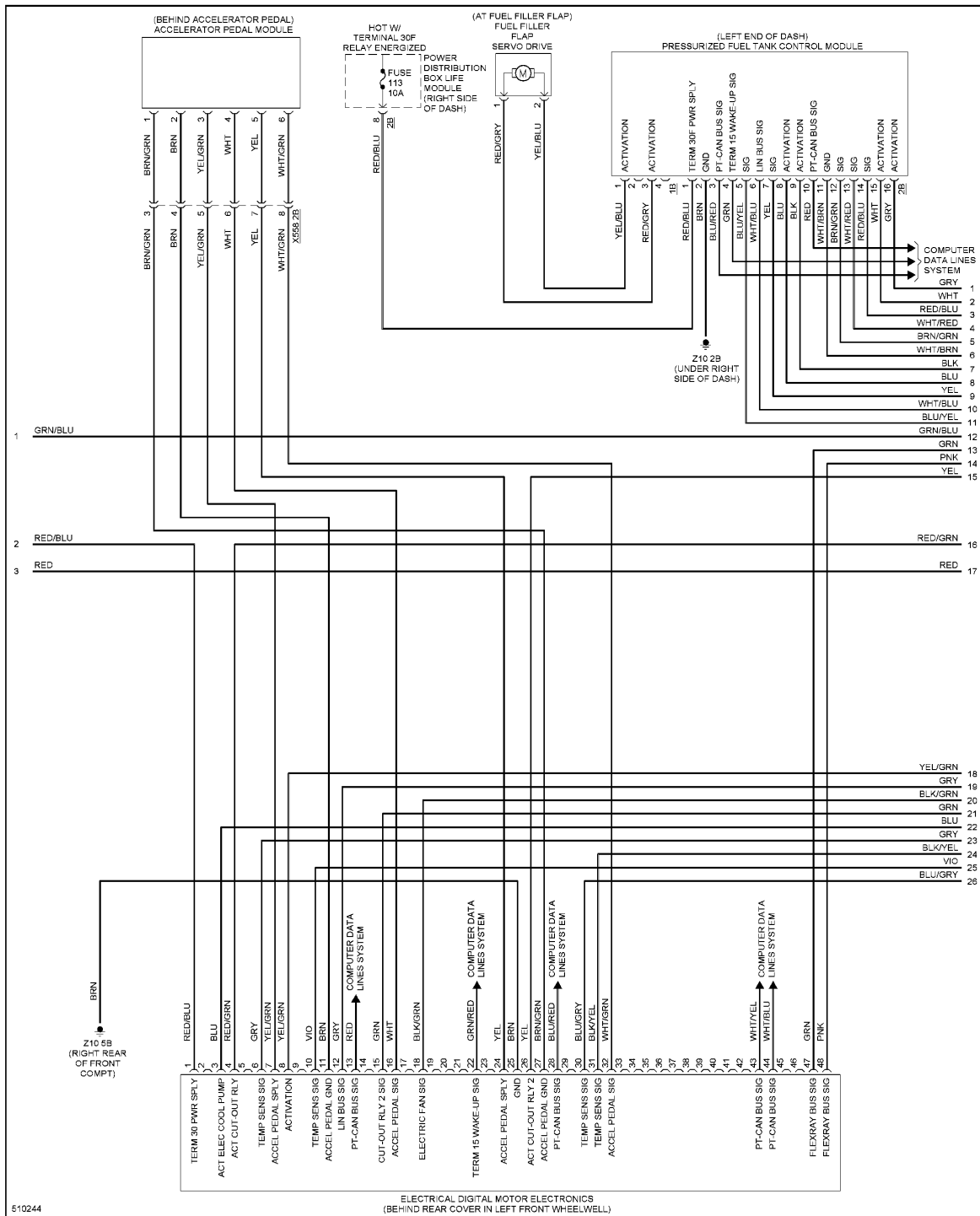


**Fig. 28: 0.6L Hybrid, Engine Performance Circuit (2 of 12)**

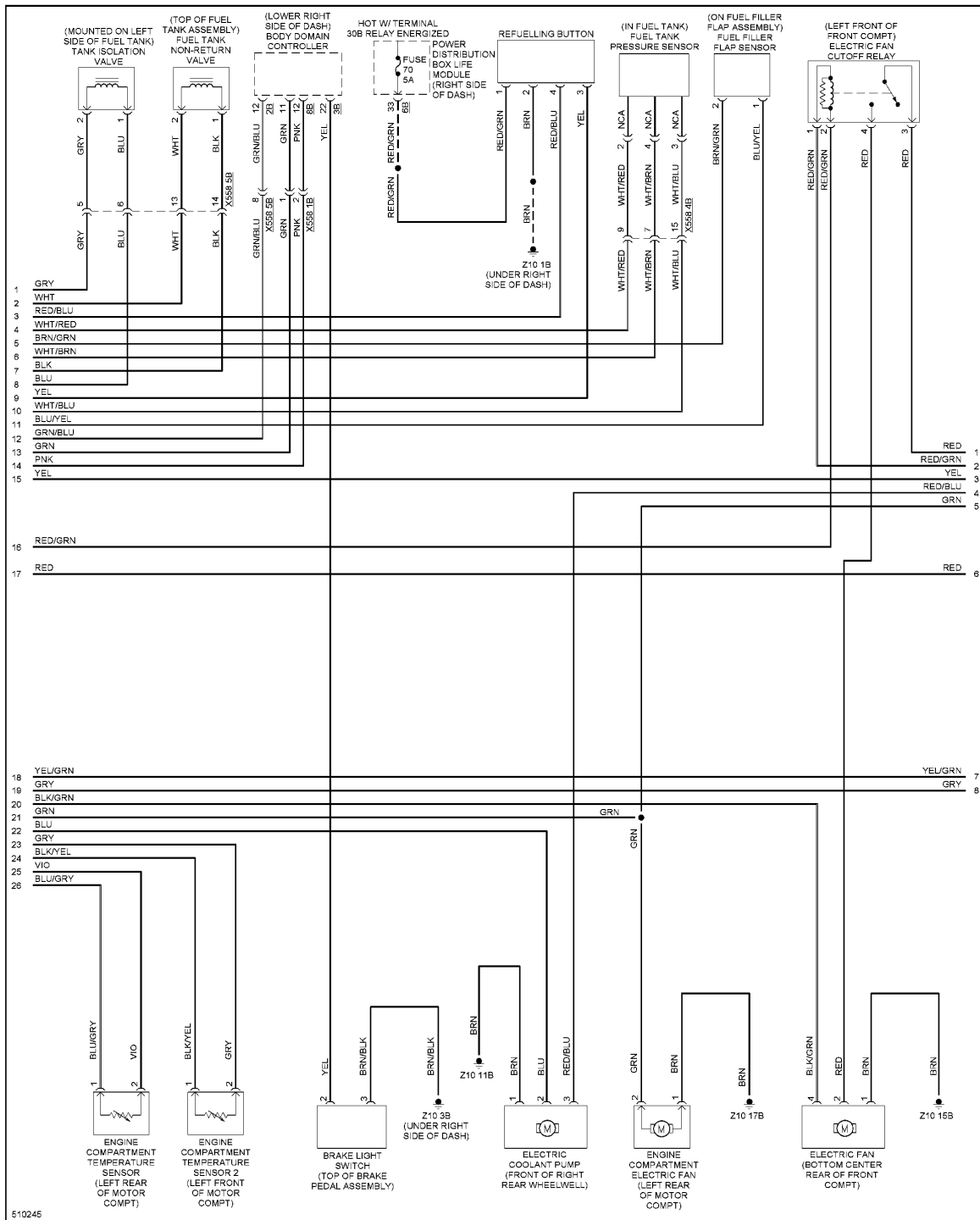




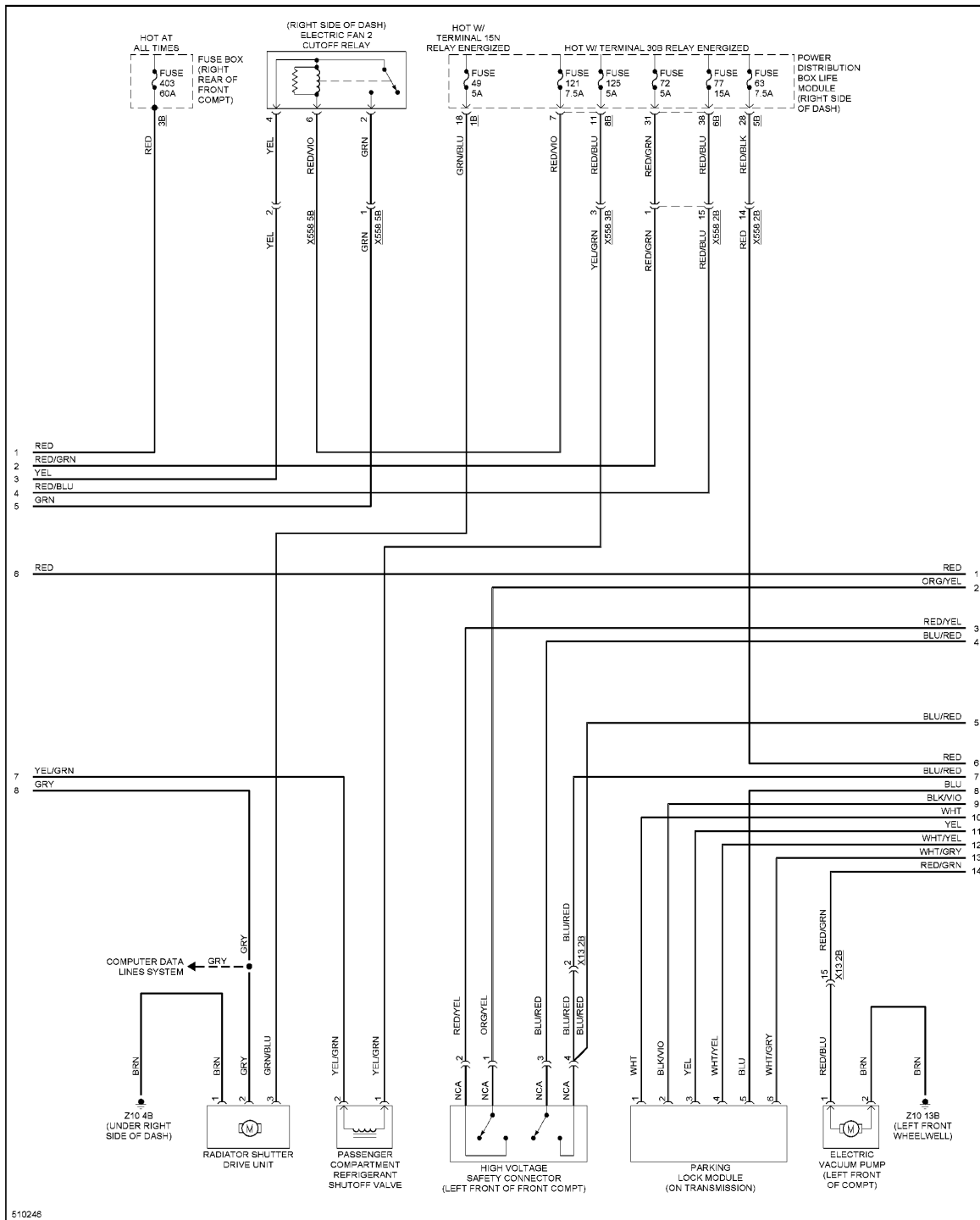
**Fig. 29: 0.6L Hybrid, Engine Performance Circuit (3 of 12)**



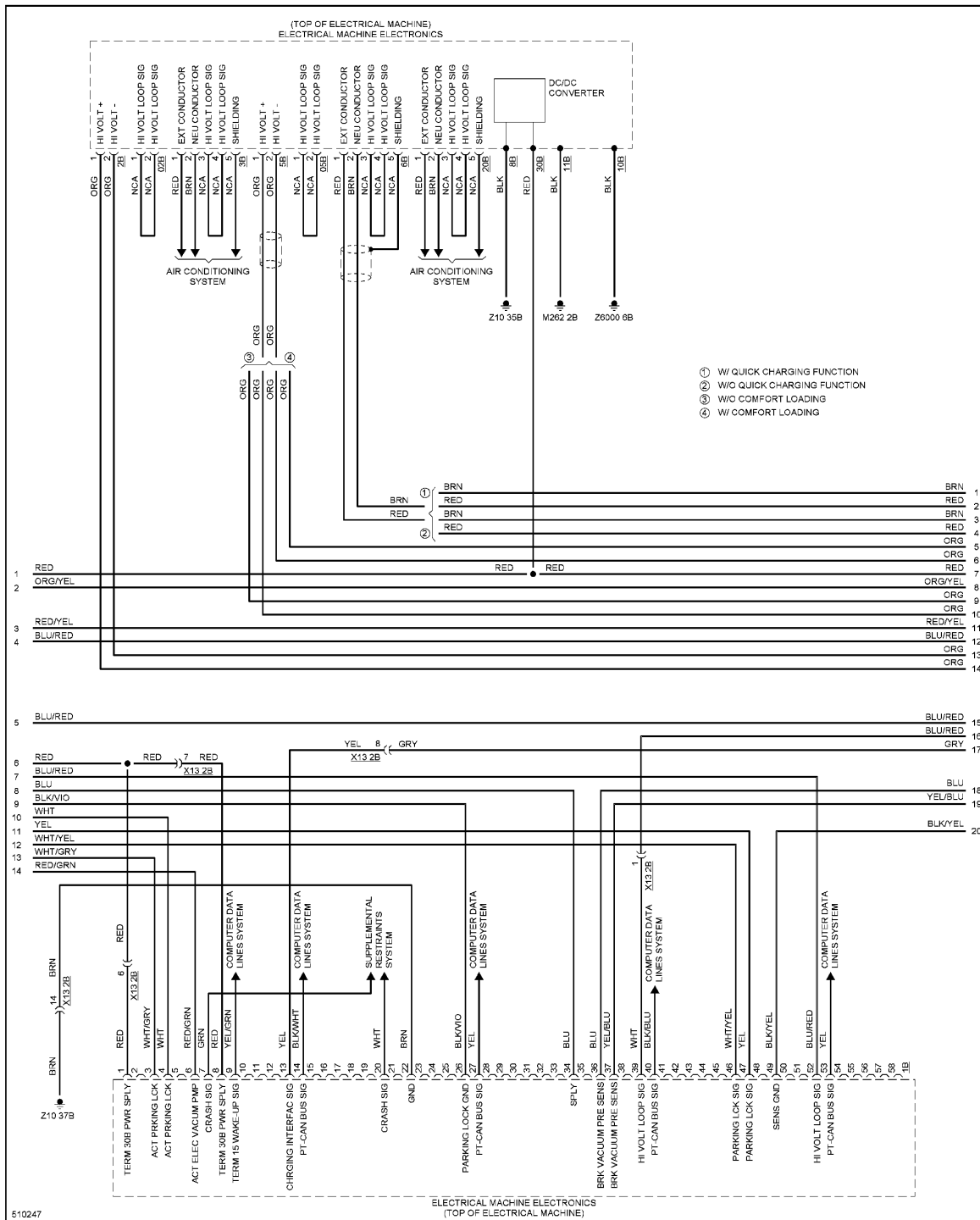
**Fig. 30: 0.6L Hybrid, Engine Performance Circuit (4 of 12)**



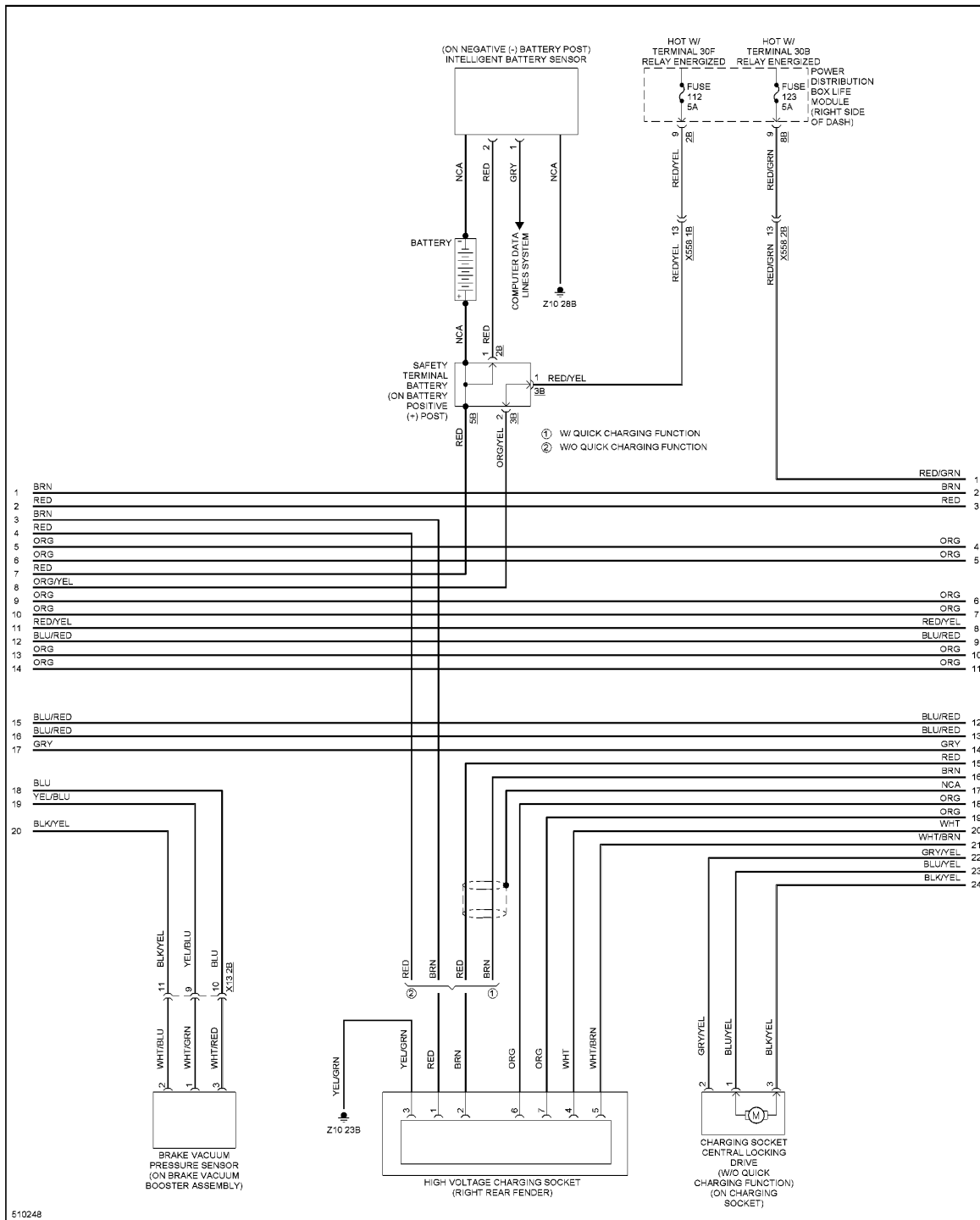
**Fig. 31: 0.6L Hybrid, Engine Performance Circuit (5 of 12)**



**Fig. 32: 0.6L Hybrid, Engine Performance Circuit (6 of 12)**

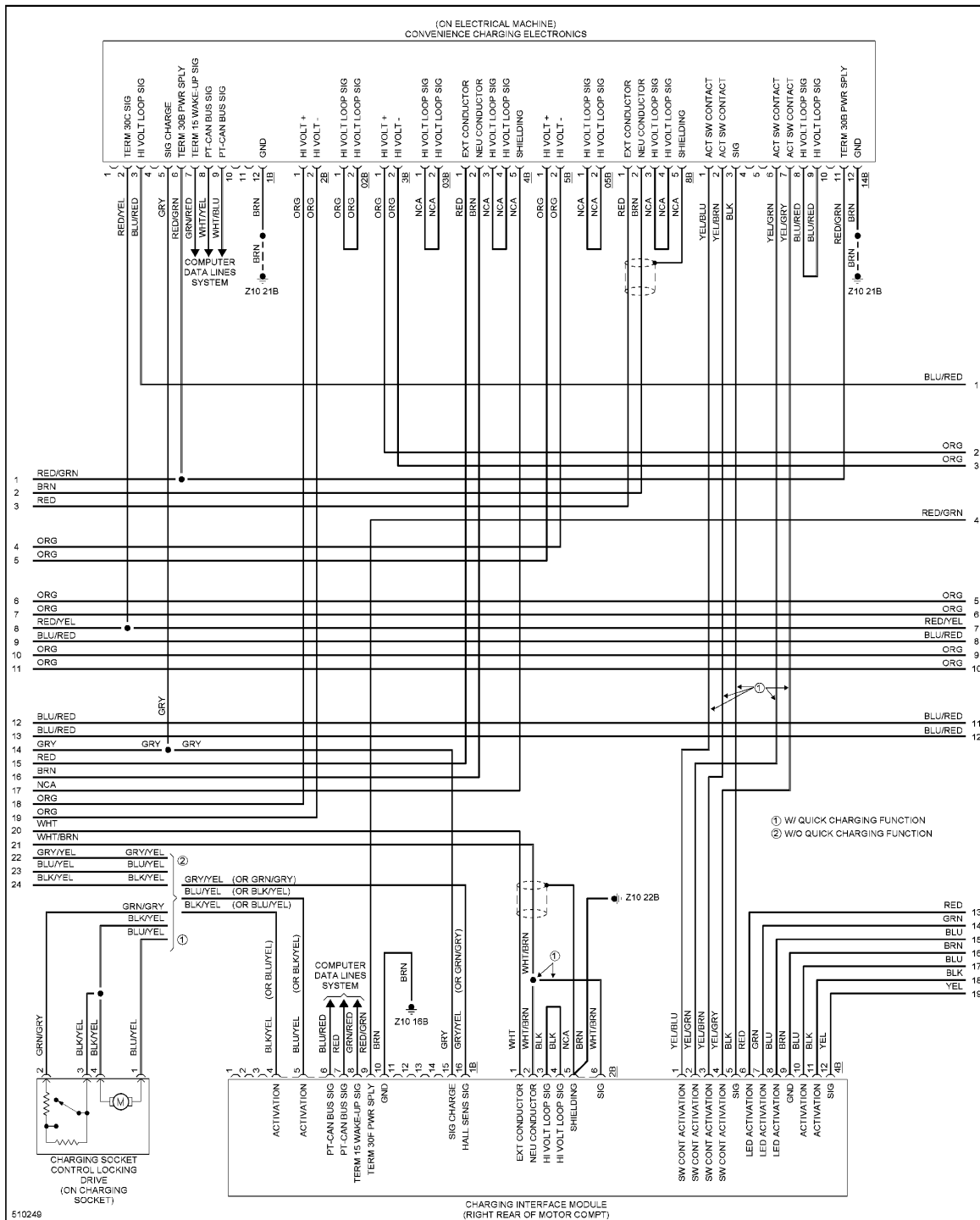


**Fig. 33: 0.6L Hybrid, Engine Performance Circuit (7 of 12)**

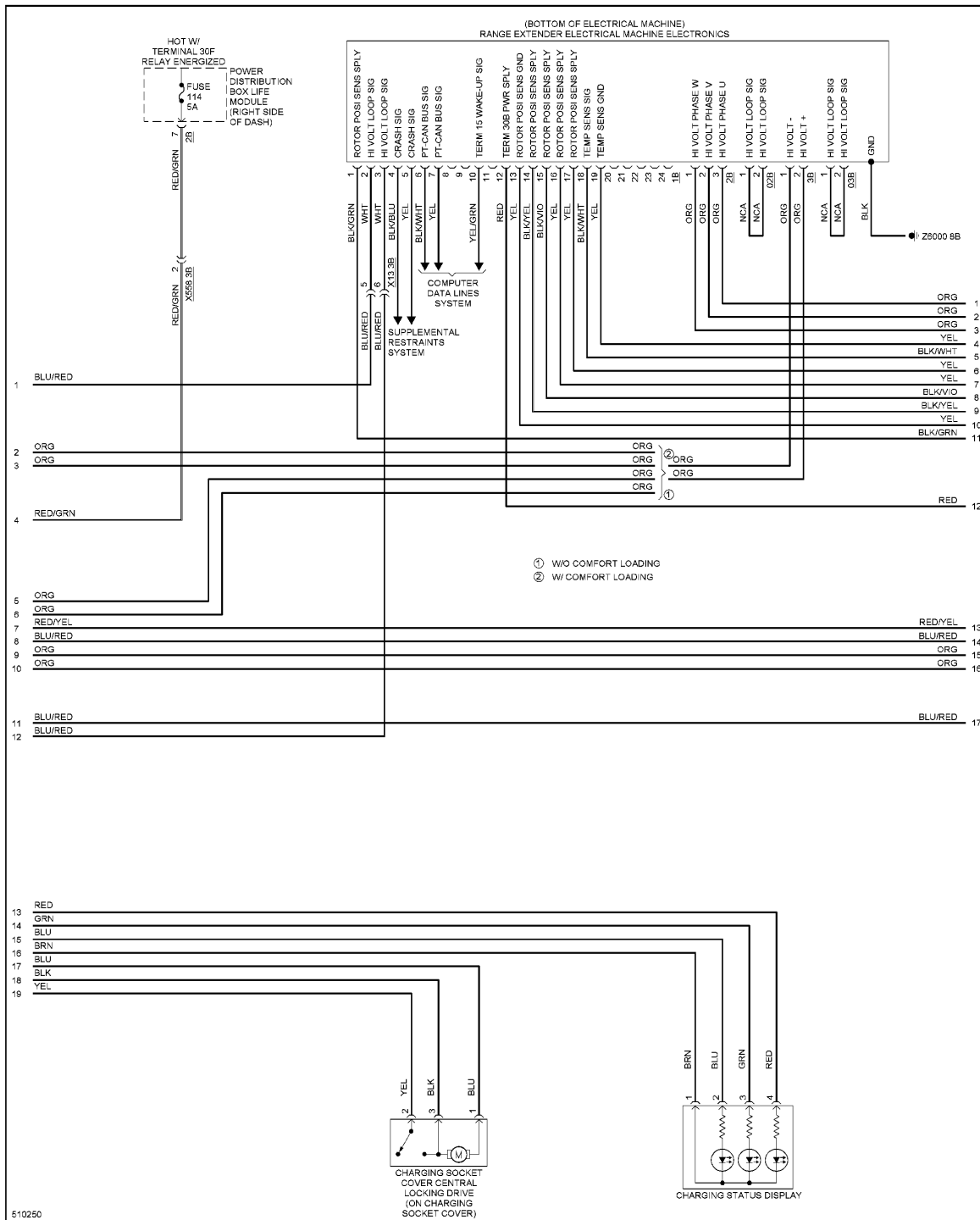


**Fig. 34: 0.6L Hybrid, Engine Performance Circuit (8 of 12)**

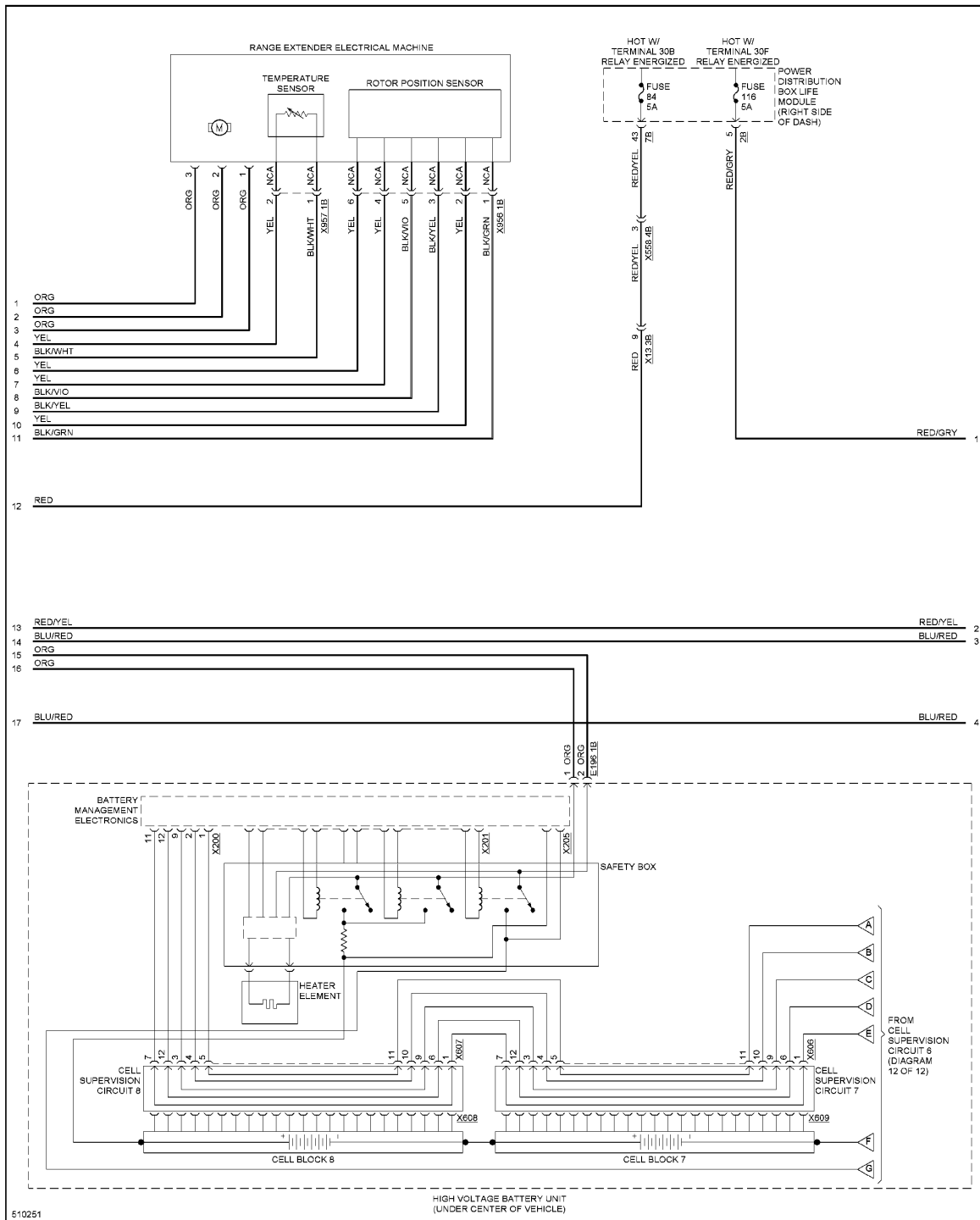




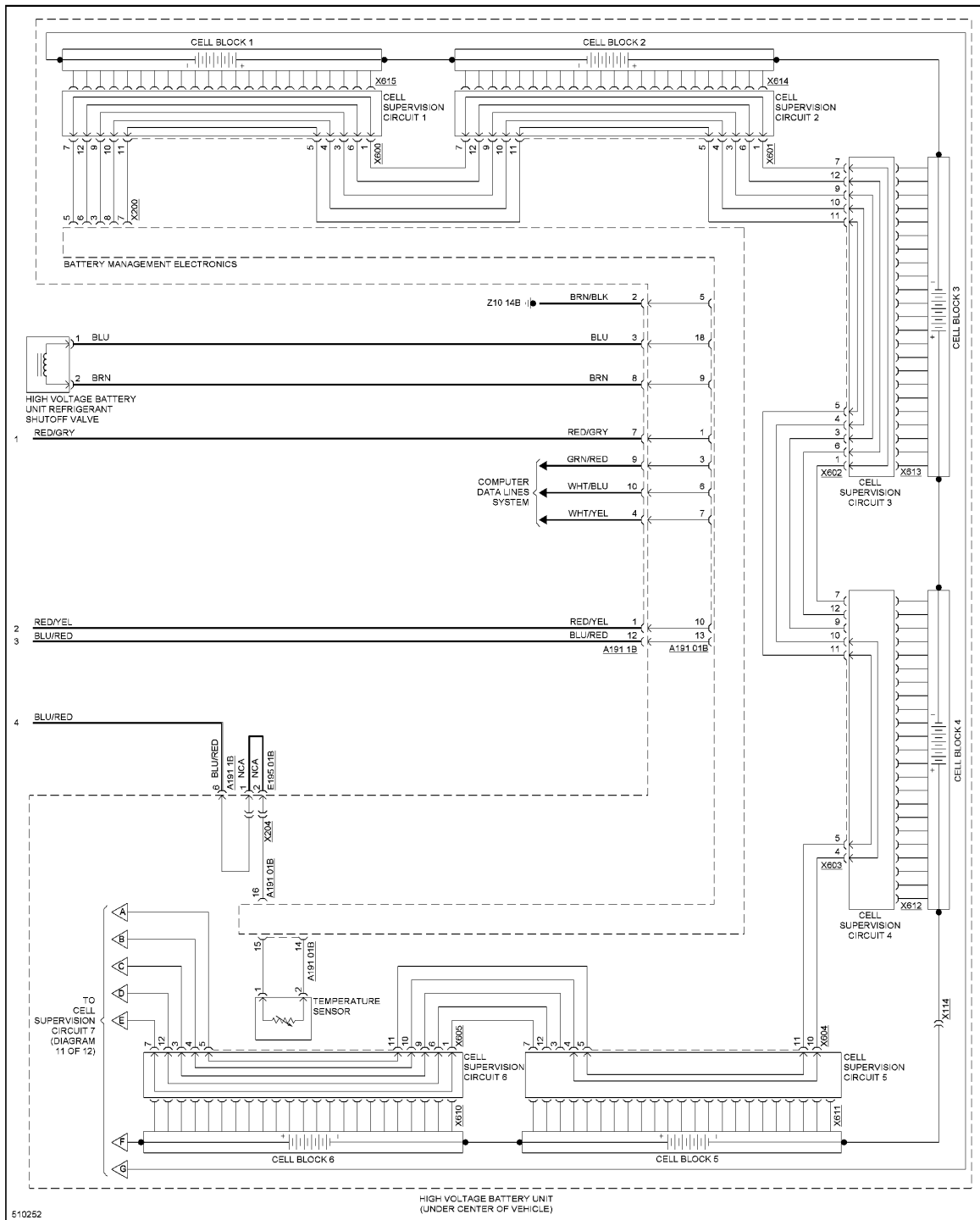
**Fig. 35: 0.6L Hybrid, Engine Performance Circuit (9 of 12)**



**Fig. 36: 0.6L Hybrid, Engine Performance Circuit (10 of 12)**

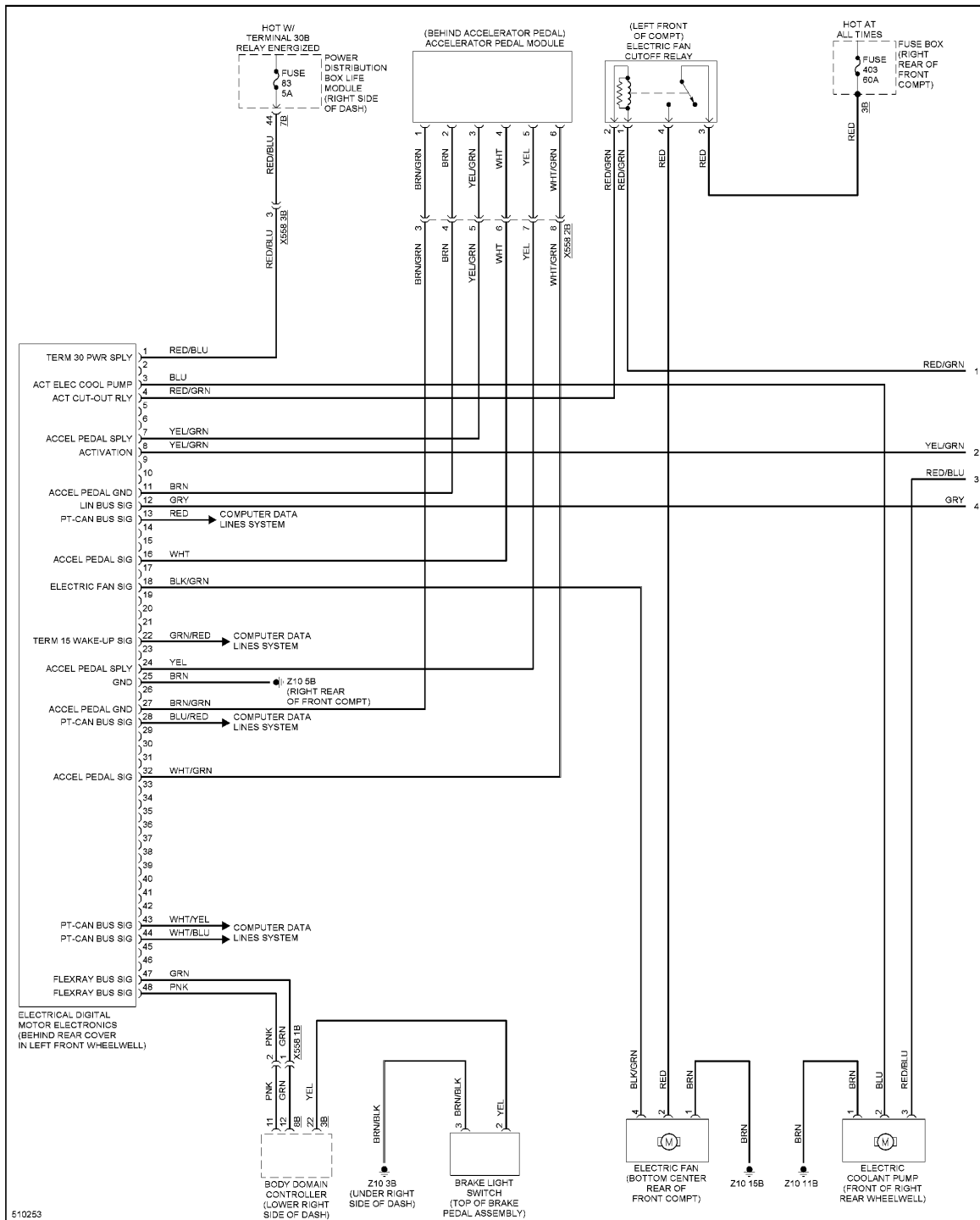


**Fig. 37: 0.6L Hybrid, Engine Performance Circuit (11 of 12)**

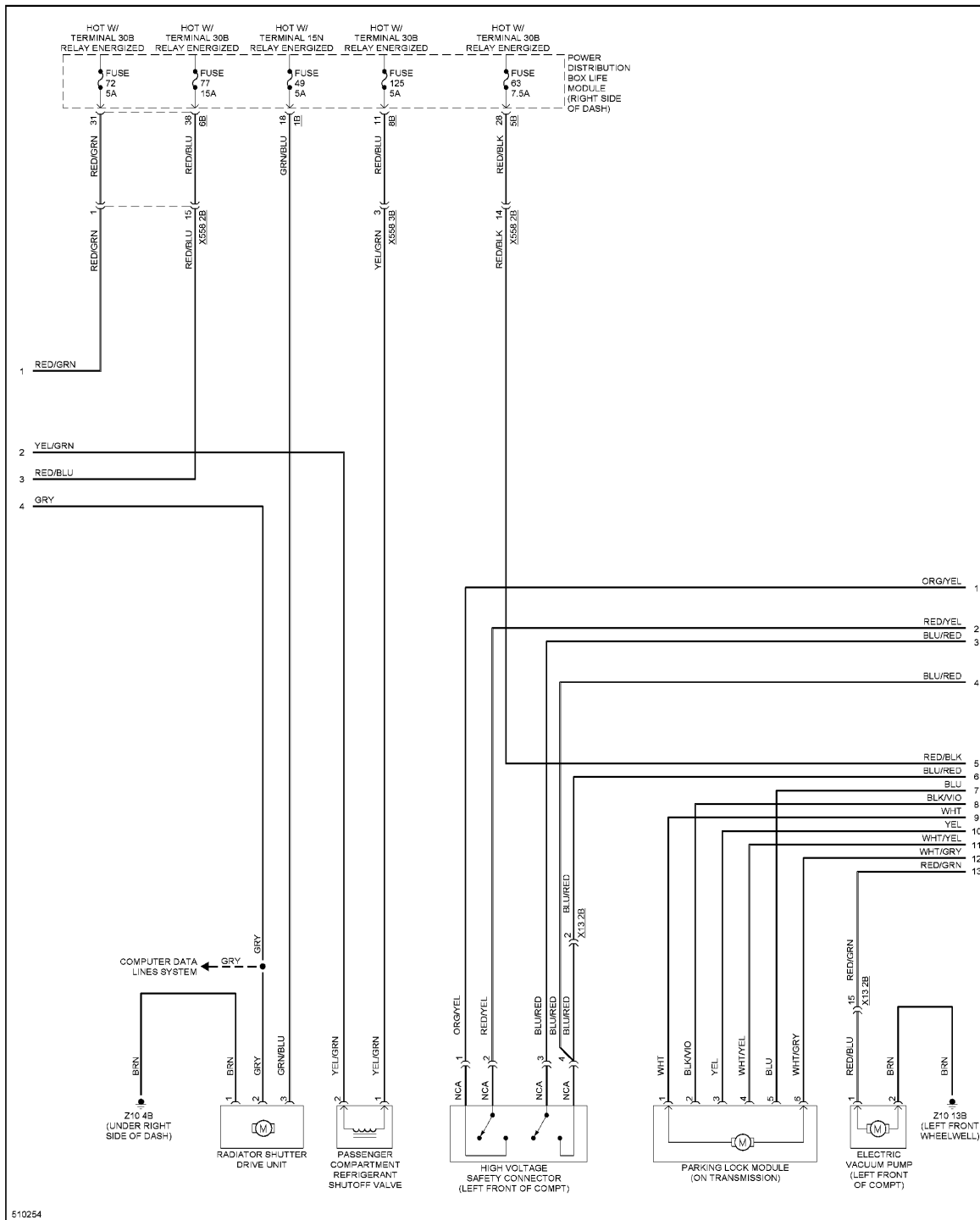


**Fig. 38: 0.6L Hybrid, Engine Performance Circuit (12 of 12)**

**ELECTRIC**

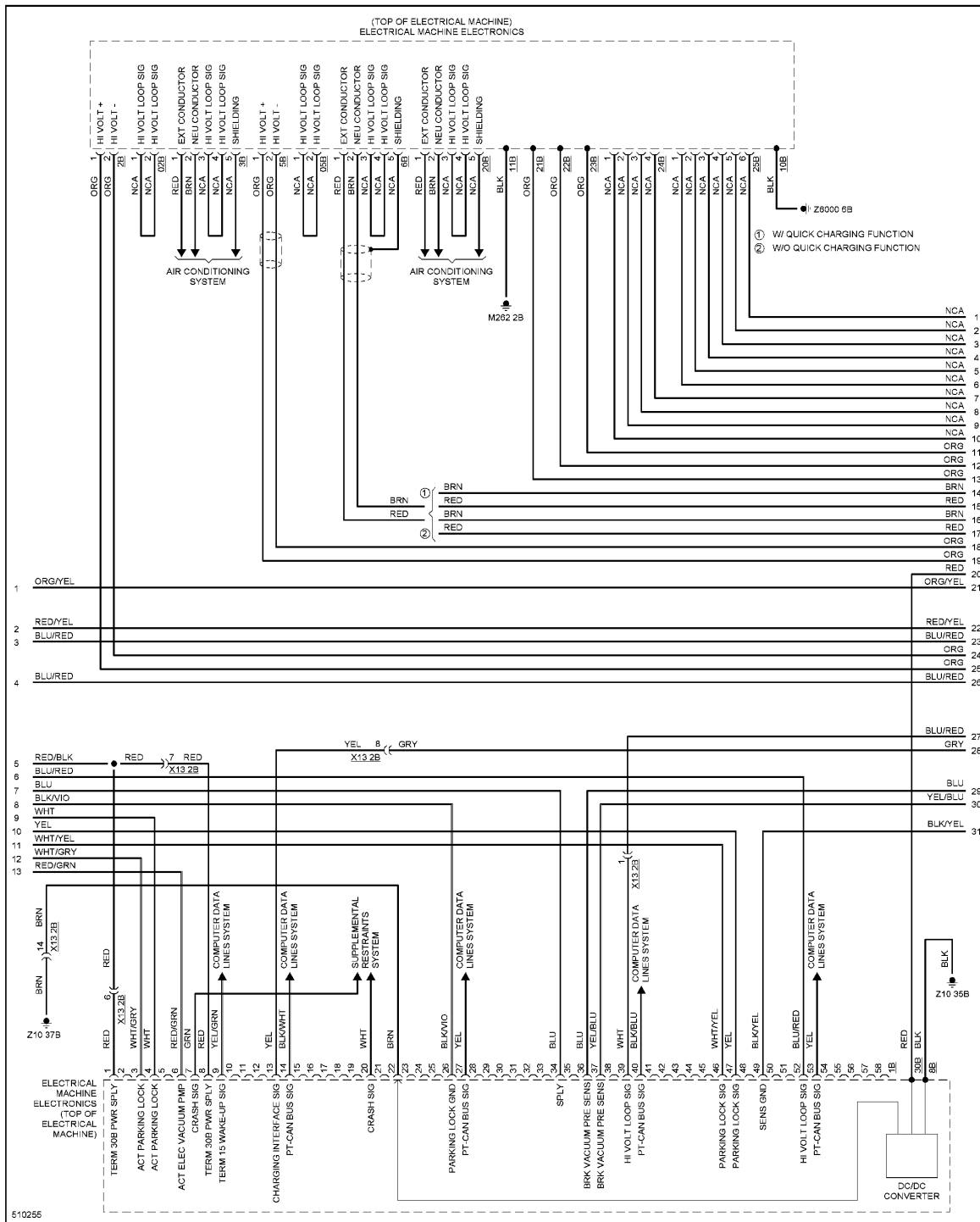


**Fig. 39: Electric, Engine Performance Circuit (1 of 7)**

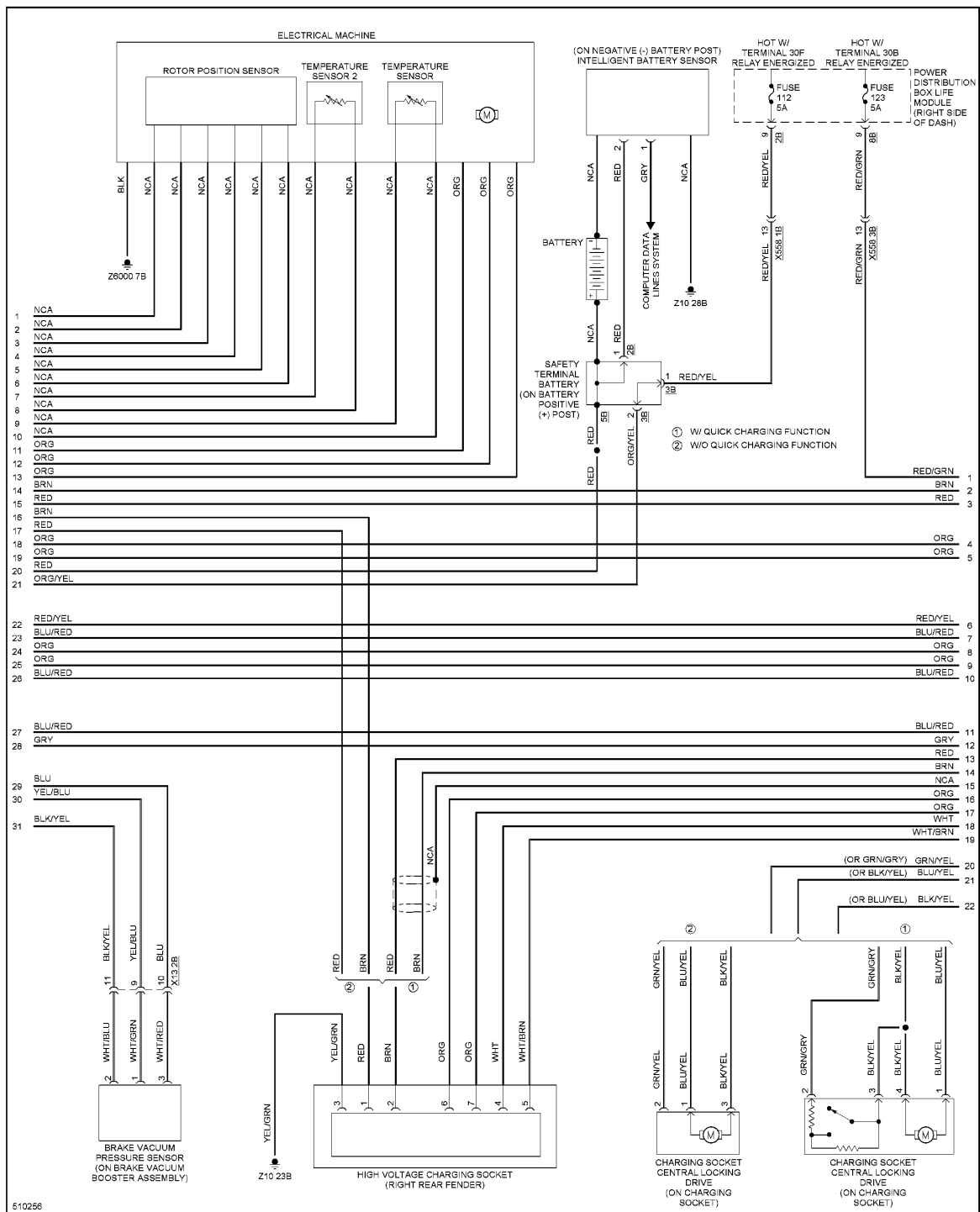


**Fig. 40: Electric, Engine Performance Circuit (2 of 7)**

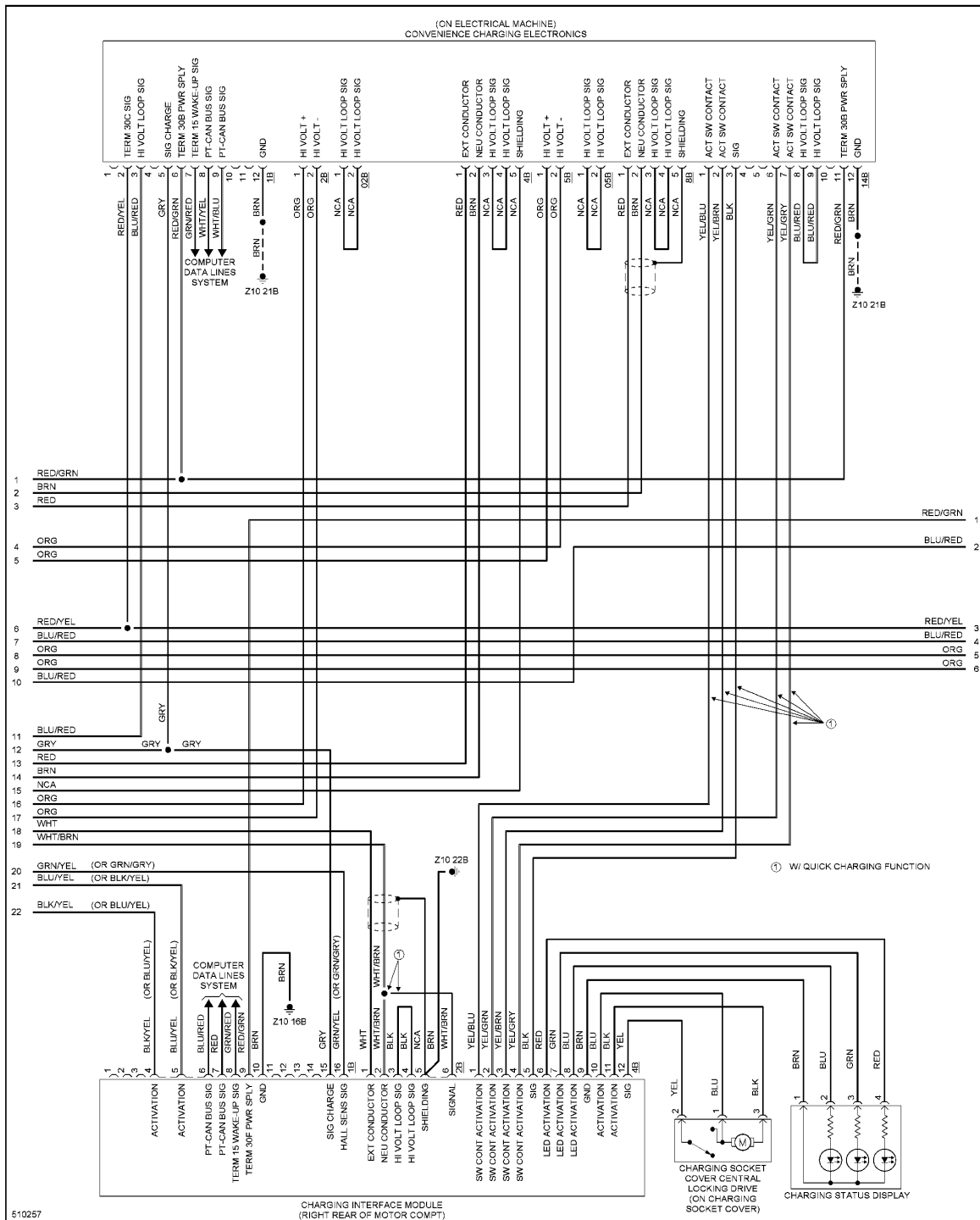




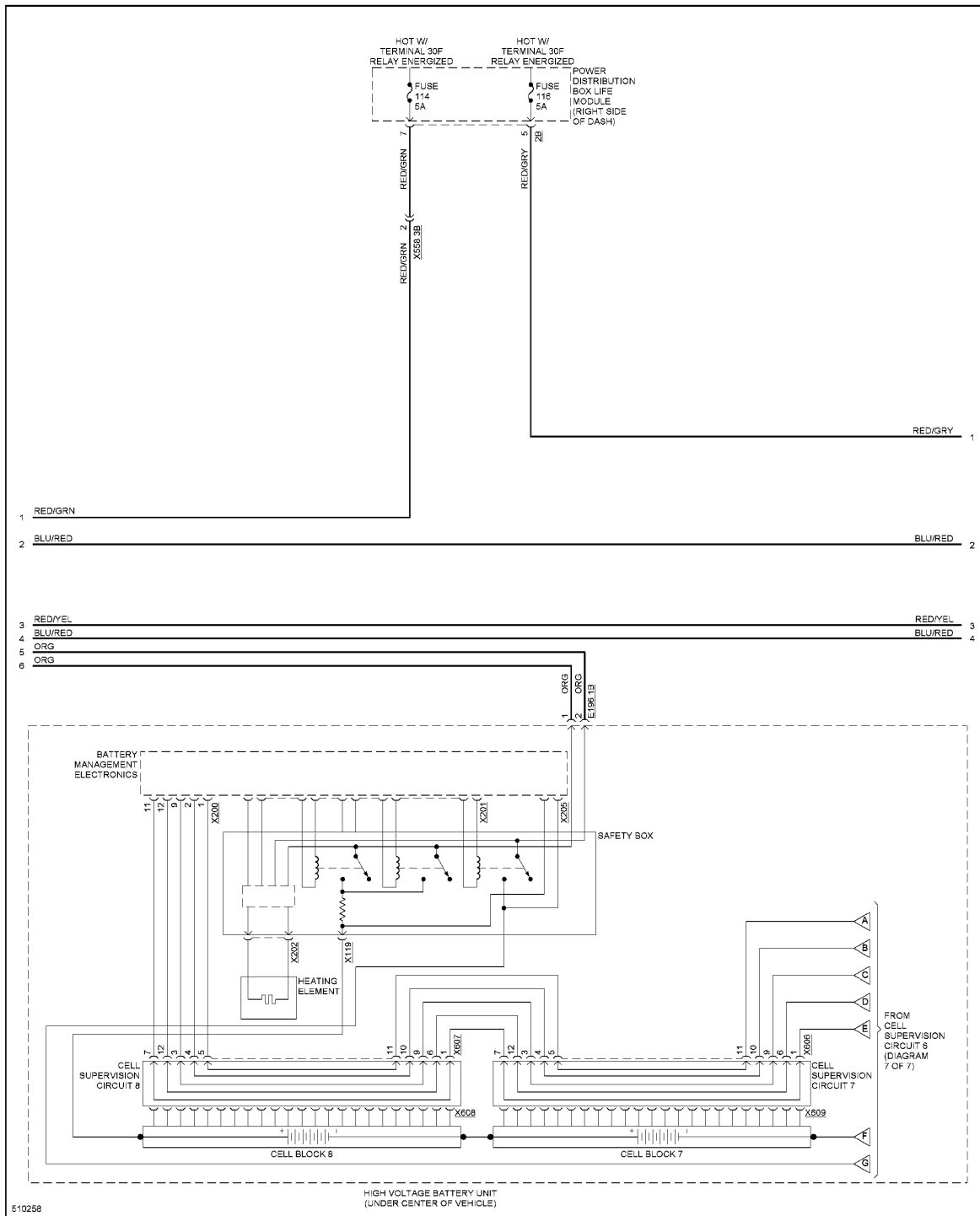
**Fig. 41: Electric, Engine Performance Circuit (3 of 7)**



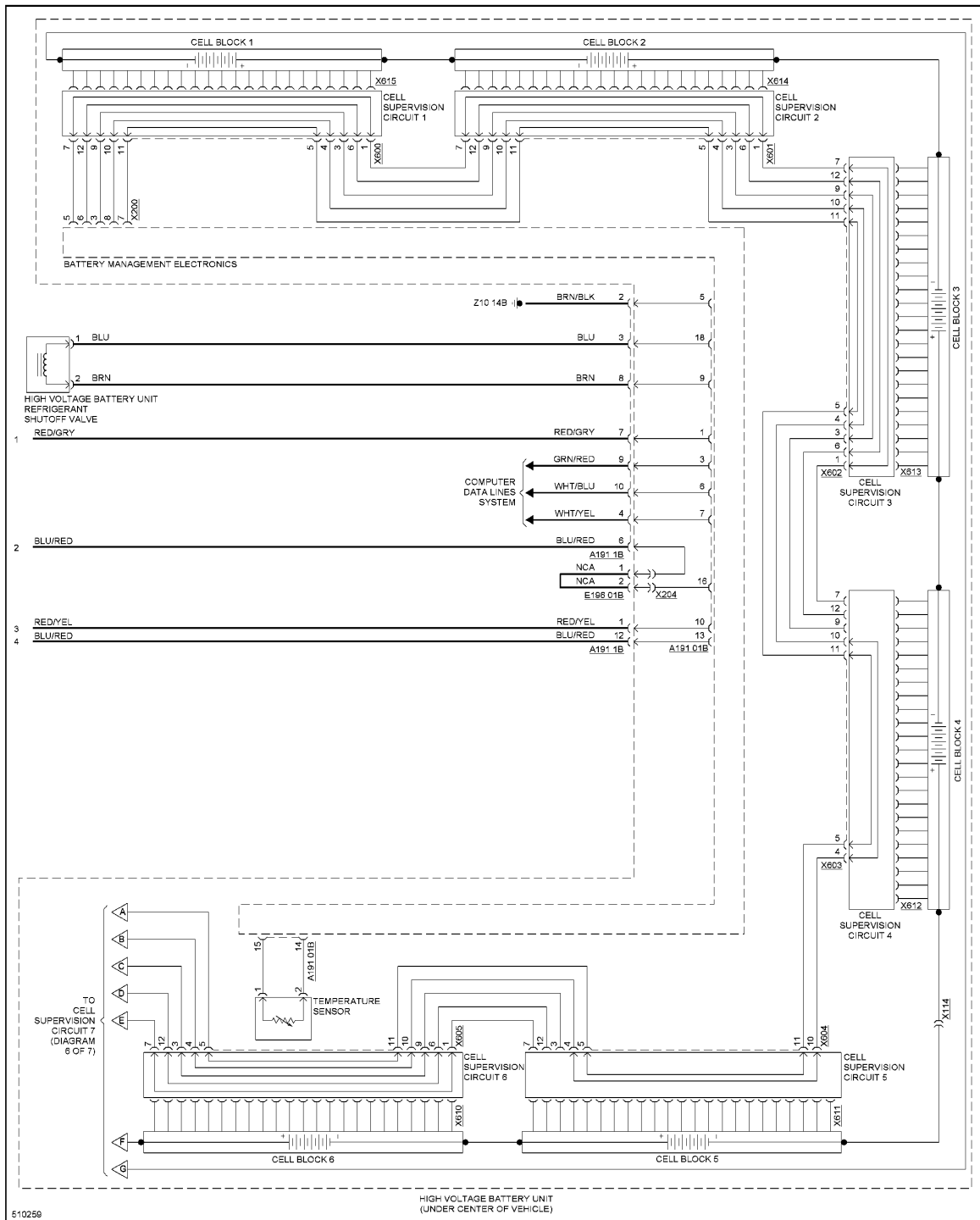
**Fig. 42: Electric, Engine Performance Circuit (4 of 7)**



**Fig. 43: Electric, Engine Performance Circuit (5 of 7)**



**Fig. 44: Electric, Engine Performance Circuit (6 of 7)**

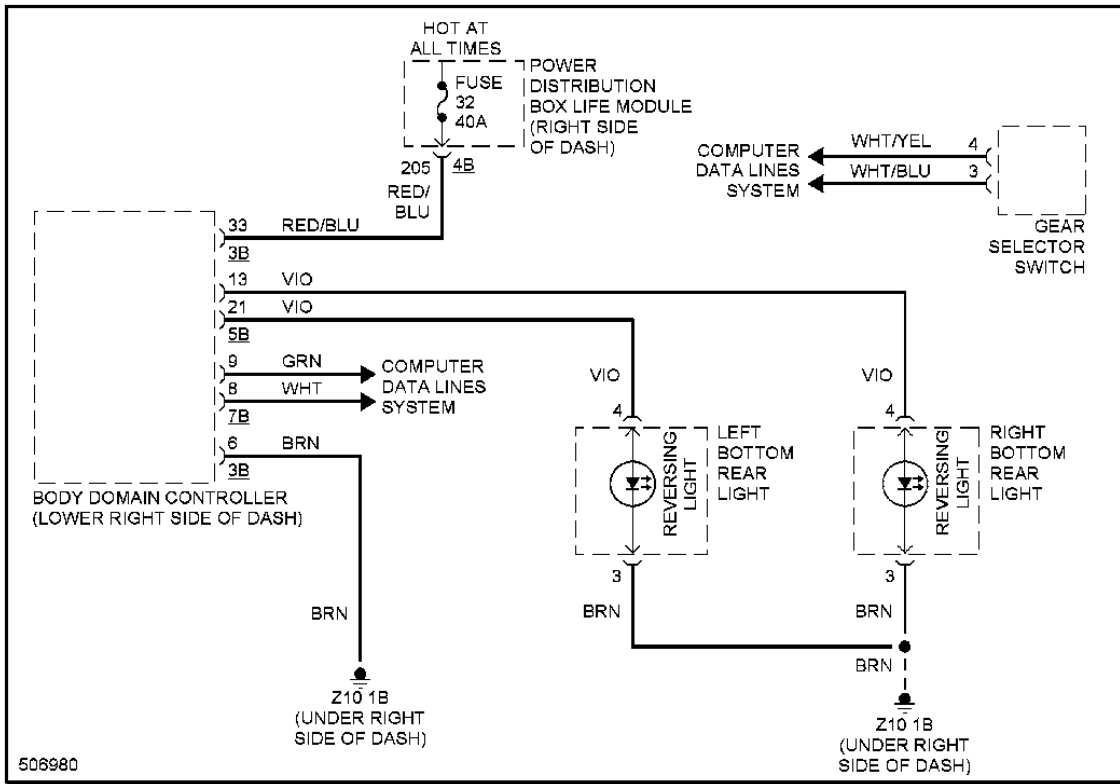


510259

HIGH VOLTAGE BATTERY UNIT  
(UNDER CENTER OF VEHICLE)

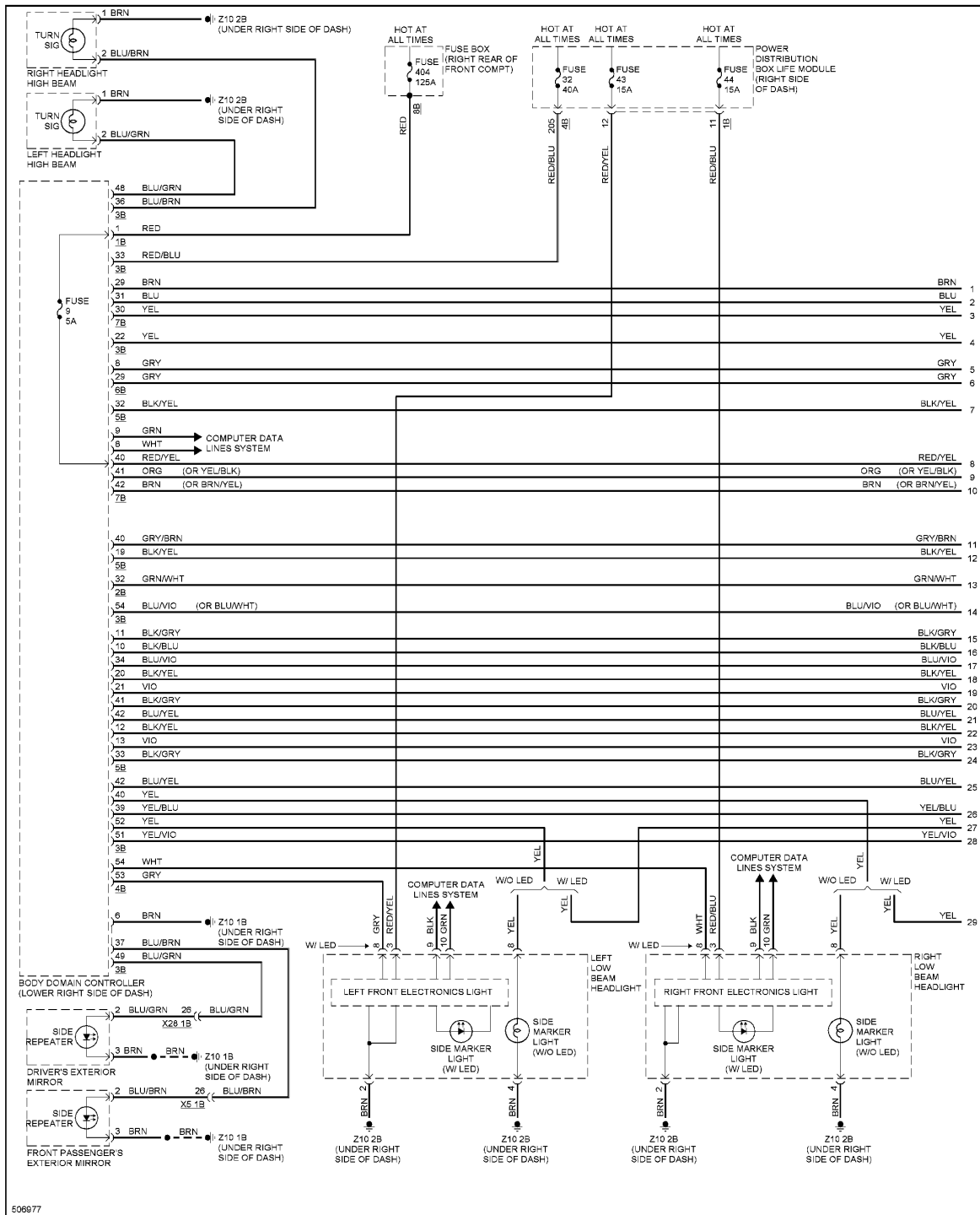
**Fig. 45: Electric, Engine Performance Circuit (7 of 7)**

## EXTERIOR LIGHTS

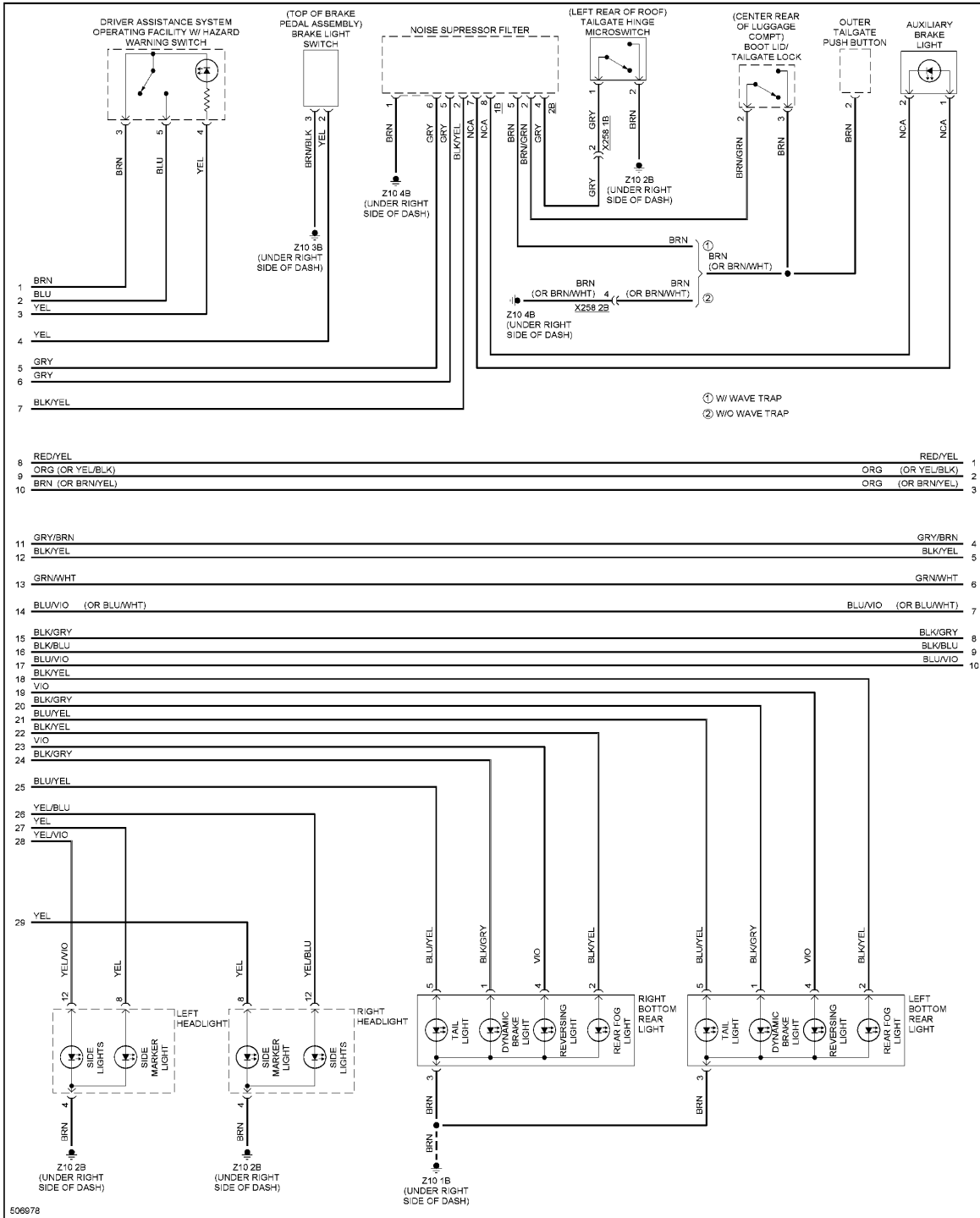


**Fig. 46: Backup Lamps Circuit**

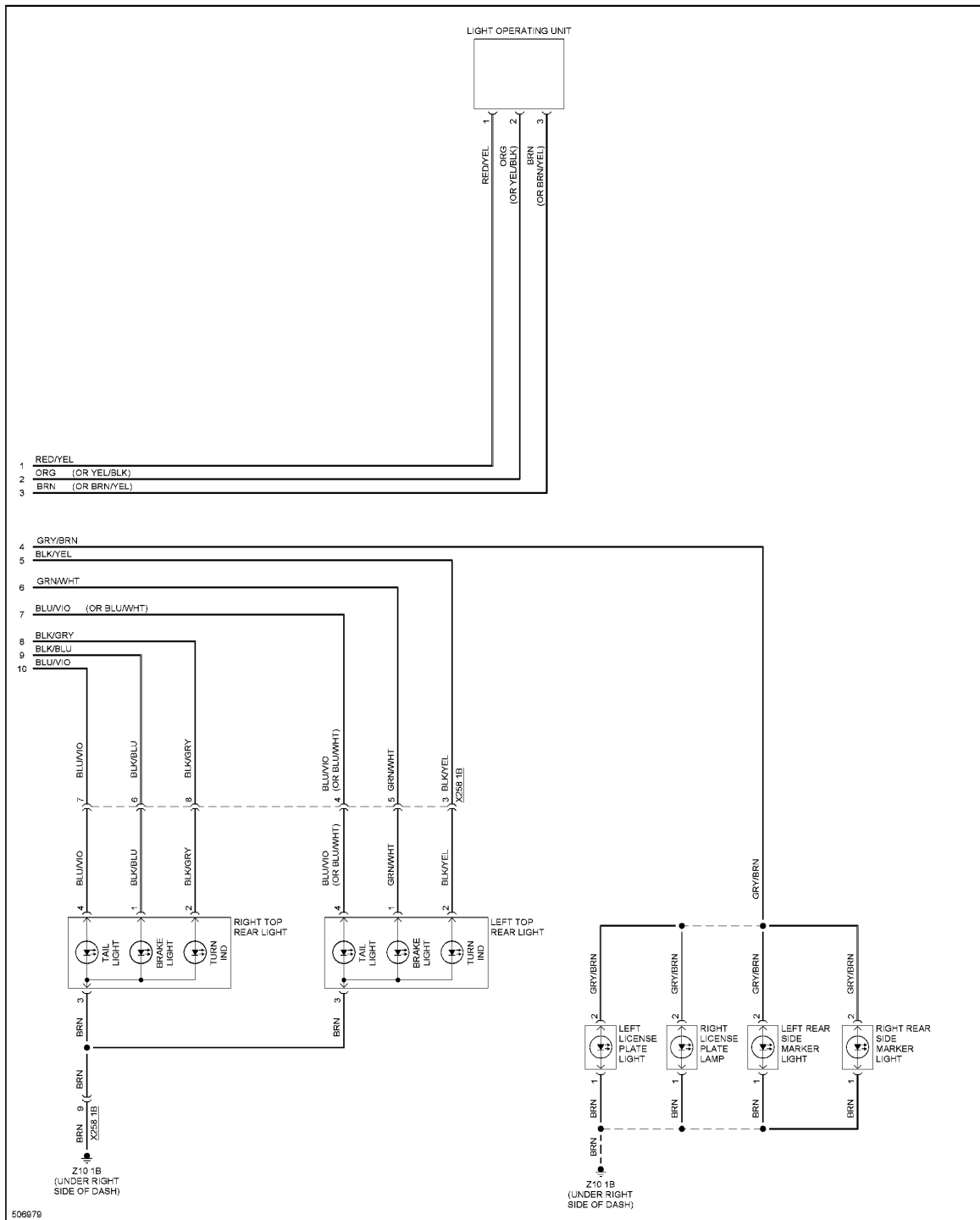




**Fig. 47: Exterior Lamps Circuit (1 of 3)**

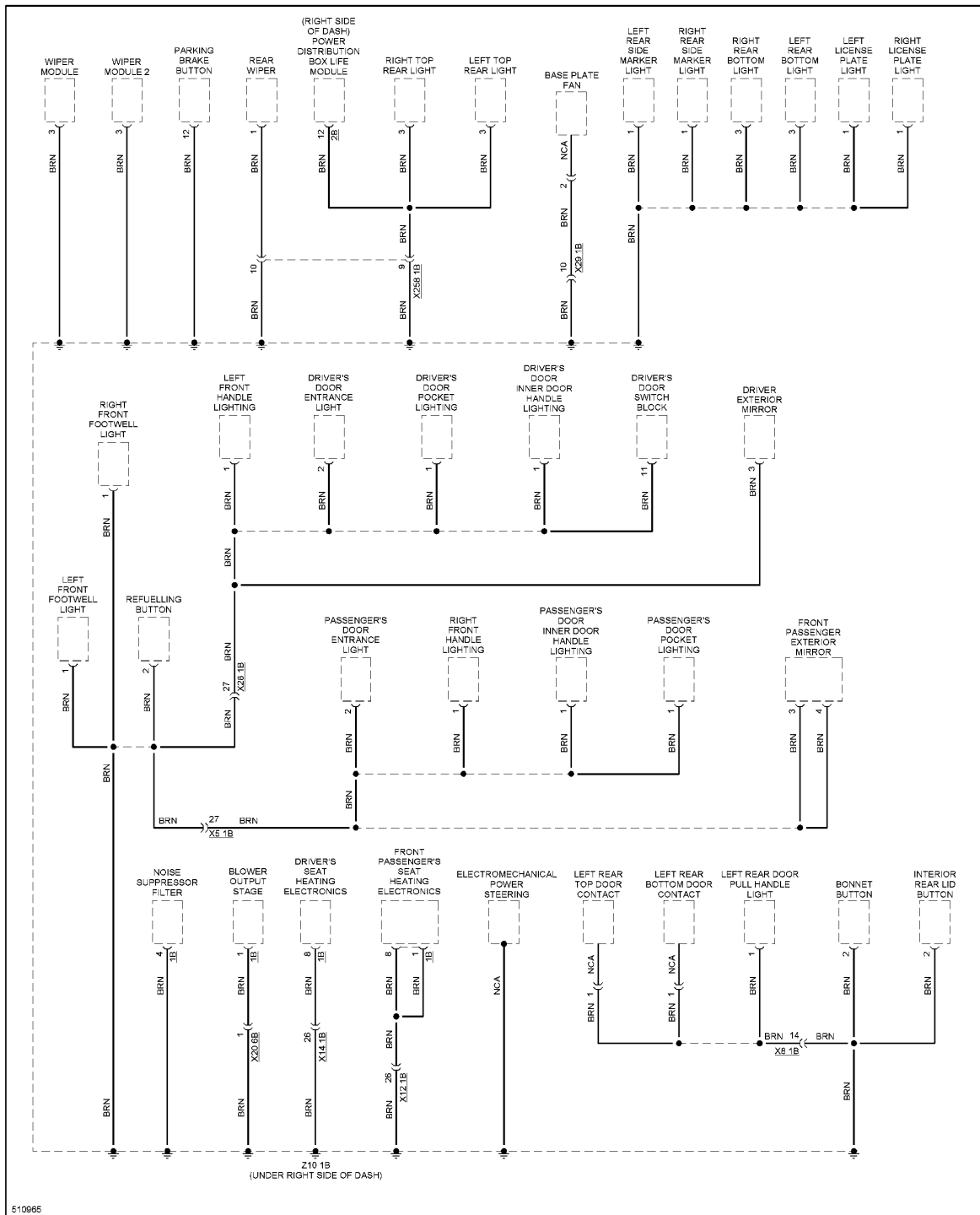


**Fig. 48: Exterior Lamps Circuit (2 of 3)**



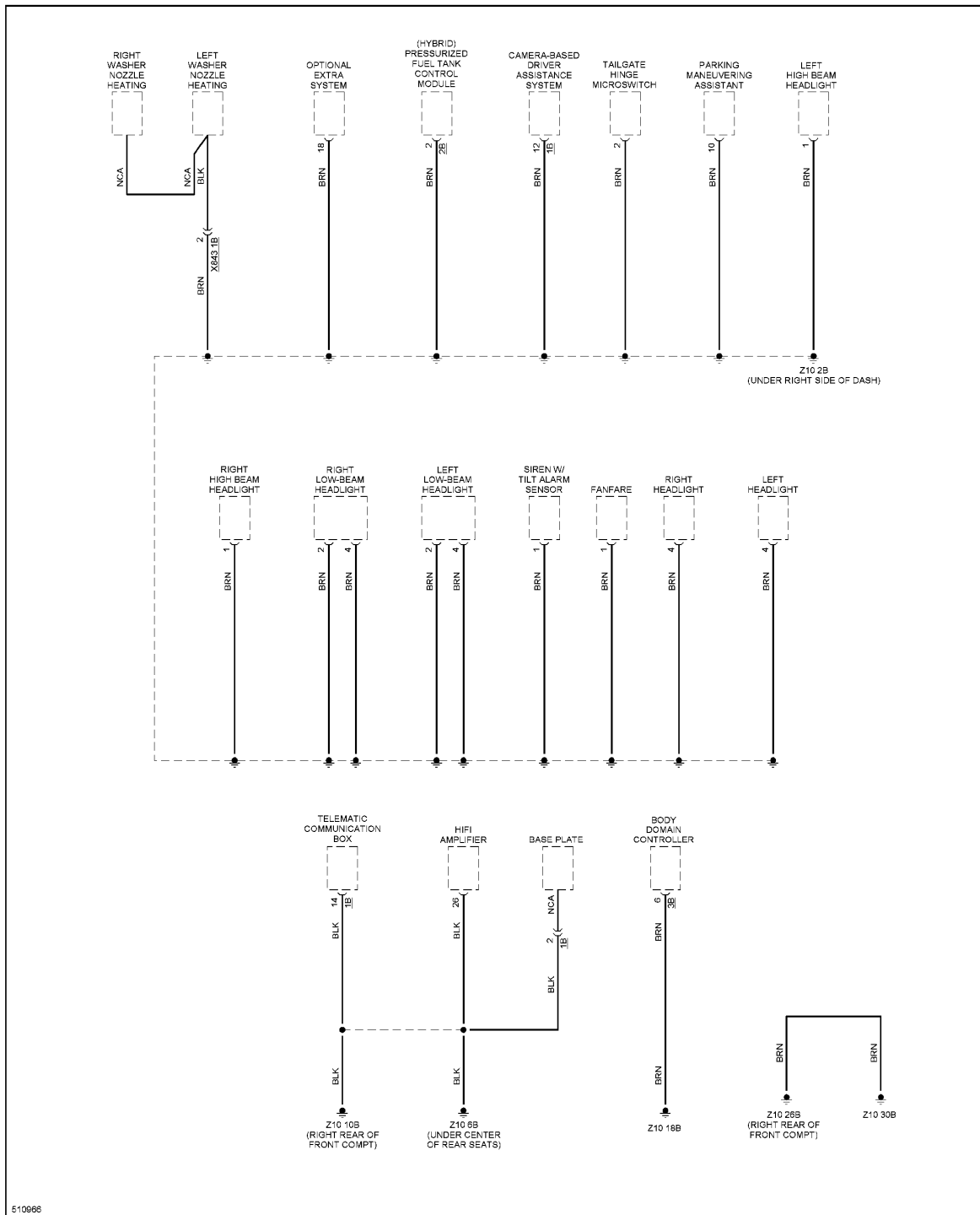
**Fig. 49: Exterior Lamps Circuit (3 of 3)**

## GROUND DISTRIBUTION



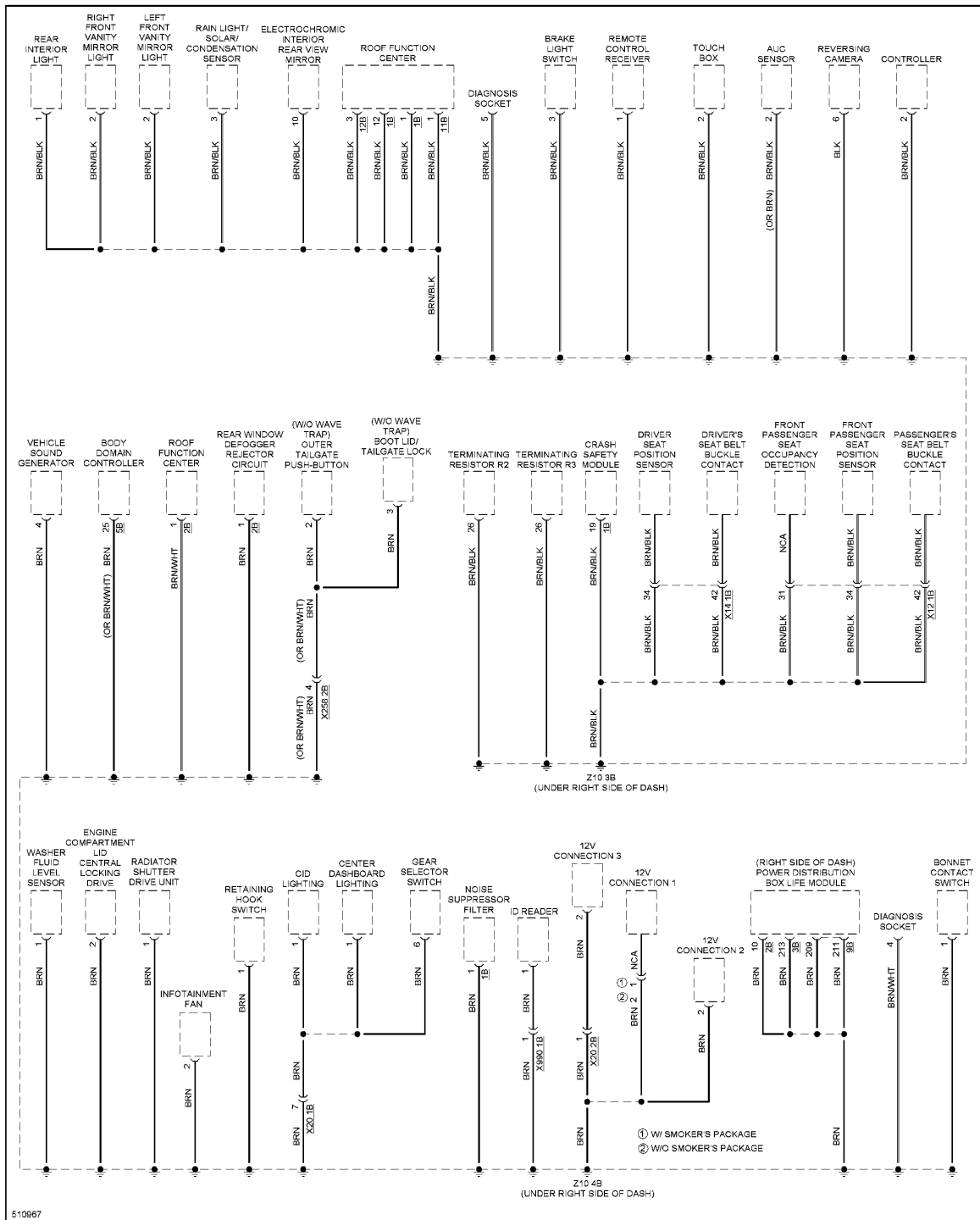
510985

**Fig. 50: Ground Distribution Circuit (1 of 4)**



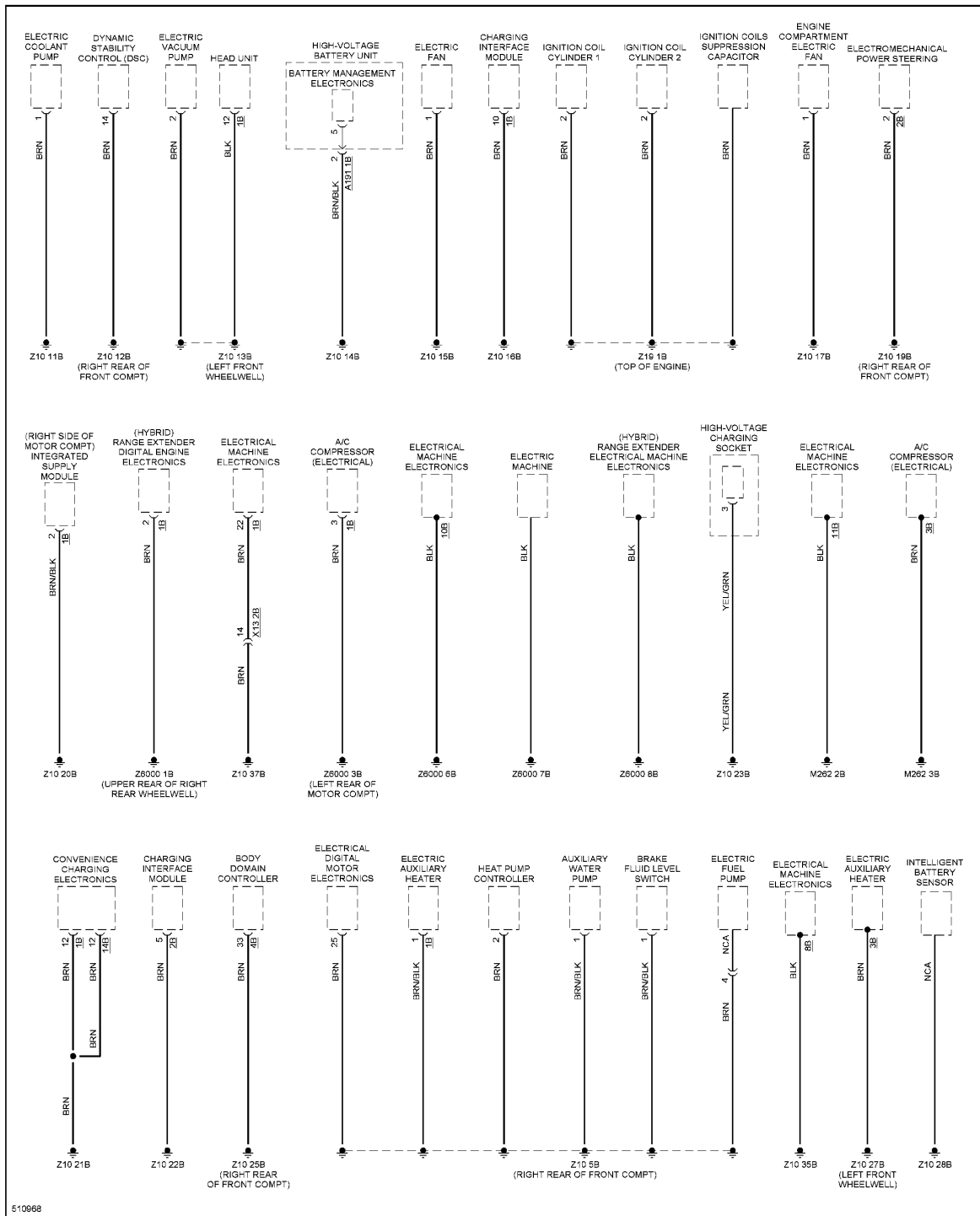
510986

**Fig. 51: Ground Distribution Circuit (2 of 4)**



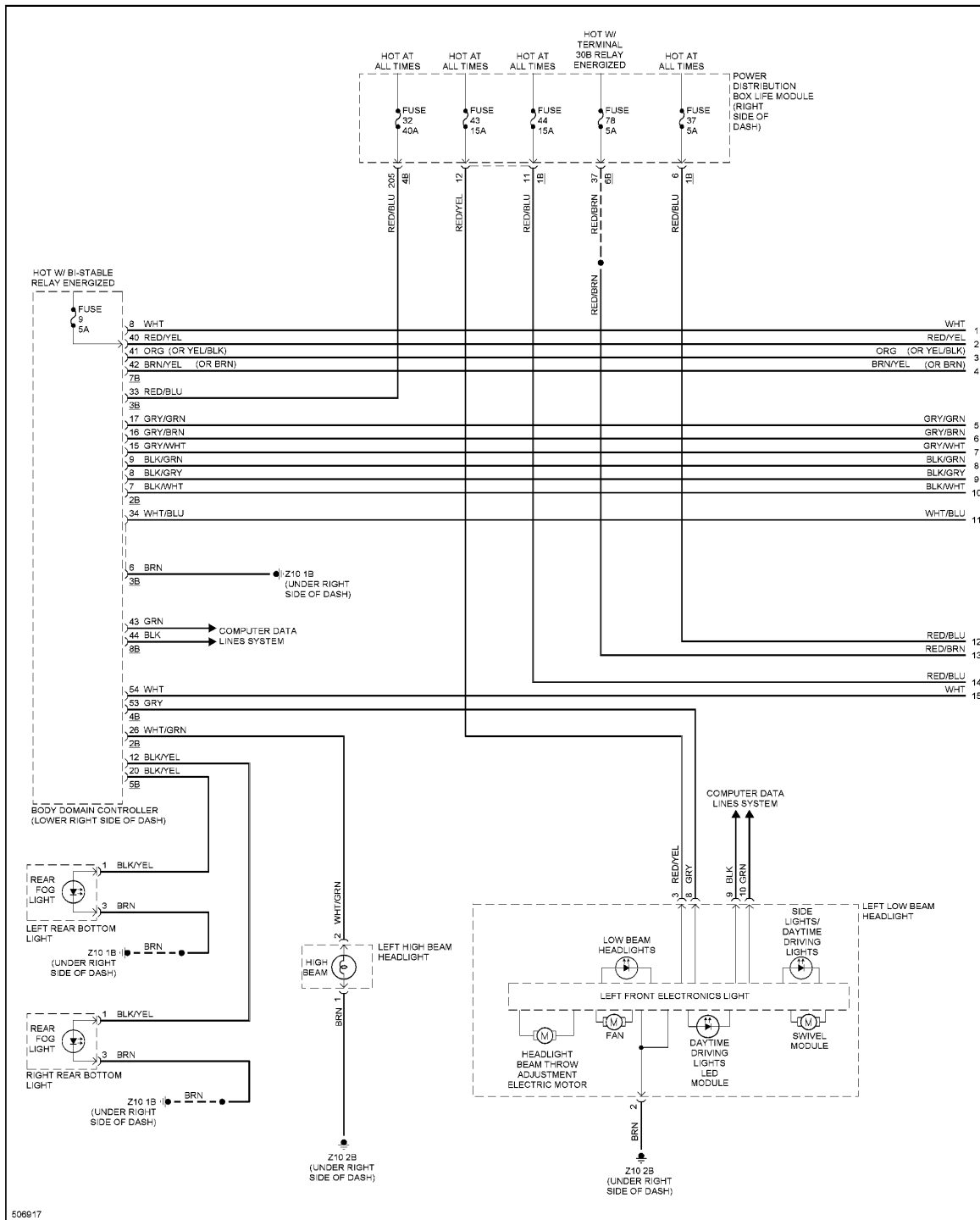
**Fig. 52: Ground Distribution Circuit (3 of 4)**



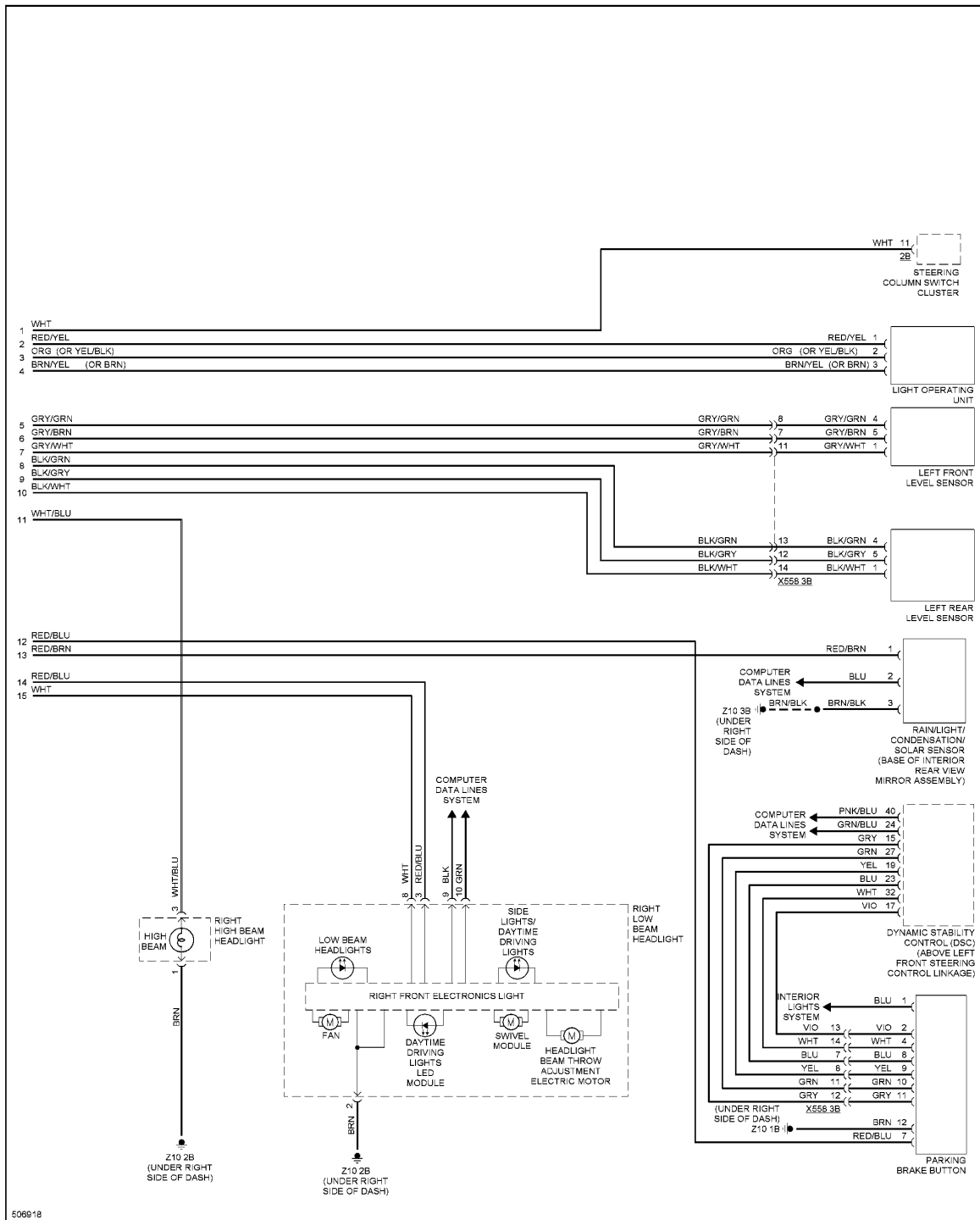


**Fig. 53: Ground Distribution Circuit (4 of 4)**

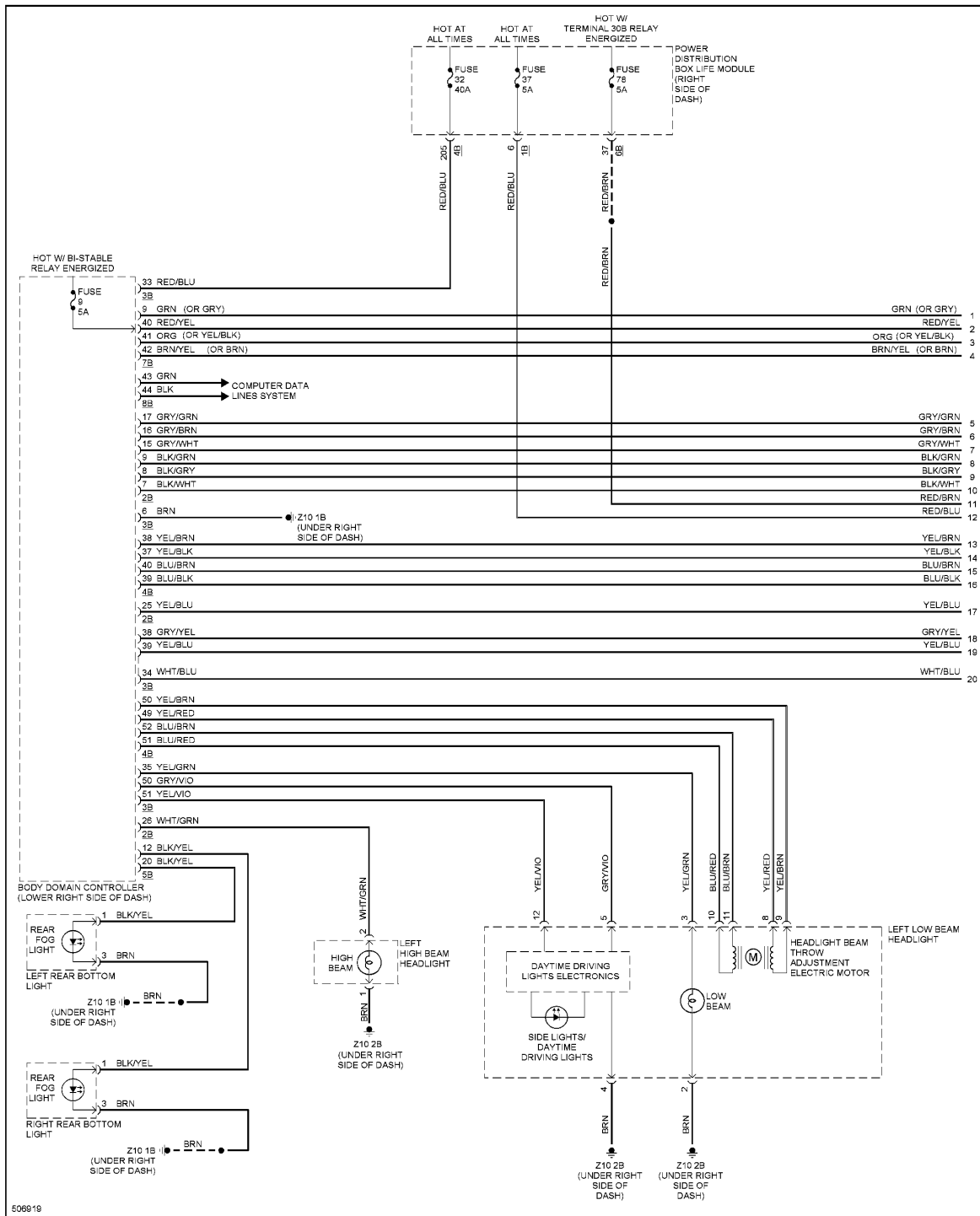
**HEADLIGHTS**



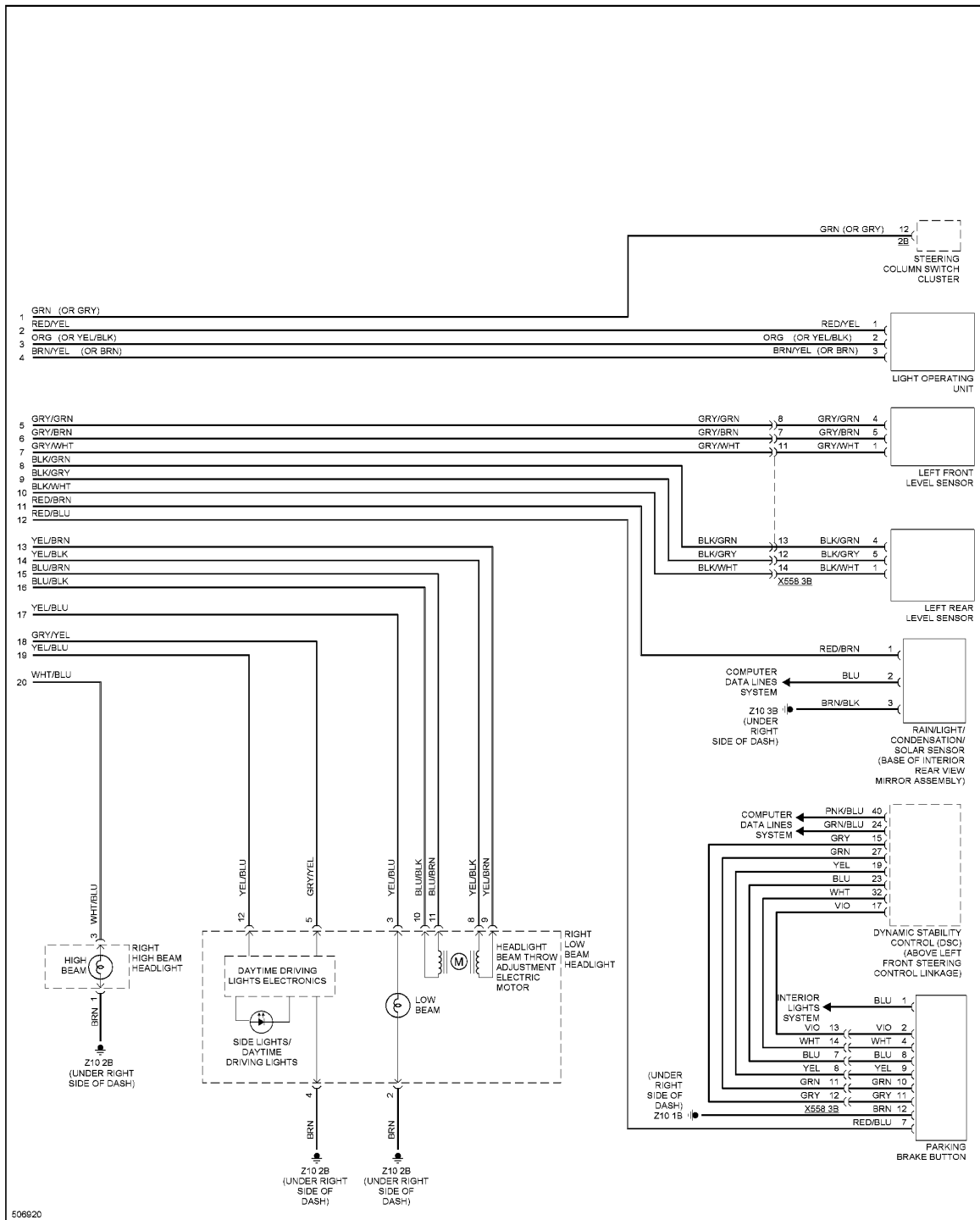
**Fig. 54: Headlights Circuit, W/ LED Headlamps (1 of 2)**



**Fig. 55: Headlights Circuit, W/ LED Headlamps (2 of 2)**

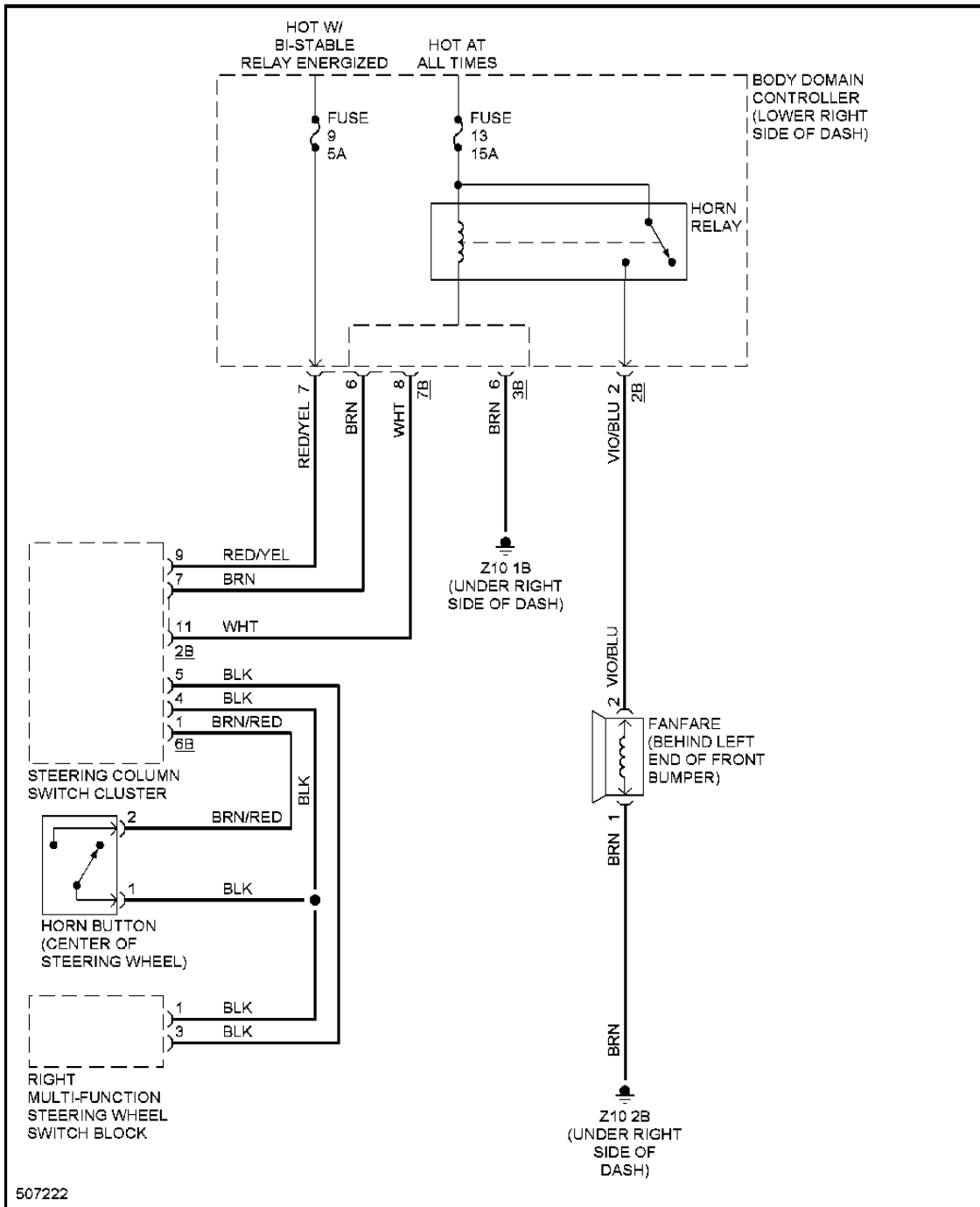


**Fig. 56: Headlights Circuit, W/O LED Headlamps (1 of 2)**



**Fig. 57: Headlights Circuit, W/O LED Headlamps (2 of 2)**

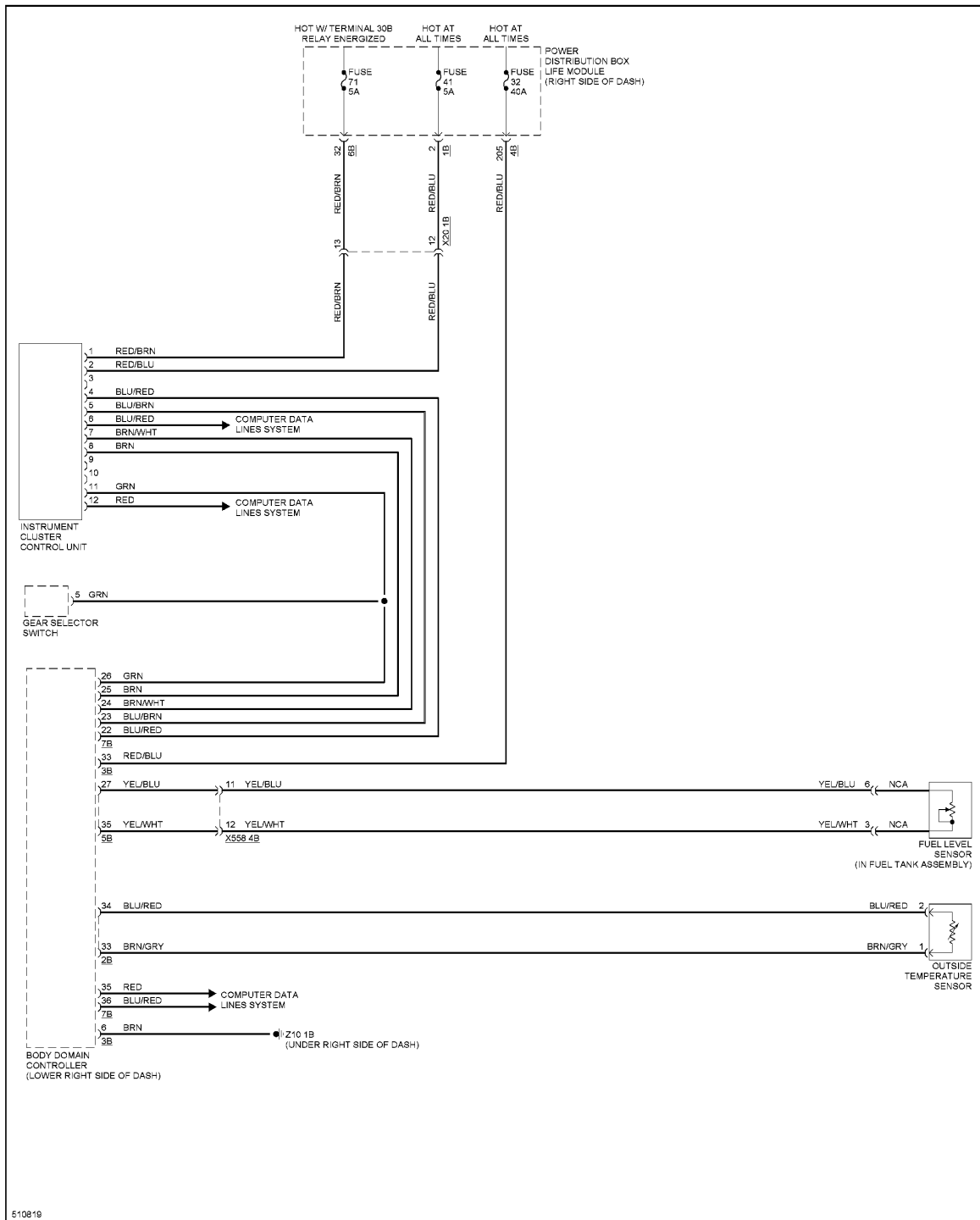
**HORN**



**Fig. 58: Horn Circuit**

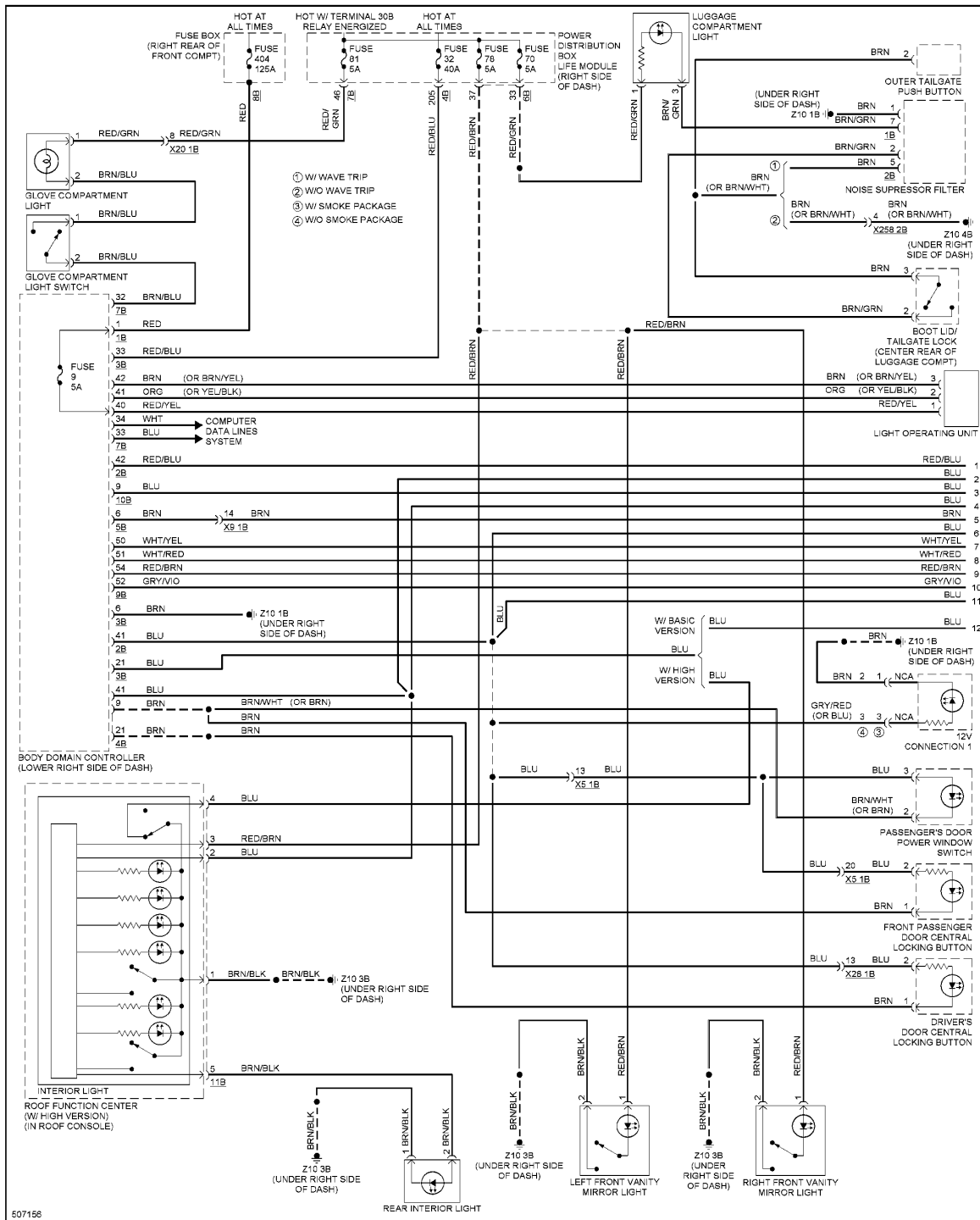
**INSTRUMENT CLUSTER**



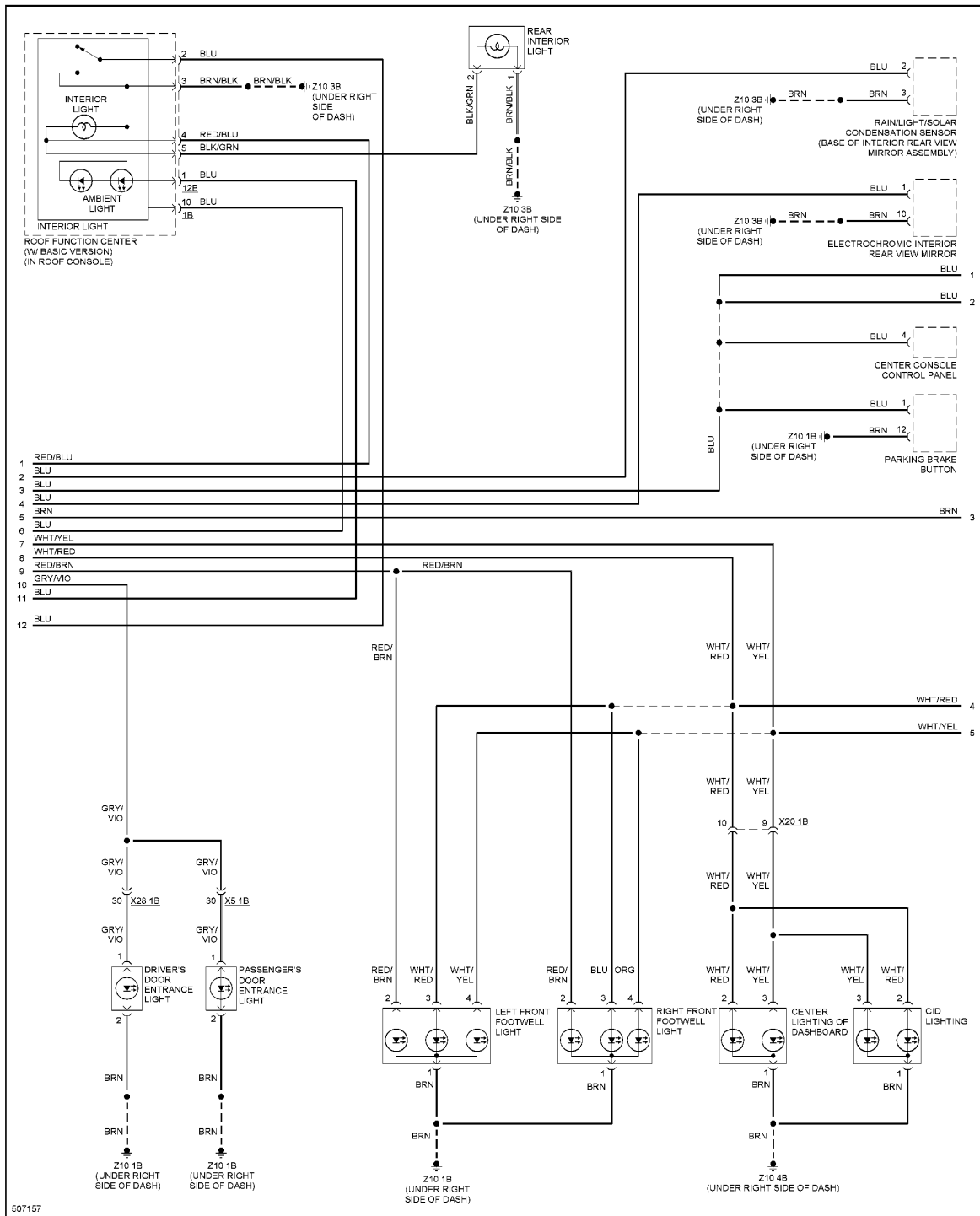


**Fig. 59: Instrument Cluster Circuit**

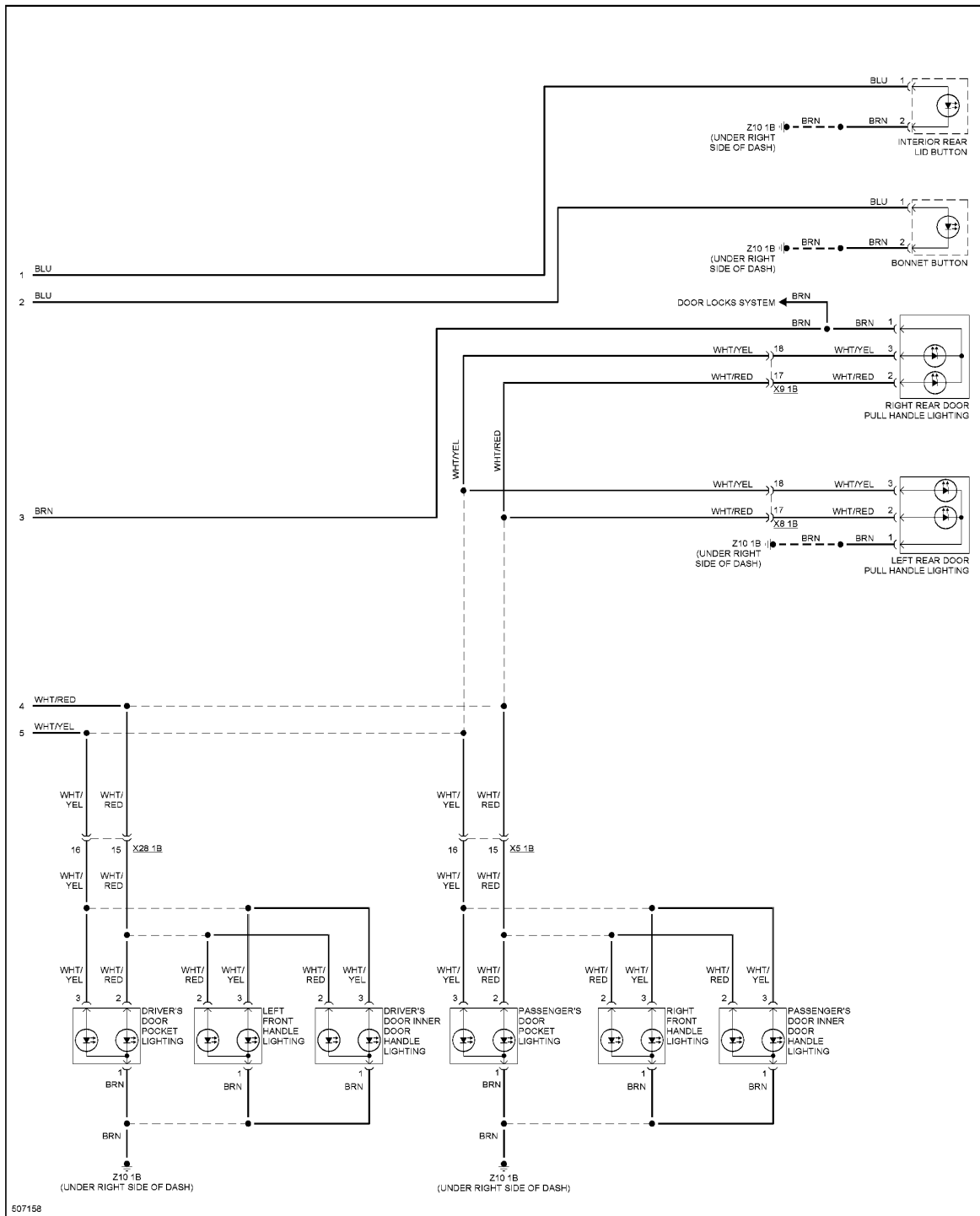
## INTERIOR LIGHTS



**Fig. 60: Interior Lights Circuit (1 of 3)**

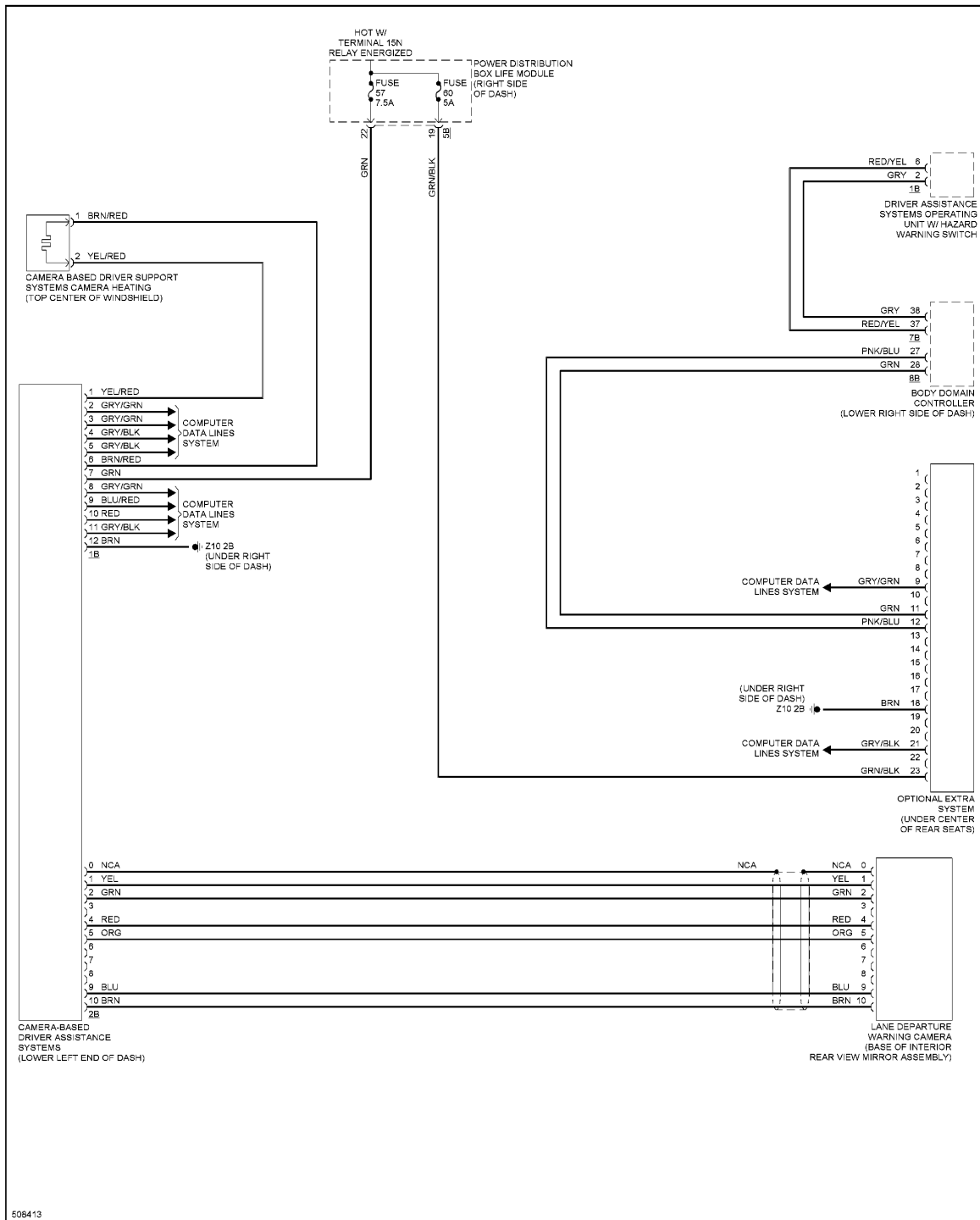


**Fig. 61: Interior Lights Circuit (2 of 3)**

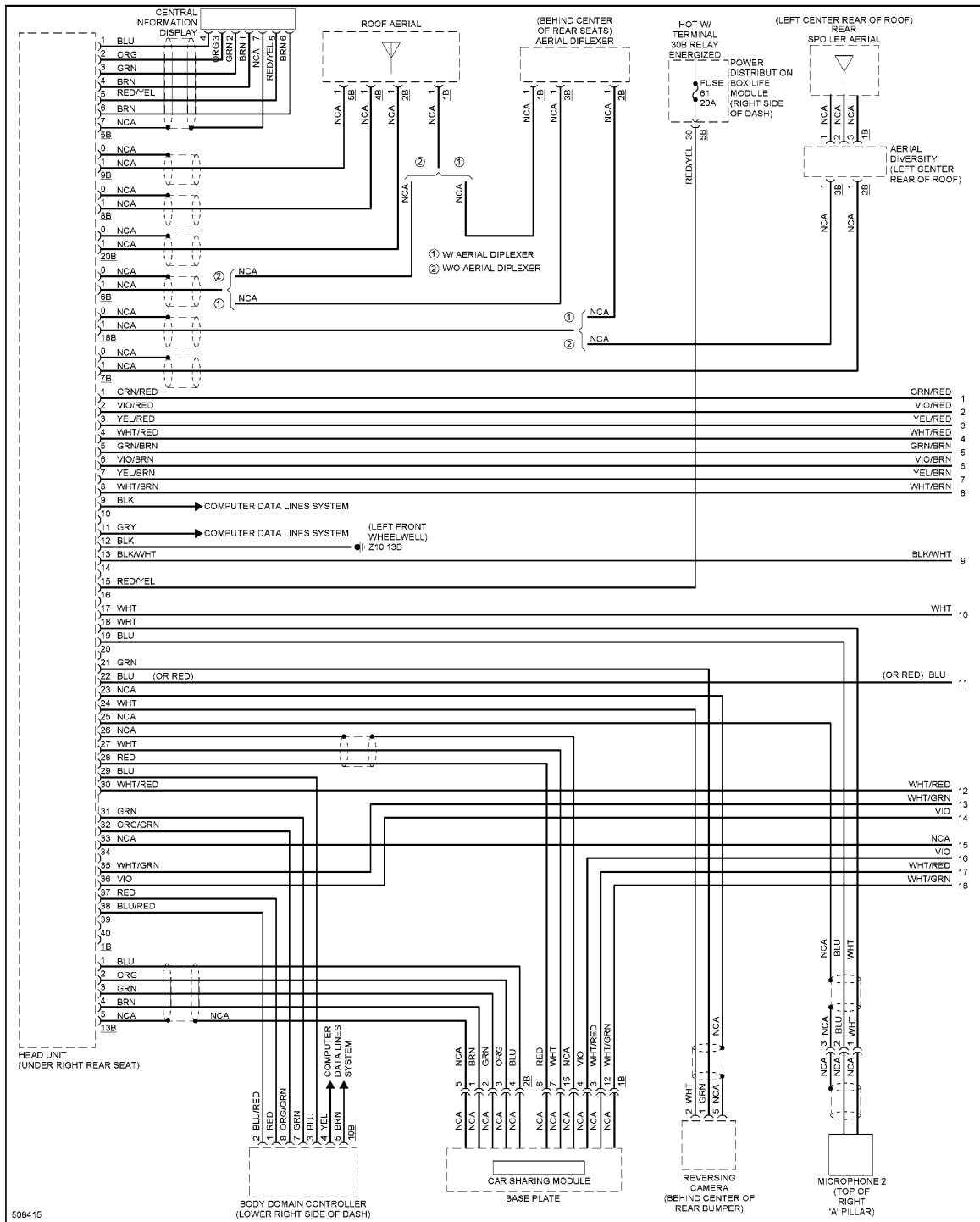


**Fig. 62: Interior Lights Circuit (3 of 3)**

**NAVIGATION**



**Fig. 63: Lane Departure Warning Circuit**



**Fig. 64: Navigation Circuit, W/ HiFi Radio (1 of 3)**



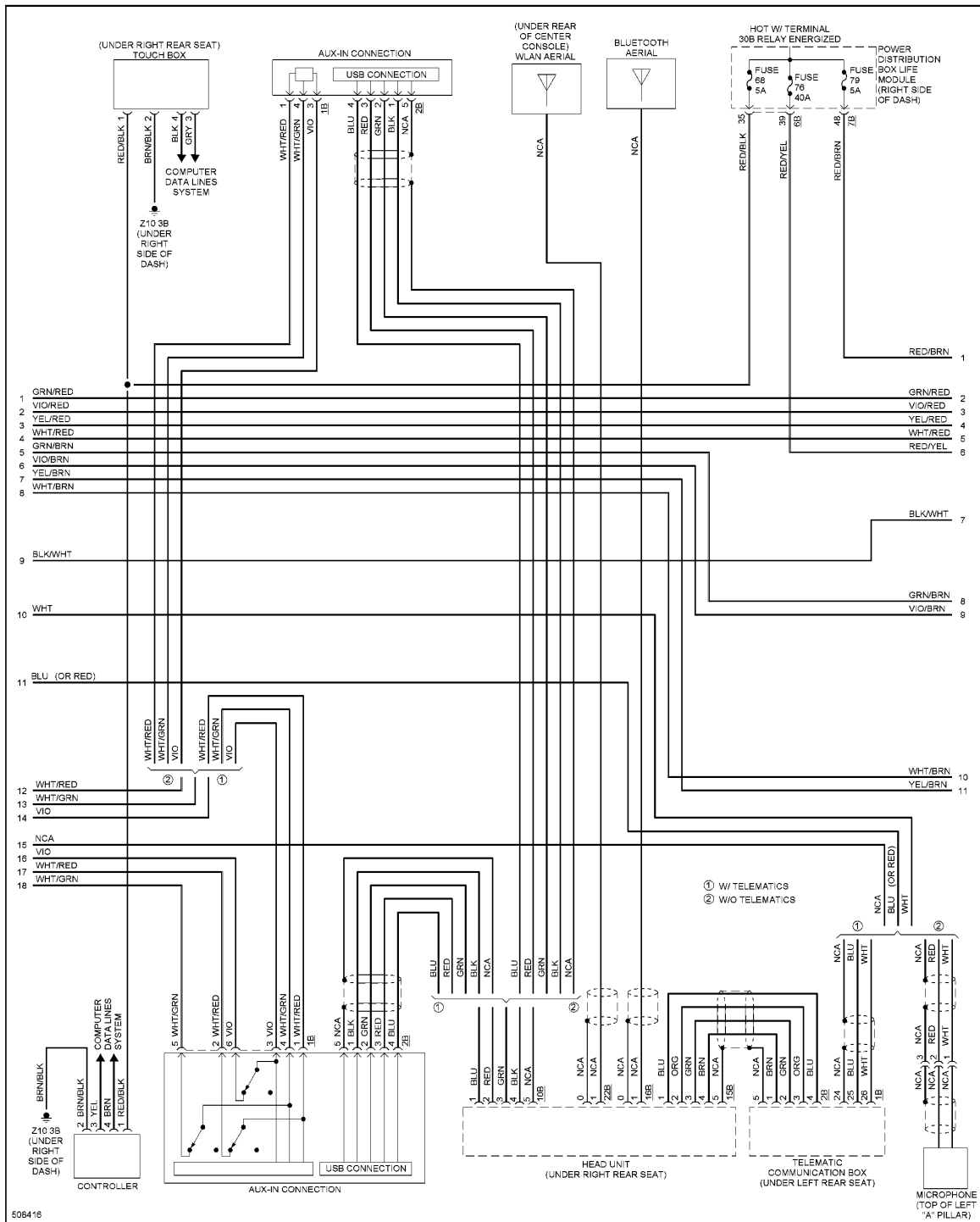
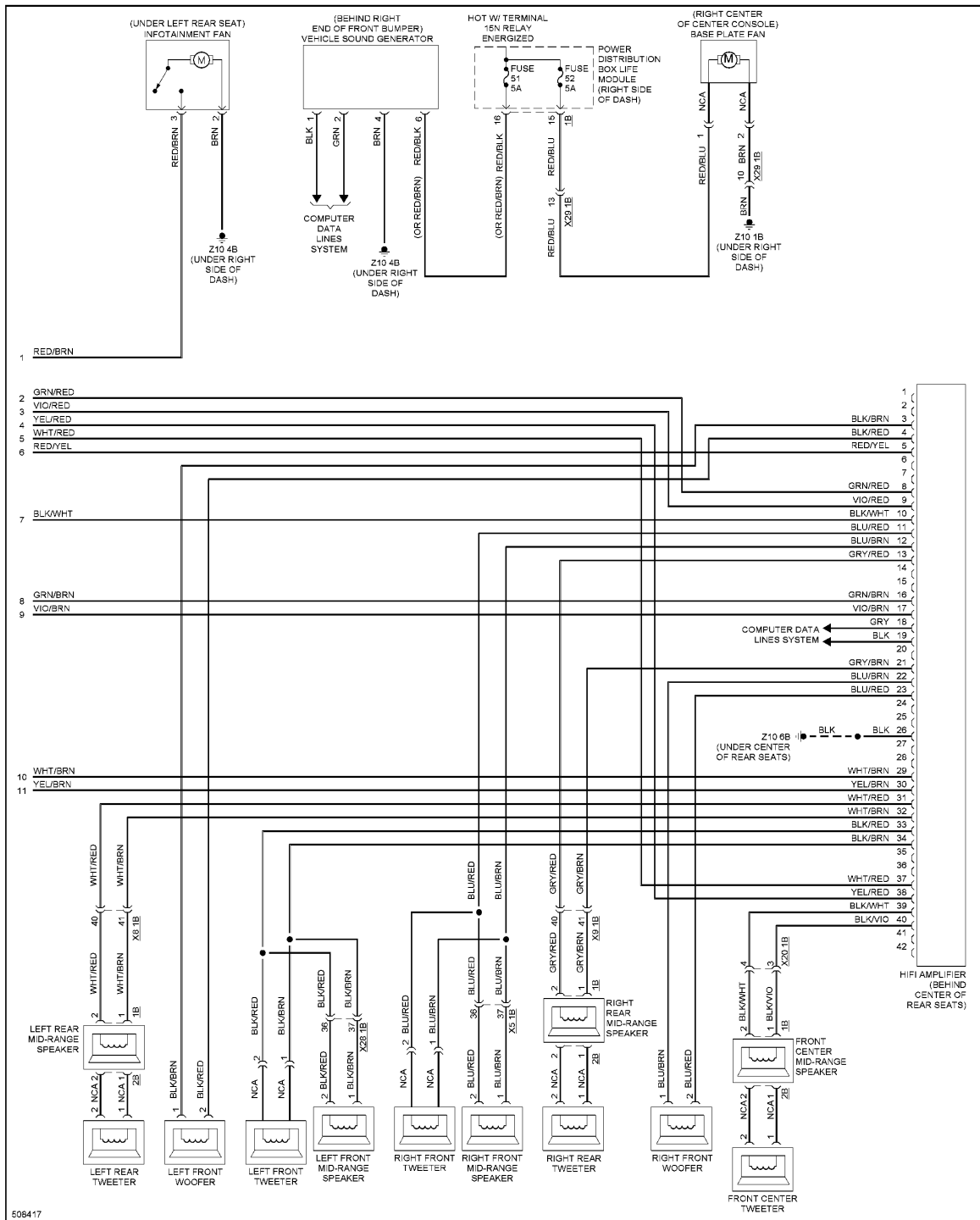
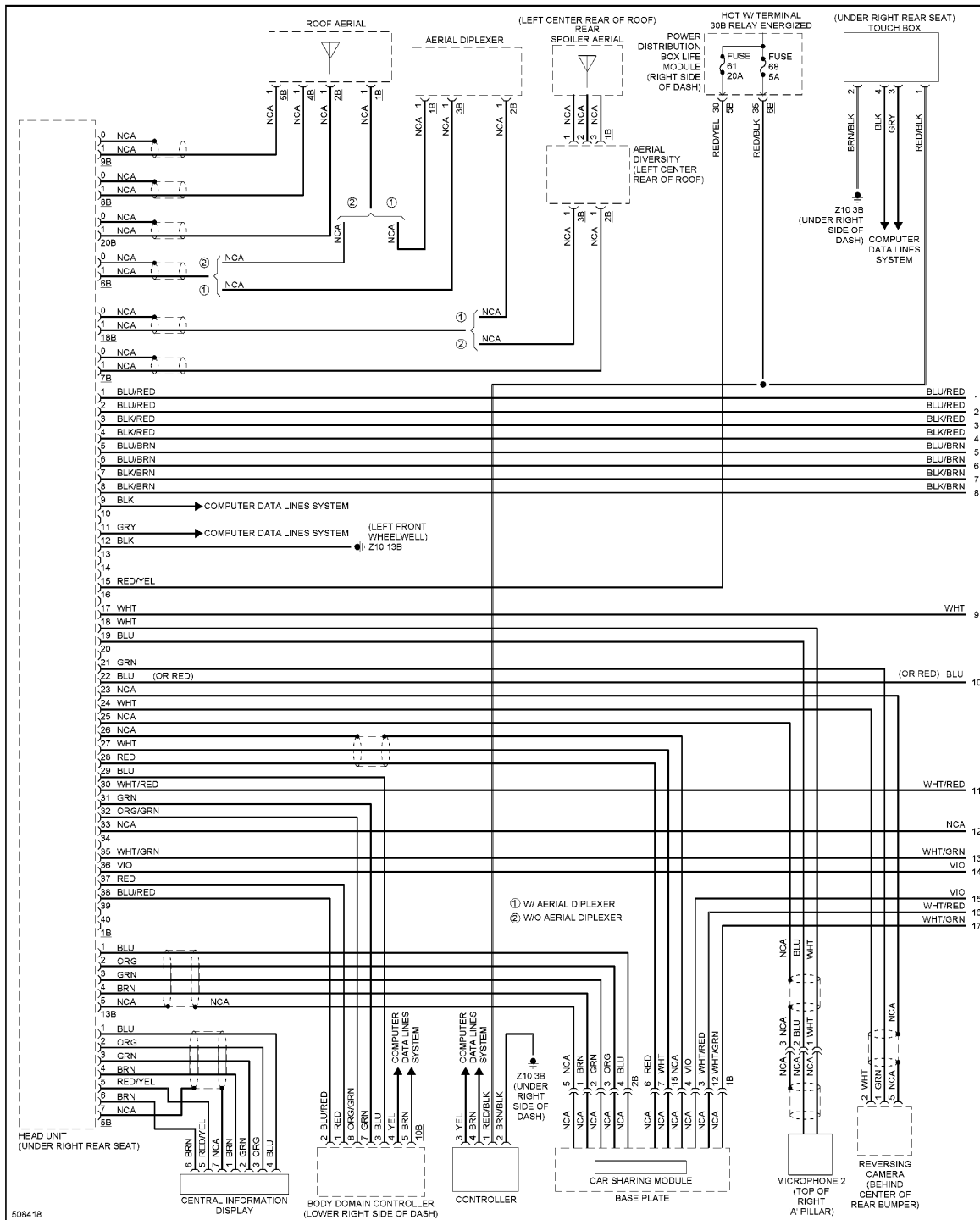


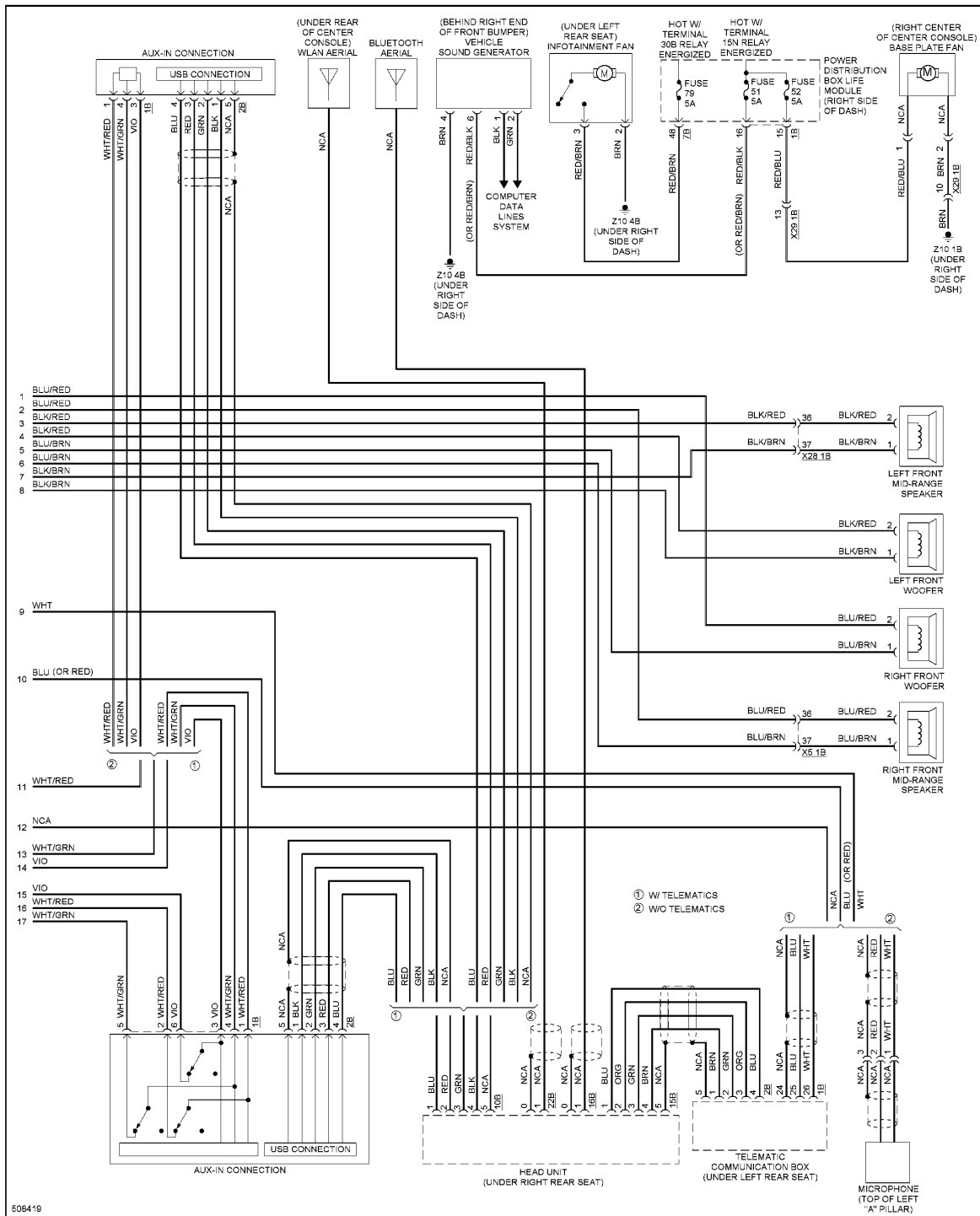
Fig. 65: Navigation Circuit, W/ HIFI Radio (2 of 3)



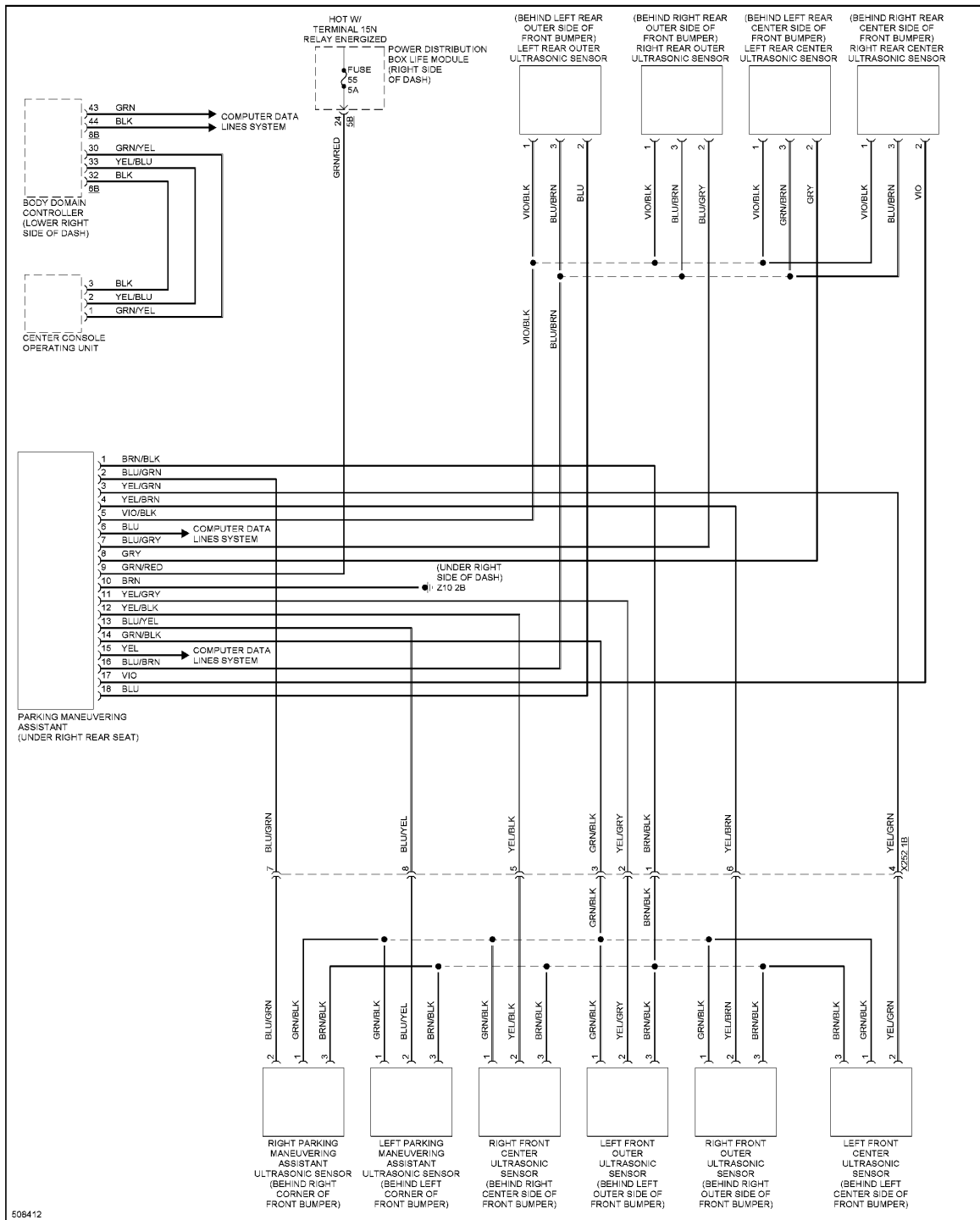
**Fig. 66: Navigation Circuit, W/ HIFI Radio (3 of 3)**



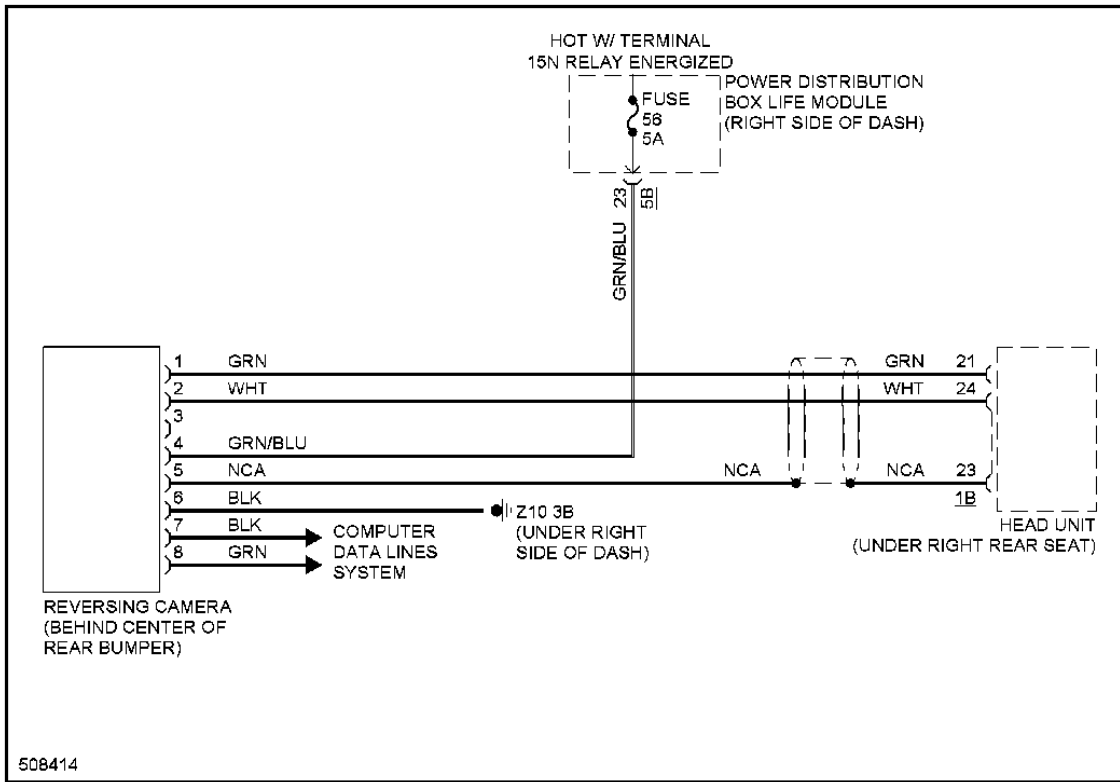
**Fig. 67: Navigation Circuit, W/O HiFi Radio (1 of 2)**



**Fig. 68: Navigation Circuit, W/O HiFi Radio (2 of 2)**



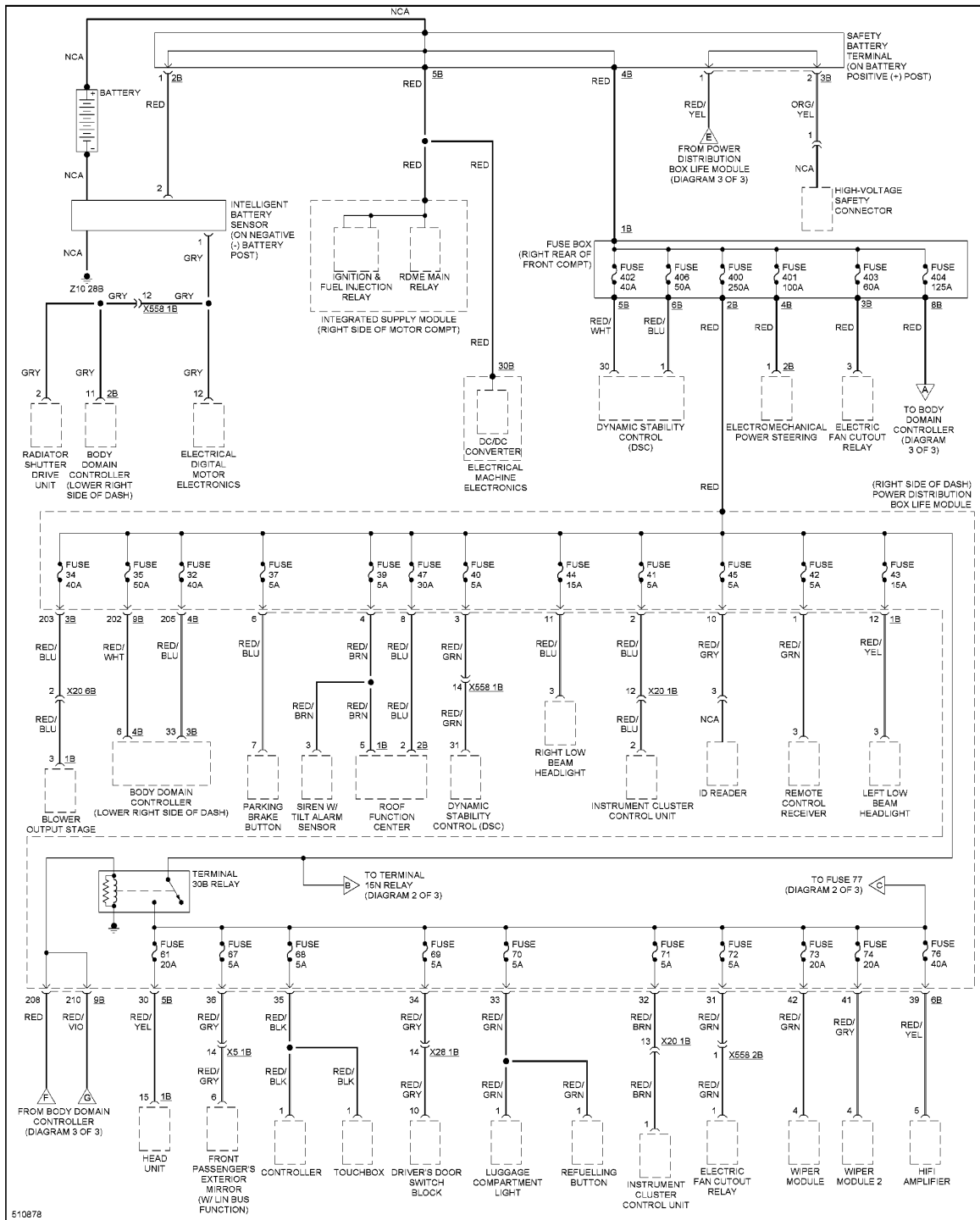
**Fig. 69: Parking Assistant Circuit**



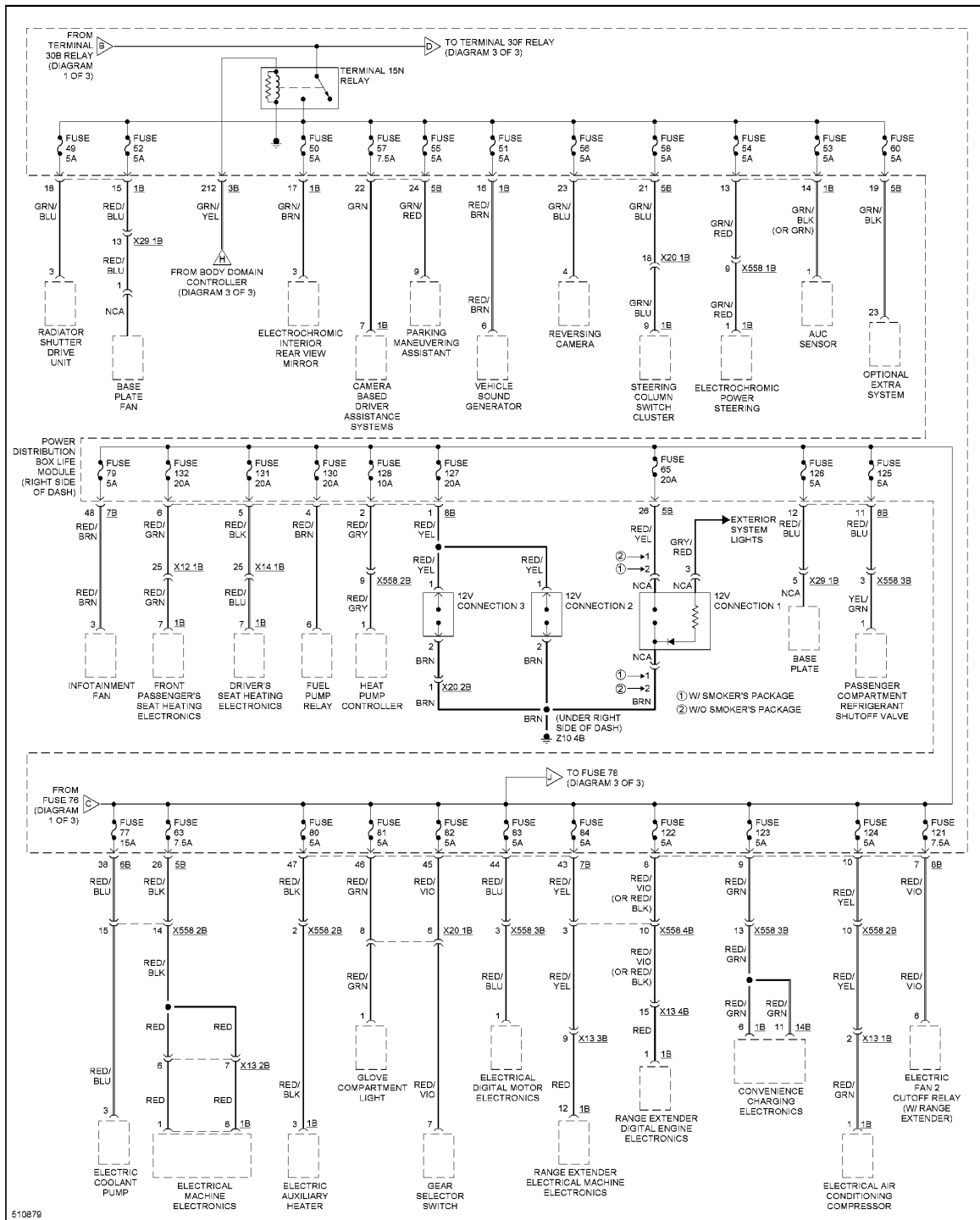
**Fig. 70: Rear Camera Circuit**

**POWER DISTRIBUTION**

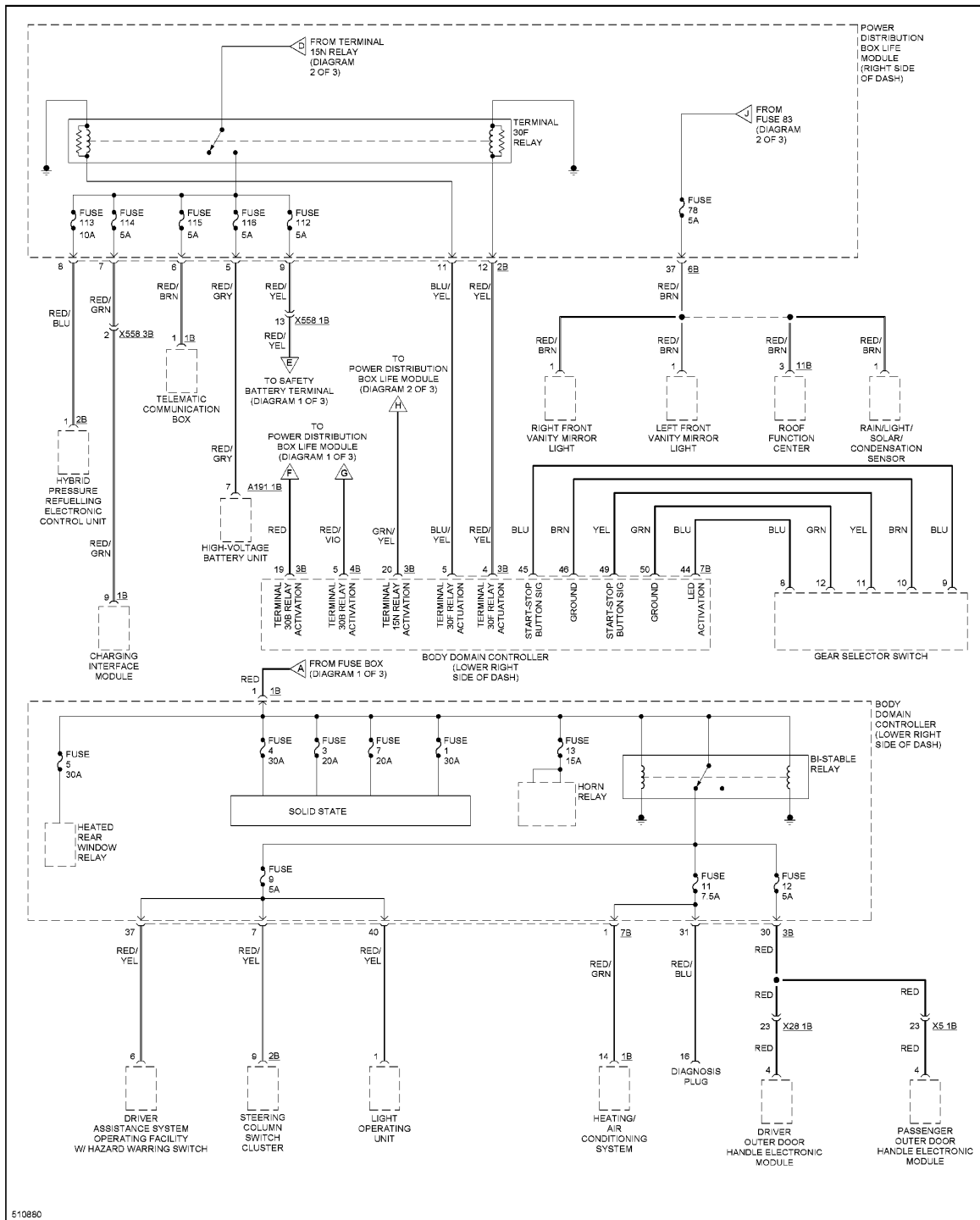




**Fig. 71: Power Distribution Circuit (1 of 3)**



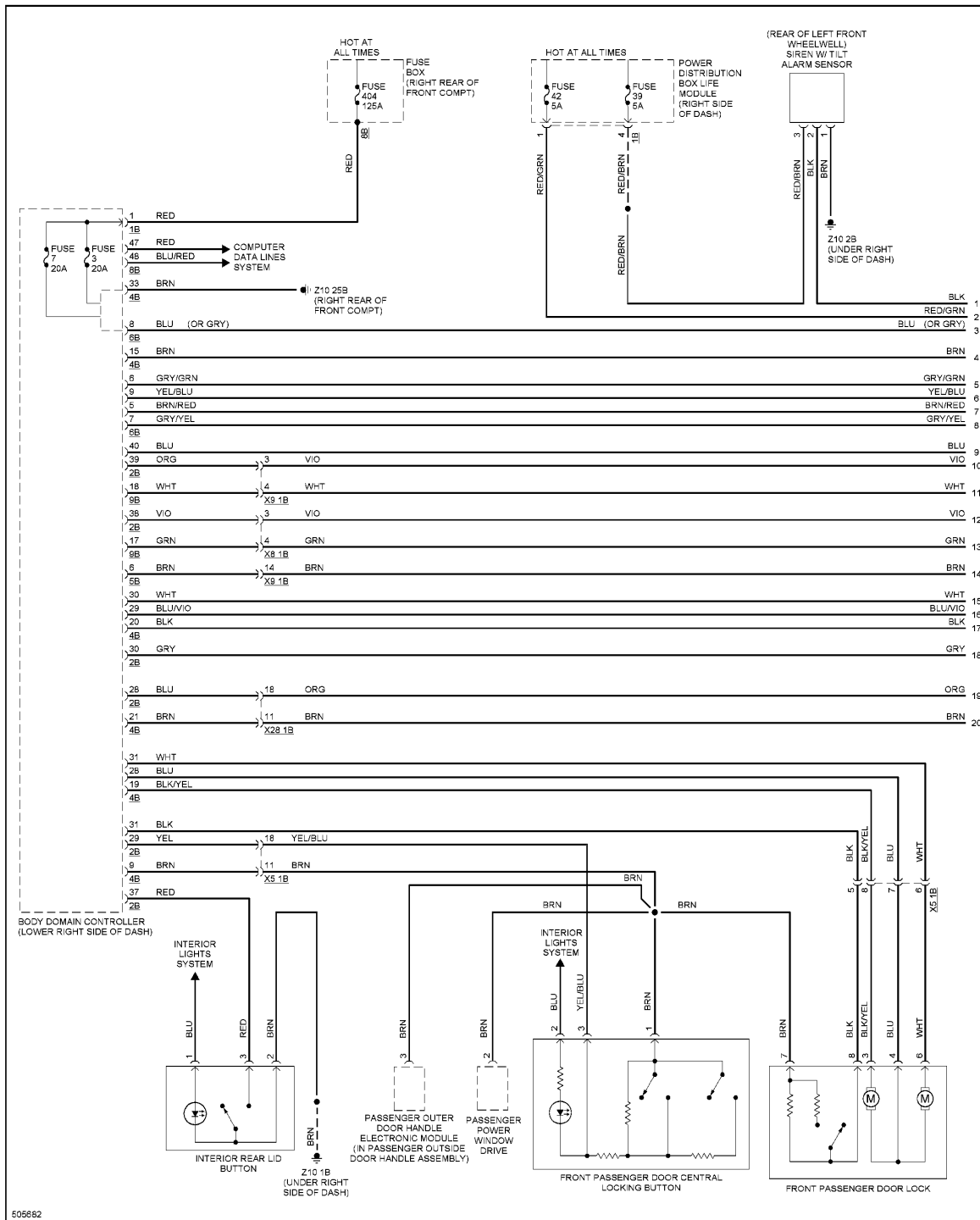
**Fig. 72: Power Distribution Circuit (2 of 3)**



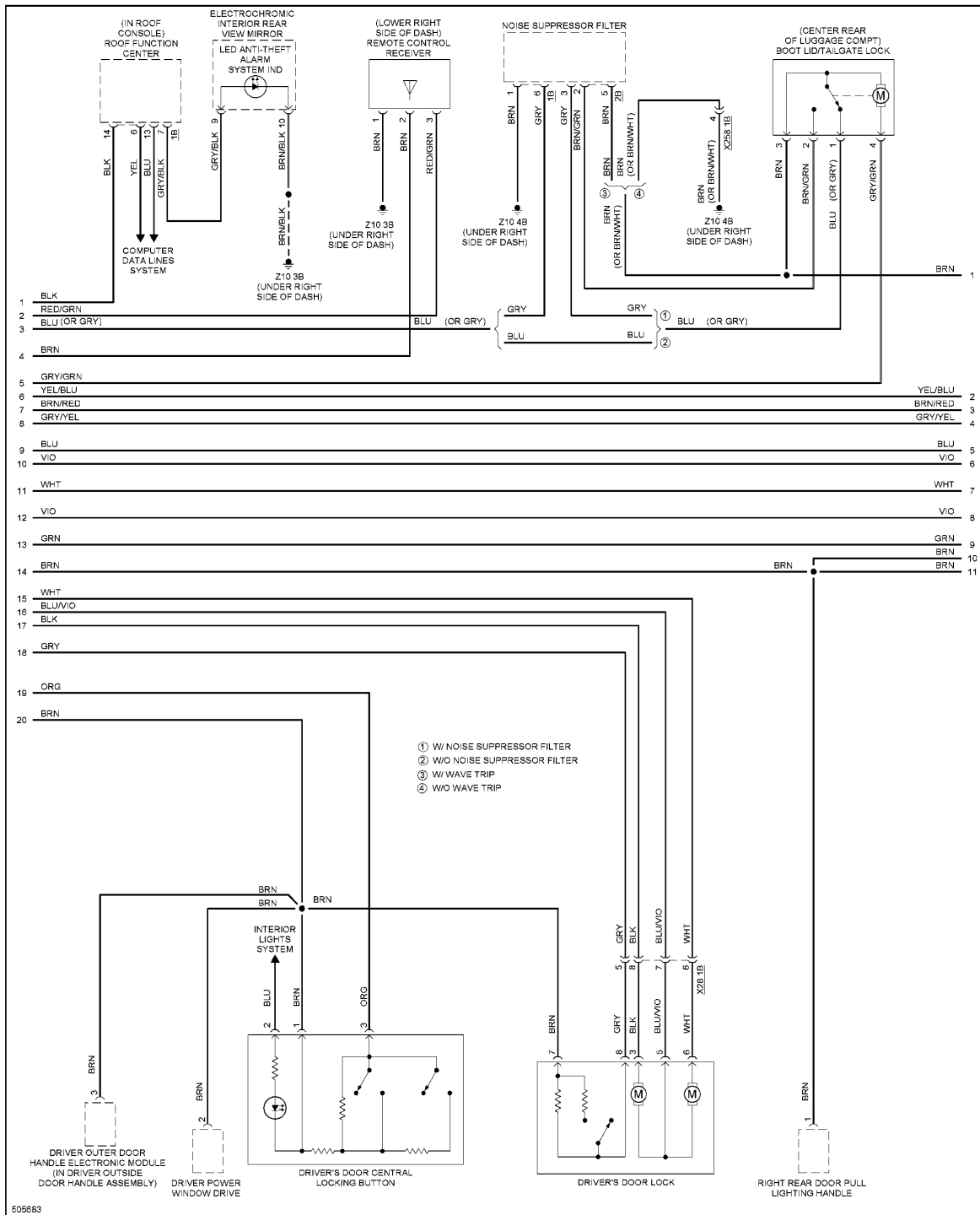
510880

**Fig. 73: Power Distribution Circuit (3 of 3)**

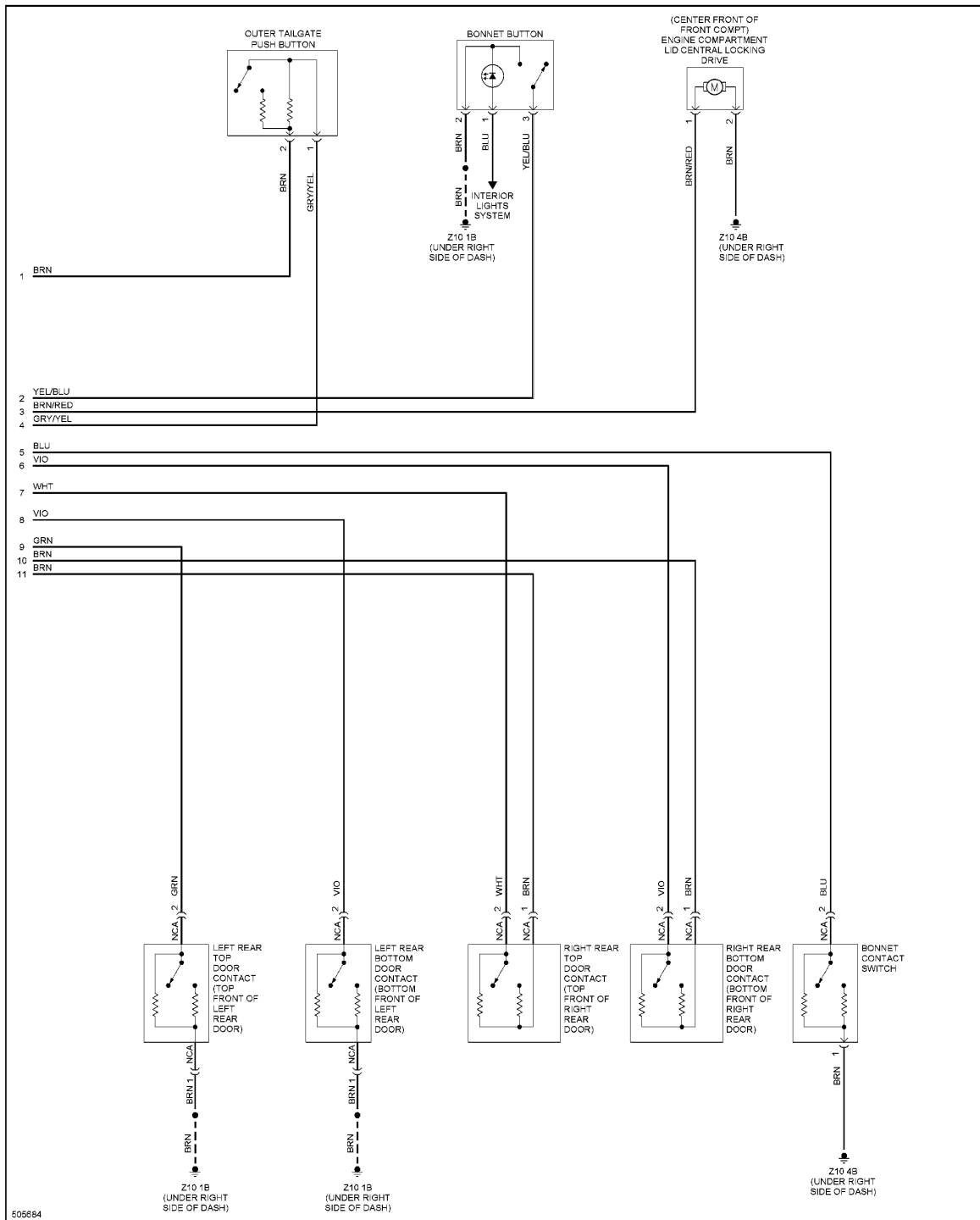
## POWER DOOR LOCKS



**Fig. 74: Power Door Locks Circuit (1 of 3)**



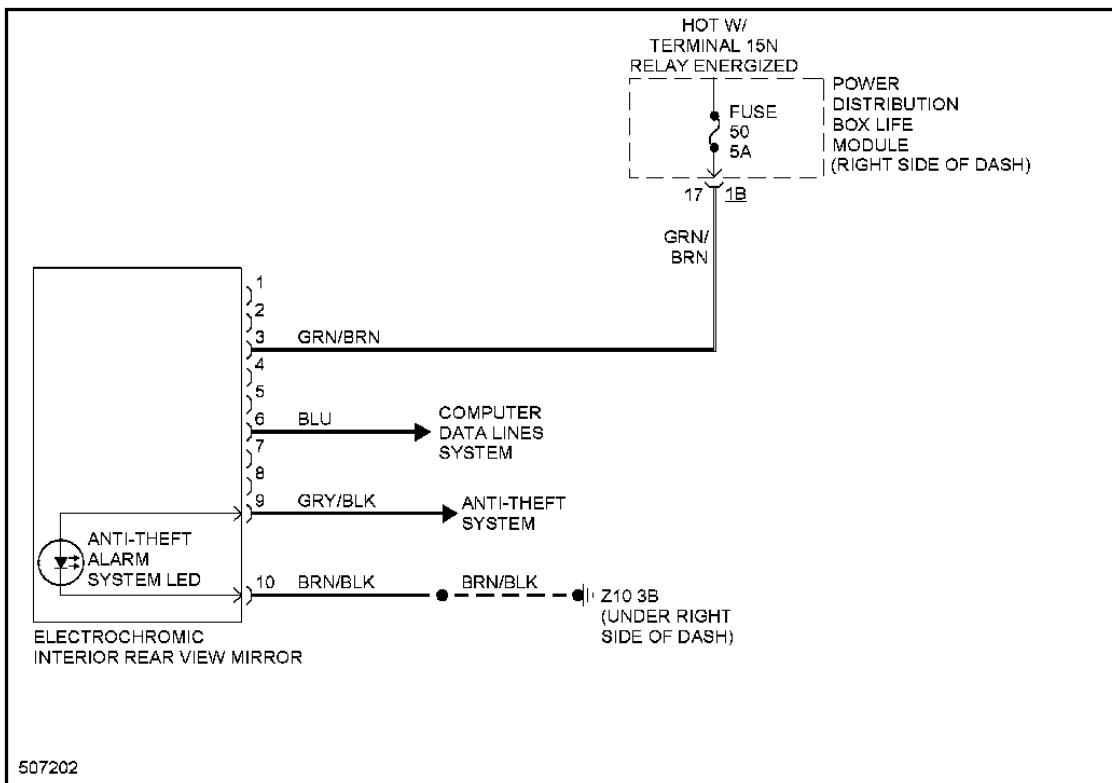
**Fig. 75: Power Door Locks Circuit (2 of 3)**



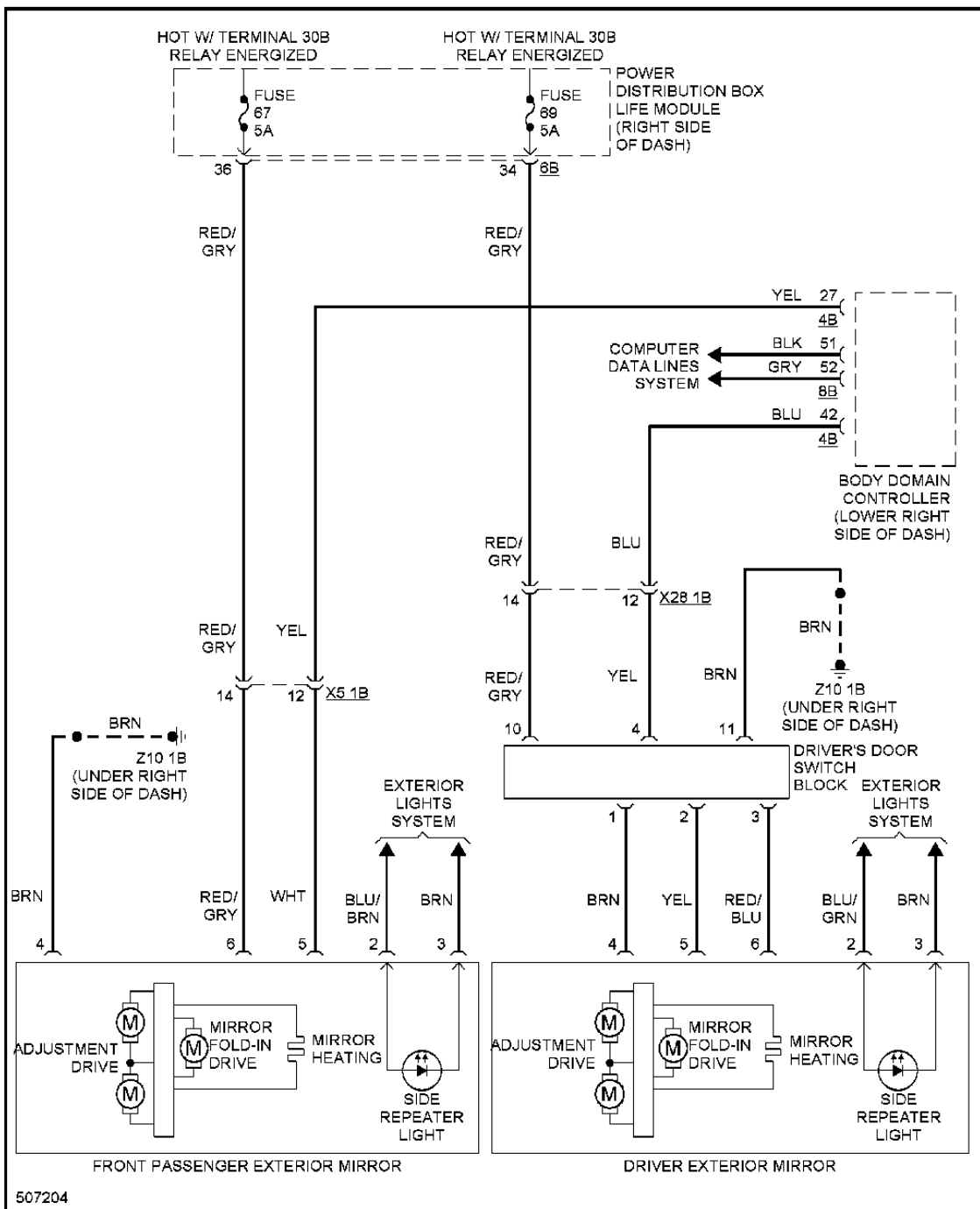
**Fig. 76: Power Door Locks Circuit (3 of 3)**

## POWER MIRRORS

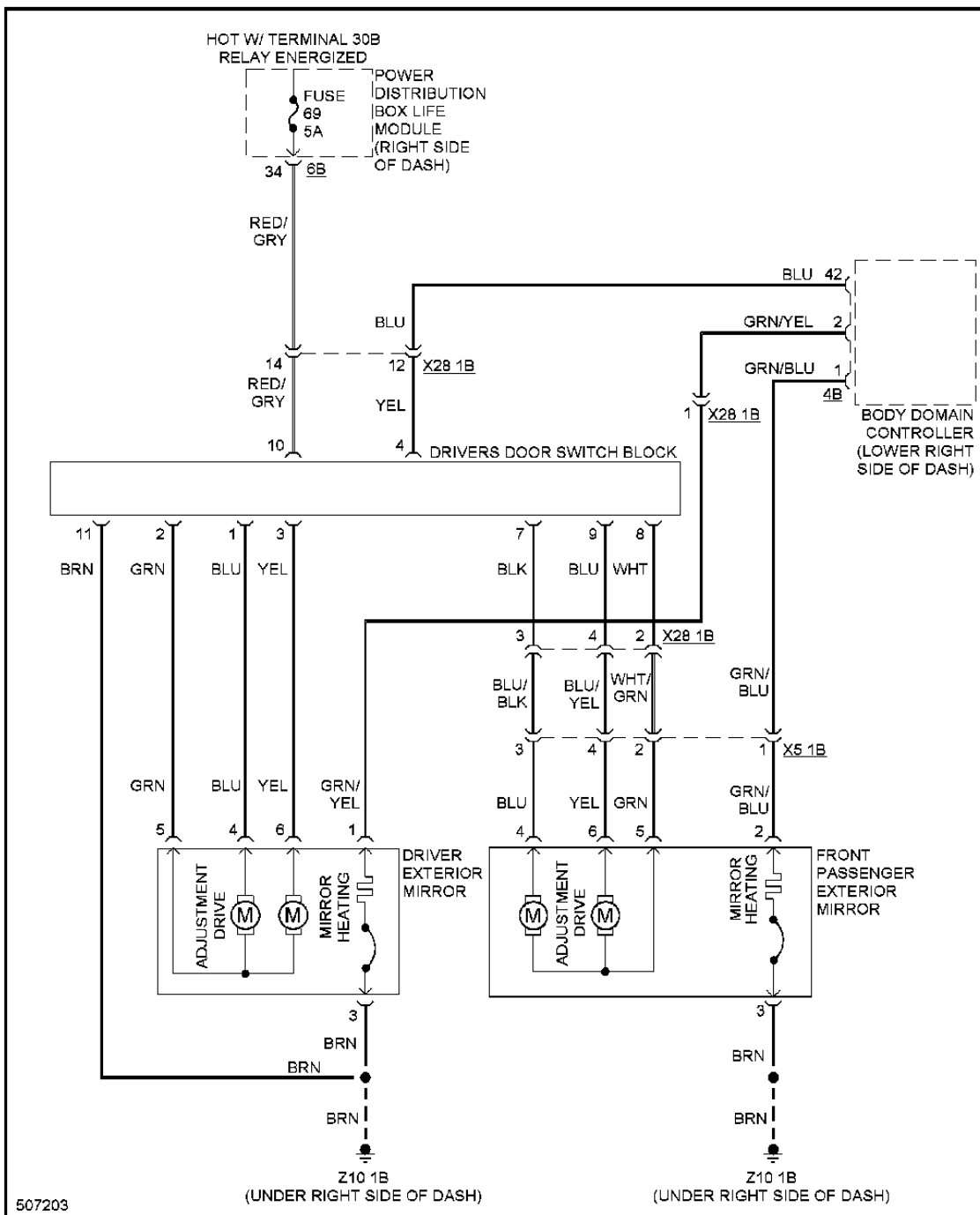




**Fig. 77: Electrochromic Mirror Circuit**

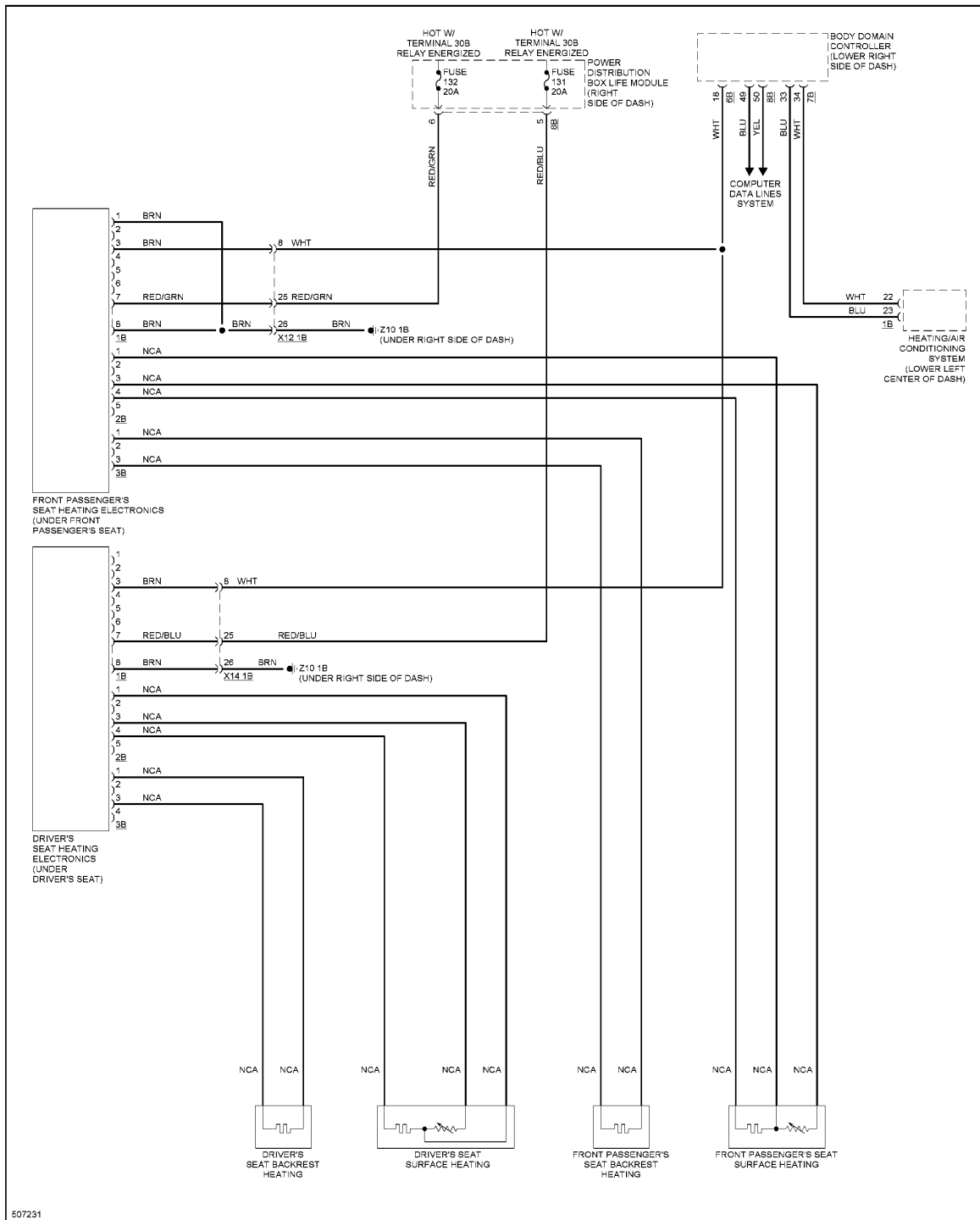


**Fig. 78: Power Mirrors Circuit, W/ LIN Bus Function**



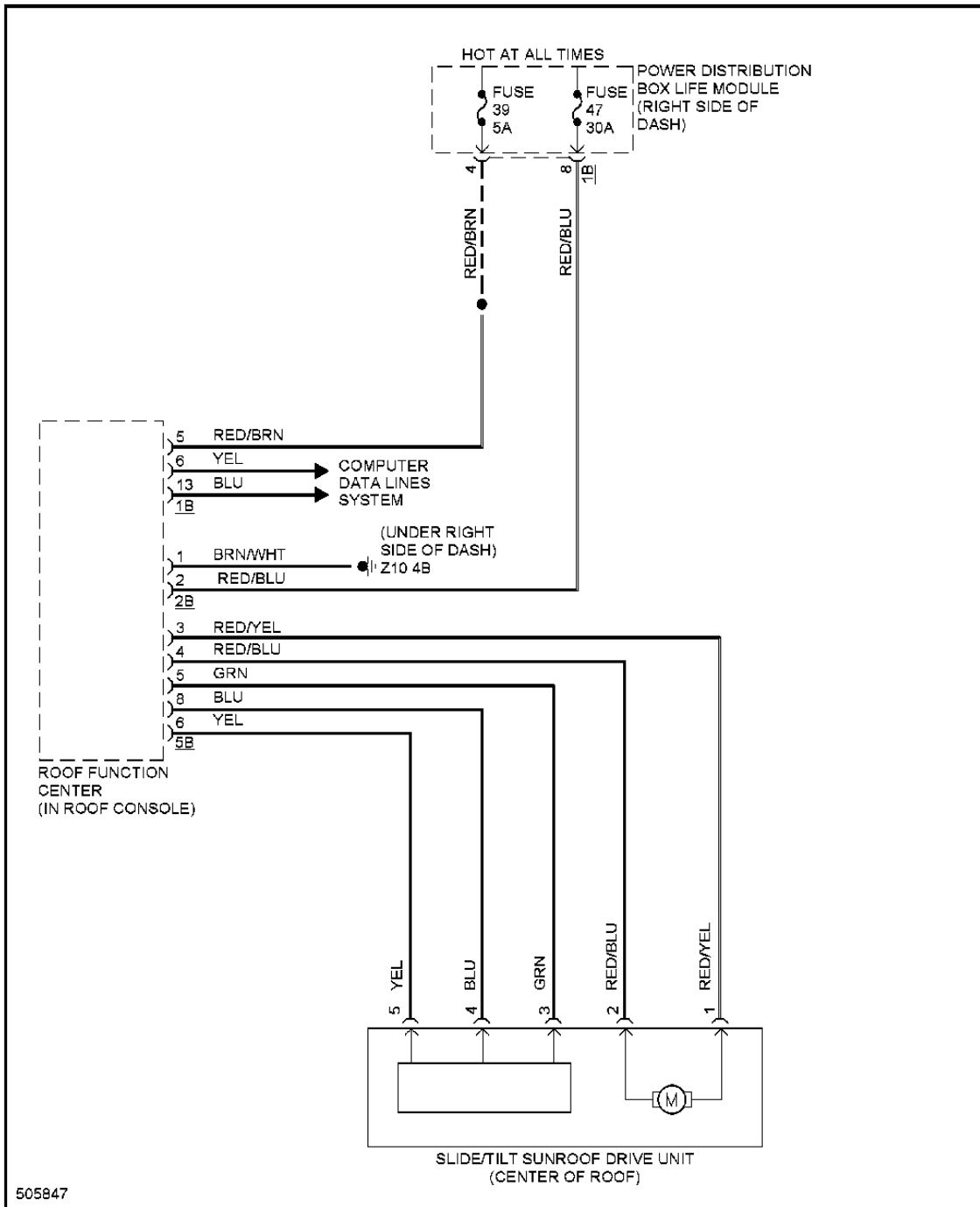
**Fig. 79: Power Mirrors Circuit, W/O LIN Bus Function**

**POWER SEATS**



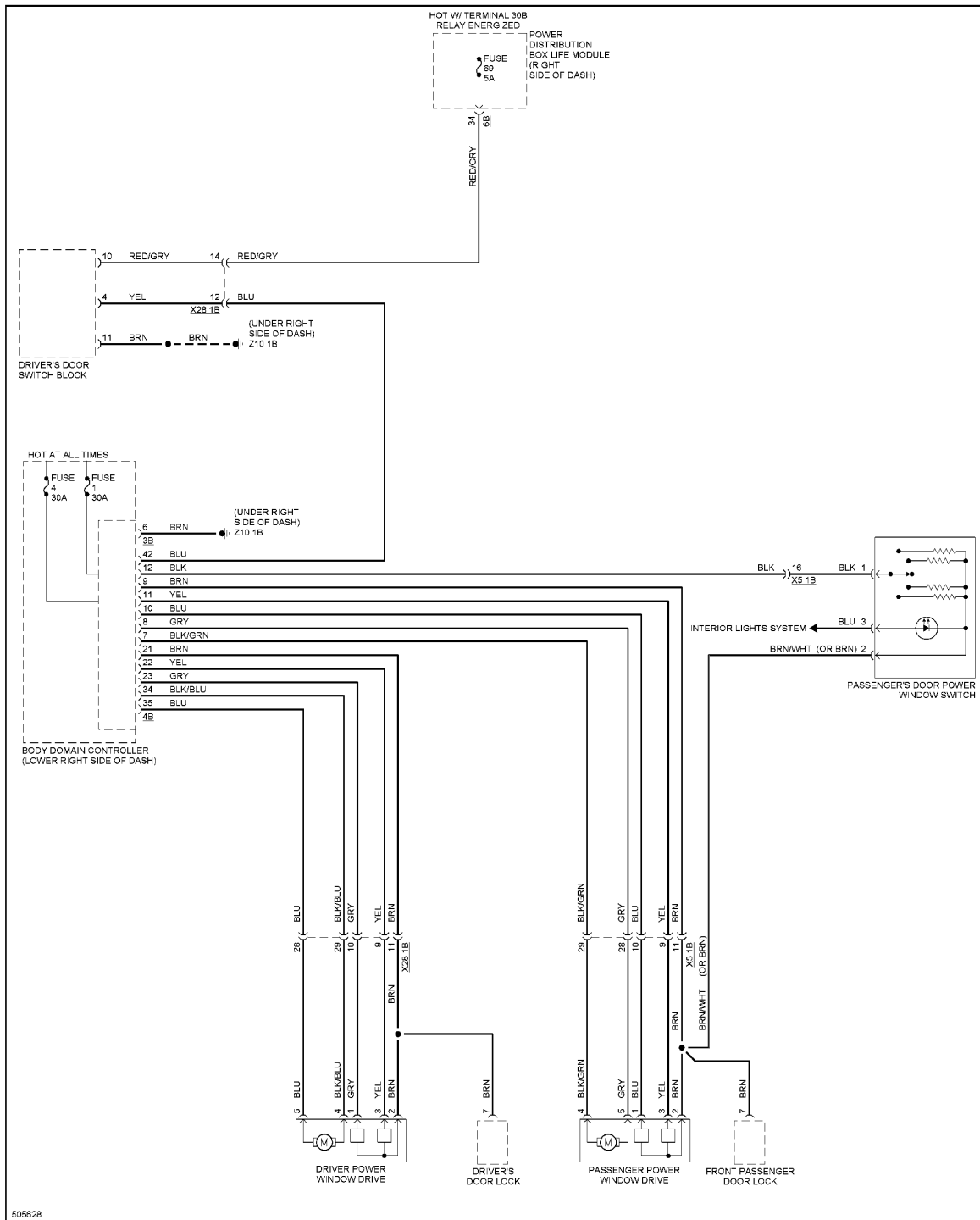
**Fig. 80: Power Seats Circuit**

**POWER TOP/SUNROOF**



**Fig. 81: Power Top/Sunroof Circuit**

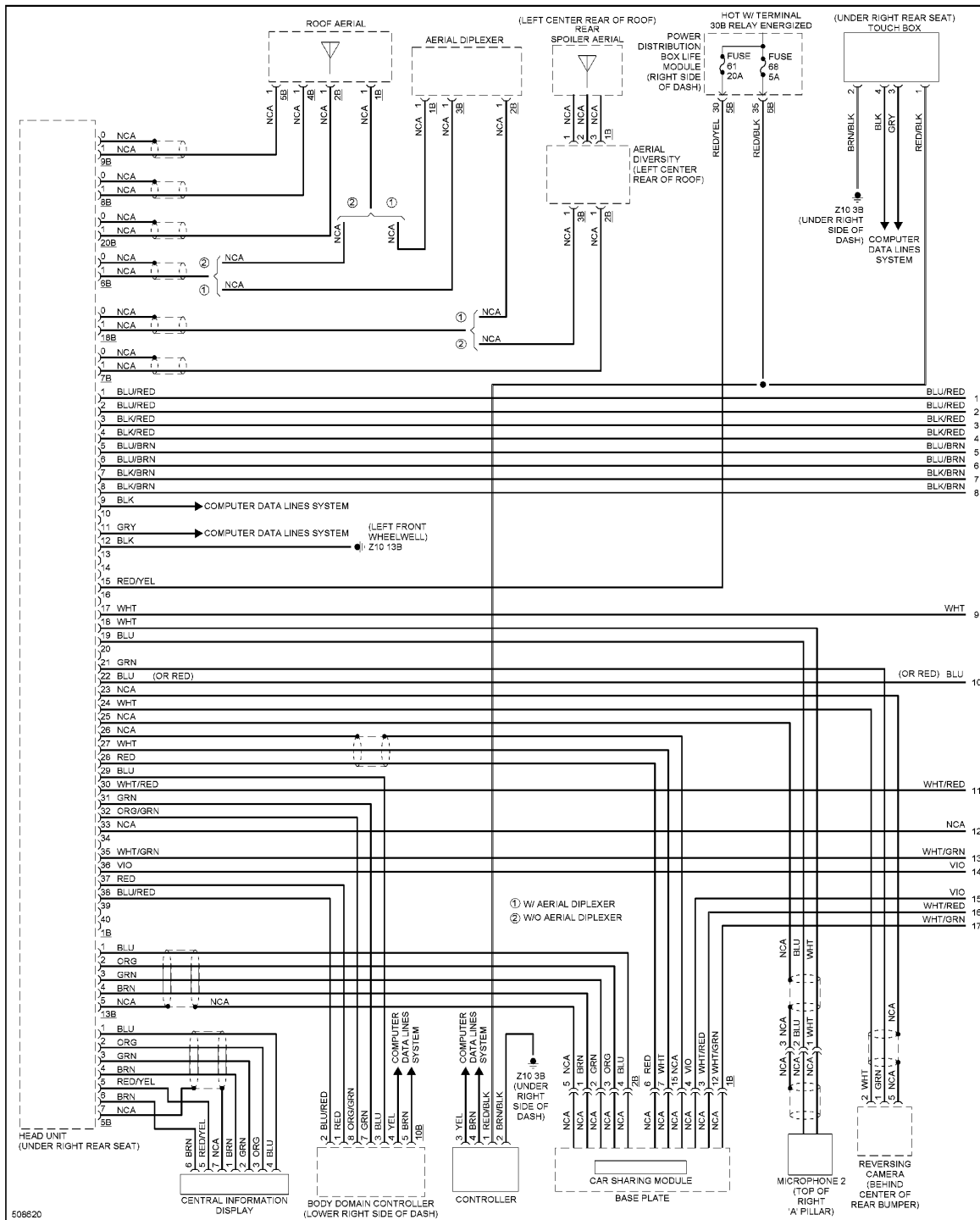
**POWER WINDOWS**



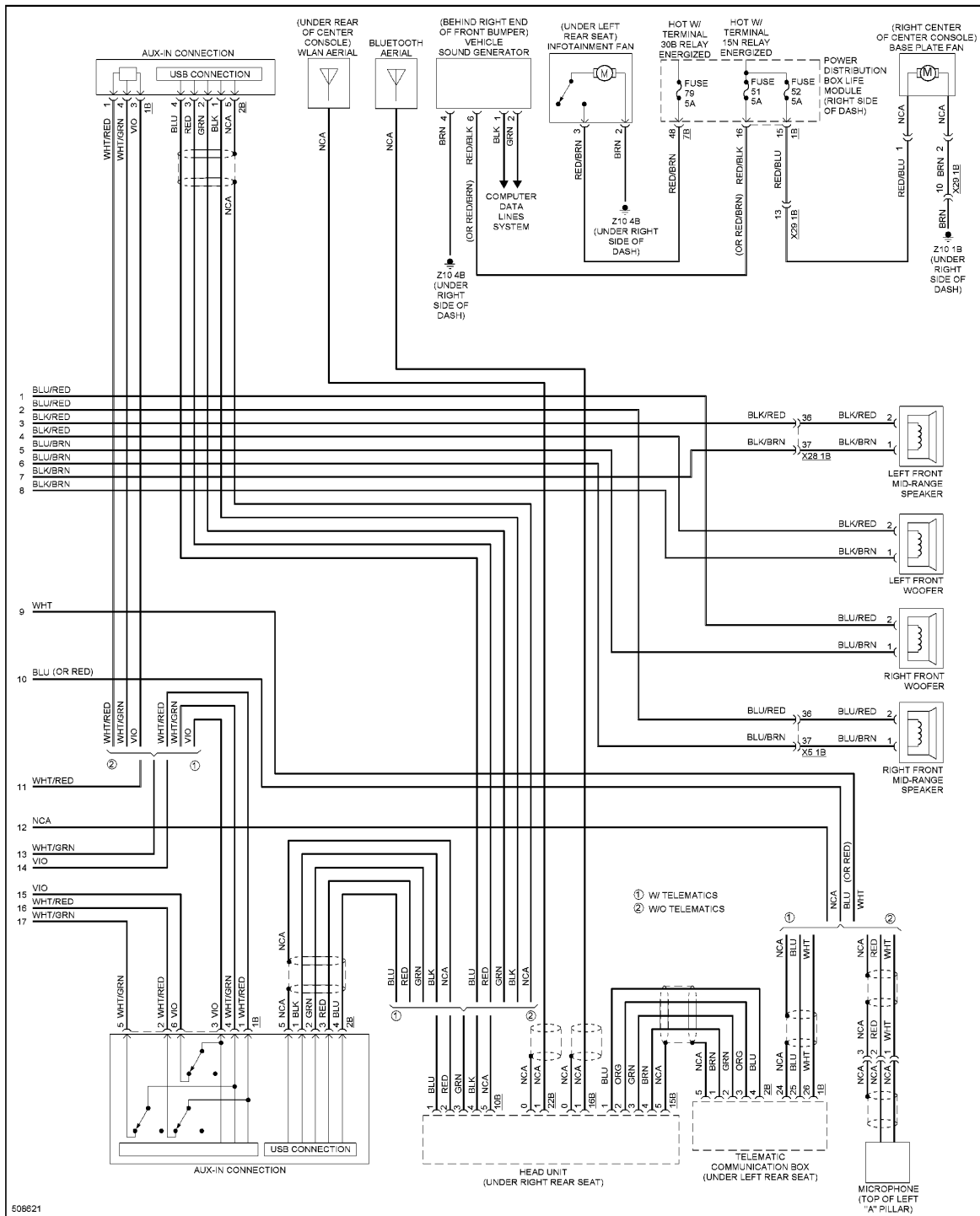
**Fig. 82: Power Windows Circuit**

**RADIO**

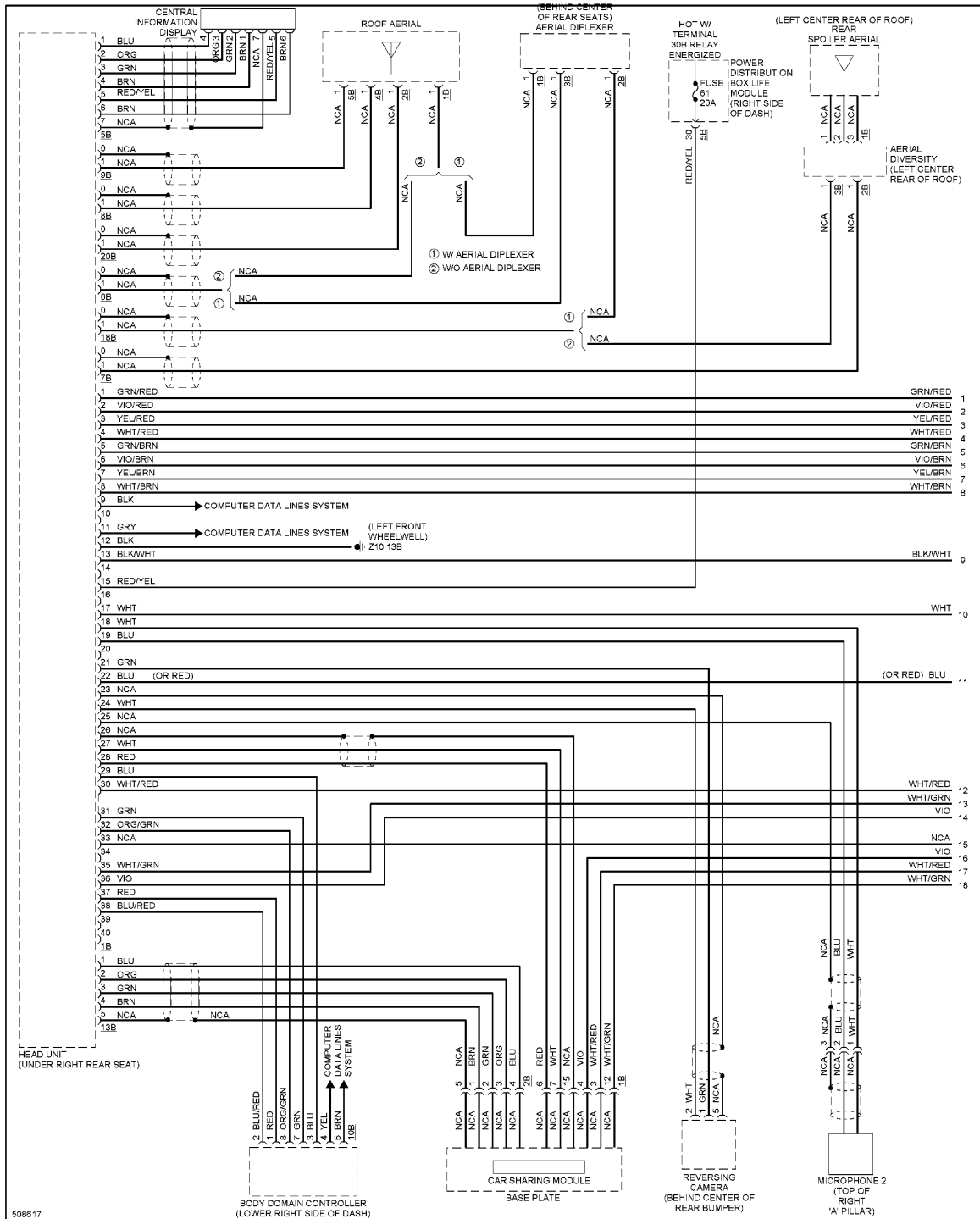




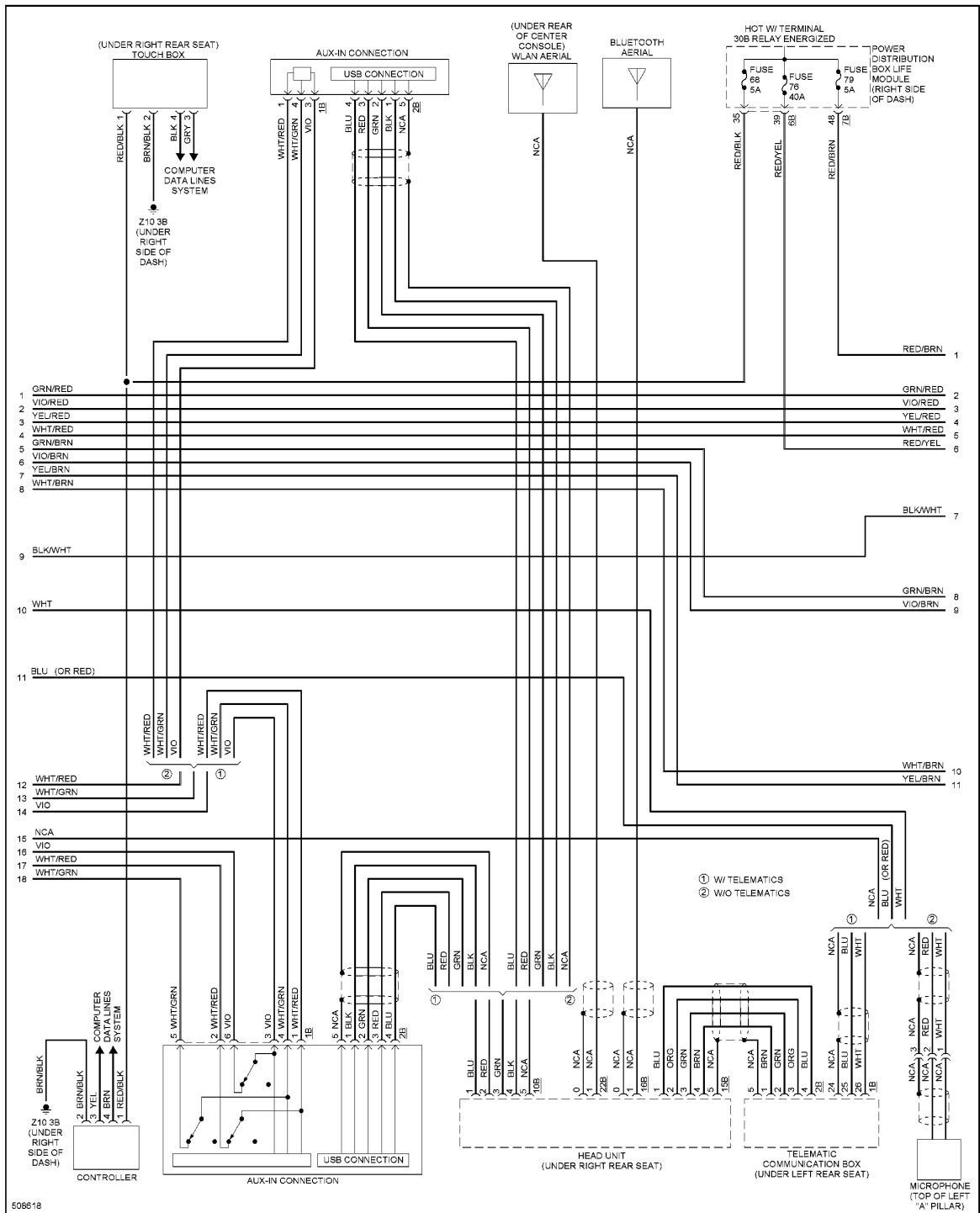
**Fig. 83: Base Radio Circuit (1 of 2)**



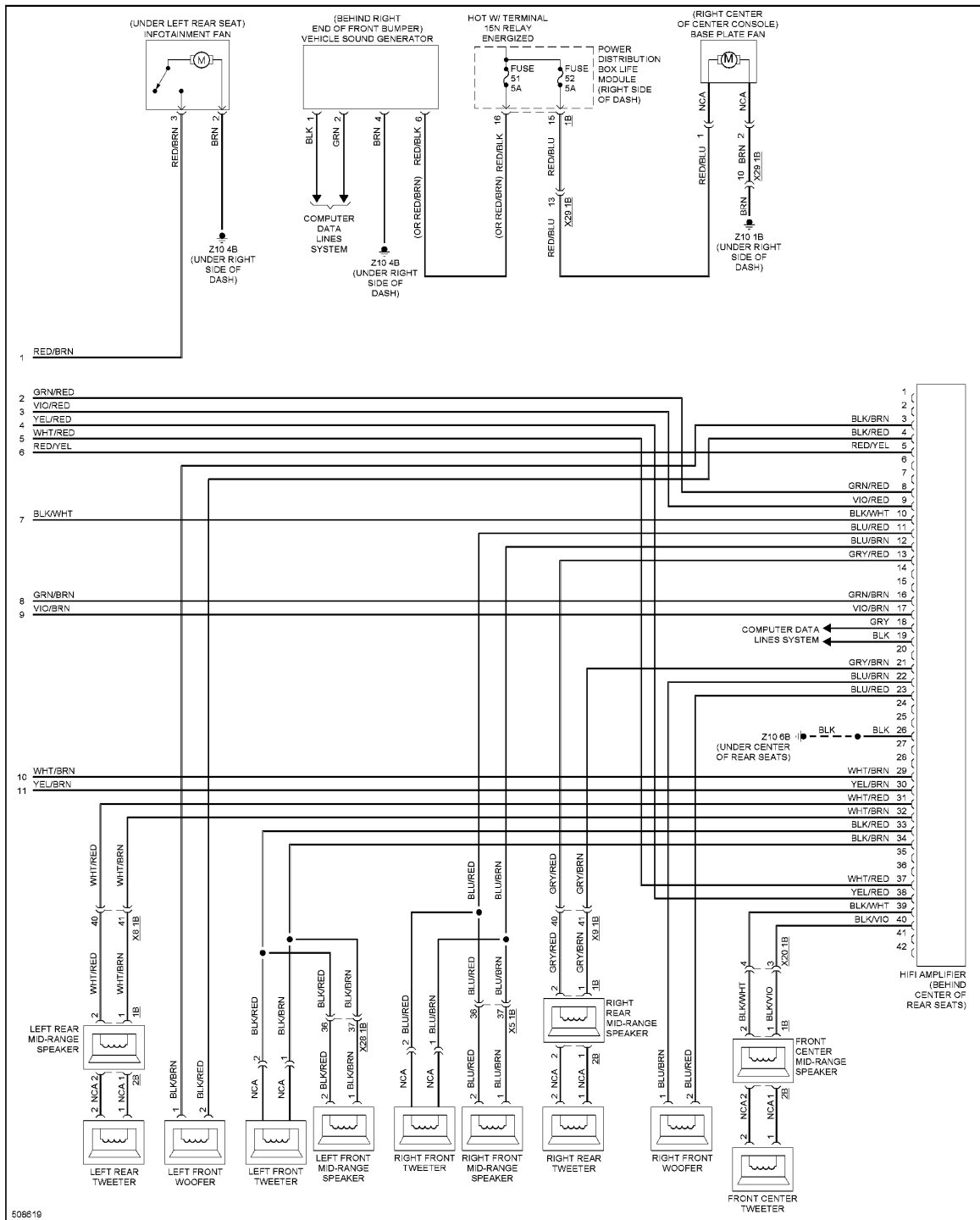
**Fig. 84: Base Radio Circuit (2 of 2)**



**Fig. 85: Hifi Radio Circuit (1 of 3)**

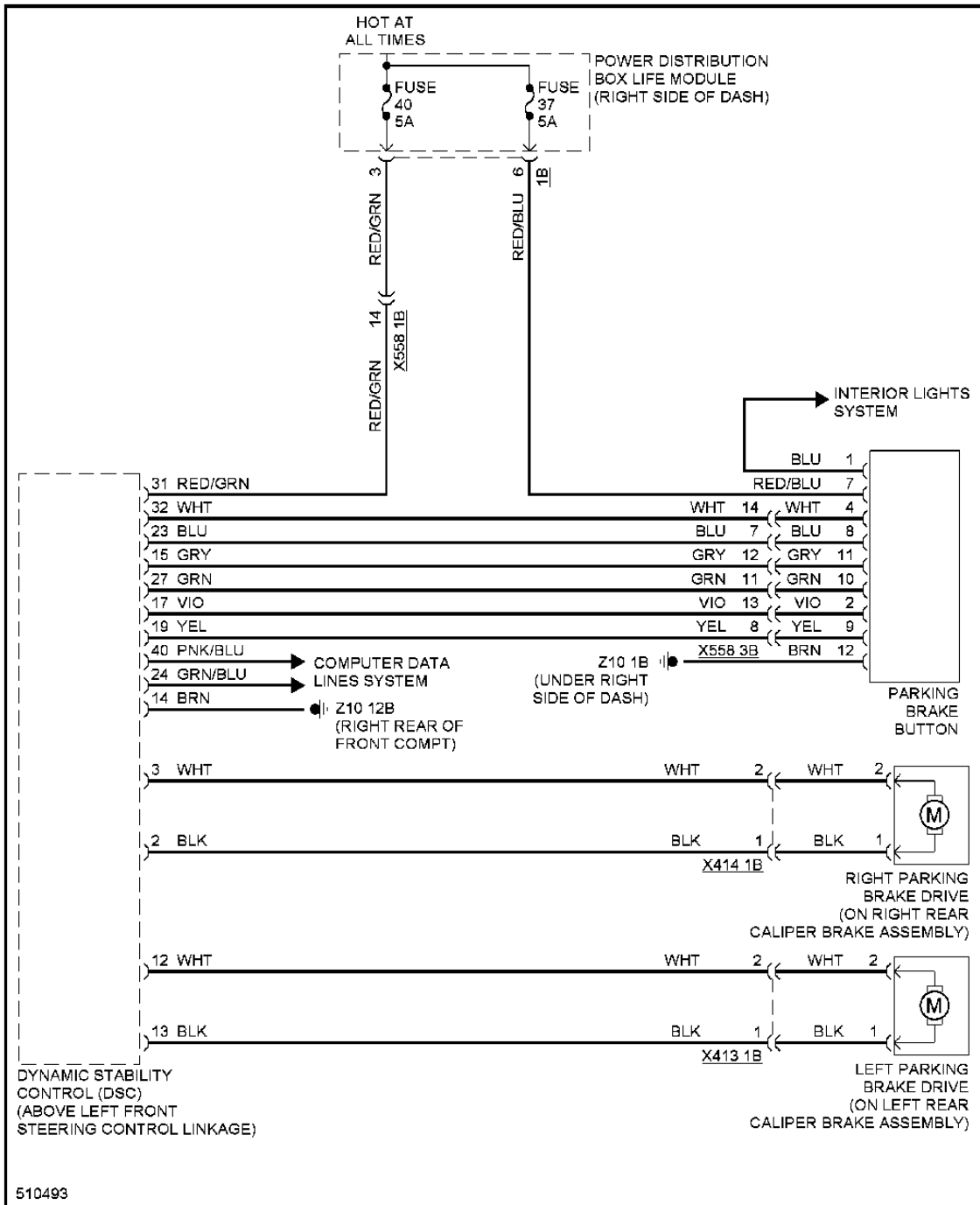


**Fig. 86: HiFi Radio Circuit (2 of 3)**



**Fig. 87: HiFi Radio Circuit (3 of 3)**

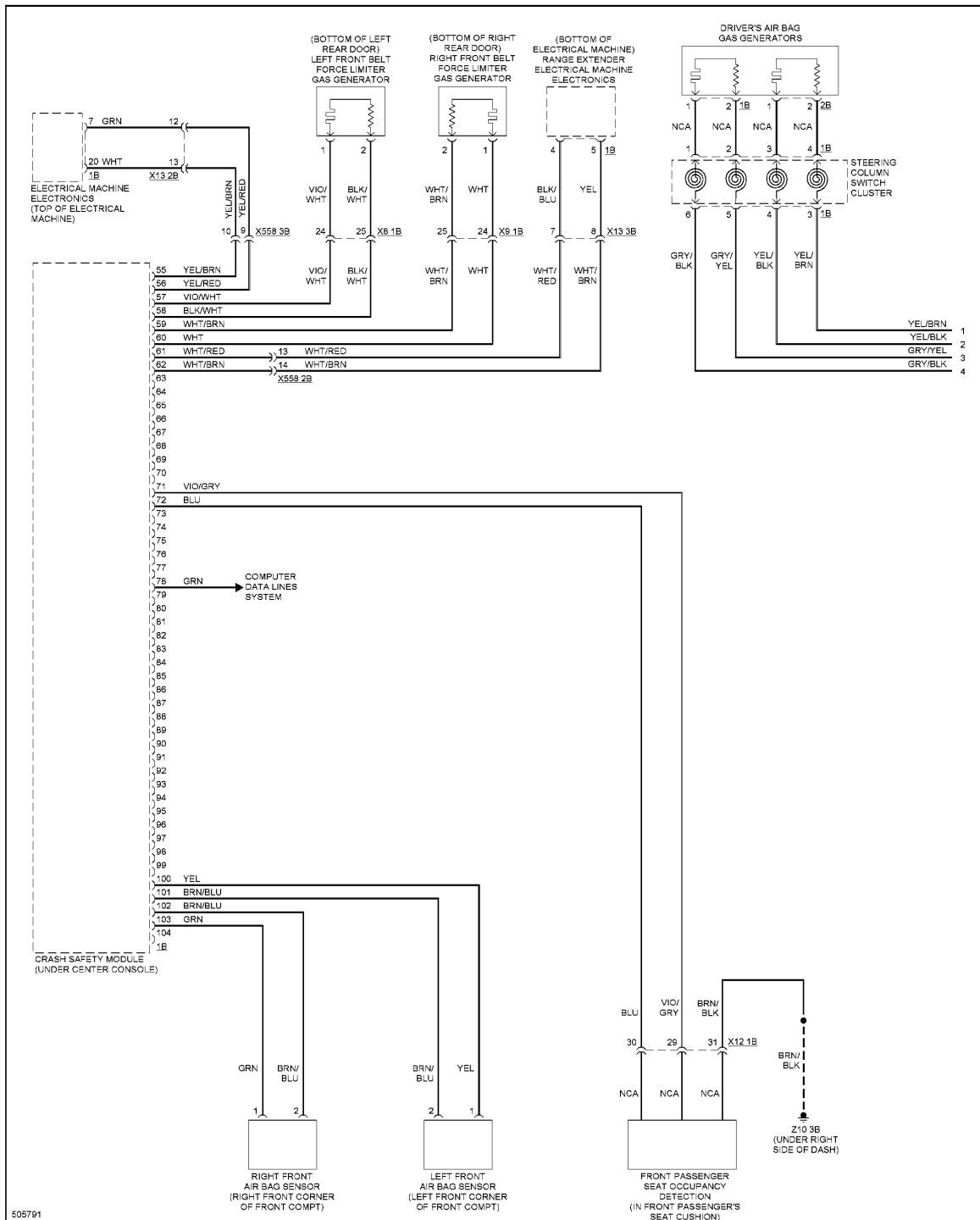
## SHIFT INTERLOCK



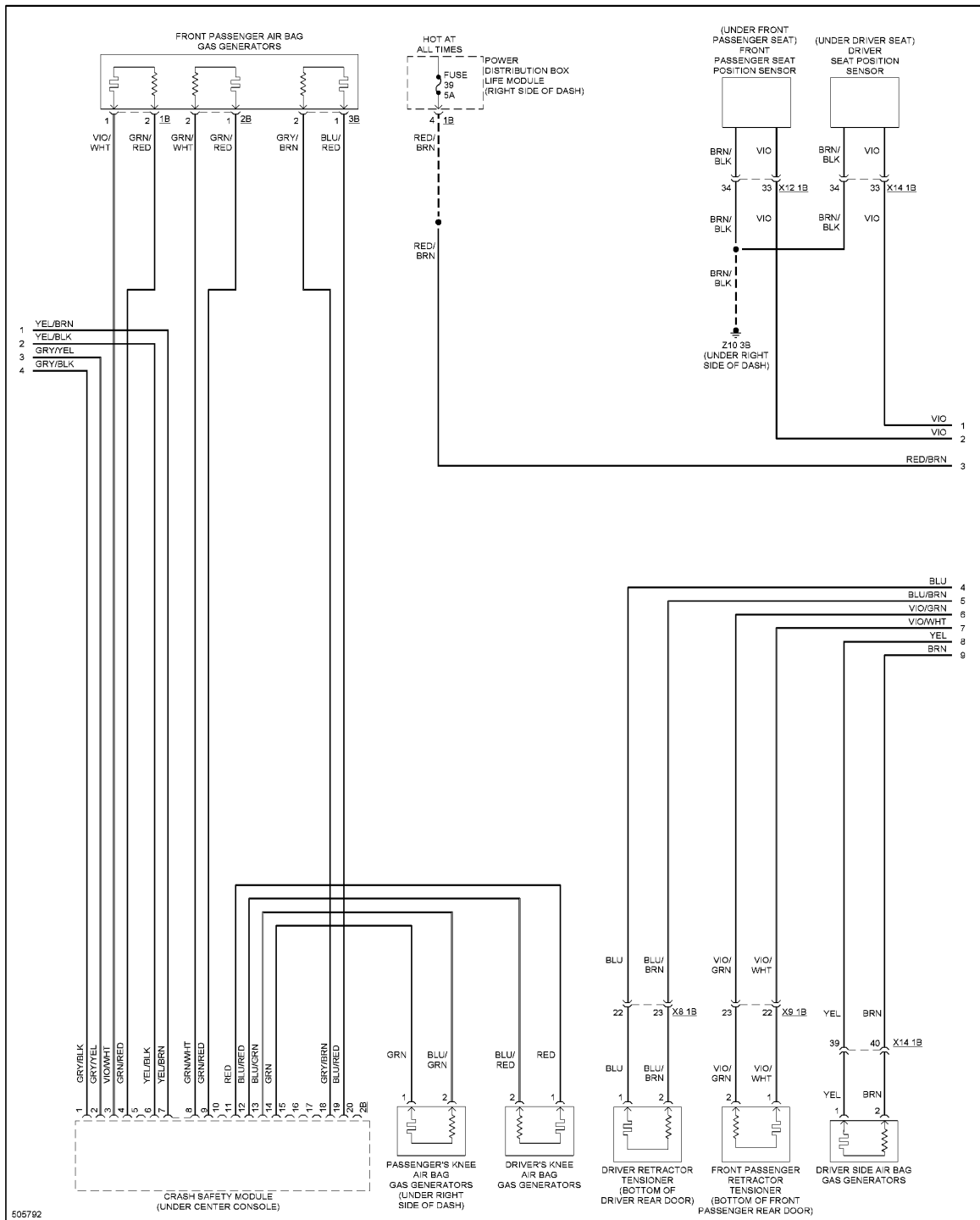
**Fig. 88: Shift Interlock Circuit**

**SUPPLEMENTAL RESTRAINTS**

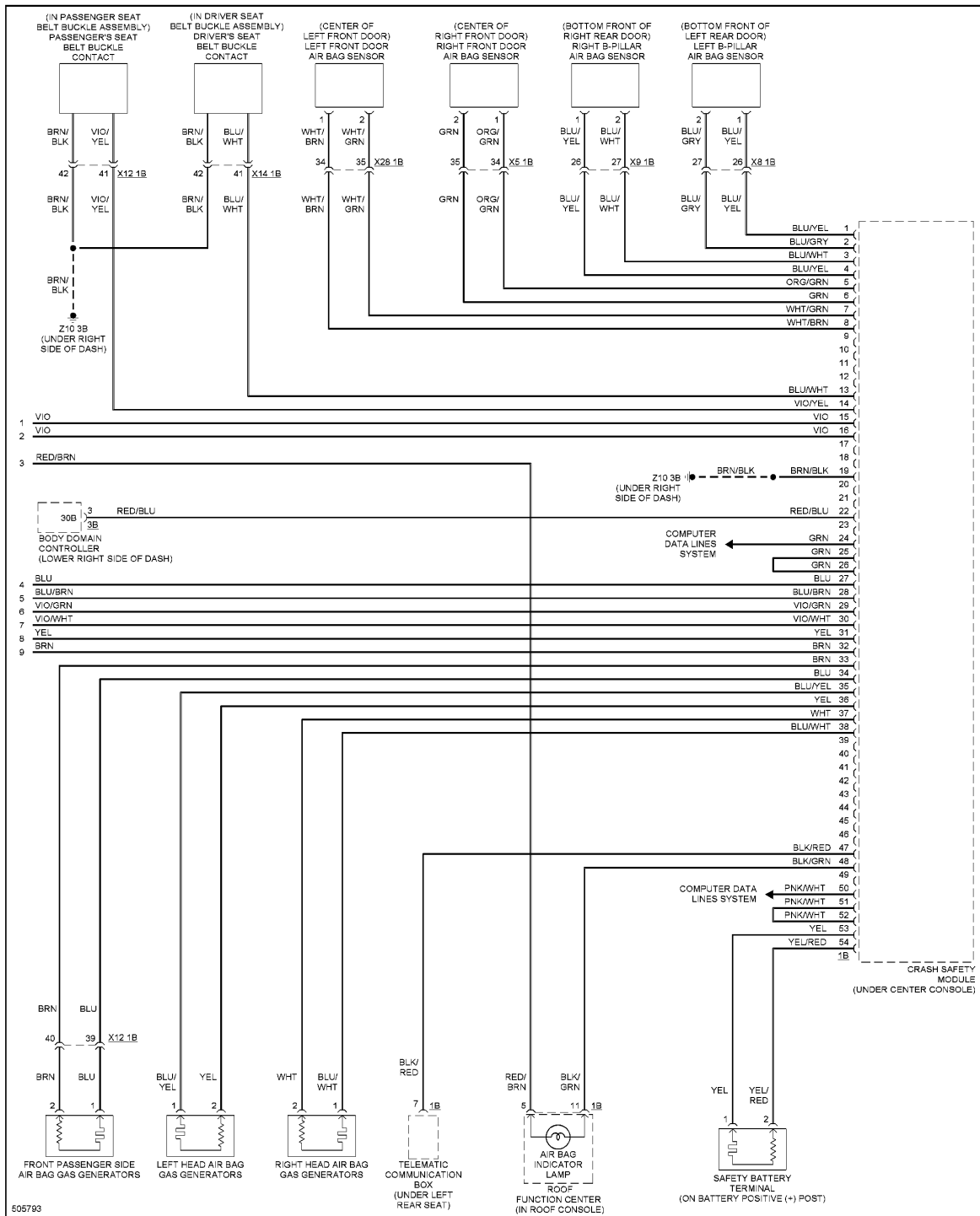




**Fig. 89: Supplemental Restraints Circuit (1 of 3)**

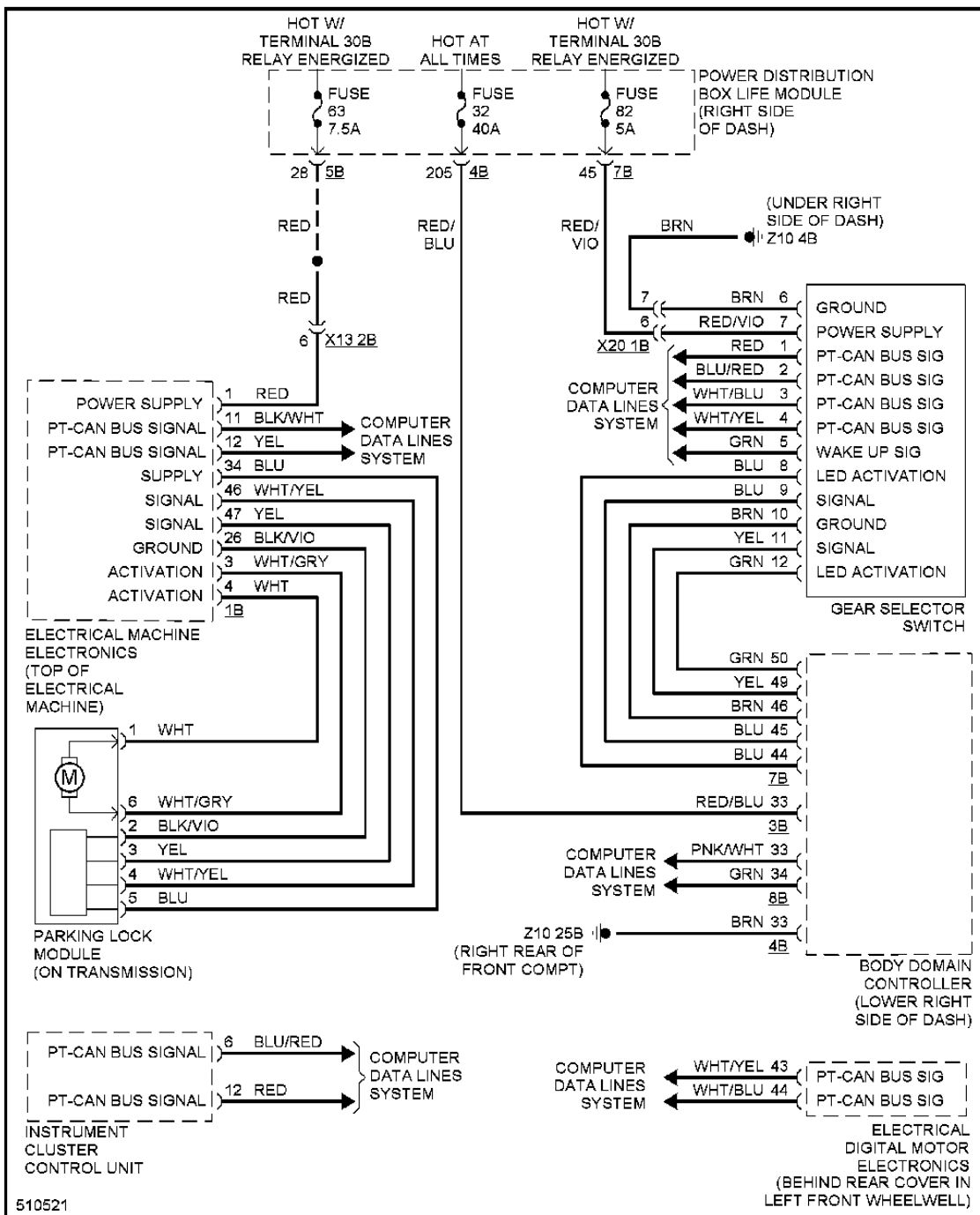


**Fig. 90: Supplemental Restraints Circuit (2 of 3)**



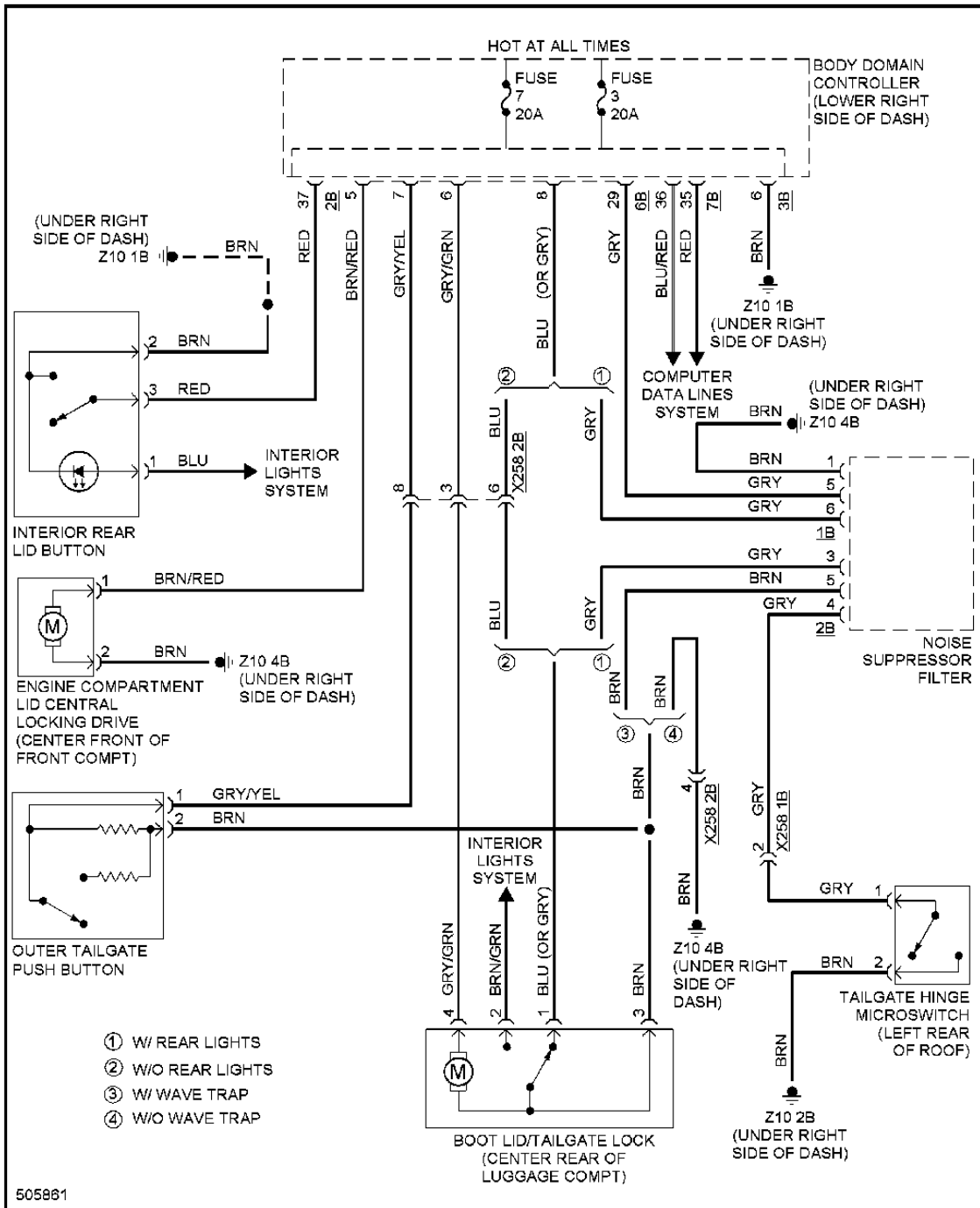
**Fig. 91: Supplemental Restraints Circuit (3 of 3)**

**TRANSMISSION**



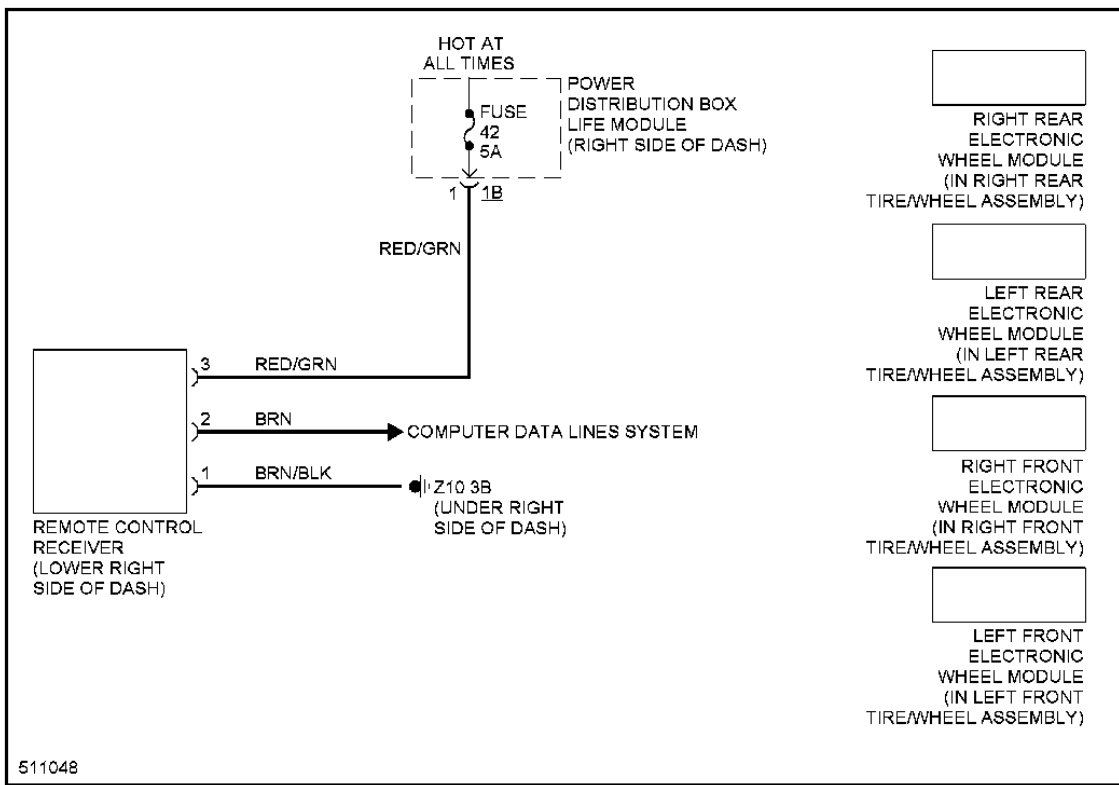
**Fig. 92: Transmission Circuit**

**TRUNK, TAILGATE, FUEL DOOR**



**Fig. 93: Trunk Release Circuit**

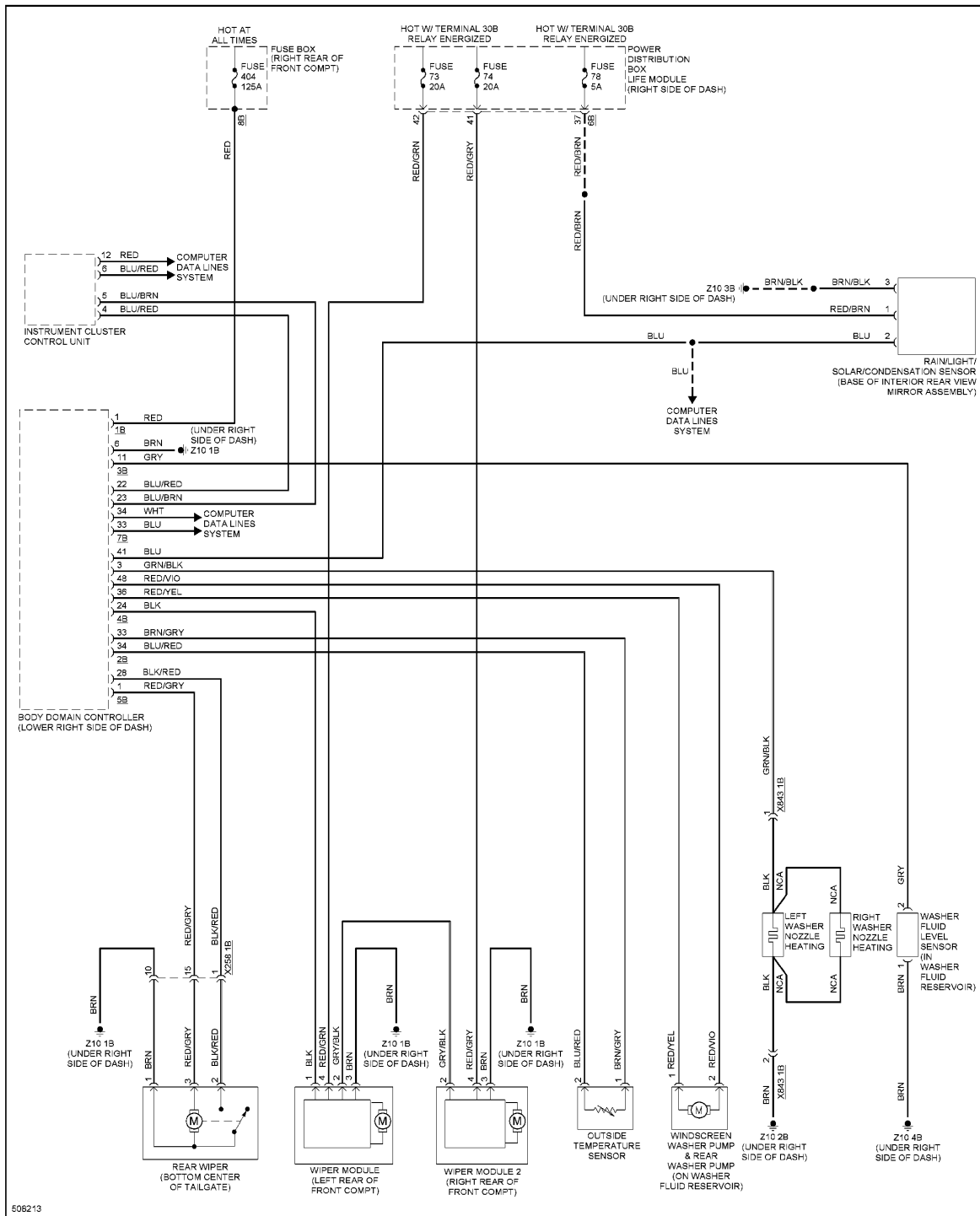
**WARNING SYSTEMS**



**Fig. 94: Warning Systems Circuit**

**WIPER/WASHER**





**Fig. 95: Wiper/Washer Circuit**

## TIRE PRESSURE MONITOR SYSTEMS

BMW - i-Series (I01, I12) - 2014-17

### DESCRIPTION & OPERATION

#### MODEL COVERAGE

**NOTE:** Models in this article belong to the I01 and I12 groups.

#### Models Covered

Model	Year(s)
i3 (I01)	2014-17
i8 (I12)	2014-17

#### TIRE PRESSURE MONITOR (TPM) SYSTEM

**NOTE:** If a tire pressure has been adjusted, or a wheel or tire has been replaced, the TPM or FTM system must be reinitialized. See appropriate tire pressure monitor system under [RESET PROCEDURES](#).

**NOTE:** The current status of the TPMS can be displayed on the Control Display anytime, whether or not the system is active.

**CAUTION:** When a low inflation pressure is indicated, DSC (Dynamic Stability Control) is switched on, if necessary.

Vehicles are equipped with one of either of two types of tire pressure monitor system:

**The Flat Tire Monitor (FTM) system**, which uses the ABS system to measure each tire's rolling radius changes and with it, the rotational speed of the wheels. Changes are detected and signaled as a flat tire. The Flat Tire Monitor (FTM) system does not use tire pressure sensors in the tires.

In the following situations, the system could be delayed or malfunction:

- When the system has not been initialized.
- When driving on snow-covered or slippery road surfaces.
- Sporty driving style: slip in the drive wheels, high lateral acceleration.
- When driving with snow chains.

**The Tire Pressure Monitor (TPM) system**, uses tire pressure sensors installed in the tires to check the tire inflation pressure in the four mounted tires. The system indicates if the tire inflation pressure has dropped considerably in one or several tires.

The system is inactive and cannot indicate a flat tire:

- For a mounted wheel without TPM electronics.
- When the TPM is disturbed by other systems or devices with the same radio frequency.

#### TIRE PRESSURE MONITOR WARNING INDICATORS

**CAUTION:** When a low inflation pressure is indicated, DSC (Dynamic Stability Control) is switched on, if necessary.

#### The Flat Tire Monitor (FTM)

**NOTE:** The Flat Tire Monitor (FTM) is an Indirect TPM system.

If a significant drop in tire pressure is detected, the system will turn on a yellow TPMS warning light, display a warning message on the iDrive Control Display, and sound an acoustic warning signal.

**NOTE:** The current status of the Flat Tire Monitor can be displayed on the Control Display anytime, whether or not FTM is active.

### Tire Pressure Monitor (TPM)

**NOTE:** Tire Pressure Monitor (TPM) is a Direct TPM system.

**CAUTION:** The system is inactive and cannot display a flat tire if a wheel has been mounted without TPM electronics or if TPM experiences temporary interference from other systems or devices that use the same radio frequency.

When a flat tire is detected, the yellow TPMS warning lamp lights up, a message appears on the iDrive Control Display, and signal sounds. If a system malfunction occurs, the yellow warning light flashes and then lights up continuously. The tires are shown in gray on the Control Display and a message is displayed.

**Status display on iDrive Control Display:** The tire and system status is indicated by the color of the tires. TPM takes the fact that the tire pressure changes during driving into account. A correction is only required if the color of the TPM display indicates that it is necessary.

- **Wheels are Green:** The tire pressure matches the learned set state. "Status: TPM active" is displayed on the Control Display.
- **One Wheel is Yellow:** There is a flat tire or a major drop in inflation pressure in the indicated tire. A message appears on the Control Display.
- **All Wheels are Yellow:** There is a flat tire or a major drop in inflation pressure in several tires, system was not reset after a wheel change, or a flat tire in one or more tires while the system is being reset. A message appears on the Control Display.
- **Wheels are Gray:** The system cannot detect a flat tire. Reasons for this can include:
  - TPM is being reset.
  - Temporary interference due to systems or devices that use the same radio frequency.
  - System malfunction.

## TPMS RESET PROCEDURES

**NOTE:** If a tire pressure has been adjusted, or a wheel or tire has been replaced, the TPM or FTM system must be reinitialized. See appropriate tire pressure monitor system below.

**CAUTION:** When a low inflation pressure is indicated, DSC (Dynamic Stability Control) is switched on, if necessary.

## TIRE PRESSURE MONITOR SYSTEM INITIALIZATION

**CAUTION:** When driving with snow chains, DO NOT reset the system.

### The Flat Tire Monitor (FTM)

**NOTE:** The resetting process finishes during driving, which can be interrupted at any time. When driving resumes, resetting is continued automatically.

1. Set the tire pressure of all wheels to specification.
2. On iDrive Control Center, select "VEHICLE INFO", then "VEHICLE STATUS".
3. Select "RESET". The initialization menu appears.
4. Start the engine, but do not begin to drive.

5. Start the Initialization with "PERFORM RESET".

6. Drive vehicle. The initialization is completed during driving. "Status: active" is displayed.

### Tire Pressure Monitor (TPM)

**CAUTION:** The system is inactive and cannot display a flat tire if a wheel has been mounted without TPM electronics or if TPM experiences temporary interference from other systems or devices that use the same radio frequency.

**NOTE:** The reset process finishes during driving, which can be interrupted at any time. When driving resumes, resetting is continued automatically.

1. Set the tire pressure of all wheels to specification.
2. On iDrive Control Center, select "SETTINGS", then "TPM".
3. Select "Reset TPM".
4. Start the engine, but do not begin to drive.
5. Select "PERFORM RESET".
6. Drive vehicle. The tires are shown in gray and "Resetting TPM..." is displayed.
7. After a few minutes of driving, the set tire inflation pressures in the tires are applied as the set values to be monitored. Resetting process is completed automatically while driving. When resetting is completed, the tires in the display turn to green and "TPM Active" is displayed.

**NOTE:** If there is a problem resetting and applying the tire inflation pressures, all tires are shown in yellow on the Control Display, and a message is displayed.

## DISMOUNTING/MOUNTING PROCEDURES

**CAUTION:** The tire should be dismounted from the wheel using the tire changer manufacturer's instructions. Use the following information to avoid damage during the dismounting/mounting procedures.

**NOTE:** If a tire pressure has been adjusted, or a wheel or tire has been replaced,, the TPM system must be reinitialized. See [RESET PROCEDURES](#).

## TIRE PRESSURE SENSOR

### Removal

1. Raise vehicle on a suitable support. Remove tire/wheel assembly from vehicle.
2. Dismount tire from wheel following tire changer manufacturer's instructions while paying special attention to the following to avoid damaging tire pressure sensor:
  - To prevent the pressing-off horn from damaging sensor, do not rest pressing-off horn on both rim sides in the area of the valve.
  - The valve should be approximately 15 cm to the right of the assembly head (to prevent tire iron from damaging sensor).
  - Tire bead must not press onto sensor.

### Installation

1. Mount tire to wheel following tire changer manufacturer's instructions while paying special attention to the following to avoid damaging tire pressure sensor:
  - When the sensor is installed, the rim must not be cleaned with high-pressure cleaning equipment.
  - Visually inspect sensor for external damage and check for tight fit. DO NOT retighten screw and union nut. If one of the valve parts is loose, replace the entire valve.
  - Keep sensor free of tire mounting paste.

- Fit lower tire bead so that no pressure forces are exerted on sensor.
  - Fit upper tire bead so that no pressure forces are exerted on sensor.
2. Install tire/wheel assembly on vehicle. Reinitialize TPM system. See [Tire Pressure Monitor \(TPM\)](#) under TIRE PRESSURE MONITOR SYSTEM INITIALIZATION.

## TORQUE SPECIFICATIONS

### SPECIFICATIONS TABLE

Component	Ft. Lbs. (N.m)
Wheel Nut	89 (119)
	INCH Lbs. (N.m)
Tire Pressure Sensor Nut	35 (4)

---

## TRACTION CONTROL, 4WD, & AWD

### BMW - 1980-19

## TRACTION CONTROL DISABLE

**WARNING:** Placing a non-compatible vehicle on a single-axle dynamometer could result in a safety hazard to technicians and damage to vehicle. Vehicles which use All-Wheel Drive (AWD) or traction control may not be clearly marked. Use common sense and take all necessary precautions when placing any vehicle on the dynamometer. Determine between full-time 4WD and All-Wheel Drive (AWD) for testing purposes. The following tables include information related to full-time 4WD and AWD vehicles, and how to disable the traction control system (if disengageable).

**WARNING:** DO NOT operate vehicle on a 2-wheel dynamometer if the DO NOT TEST column is marked.

### BMW

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
128i & 135i							
2008-13	...	X	...	...	...	X (6)	...
2 Series							
2015-19 (xDrive)	...	...	...	...	X	...	X
2014-19 (RWD)	...	X	...	...	...	X (7)	...
1M							
2011	...	X	...	...	...	X (6)	...
3 Series (Except iX or xi Models, and 335 Models)							
1994-00	...	X	...	...	...	X (1)	...
2001-06	...	X	...	...	...	X (3)	...
2007-13	...	X	...	...	...	X (6)	...
3 Series (iX and xi Models)							
1988-13	...	...	...	...	X	...	X
335i, 335is & 335d							
2007-13	...	X	...	...	...	X (3)	...
3 Series							
2014-19 (xDrive)	...	...	...	...	X	...	X
2014-19 (RWD)	...	X	...	...	...	X (7)	...
4 Series							
2014-19 (xDrive)	...	...	...	...	X	...	X
2014-19 (RWD)	...	X	...	...	...	X (7)	...
5 Series (Except xi Models, and 550 Models)							



Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
1991-95	...	X	...	...	...	X (1)	...
2001-07	...	X	...	...	...	X (1)	...
2008-13	...	X	...	...	...	X (6)	...
5 Series (xi Models)							
2006-13	...	...	...	...	X	...	X
550i (& GT)							
2006-13	...	X	...	...	...	X (6)	...
5 Series							
2014-19 (xDrive)	...	...	...	...	X	...	X
2014-19 (RWD)	...	X	...	...	...	X (7)	...
6 Series (Except xi Models)							
2004-06 (2)	...	X	...	...	...	X (3)	...
2006-10	...	X	...	...	...	X (5)	...
2012-13	...	X	...	...	...	X (7)	...
6 Series (xi Models)							
2012-13	...	...	...	...	X	...	X
6 Series							
2014-19 (xDrive)	...	...	...	...	X	...	X
2014-19 (RWD)	...	X	...	...	...	X (7)	...
7 Series (Except xi Models)							
1991-01	...	X	...	...	...	X (1)	...
2002-06	...	X	...	...	...	X (5)	...
2006-13 (9)	...	X	...	...	...	X (7)	...
7 Series (xi Models)							
2010-13	...	...	...	...	X	...	X
7 Series							
2014-19 (xDrive)	...	...	...	...	X	...	X
2014-19 (RWD)	...	X	...	...	...	X (7)	...
8 Series							
1991-97	...	X	...	...	...	X (1)	...
Active Hybrid Models							
2011-15	...	X	...	...	...	X (7)	...
Alpina							
2007-08	...	X	...	...	...	X (1)	...
2010-19 (AWD)	...	...	...	...	X	...	X
2010-16 (RWD)	...	X	...	...	...	X (7)	...

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
2006-10	...	X	...	...	...	X (5)	...
2019 (B6)	...	...	...	...	X	X	...
2019 (B7)	...	...	...	...	X	X	...
i Series							
2014-19 (i8)	...	...	...	...	X	...	X
2014-19 (i3)	...	X	...	...	...	X (5)	...
M2 Series							
2015-19 (xDrive)	...	...	...	...	X	...	X
2014-19 (RWD)	...	X	...	...	...	X (7)	...
M3							
1995-06	...	X	...	...	...	X (1)	...
2008-09	...	X	...	...	...	X (8)	...
2010-13	...	X	...	...	...	X (6)	...
2015-19	...	X	...	...	...	X (7)	...
M4							
2014-15	...	X	...	...	...	X (7)	...
2016-19	...	X	...	...	...	X	...
M5 & M6							
1991-93	...	X	...	...	...	X (1)	...
2000-03	...	X	...	...	...	X (1)	...
2006-10	...	X	...	...	...	X (5)	...
2013-19	...	X	...	...	...	X (7)	...
M7							
2017-19 (xDrive)	...	...	...	...	X	...	X
X1							
2013-19 (AWD)	...	...	...	...	X	...	X
2013-19 (RWD)	...	X	...	...	...	X (7)	...
X3							
2004-14	...	...	...	...	X	...	X
2015-19 (xDrive)	...	...	...	...	X	...	X
2015-19 (sDrive)	...	X	...	...	...	X (7)	...
X4							
2015-19	...	...	...	...	X	...	X
X5 & X5 M							
2000-19 (AWD)	...	...	...	...	X	...	X
2014-19 (RWD)	...	X	...	...	...	X (7)	...
X6 & X6 M							

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
2008-19 (AWD)	...	...	...	...	X	X	X
2015-19 (RWD)	...	X	...	...	...	X (7)	...
<b>Z3</b>							
1996-00	...	X	...	...	...	X (1)	...
2001-02	...	X	...	...	...	X (1)	...
<b>Z4</b>							
2003-05	...	X	...	...	...	X (1)	...
2006-11	...	X	...	...	...	X (6)	...
2012-16	...	X	...	...	...	X (7)	X
<b>Z8</b>							
2000-03	...	X	...	...	...	X (1)	...

- (1) The Automatic Stability Control (ASC) or Dynamic Stability Control (DSC) switch is located on center console. Indicator/warning light on instrument panel will illuminate when system is disabled.
- (2) The ASC switch is located on left side of dash. Indicator/warning light on instrument panel will illuminate when system is disabled.
- (3) The ASC or Dynamic Stability Control (DSC) switch is located on center console. Indicator/warning light on instrument panel will illuminate when system is disabled. On models with DSC and Automatic Differential Braking (ADB), depress and hold DSC switch button for 3 seconds. The DSC and Yellow brake warning lights will stay illuminated the entire time the ADB, DSC and the Dynamic Brake Control (DBC) systems are switched off.
- (4) Cannot be shifted into 2WD.
- (5) Deactivating DSC automatically deactivates DTC as well. Select "Settings" with controller on control panel. Select "DSC" and confirm. Indicator lamp in Info Display remains on. To reactivate, select "Settings". Select "DSC" and confirm. Indicator lamp goes out.
- (6) Press the DTC button, at the center console, for at least 3 seconds; the indicator lamps for DSC in the instrument cluster light up. Dynamic Traction Control DTC and DSC have been simultaneously deactivated. Push button again to activate.
- (7) Press and hold the DSC OFF button, for not longer than 10 seconds, until the indicator lamp for the DSC lights up in the instrument cluster and DSC OFF is displayed. Push button again to activate.
- (8) Press and hold the DSC OFF button (to the right of the shift lever), for longer than 1 second, until the indicator lamp for the DSC lights up in the instrument cluster. Push button again to activate.
- (9) On 2006 models with iDrive, see footnote 5.

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## TRANSMISSION

Automatic Transmission - Special Tools - All I3 Models - i3

## MANUAL TRANSMISSION

### 234100 MANDREL MINIMUM SET: MECHANICAL TOOLS

**NOTE:** For driving in shaft seal on drive shaft.

#### Storage Location

A54

#### SI number

01 02 05 (173)



**Fig. 1: Identifying Mandrel (234100)**

Courtesy of BMW OF NORTH AMERICA, INC.

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## TRANSMISSION

### Automatic Transmission - Technical Data - All I3 Models - i3

## TRANSMISSION FILLING CAPACITIES

### 27 00 TRANSMISSION FILLING CAPACITIES

#### TRANSMISSION FILLING CAPACITIES I01 SPECIFICATION

Oil grade: refer to <b><u>OPERATING FLUIDS</u></b>	Â	Â
Oil capacity for refilling or exchange transmission	liter	0.5

---

## TRANSMISSION

### Automatic Transmission

## 14.0 AUTOMATIC TRANSMISSION FLUID FOR ZF-TRANSMISSION GA8HP45Z / GA8HP50Z / GA8HP70Z / GA8HP90Z / GA8P70H / GA8P75H / GA8HP75Z

**NOTE:** The automatic transmissions have a life-time oil filling. These transmissions require no oil change for their entire service life.

The approved lifetime fluid must be used after repairs on the transmission or transmission oil cooler.

### Attention!

The lifetime oil must not be mixed with or replaced by other types of automatic transmission fluid as this will cause transmission failure.

**Exception:** Shell ATF oil L12108 may be mixed with ATF-3.

Trade name	BMW part number	Container size
ATF oil Shell L12108*	83 22 2 152 426	20 liters

\*Can be substituted by the lifetime oil specified below.

Trade name	BMW part number	Container size
ATF-3+	83 22 2 289 720	1 liter

The lifetime fluids ATF-3 and ATF-3+ can be mixed with each other.

Date: 07/2015

## 1.0 GENERAL INFORMATION ON AUTOMATIC TRANSMISSION FLUIDS

Automatic Transmission Fluid was developed especially for automatic transmissions. It requires additives which are carefully matched with each other, a high viscosity index and a solidification point below  $-40^{\circ}\text{F}/-40^{\circ}\text{C}$ .

Friction behavior of Automatic Transmission Fluid in plate-type clutches under very different operating conditions is extremely important. Other important factors are:

- Wear protection
- Oil film shear resistance
- Adhesive property
- Oxidation resistance
- Corrosion inhibition
- Sludge prevention
- Temperature-dependent viscosity changes
- Compatibility with sealing materials.

## 2.0 OIL ADDITIVES

Automatic transmissions are designed so that oil additives are not necessary. BMW disapproves the use of any oil additives and cannot accept the liability for any consequential damage which results from



using oil additives.

## **3.0 APPROVED AUTOMATIC TRANSMISSION FLUIDS FOR INITIAL FILLINGS AND CORRECTING FLUID LEVELS**

### **3.1 GM TRANSMISSIONS**

#### **USE OF ANY OTHER OIL WILL CAUSE A NON WARRANTABLE TRANSMISSION FAILURE**

**\*Transmission identification plate can be utilized to determine proper transmission fitted in vehicle**

#### **Dexron® Fluid Compatibility**

Dexron® III and Dexron® VI are fully compatible. Any transmission that requires a Dexron® III fluid can also use the Dexron® VI fluid. However a vehicle that uses the Dexron® VI fluid exclusively should not have Dexron® III installed.

BMW Part No. 83 22 2 163 514 - Automatic Transmission Fluid Dexron VI (1 L 6 Pack)

BMW Part No. 83 22 0 397 114 - Automatic Transmission Fluid Dexron VI (4 L 4 Pack)

\*Or all reputable brand name Automatic Transmission Fluids of the Dexron® III or VI formulation

#### **A4S 270R (THM-R1W)**

##### **E36**

318i/is/iC/ti from 1996 to 1999 production

323i/is/iC from 1998 to 1999 production

328i/is/iC from 1996 to 1998 production

Z3 1.9 from 1996 to 1999 production

Z3 2.3/2.8 from 1997 to 2000 production

BMW Part No. 83 22 2 163 514 - Automatic Transmission Fluid Dexron VI (1 L 6 Pack)

BMW Part No. 83 22 0 397 114 - Automatic Transmission Fluid Dexron VI (4 L 4 Pack)

\*Or all reputable brand name Automatic Transmission Fluids of the Dexron® III or VI formulation

##### **E39**

528i/iT from 1997-1999 production

BMW Part No. 83 22 2 163 514 - Automatic Transmission Fluid Dexron VI (1 L 6 Pack)

BMW Part No. 83 22 0 397 114 - Automatic Transmission Fluid Dexron VI (4 L 4 Pack)

\*Or all reputable brand name Automatic Transmission Fluids of the Dexron® III or VI formulation

#### **A4S 310R (THM-R1)**

##### **E34**

525i from 1990 to 1995 production

BMW Part No. 83 22 2 163 514 - Automatic Transmission Fluid Dexron VI (1 L 6 Pack)

BMW Part No. 83 22 0 397 114 - Automatic Transmission Fluid Dexron VI (4 L 4 Pack)

\*Or all reputable brand name Automatic Transmission Fluids of the Dexron® III or VI formulation

### **E36**

318i/is/iC/ti from 1992 to 1995 production

325i/is/iC from 1992 to 1995 production

BMW Part No. 83 22 2 163 514 - Automatic Transmission Fluid Dexron VI (1 L 6 Pack)

BMW Part No. 83 22 0 397 114 - Automatic Transmission Fluid Dexron VI (4 L 4 Pack)

\*Or all reputable brand name Automatic Transmission Fluids of the Dexron® III or VI formulation

### **A5S 360R (GM5)**

#### **E46**

323i/Ci/Cic from 6/98 to 3/00 production

323iT from 1/00 to 3/01 to production

328i/Ci/Cic from 6/98 to 3/01 production

The transmission oil pan will be labeled with either Texaco ETL - 7045 or Dexron® III; fill or top off with the proper fluid only. Do not mix Texaco ETL - 7045 and Dexron® III fluids.

### **A5S 390R (GM5)**

#### **E46**

330xi from 6/00 production to present

325xiT from 9/00 production to present

#### **E53**

X5 3.0 from 8/03 production to present

#### **E83**

X3 2.5, 3.0 from 8/03 production to present

The transmission oil pan will be labeled with either Texaco ETL - 7045 or Dexron® III; fill or top off with the proper fluid only. Do not mix Texaco ETL - 7045 and Dexron® III fluids.

### **GA6L45R (GM6)**

#### **E82**

128i from 12/07 production to present

#### **E83**

X3 LCI from 9/06 production to present

#### **E88**

128i from 12/07 production to present

#### **E90**

328Xi from 9/06 production to present

#### **E91**

328Xi from 9/06 production to present

No subsequent transmission fluid changes are necessary.

Utilizes a long life filling of Automatic Transmission Fluid

BMW Part No. 83 22 2 163 514 - Automatic Transmission Fluid Dexron VI (1 L 6 Pack)

BMW Part No. 83 22 0 397 114 - Automatic Transmission Fluid Dexron VI (4 L 4 Pack)

\*Or all reputable brand name Automatic Transmission Fluids of the Dexron® VI formulation

### **GA7AHSCD (Active Hybrid Transmission)**

#### **E72**

Active Hybrid X6, produced from 10/2009 to 03/2010

Utilizes a long life filling of Automatic Transmission Fluid

BMW Part No. 83 22 2 163 514 - Automatic Transmission Fluid Dexron VI (1 L 6 Pack)

BMW Part No. 83 22 0 397 114 - Automatic Transmission Fluid Dexron VI (4 L 4 Pack)

\*Or all reputable brand name Automatic Transmission Fluids of the Dexron® VI formulation

## **3.2 ZF TRANSMISSIONS**

### **USE OF ANY OTHER OIL WILL CAUSE A NON WARRANTABLE TRANSMISSION FAILURE**

**\*Transmission identification plate can be utilized to determine proper transmission fitted in vehicle**

#### **ZF 3HP22, 4HP22, 4HP24**

Utilizes Castrol TQ or Texaco Havoline Automatic Transmission Fluids of the Dexron® III formulation. Never mix any other oil with this transmission fluid when doing repairs or topping up.

#### **A5S 310Z (5HP18)**

#### **E36**

M3 from 1995 to 1999 production

Utilizes a long life filling of synthetic transmission fluid, ESSO LT 71141, no subsequent transmission fluid changes are necessary. Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 71141, BMW Part No. 83 22 9 407 807.

#### **E34**

530i/iT from 1993 through 1995 production

Utilizes Castrol TQ or Texaco Havoline Automatic Transmission Fluids of the Dexron® III formulation. Never mix any other oil with this transmission fluid when doing repairs or topping up.

#### **A5S325Z (5HP19)**

#### **E46**

323i/Ci/Cic from 3/00 to 8/00 production

325iT from 4/01 production to present

330i/Ci/Cic from 6/00 production to present

325i/Ci/Cic from 9/00 production to present

No subsequent transmission fluid changes are necessary. Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 71141, BMW Part No. 83 22 9 407 807.

### **E39**

525i/iT from 3/01 production to present

530i from 3/01 production to present

No subsequent transmission fluid changes are necessary. Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 71141, BMW Part No. 83 22 9 407 807.

### **E85**

Z4 3.0 M54 from 9/02 production to present

Z4 2.5 M54 from 9/02 production to present

No subsequent transmission fluid changes are necessary. Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 71141, BMW Part No. 83 22 9 407 807.

### **A5S 440Z (5HP24)**

### **E31**

840Ci from 9/96 to the present

No subsequent transmission fluid changes are necessary. Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 71141, BMW Part No. 83 22 9 407 807.

### **E38**

740i/iL from 1/97 production to present

No subsequent transmission fluid changes are necessary. Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 71141, BMW Part No. 83 22 9 407 807.

### **E39**

540i/iT from 1/97 production to present

No subsequent transmission fluid changes are necessary. Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 711 41, BMW Part No. 83 22 9 407 807.

### **E53**

X5 4.4i from 9/99 production to present

X5 4.6i from 9/01 production to present

No subsequent transmission fluid changes are necessary. Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 711 41, BMW Part No. 83 22 9 407 807.

## A5S 560Z (5HP30)

### E31

840Ci equipped with M60 engine

Utilizes a lifetime fill of transmission fluid, no subsequent oil changes are necessary on this transmission. If transmission fluid is required for repair purposes, use only the oil approved for this transmission. It is not permitted to mix this oil with other grades of transmission fluid.

Shell LA 2634, BMW Part No. 83 22 9 407 765.

### E31

840Ci equipped with M62 engine

850Ci equipped with M73 Engine

Utilizes lifetime fill of transmission fluid, no subsequent transmission fluid changes are necessary.

Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 711 41, BMW Part No. 83 22 9 407 807.

### E32

740i/iL from 1993 through 1994 production

Utilizes a lifetime fill of transmission fluid, no subsequent oil changes are necessary on this transmission. If transmission fluid is required for repair purposes, use only the oil approved for this transmission. It is not permitted to mix this oil with other grades of transmission fluid.

Shell LA 2634, BMW Part No. 83 22 9 407 765.

### E34

540i/iT from 1993 through 1995 production

Utilizes a lifetime fill of transmission fluid, no subsequent oil changes are necessary on this transmission. If transmission fluid is required for repair purposes, use only the oil approved for this transmission. It is not permitted to mix this oil with other grades of transmission fluid.

Shell LA 2634, BMW Part No. 83 22 9 407 765.

**Effective with model year 1995 and later:**

### E31

850Ci from 10/94 to 6/97 production

840Ci from 12/95 to 8/96 production

Utilizes lifetime fill of transmission fluid, no subsequent transmission fluid changes are necessary.

Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 711 41, BMW Part No. 83 22 9 407 807.

### E38

750iL from 1/95 production to present

740i/iL from 7/94 to 12/96 production

Utilizes lifetime fill of transmission fluid, no subsequent transmission fluid changes are necessary.

Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 711 41, BMW Part No. 83 22 9 407 807.

### **E39**

540i/iT from 3/96 to 12/96 production

Utilizes lifetime fill of transmission fluid, no subsequent transmission fluid changes are necessary.

Never mix any other oil with this transmission fluid when doing repairs or topping up.

ESSO LT 711 41, BMW Part No. 83 22 9 407 807.

### **GA6HP19Z**

#### **E60/61**

525i, 530i from 8/03 production to present

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

#### **E82/E88**

135i All

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

#### **E84**

All with 3.5i

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

#### **E85/E86**

Z4 with N52K All

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

#### **E89**

All with 3.0i

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.



## E90/91/92

325i, 328i, 330i, 335i, All

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

## GA6HP19ZTU

### E70

3.0i from start production to present

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

### E71

X6 xDrive35i

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

## GA6HP26Z

### E60

545i from 8/03 production to present

550i All

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

### E63, E64

645Ci, 645CiC from start of production to present

650Ci, 650CiC All

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

### E65

745i from 11/2001 production to present

750i All

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing

repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

#### **E66**

745Li from 3/2002 production to present

750Li All

760Li from 9/2002 production to present

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

#### **E70**

X5 4.8i from start production to present

X5 3.5D from start of production to present

X5M from start of production to present

#### **E71**

X6 xDrive50i from start production to present

X6M from start of production to present

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

#### **F01, F02 with N63 Engine**

750i, 750Li, 760i, 760Li from start production to present

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-1375.4, BMW Part No. 83 22 0 142 516.

#### **GA8HP45Z**

#### **E84 with N20 engine**

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

#### **E89 with N55 engine**

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

#### **F06, F12 and F13 with N55 engine**

The transmission fluid has a Condition Based Service interval of approximately 100, 000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up. Shell M-L12108, BMW Part No. 83 22 2 152 426

#### **F10 with N20, N52T and N55 engines**

528i and 535i from start of production to present

The transmission fluid has a Condition Based Service interval of approximately 100, 000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

#### **F25 with N52T and N55 engines**

2.8iX and 3.5iX from start of production to present

The transmission fluid has a Condition Based Service interval of approximately 100, 000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

#### **F30 and F31 with N20, N26, N52T and N55 engines**

328i and 335i from start of production

The transmission fluid has a Condition Based Service interval of approximately 100, 000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

#### **GA8HP70Z**

#### **F01, F02 with N63TU engine**

The transmission fluid has a Condition Based Service interval of approximately 100, 000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

#### **E70**

X5 xDrive50i from start of production

The transmission fluid has a Condition Based Service interval of approximately 100, 000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

#### **E71**

X6 xDrive50i from start of production

The transmission fluid has a Condition Based Service interval of approximately 100, 000 miles; refer to [\*\*S.I. B00 07 02\*\*](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

## F04

Hybrid 7 from start of production to present

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

## F07

550i Gran Turismo from start production to present

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

## F06, F10, F12 and F13 with N63TU engine

550i from start of production to present

The transmission fluid has a Condition Based Service interval of approximately 100,000 miles; refer to [S.I. B00 07 02](#) for further information. Never mix any other oil with this transmission fluid when doing repairs or topping up.

Shell M-L12108, BMW Part No. 83 22 2 152 426

## 4.0 CHECKING TRANSMISSION FLUID LEVEL

Due to the substantial expansion of transmission fluid when heated it is only possible to measure the oil level correctly at specified oil temperatures (after driving a distance of about 12 mi./20 km).

### ZF 3HP AND 4HP

Due to the substantial expansion of transmission fluid when heated it is only possible to measure the oil level correctly at specified oil temperatures (after driving a distance of about 12 mi./20 km).

### A5S 560Z, A5S440Z, GA6HP19Z, GA6HP26Z, GA6HP26Z, GA8HP70Z A5S325Z, A5S 310Z

All 5, 6 and 8 speed transmissions require the fluid to be checked when fluid temperature is between 30-50°C using DIS Plus or GT1. Do not check fluid level after temperature has exceeded 50°C Celsius.

### A4S 270R, A4S 310R, A5S 360R, GA6L45R

#### Fluid Level Checking Procedure for all Transmissions without a Dipstick:

1. The transmission temperature must be between 30°C and 50°C before checking can begin. Use the DIS or the MODIC to determine the transmission temperature.
2. The vehicle must be level and without load. With the engine running, switch on the air conditioning. This will increase the idle speed and ensure that all oil passages in the transmission are filled with oil.
3. Step on the brake firmly, apply parking brake fully and move the selector lever through each gear position, pausing briefly in each gear.
4. With the engine running and the selector lever in Park position, remove the filler plug located on the transmission (see illustration for location). If a small stream of oil runs out, the fluid level is correct.
5. If no oil runs out when the filler plug is removed, the fluid level is too low. Add oil until it starts to overflow.
6. With the engine running, reinstall the oil filler plug and tighten.

## **8HP TRANSMISSION: FLUID LOSS FROM COOLER LINE CONNECTIONS - FROM SERVICE BULLETIN SI B24 02 15 (6/2015)**

Applies to the following models with N20, N26, or N55 engine and 8HP transmission:

- E84 (X1)
- E89 (Z4)
- F22 (2 Series Coupe)
- F23 (2 Series Convertible)
- F30 (3 Series Sedan)
- F31 (3 Series Sports Wagon)
- F32 (4 Series Coupe)
- F33 (4 Series Convertible)
- F34 (3 Series Gran Turismo)
- F36 (4 Series Gran Coupe)

### **Situation:**

There is a transmission fluid leak in the area around the oil cooler lines (on the transmission side).

### **Cause:**

Damaged o-rings due to unfavorable cooling line connection tolerances.

### **Procedure:**

Verify that the transmission fluid leak originates from the cooling lines area.

If so, replace the o-rings and the cooling lines.

Only replacing the o-rings may cause a repeat failure.

## **E70, E71, F25: OIL LEAK FROM TRANSFER CASE - FROM SERVICE BULLETIN SI B24 01 13 (3/2013)**

Applies to the following models:

- E70
- E71
- F25

### **Situation:**

Oil is leaking from the transmission area, or oil seepage is noticed from the transmission/transfer case area during a service.

### **Cause:**

The leak can be misdiagnosed as a transmission fluid leak from either the mechatronics sleeve or transmission oil pan. The leak is actually coming from the transfer case (input or output shaft seal).

### **Procedure:**

Before attempting to perform any repairs, check the fluid level in both the transmission and transfer case.

If the level is low in the transfer case, repair as necessary.

## 5.0 TRANSMISSION FLUID CHANGE INTERVALS (IF APPLICABLE)

Refer to applicable Service and Maintenance Checklist for each vehicle.

### CONDITION BASED SERVICE (APPLIES TO CERTAIN VEHICLES ONLY) - SERVICE BULLETIN SI B 00 07 02 (2/2009)

**NOTE:** This Service Information bulletin supersedes SI B00 07 02 dated November 2007.

#### SUBJECT

Condition Based Service

#### MODEL

All models with Condition Based Service

#### SITUATION

This information is intended to provide a general system overview of Condition Based Service (CBS), which is an advanced development of the previous Service Interval Indicator systems.

CBS measures, monitors and determines the required maintenance of several service items independently of each other. This technology prompts the customer to bring the vehicle in for service whenever one of the CBS items requires maintenance or replacement. CBS strikes a compromise between too frequent maintenance intervals and too rigid service intervals that call for the replacement of service items that may still have substantial remaining useful life. CBS also details the recommended, due, and overdue required maintenance during and after the BMW Vehicle Maintenance Program Agreement.

For details of CBS service items and maintenance intervals, refer to the relevant vehicle Owner's Manual.

#### SERVICE RECOGNITION

The vehicle recognizes when a service is required using the following three methods:

- A. **Adaptive**, using sensor technology and algorithms to determine the required maintenance of a service item depending upon the individual customer driving style. For example:

Oil change is determined from the engine oil condition sensor which monitors the oil condition, oil level, and oil temperature, and from additional algorithms using these parameters: engine load, fuel consumption, time and distance since the last oil change.

Microfilter replacement (dependent on vehicle model and CBS version).

Replacements of front and rear brake pads are determined from 2-stage brake lining wear sensors located on the left front and right rear brake pads, and from residual wear algorithms using these input parameters: travel distance, wheel speed, braking pressure, braking time, and braking frequency.

- B. **Fixed Time** (months) to determine the required maintenance of a service item. For example:

Brake Fluid and Engine Coolant changes.

State Safety and Emissions Inspections.

- C. **Fixed Distance** (miles) to determine the required maintenance of a service item. For example:

Vehicle Check.

Spark plug replacement (dependent on vehicle model and CBS version)

State Safety and Emissions inspections



D. **Connected to Oil Service** , based on which oil service being performed. For example:

Spark plug replacement (dependent on vehicle model and CBS version)

Air filter

Automatic transmission fluid

Microfilter replacement (dependent on vehicle model and CBS version)

### **SERVICE INDICATION (EXCEPT E65 AND E66)**

The service indicators are displayed in two possible locations inside the vehicle:

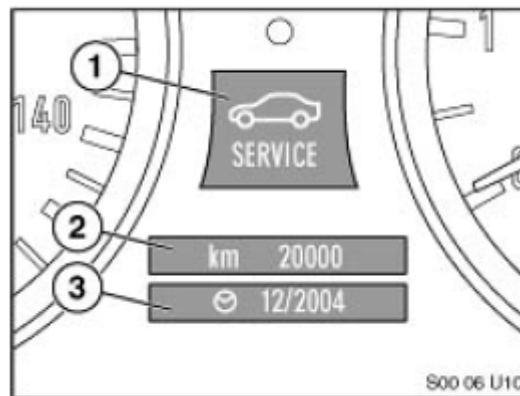
#### **1. Instrument Cluster**

The Instrument Cluster CBS display uses two separate displays:

- A colored symbol in the **center upper display**:
  - Orange for normal
  - Yellow for service due
  - Red for service overdue
- The remaining distance display is in the center lower display.

**Fig. 1** shows the CBS Display in the Instrument Cluster.

1. (1) The CBS symbol in center upper display
2. (2) The remaining distance display in the center lower display
3. (3) The Next Service Due date information in the center lower display



**Fig. 1: CBS Display In Instrument Cluster**

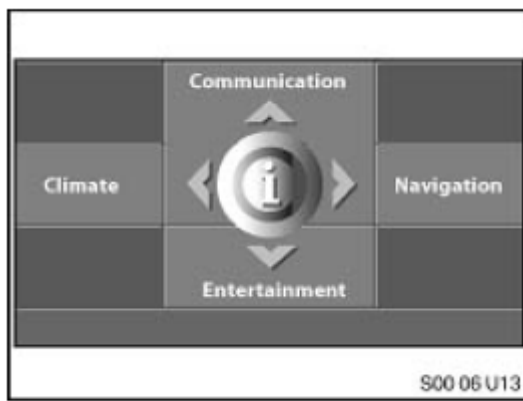
Courtesy of BMW OF NORTH AMERICA, INC.

#### **2. Central Information Display (CID)**

For vehicles with a CID, the CID can display all information on the individual service operations. The CBS functions are stored in the "Settings" menu item and can be used exclusively for individual user settings.

Press the controller down in the main menu and the "Settings" menu will appear.

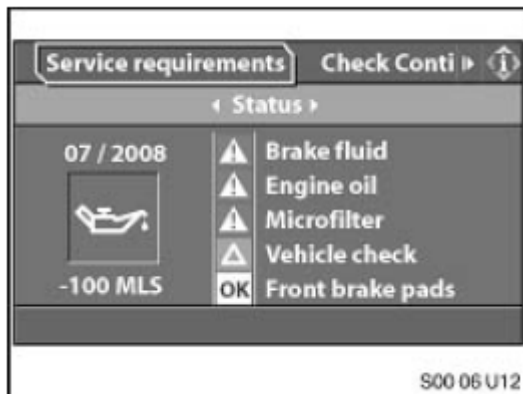
Turn the controller until "Service" is highlighted, then press to activate the CBS menu.



**Fig. 2: Central Information Display - Settings Menu**  
 Courtesy of BMW OF NORTH AMERICA, INC.

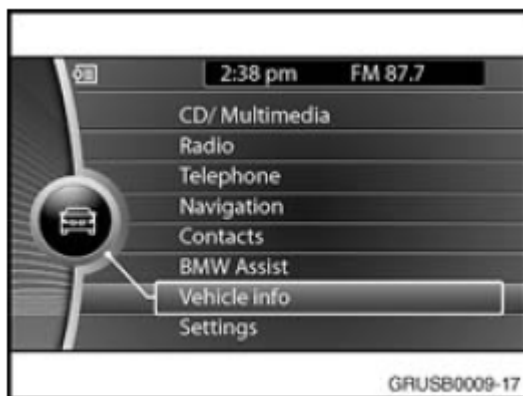
The CBS menu window will appear and is divided into the following control and display fields:

- Status bar
- First menu bar
- Second menu bar
- Display field for CBS symbol
- Display field for service operation.



**Fig. 3: Central Information Display - CBS Menu**  
 Courtesy of BMW OF NORTH AMERICA, INC.

For vehicles with a CIC (Car Information Computer): from the start screen, select Vehicle Info / Vehicle status / Service required.



**Fig. 4: Central Information Display - Select Vehicle Info**  
 Courtesy of BMW OF NORTH AMERICA, INC.

The Service required screen displays all the maintenance items and their current status.



**Fig. 5: Central Information Display - Service Required Screen**  
 Courtesy of BMW OF NORTH AMERICA, INC.

**PROCEDURE TO VIEW OR RESET SERVICE ITEMS IN THE INSTRUMENT CLUSTER (EXCEPT THE E65 AND E66)**

1. Turn ignition to Terminal 15.
2. Press and hold the Instrument Cluster Set/Reset button for 10 seconds.
3. The upper display in the Instrument Cluster will be illuminated with a Service Item (example: An oil can is the designation for Oil Service). The lower display in the Instrument Cluster will indicate the remaining time or mileage left for that Service Item (example: 14000). Pressing the button repeatedly will allow the display to scroll through all of the Condition Based Service Items.
4. Press and hold the Instrument Cluster Set/Reset button again and the lower display screen will indicate "OK" or "DUE".
5. Pressing the Instrument Cluster Set/Reset button again will allow the "RESET" to appear in the lower window for that service. Releasing and reapplying the button one more time will reset the service displayed in the upper window only. Repeat the procedure for any additional service reset needs.

**NOTE:** The CBS service items for both State Vehicle Safety Inspection and State Emissions Inspection cannot be viewed in the Instrument Cluster. These State Inspections can be viewed on the CBS Menu in the Control Display or by DISplus / GT1.

**PROCEDURE TO RESET THE CBS DISPLAY BMW GROUP DIAGNOSTIC SYSTEM (EXCEPT THE E65 AND E66)**

Using the BMW diagnostic system, the CBS Reset sets the selected service item to 100% (full service interval) and displays a service counter indicating how many times the service item has been reset.

The CBS reset procedure is found under: **Diagnosis - Function Selection - Service Functions - Maintenance - CBS Reset - Test Plan**. Then highlight the listed procedure and press the bottom right corner green arrow to the right.

**NOTE:** The original value of the individual CBS service item will be deleted during the reset procedure.

The next screen offers 3 selection menus:

**SELECTION MENUS**

Selection 1: CBS reset	Selection 2: CBS reset	Selection 3: End
1. Engine oil	1. Spark plugs	⤴
2. Microfilter	2. Brake fluid	⤴
3. Front brakes	3. Coolant	⤴
4. Rear brakes	4. State Safety inspection	⤴
5. Vehicle check	5. Emissions inspection	⤴

The **CBS vehicle data correction** allows "quick access" to correct or change the basic data stored in the vehicle after the CBS reset. This procedure is found under: **Diagnosis - Function Selection - Service Functions - Maintenance - CBS Correction, Vehicle Data - Test Plan**. Then highlight the listed procedure and press the bottom right corner **green arrow** to the right.

The next screen offers 4 selection menus:

**SELECTION MENUS**

<b>Selection 1: Correction</b>	<b>Selection 2: Correction</b>	<b>Selection 3: Correction</b>	<b>Selection 4: End</b>
1. Engine oil	1. Spark plugs	1. Telephone numbers	⤵
2. Microfilter	2. Brake fluid	2. Date of first registration	⤵
3. Front brakes	3. State Safety inspection	3. Reset annual kilometer setting.	⤵
4. Rear brakes	4. Emissions inspection	⤵	⤵
5. Vehicle check	⤵	⤵	⤵

**RESET ANNUAL KILOMETER SETTING**

This setting is designed to compare the mileage of the vehicle to time. This reset should only be performed one time for each customer, and not reset annually. This replaces the date and time of day automatically downloaded in the vehicle as seen previously in the E65 and E66 vehicles. This is an enhancement to further refine the service intervals to properly match the customer's driving habits.

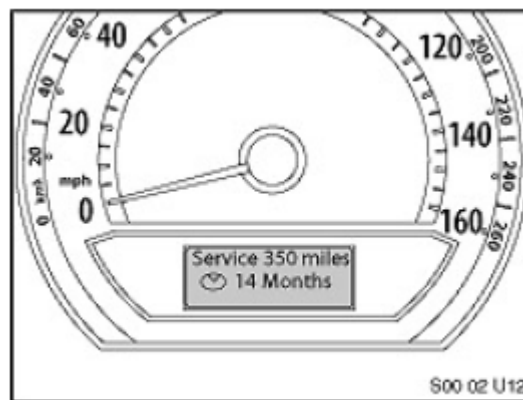
The reset of the Annual Kilometer Setting should be performed when the vehicle is delivered to the customer. If the vehicle is sold as a used vehicle in the future, the reset should again be performed for each subsequent owner.

**E65 AND E66 SERVICE INDICATION**

The service indicators can be displayed in three different locations inside the vehicle:

- A. The **Service Need Display (SBA)** , located in the Instrument Cluster under the Speedometer, is the evolution of the SIA4 Service Interval Display. When the ignition (KL15 Terminal) is on, the SBA appears briefly. The first line specifies the mileage range before the next service is due. The second line, displayed by a clock symbol, specifies the time range before the next service is due. If service is overdue, a minus sign ("-") will appear with the overdue mileage or time.

**For example:** The next mileage-dependent service item is due in 350 miles and the next time-dependent service item is due in 14 months.

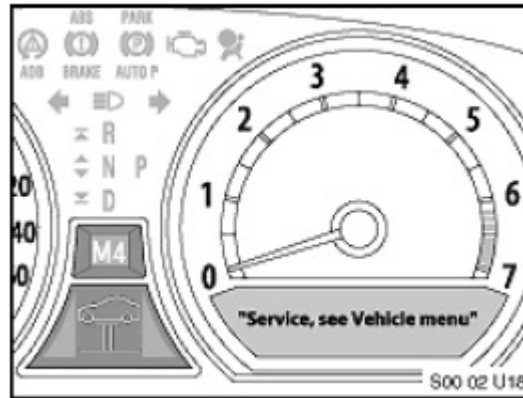


**Fig. 6: Service Need Display Located Instrument Cluster**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- B. The **Check Control Display** located in the Instrument Cluster under the Tachometer.

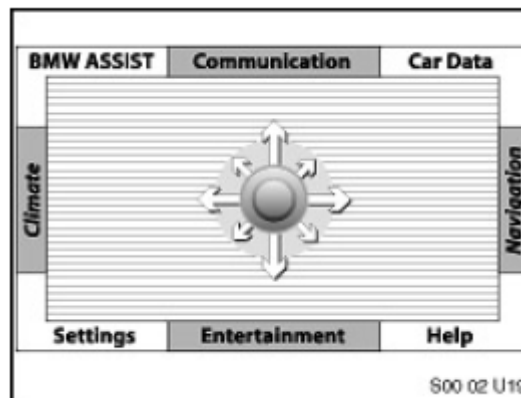
**For example:** If either the front or rear brake linings are worn, the following is displayed:

- "Service, see Vehicle menu" is displayed in the Check Control Display. For more detailed information, the user can access the CBS Menu in the Control Display.
- The general brake warning lamp and the variable control lamp illuminate in the Instrument Cluster.
- The variable control lamp shows the symbol of a car on a lifting platform in the bottom center of the Instrument Cluster.



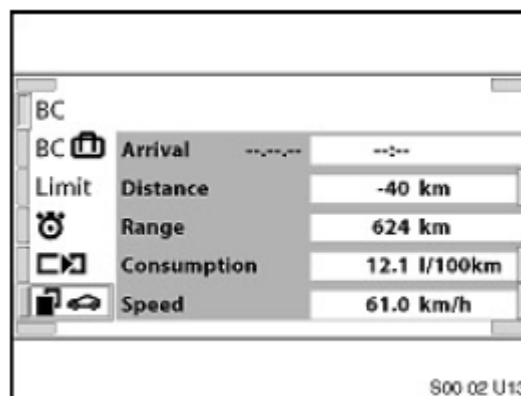
**Fig. 7: Check Control Display Located Instrument Cluster**  
 Courtesy of BMW OF NORTH AMERICA, INC.

- C. The **CBS Menu** in the Control Display provides additional information on any required service. The CBS Menu can be accessed by doing the following:
- Select the "Car Data" menu using the controller.



**Fig. 8: CBS Menu In Control Display**  
 Courtesy of BMW OF NORTH AMERICA, INC.

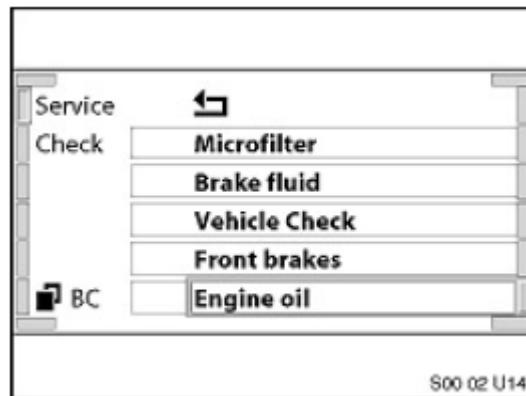
- After releasing the controller or returning to the central position, the "On-board Data" menu appears.
- Turn the controller until the Vehicle Symbol (bottom left) is highlighted.
- Confirm the selection by pressing the controller.



### **Fig. 9: On-Board Data Menu**

Courtesy of BMW OF NORTH AMERICA, INC.

- Turn the controller until Service (top left) is highlighted.
- Confirm the selection by pressing the controller.
- The CBS menu appears with the service items.



### **Fig. 10: CBS Menu With Service Items**

Courtesy of BMW OF NORTH AMERICA, INC.

The service items are displayed in three different colors:

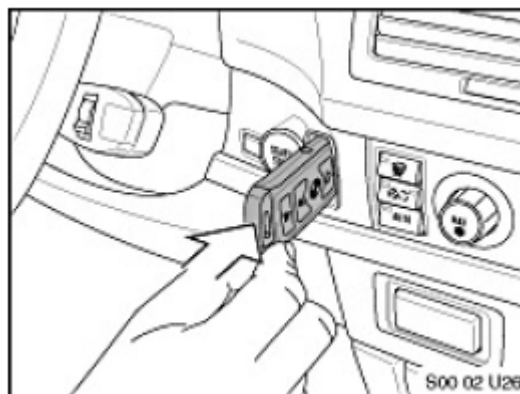
1. Green - No service is currently required.
2. Yellow - Service deadline is approaching (please see the above table: "Yellow" Interval Before Service Is Due).
3. Red - Service deadline has already passed (overdue).

To display the information of a service item, turn the controller to select the item and confirm the selection by pressing the controller.

### **E65 AND E66 PROCEDURE TO RESET THE CBS DISPLAY USING THE INSTRUMENT CLUSTER**

The CBS Reset procedure enables resetting of the individual service item. After a service has been performed, the service item must be reset to 100% (full service interval). To reset a service item:

1. Insert the Remote Control into the Ignition Lock.

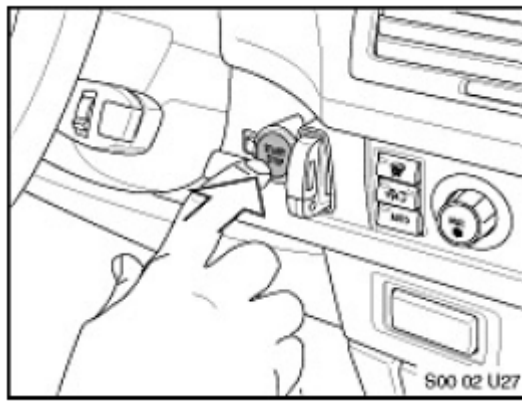


### **Fig. 11: Inserting Remote Control Into Ignition Lock**

Courtesy of BMW OF NORTH AMERICA, INC.

2. Press the Start/Stop Button once (KL15 is "On") with foot off the Brake Pedal.

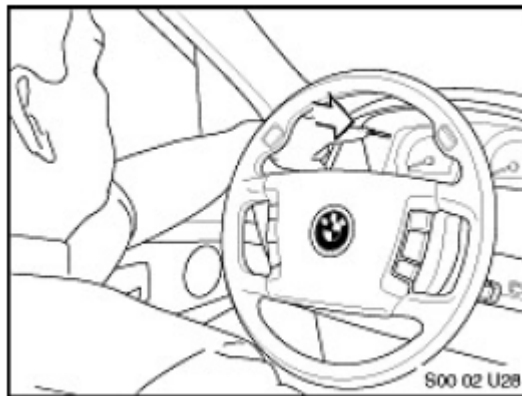




**Fig. 12: Pressing Start/Stop Button**

Courtesy of BMW OF NORTH AMERICA, INC.

3. Press and hold the Reset Button located on the upper left side of the Instrument Cluster for about 5 seconds.
4. Release the Reset Button when a 4-line menu appears inside the Speedometer display. At the top line is the "Back" function, followed by the first 3 service items. The menu will list the service items sorted by priority of the service due.



**Fig. 13: Pressing Reset Button Located On Upper Left Side Of Instrument Cluster**

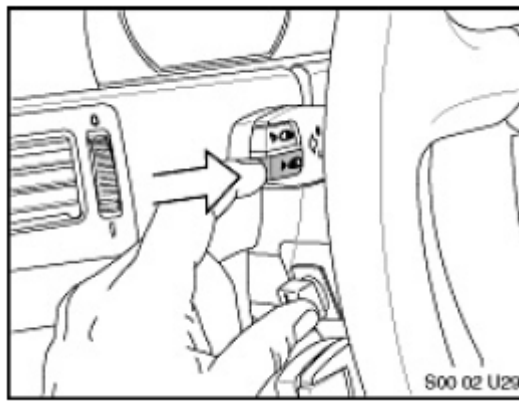
Courtesy of BMW OF NORTH AMERICA, INC.

**NOTE:** If the Reset Button is held too long and not released when the above 4-line menu appears, the system will go into Instrument Cluster Test Functions:

- 01 Identification
- 02 System test
- 03 Not used
- 04 Consumption

To exit Test Functions, remove the Remote Control from the Ignition Lock and repeat steps 1 through 4 above.

5. Tap the Reset Button or the lower FAS Button located in the side of the Turn Signal/High Beam Stalk to view the next service items in the menu.
6. Select the Service Item with "!" or "-" by tapping the Reset Button or the lower FAS Button.



**Fig. 14: Tapping Reset Button Or Lower FAS Button Located In Side Of Turn Signal/High Beam Stalk**

**Courtesy of BMW OF NORTH AMERICA, INC.**

7. Press and hold the Reset Button for a few seconds to display a 2-line menu in the Tachometer. The third menu line will appear to confirm if the reset is successful. The nominal interval for the service item will also be highlighted in the Service Need Display (SBA), located under the Speedometer in the Instrument Cluster.

### **E65 AND E66 PROCEDURE TO RESET THE CBS DISPLAY USING BMW DIAGNOSTIC TESTER**

Using the BMW diagnostic tester, the CBS Reset sets the selected service item to 100% (full service interval) and displays a service counter indicating how many times the service item has been reset.

The CBS reset procedure is found under: Diagnosis - Function Selection - **Service Functions - Maintenance - CBS Reset - Test Plan**. Then highlight the listed procedure and press the bottom right corner green arrow to the right. The original value of the individual CBS service item will be deleted during the reset procedure.

The first vital step of the reset procedure is to verify the DISplus or GT1 correct date and time: "Are the current date and time correct?" This is important for time and distance-based service items that are managed by the Instrument Cluster, because the internal vehicle trip odometer and vehicle data will be synchronized with the internal Tester data. Confirm by either pressing **Yes** or **No** (if required, correct date and time in Main Menu - Administration - **DIS - Date/Time** ). Then select the bottom right corner **green arrow** to the right.

The next screen offers 3 selection menus:

#### **SELECTION MENUS**

<b>Selection 1: CBS reset</b>	<b>Selection 2: CBS reset</b>	<b>Selection 3: End</b>
1. Engine oil	1. Spark plugs	↗
2. Microfilter	2. Brake fluid	↗
3. Front brakes	3. Coolant	↗
4. Rear brakes	4. State Safety inspection	↗
5. Vehicle check	5. Emissions inspection	↗

To properly complete the CBS reset, the date and time of service/maintenance will be transferred to the vehicle. This includes setting the day counter and the date. The transfer completion is confirmed by: **OKAY** in the setting status.

The CBS vehicle data correction allows "quick access" to correct or change the basic data stored in the vehicle after the CBS reset. This procedure is found under: Diagnosis - Function Selection - **Service Functions - Maintenance - CBS Correction, Vehicle Data - Test Plan**. Then highlight the listed procedure and press the bottom right corner **green arrow** to the right. Please verify the correct date and time of the DISplus or GT1 before proceeding.

The next screen offers 4 selection menus:

#### **SELECTION MENUS**

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<b>Selection 1: Correction</b>	<b>Selection 2: Correction</b>	<b>Selection 3: Correction</b>	<b>Selection 4: End</b>
1. Engine oil	1. Spark plugs	1. Telephone numbers	Å
2. Microfilter	2. Brake fluid	2. Date of first registration	Å
3. Front brakes	3. Coolant	Å	Å
4. Rear brakes	4. State Safety inspection	Å	Å
5. Vehicle check	5. Emissions inspection	Å	Å

**NOTE:** CBS reset and correction may be required if a control module has been replaced or reprogrammed.

**FLUID MAINTENANCE SERVICE INTERVAL FOR HYBRID F30, F10, F02 - SERVICE BULLETIN SI B24 07 12 (8/2015)**

Applies to the following models:

- F30 (ActiveHybrid 3)
- F10 (ActiveHybrid 5)
- F02 (ActiveHybrid 7)

The automatic transmission fluid is required to be changed at every second or third engine oil service depending on the production date of the vehicle ("connected" maintenance service to the engine oil service at Service Counter numbers: 2, 4, 6, or 3, 6, 9 etc.).

On vehicles with option code 8KC (CBS oil service interval of 15k miles/24 months) produced up to 07/2013: Transmission fluid service is scheduled on every second oil service.

On vehicles with option code 8KL (CBS oil service interval of 10k miles/12 months) produced from 07/2013: Transmission fluid service is scheduled on every third oil service.

Only properly trained personnel, who have passed all applicable technical training courses, should perform any maintenance or repairs on any Hybrid or Electric Vehicle.  
**IMPORTANT:** Work performed by unqualified persons may result in severe injury or damage to the vehicle. Additional information may be found in REP 61 00 Observe safety instructions when handling electric vehicles.

This requirement is due to the hybrid-specific components that are contained in the transmission.

Automatic transmission fluid L 12108 (20 Liters bulk)

BMW part number: 83 22 2 220 439

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## TRANSMISSION

### BMW Operating Fluids

#### 1.0 GENERAL INFORMATION

Brake fluid is used as an operating fluid for hydraulic clutch operation.

Refer to [BRAKES](#) - for complete details about brake fluid.

#### 2.0 SMG: SEQUENTIAL MANUAL GEAR BOX

All models SMG Hydraulic Unit require the use of Pentosin CHF 11S fluid.

#### 3.0 OTHER OPERATING FLUIDS

##### CLUTCH COMPONENT GREASE

Use UNIREX S2 (replaces Klueber Microlube GL 261) for the lubrication of splines on the transmission input shaft, lubricating groove of the clutch release bearing, piston rod sleeve, clutch master cylinder and front push rod of the clutch slave cylinder.

UNIREX S2 Grease BMW Part No. 83 23 9 416 138

As of 11/93 the clutch release bearings are available as a replacement part which have plastic sliding sleeves instead of aluminum. Such updated bearings should not be lubricated at all. This applies to all models with manual transmission except for 8 Series models.

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## TRANSMISSION

### Checking & Adding Transmission Oil - Repair - All I3 Models - i3\_I01

## TRANSMISSION OIL

### 00 11 240 CHECK/ADD TRANSMISSION OIL IN E-TRANSMISSION I01 (WITH OIL FILLER PLUG)

IMPORTANT: Deletion of oil filler plug:

For motor vehicles with range extender from 04.2015

For motor vehicles without range extender from 05.2015.

Transmission oil is filled via input of output shaft into E-transmission.

#### Necessary preliminary tasks:

- Remove RIGHT HORIZONTAL STRUT

**NOTE:** Transmission must be at operating temperature.

Transmission oil:

- refer to [OPERATING FLUIDS](#) .

Filling capacities:

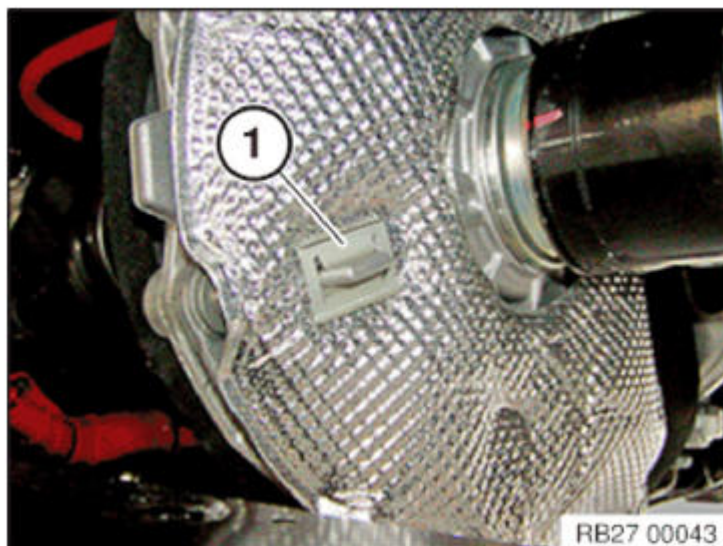
- Refer to [TECHNICAL DATA](#) .

Pry off clamps (1) of sound insulation (2).

List sound insulation (2).

*Installation note:*

Replace clamps (1).



**Fig. 1: Identifying Sound Insulation Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Draining transmission oil:

**Parts:** Replace gaskets.

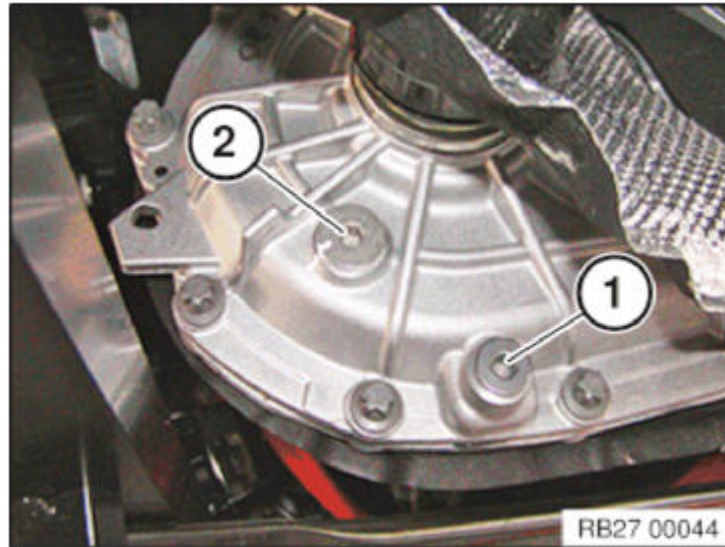
- Release oil drain plug (1) and oil filler plug (2).
- Clean oil drain plug (1) and screw in.

Tightening torque [27 00 13AZ](#) .

Fill transmission with transmission oil.

- Pour in gear oil until overflowing.
- Screw in oil filler plug (2).

Tightening torque: [27 00 13AZ](#) .



**Fig. 2: Identifying Oil Drain Plug And Oil Filler Plug**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **00 11 240 CHECK/ADD TRANSMISSION OIL IN E-GEAR I01 (WITH OIL FILLER PLUG)**

IMPORTANT: Deletion of oil filler plug:

For motor vehicles with range extender from 04.2015

For motor vehicles without range extender from 05.2015.

Transmission oil is filled via input of output shaft into E-gear.

**Necessary preliminary tasks:**

- Remove STRUT ON HORIZONTAL RIGHT .
- Remove output shaft on left or right. See [REPLACING LEFT OUTPUT SHAFT](#) or [REPLACING RIGHT OUTPUT SHAFT](#) .

**NOTE:** Transmission must be at operating temperature.

Transmission oil:

- refer to [OPERATING FLUIDS](#) .

Filling capacities:

- Refer to [TECHNICAL DATA](#) .

Pry off clamps (1) of sound insulation (2).



Remove soundproofing (2).

*Installation note:*

Replace clamps (1).



**Fig. 3: Identifying Sound Insulation And Clamps**  
Courtesy of BMW OF NORTH AMERICA, INC.

Draining transmission oil:

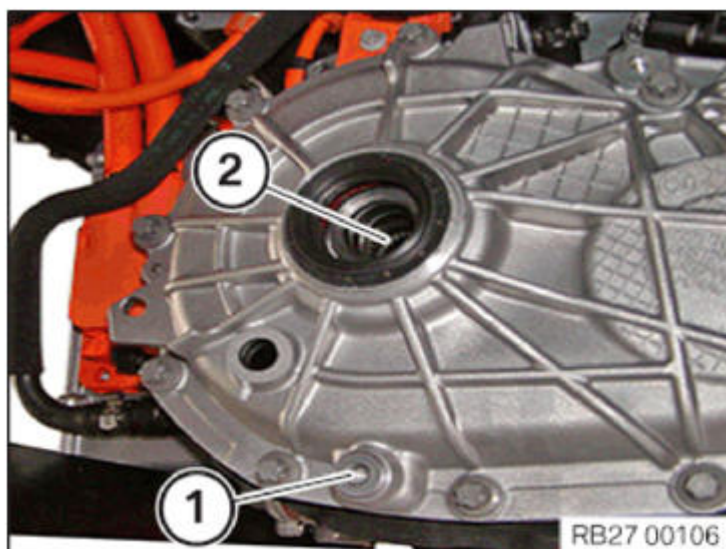
**Parts:** Replace gasket.

- Remove oil drain plug (1).
- Clean oil drain plug (1) and screw in.

Tightening torque [27 00 13AZ](#) .

Fill transmission with transmission oil.

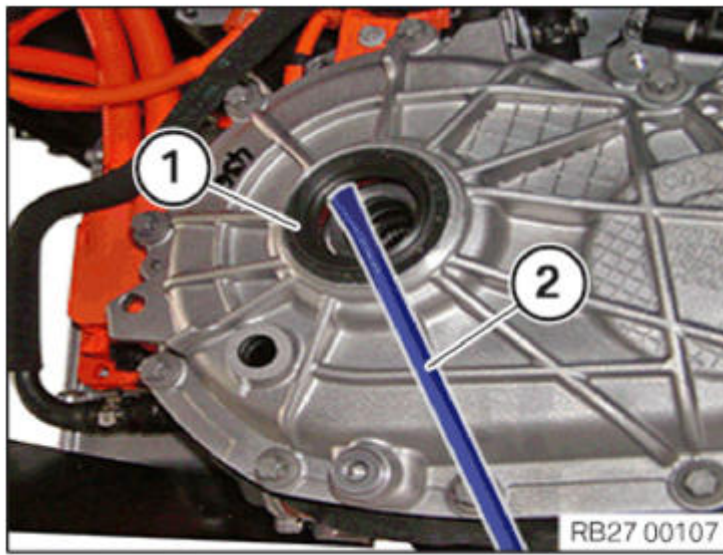
- Fill in 0.5 l transmission oil via input of output shaft (2) into E-transmission.



**Fig. 4: Identifying Oil Drain Plug And Output Shaft**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Parts:** The radial shaft seal (1) must be renewed.

Lift out radial shaft seal (1) using a screwdriver (2) from E-transmission.



**Fig. 5: Lifting Out Radial Shaft Seal Using Screwdriver**  
Courtesy of BMW OF NORTH AMERICA, INC.

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## TRANSMISSION

### Electric Vehicle Driveline - Repair - All I3 Models - i3\_I01

## ELECTRIC VEHICLE DRIVELINE

### 27 21 315 REMOVING AND INSTALLING ACTUATOR FOR PARKING LOCK (VEHICLES WITHOUT RANGE EXTENDER)

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

#### Necessary preliminary tasks:

- De-energize the [HIGH-VOLTAGE SYSTEM](#).

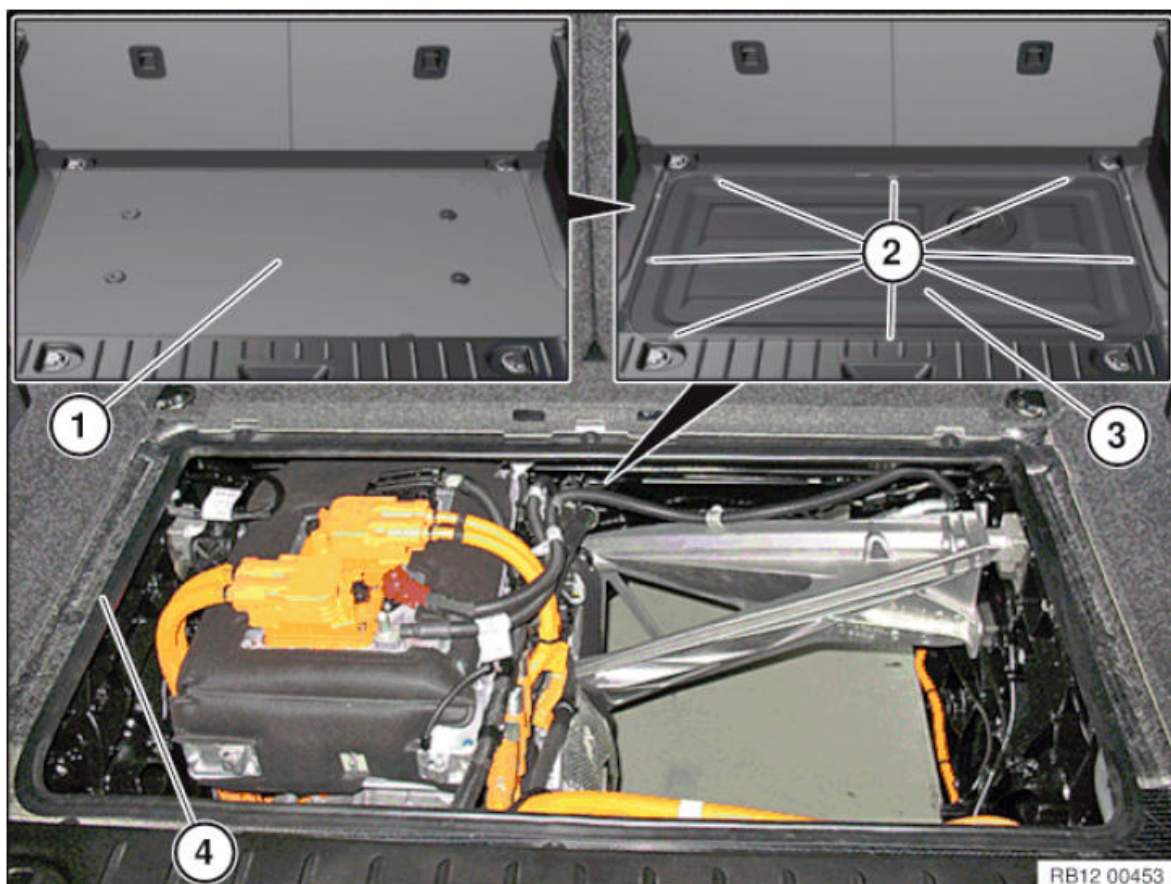
Remove luggage compartment floor trim panel (1).

Release screws (2) and remove service cap (3) towards top.

Tightening torque [51 47 04AZ](#).

Installation note:

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.



**Fig. 1: Identifying Floor Trim Panel, Service Cap, Gasket And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

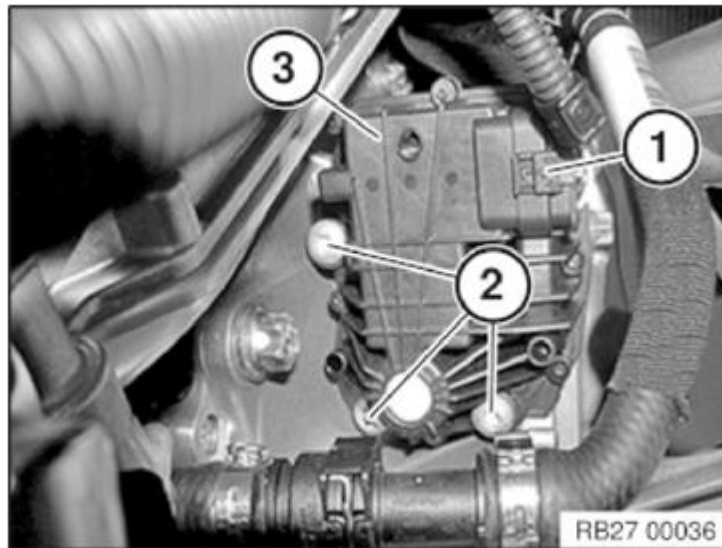
Unlock connector (1) from actuator and disconnect.

Unfasten screws (2).

Remove actuator (3).

*Installation note:*

Tightening torque [27 00 12AZ](#) .



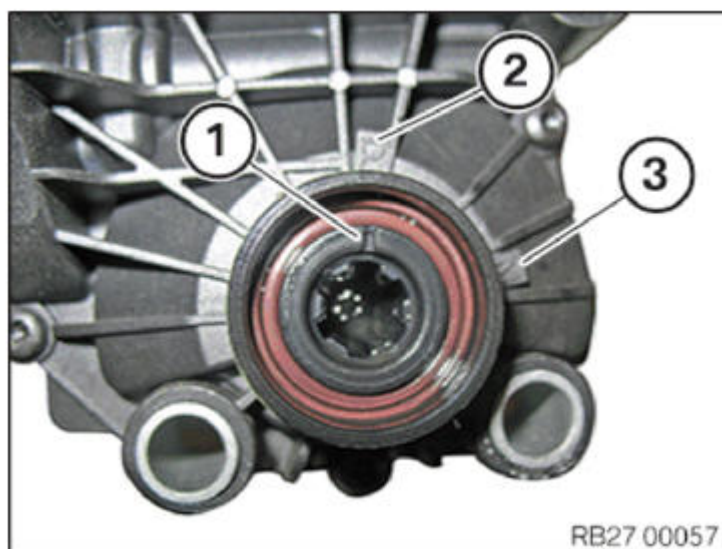
**Fig. 2: Identifying Actuator, Connector And Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

Check the position of the disassembled actuator with the help of mark (1).

If mark (1) on the disassembled actuator is pointing to "N" position (3) →**install a new actuator**

If mark (1) on the disassembled actuator is pointing to "P" position (2) →**see the following instructions**



**Fig. 3: Identifying Disassembled Actuator Mark, P And N Positions**

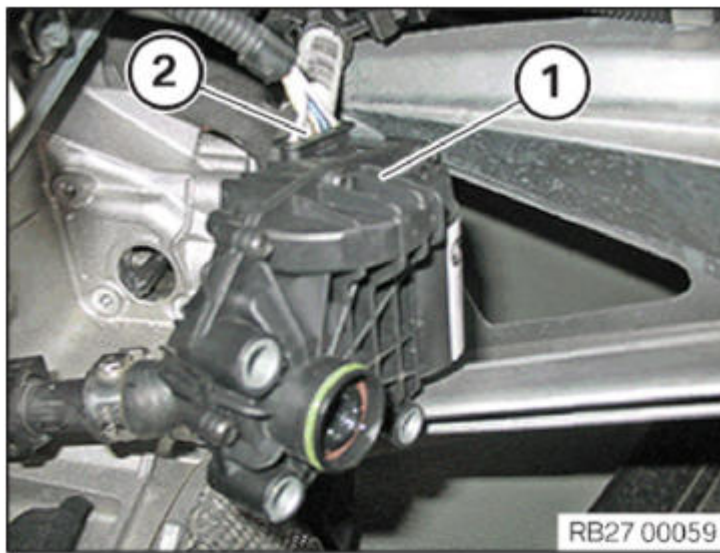
Courtesy of BMW OF NORTH AMERICA, INC.

**Moving the new actuator to "P" position:**

Connect the new actuator (1) to the wiring harness (2) before installation.

Perform the service function "**EME: preparing parking lock module for installation**" . (Move actuator to "P" position)





**Fig. 4: Identifying Actuator And Wiring Harness**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Before installing the actuator, it is essential that the sealing ring (1) is coated with lubricant.



**Fig. 5: Identifying Sealing Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

After installing the actuator, the parking lock module must be re-initialized with the service function "EME: teach-in parking lock module".

### **27 21 320 REMOVING AND INSTALLING ACTUATOR FOR PARKING LOCK (VEHICLES WITH RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

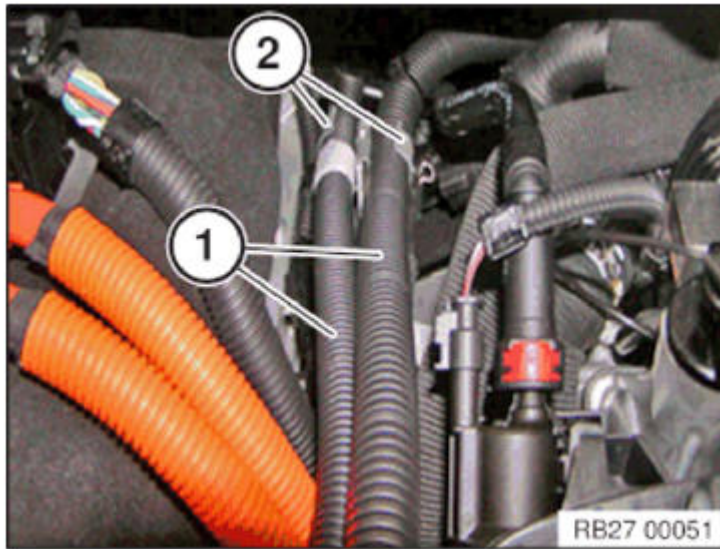
**Necessary preliminary tasks:**

- De-energize the **HIGH-VOLTAGE SYSTEM**.

- Drain coolant. See [DRAINING COOLING CIRCUIT \(HIGH-TEMPERATURE COOLING SYSTEM\)](#) or [DRAINING COOLING CIRCUIT \(LOW TEMPERATURE COOLING SYSTEM\)](#).
- Remove [INTAKE PLENUM](#)

Release lines (1) from brackets (2).

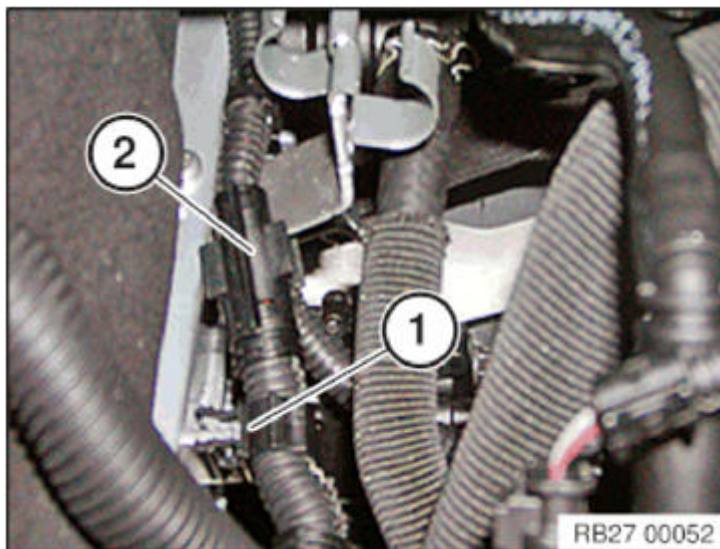
Lay lines to one side.



**Fig. 6: Identifying Lines And Brackets**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release clip (1) from electrical machine.

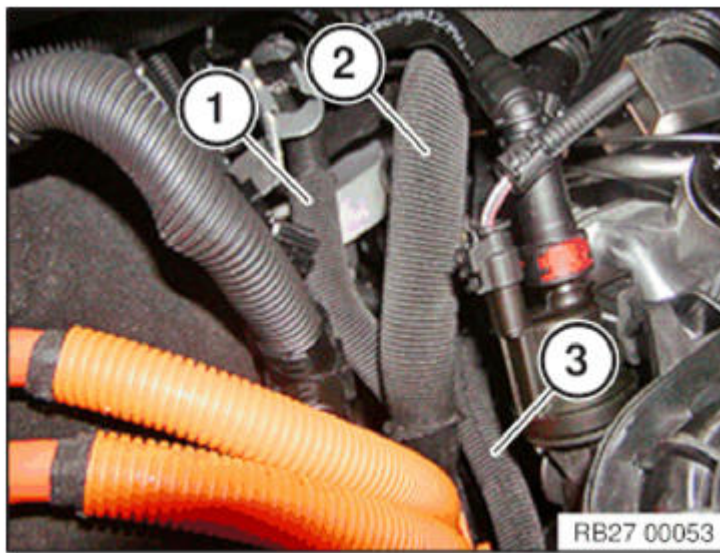
Lay cable (2) to one side.



**Fig. 7: Identifying Cable And Clip**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect coolant hoses (1, 2, 3) at connections and lay to one side.





**Fig. 8: Identifying Coolant Hoses**

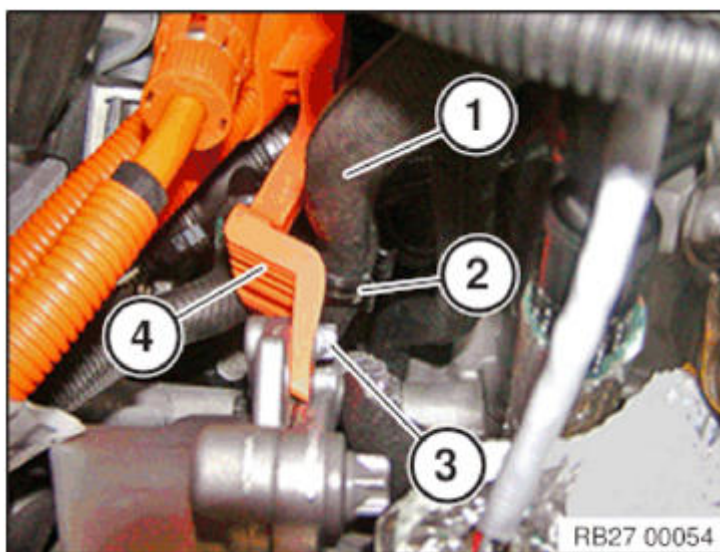
Courtesy of BMW OF NORTH AMERICA, INC.

Release coolant hose (1) from bracket (2).

Release screw (3).

Release connector from transmission (4).

Tightening torque [27 00 11AZ](#) .



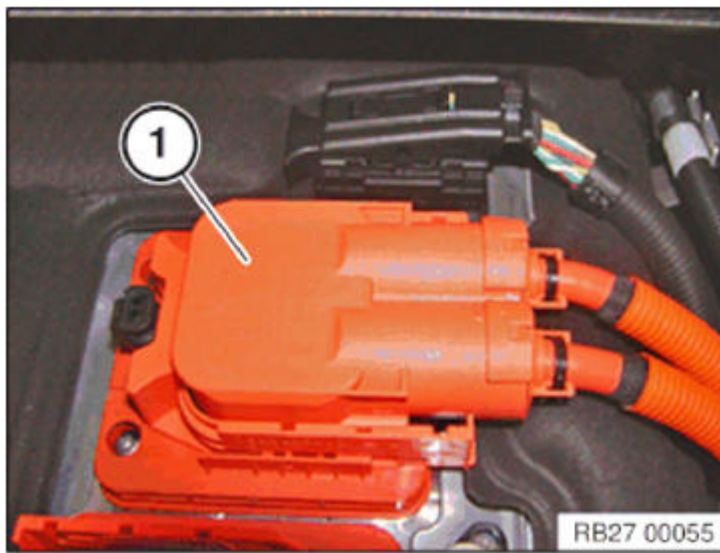
**Fig. 9: Identifying Coolant Hose, Bracket, Screw And Transmission Connector**

Courtesy of BMW OF NORTH AMERICA, INC.

Disconnect high-voltage cable (1) for convenience charging electronics.

Lay high-voltage cable to one side towards rear.

IMPORTANT: Observe notes on [UNLOCKING AND DISCONNECTING PLUG CONNECTIONS](#) on electric vehicles.



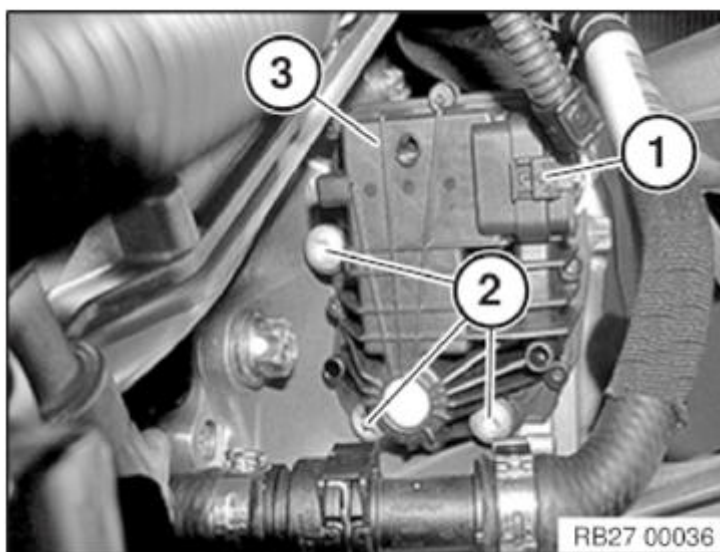
**Fig. 10: Identifying High-Voltage Cable**  
Courtesy of BMW OF NORTH AMERICA, INC.

Unlock connector (1) from actuator and disconnect.

Unfasten screws (2).

Remove actuator (3).

Tightening torque [27 00 12AZ](#) .

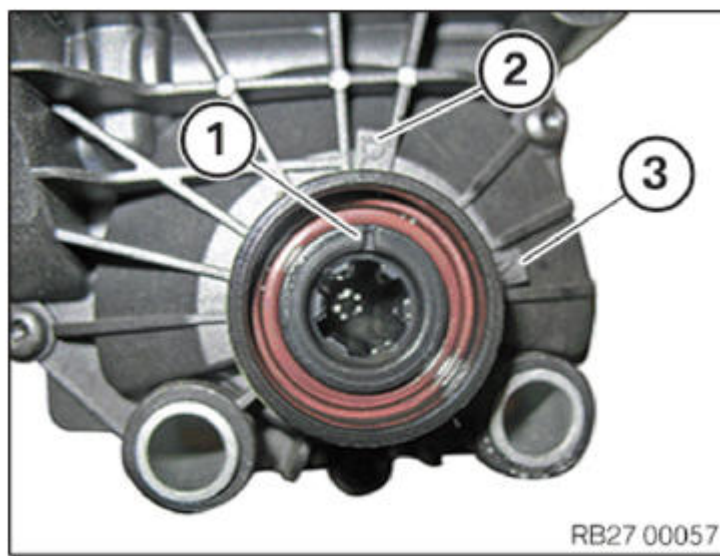


**Fig. 11: Identifying Actuator, Connector And Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

Check the position of the disassembled actuator with the help of mark (1).

If the mark (1) is pointing to position "N" (3) after actuator disassembly, →**Install new actuator**

If mark (1) on the disassembled actuator is pointing to "P" position (2) →**see the following instructions**

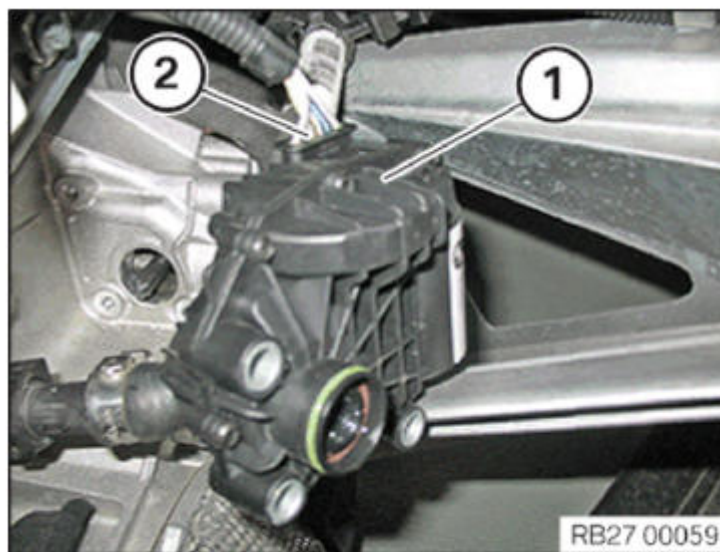


**Fig. 12: Identifying Disassembled Actuator Mark, P And N Positions**  
Courtesy of BMW OF NORTH AMERICA, INC.

**Moving the new actuator to "P" position:**

Connect the new actuator (1) to the wiring harness (2) before installation.

Perform the service function "EME: Perform **Prepare parking lock module for installation**" (set actuator to position "P").



**Fig. 13: Identifying Actuator And Wiring Harness**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Before installing the actuator, it is essential that the sealing ring 1 is coated with lubricant.



**Fig. 14: Identifying Sealing Ring**

Courtesy of BMW OF NORTH AMERICA, INC.

**After installation:**

After installing the actuator, the parking lock module must be re-initialized with the service function "EME: Teach-in parking lock module"!

**22 11 155 REMOVING AND INSTALLING/REPLACING MOUNTING BRACKET OF ELECTRICAL MACHINE (ALL VEHICLES)**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**IMPORTANT:** If the mounting bracket or the screw connection of the support bearing is broken, it is absolutely mandatory to follow the [REPAIR INSTRUCTIONS](#).

**Necessary preliminary tasks:**

- Remove complete drive unit. See [REMOVING COMPLETE DRIVE UNIT](#) or [REMOVING COMPLETE DRIVE UNIT \(RANGE EXTENDER\)](#).

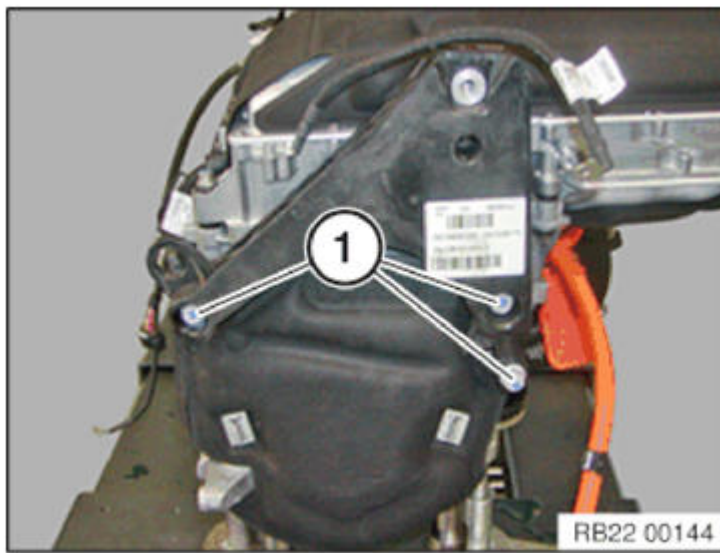
Release screws (1).

Remove transmission mounting bracket.

*Installation note:*

Tightening torque [27 00 5AZ](#).





**Fig. 15: Identifying Transmission Mounting Bracket Screws**

Courtesy of BMW OF NORTH AMERICA, INC.

## **22 11 160 REMOVING AND INSTALLING/REPLACING TRANSMISSION BEARING BLOCK (VEHICLES WITHOUT RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

**IMPORTANT:** If the transmission mounting bracket or the screw connection of the support bearing is broken, it is absolutely mandatory to follow the **REPAIR INSTRUCTIONS**.

### **Necessary preliminary tasks:**

- Remove HORIZONTAL STRUT on left or right
- The drive unit must be supported by a jack throughout the entire procedure while the transmission mounting bracket is being removed and installed.

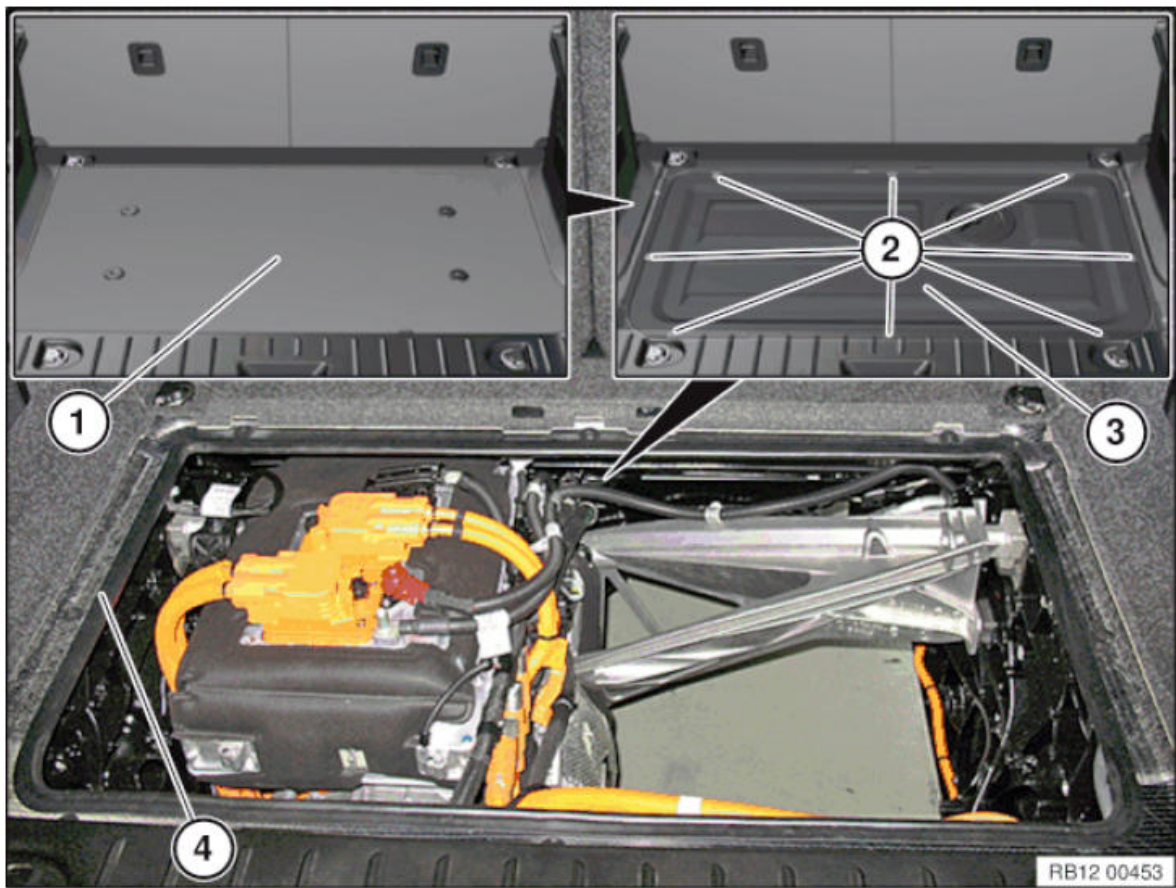
Remove luggage compartment floor trim panel (1).

Release screws (2) and remove service cap (3) towards top.

Tightening torque **51 47 4AZ**.

### *Installation note:*

Check the neoprene nuts of the screw connections (2) and gasket (4) for damage and replace if necessary.



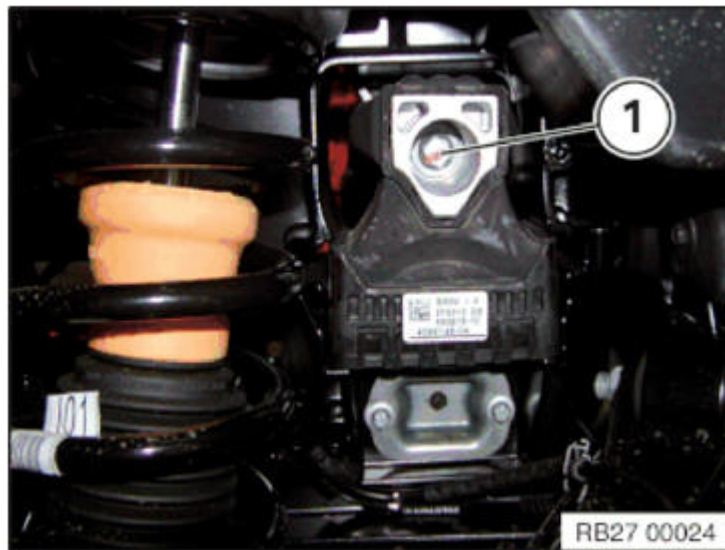
**Fig. 16: Identifying Floor Trim Panel, Service Cap, Gasket And Screws**  
 Courtesy of BMW OF NORTH AMERICA, INC.

Release screw (1).

*Installation note:*

Replace screw.

Tightening torque **27 00 6AZ** .



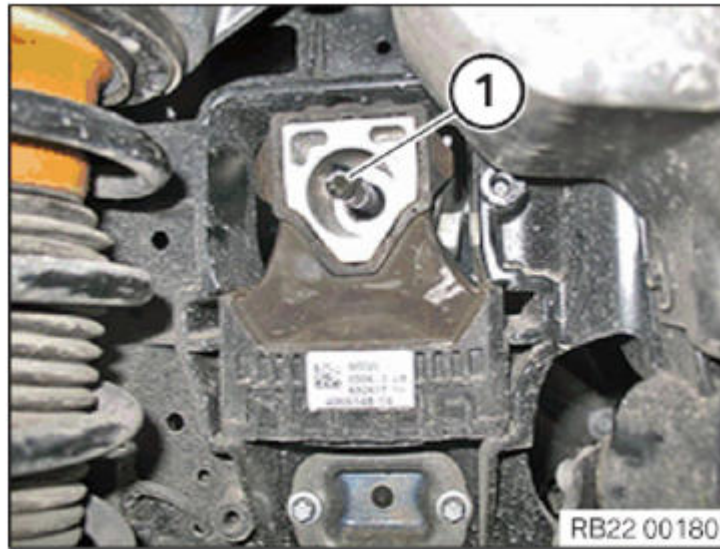
**Fig. 17: Identifying Screw**  
 Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

**IMPORTANT:** During installation, the bore holes of support bearing and transmission mounting bracket **absolutely** must fall in line precisely.



For alignment of bore holes use a suitable tool (1), for example drill with 11 mm diameter shank.



**Fig. 18: Identifying Transmission Mounting Bracket Bore Hole**  
Courtesy of BMW OF NORTH AMERICA, INC.

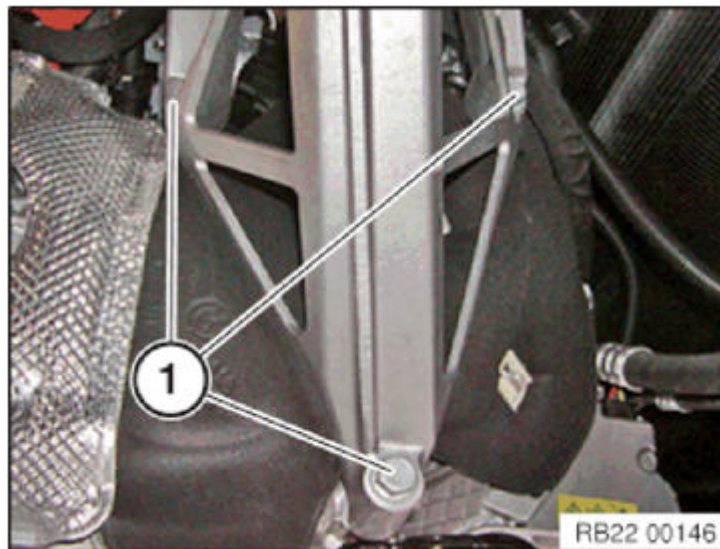
Release screws (1).

Remove transmission mounting bracket (2).

Tightening torque **27 00 3AZ** .

*Installation note:*

Screws must be replaced.



**Fig. 19: Identifying Transmission Mounting Bracket Screws**  
Courtesy of BMW OF NORTH AMERICA, INC.

## **22 11... REPAIR INSTRUCTIONS FOR BROKEN ENGINE MOUNTING BRACKET/ENGINE MOUNT SCREW CONNECTION**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

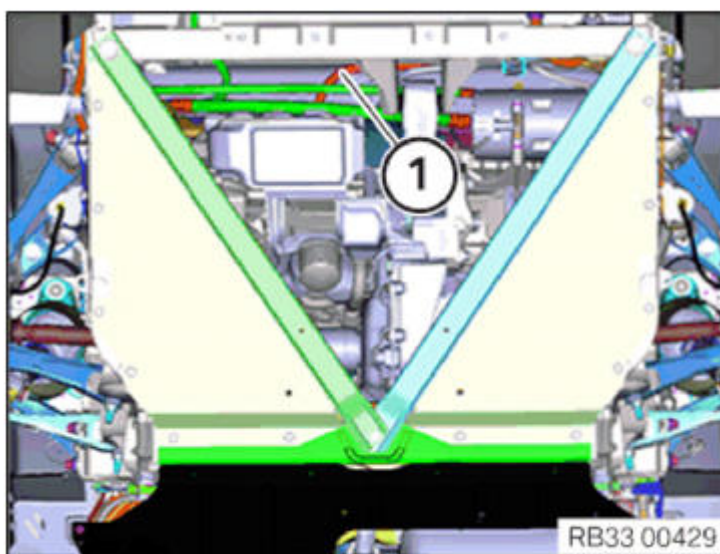
- Observe **SAFETY INFORMATION** for working with electric vehicles.

The following work must be performed when the engine mount screw connection or the engine mounting bracket is broken.

- Replace **LEFT AND RIGHT SUPPORT BEARINGS INCL. SCREW CONNECTION**
- Replace left and right mounting brackets. See **REMOVING/INSTALLING/REPLACING TRANSMISSION BEARING BLOCK** .

Vehicles with range extender: see **REMOVING/INSTALLING/REPLACING MOUNTING BRACKET OF ELECTRICAL MACHINE** and **REMOVING/INSTALLING TRANSMISSION MOUNTING BRACKET OF RANGE EXTENDER** .

- Replace left and right output shaft. See **REMOVING/INSTALLING/REPLACING LEFT OUTPUT SHAFT** and **REMOVING/INSTALLING/REPLACING RIGHT OUTPUT SHAFT** .
- Replace **A/C LINES**
- Check the **HIGH-VOLTAGE CABLE** under the drive shaft sleeve and replace it in the event of damage
- Check the BRACING STRUT for paintwork damage and apply corrosion protection to potentially damaged areas of the paintwork
- Check **BATTERY VOLTAGE LINE** in the area of the iso-fix strip for damage and replace if necessary.
- Program the vehicle to integration level version I001-15-11-501 (from ISTA/P3.57.0)
- Check fuel lines (1) for damage. Replace damaged fuel lines.



**Fig. 20: Identifying Fuel Lines**

Courtesy of BMW OF NORTH AMERICA, INC.

### **27 21 630 REPLACE SEALING RING BETWEEN E-TRANSMISSION AND E-MACHINE (VEHICLES WITHOUT RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

- Observe **SAFETY INFORMATION** for working with electric vehicles.

Necessary preliminary tasks:

- Remove **E-TRANSMISSION**

Release sealing ring (1) from groove with suitable tool.

IMPORTANT: The E-transmission must not be damaged when the sealing ring is removed.

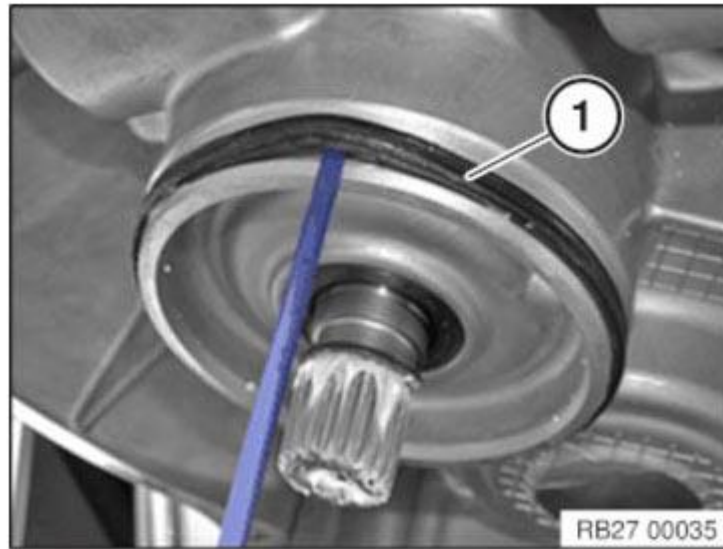
Damage can lead to failure of the E-transmission or E-machine.

*Installation note:*

Clean sealing ring groove. All existing grease must be removed entirely.

Apply grease SYN-setral-INT/250 A-2 all around sealing ring (1).

Install sealing ring.



**Fig. 21: Applying Grease To Sealing Ring**

Courtesy of BMW OF NORTH AMERICA, INC.

## **27 21 615 REPLACING RADIAL SHAFT SEAL FOR DRIVE SHAFT (VEHICLES WITHOUT RANGE EXTENDER)**

**Special tools required:**

- 23 0 490
- [2 285 546](#)

### **WARNING:**

**High-voltage system - danger to life!**

**The following points must be strictly observed prior to starting work and during work:**

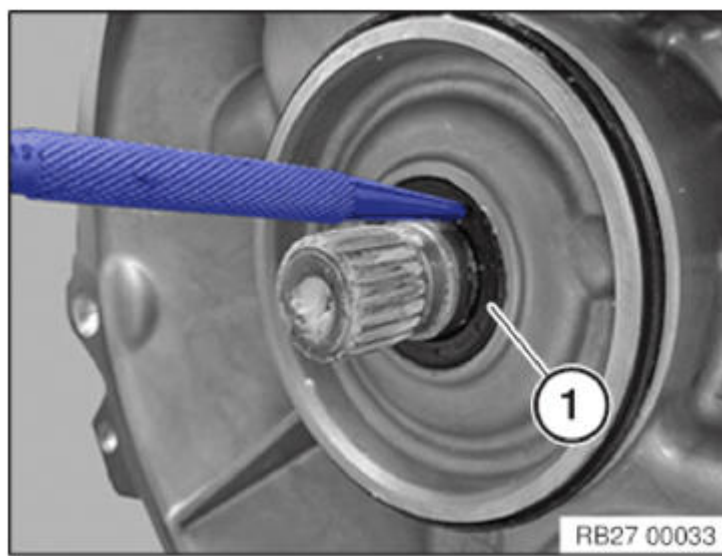
- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

**Necessary preliminary tasks:**

- Remove [E-TRANSMISSION](#)

Drive a hole into radial shaft seal (1) using a center punch.

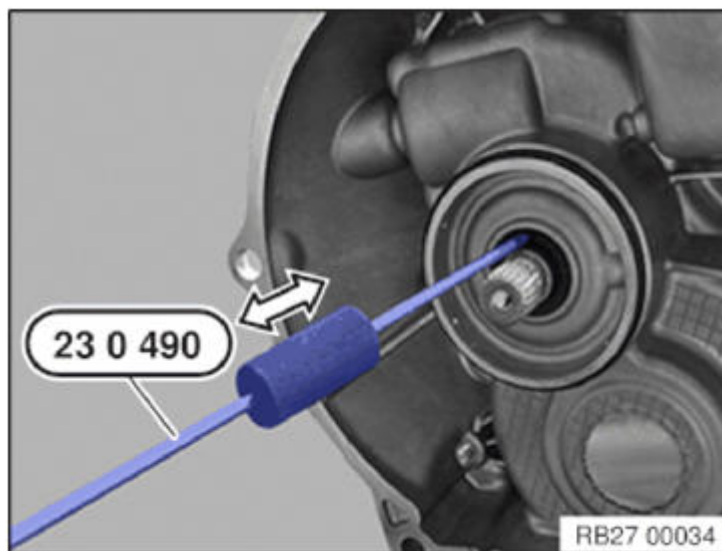
IMPORTANT: Do not use a drill as metallic shavings may result in transmission malfunction.



**Fig. 22: Driving Hole Into Radial Shaft Seal Using Center Punch**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tool 23 0 490 into radial shaft seal.

Withdraw radial shaft seal from  
transmission housing with aid of impact weight.



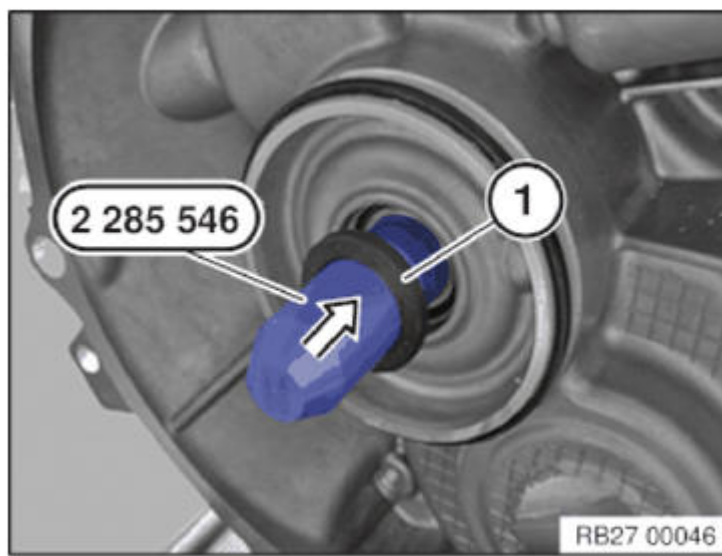
**Fig. 23: Installing Special Tool (23 0 490) Into Radial Shaft Seal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply a light coat of grease SYN-setral - INT/250 A-2 all around the sealing lips of the radial shaft seal.

Push radial shaft seal (1) onto guide sleeve of special tool [2 285 546](#).

Slide guide sleeve with radial shaft seal all the way onto transmission input shaft.

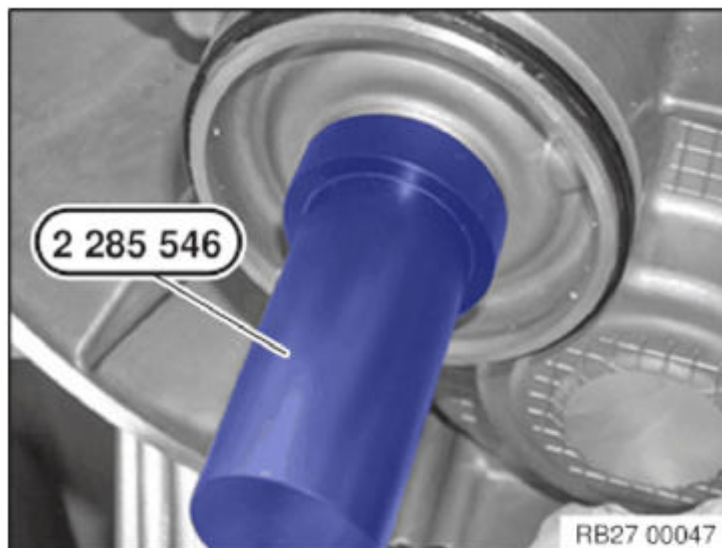




**Fig. 24: Pushing Radial Shaft Seal Onto Guide Sleeve Of Special Tool (2 285 546)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide impactor of special tool [2 285 546](#) onto guide sleeve.

Drive in radial shaft seal with plastic hammer as far as it will go.



**Fig. 25: Installing Special Tool (2 285 546) Impactor Onto Guide Sleeve**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **27 21 616 REPLACING RADIAL SHAFT SEAL FOR DRIVE SHAFT (VEHICLES WITH RANGE EXTENDER)**

Special tools required:

- 23 0 490
- [2 285 546](#)

**WARNING:** High-voltage system - danger to life!  
The following points must be strictly observed prior to starting work and during work:

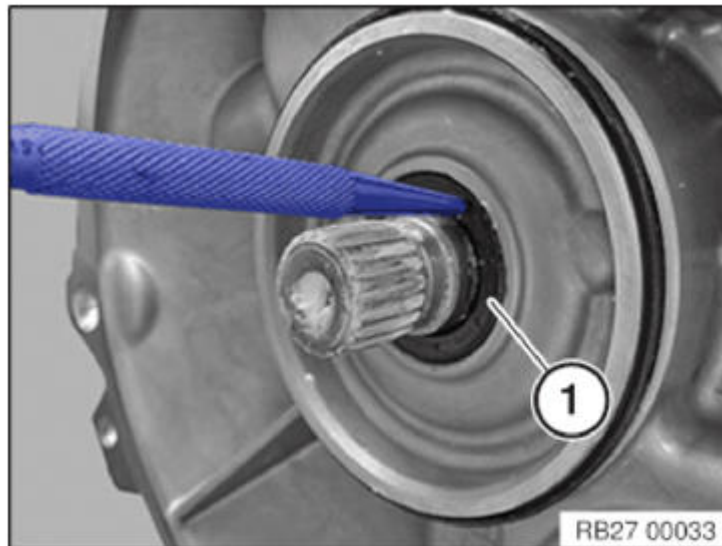
- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

Necessary preliminary tasks:

- Remove [E-TRANSMISSION](#)

Drive a hole into radial shaft seal (1) using a center punch.

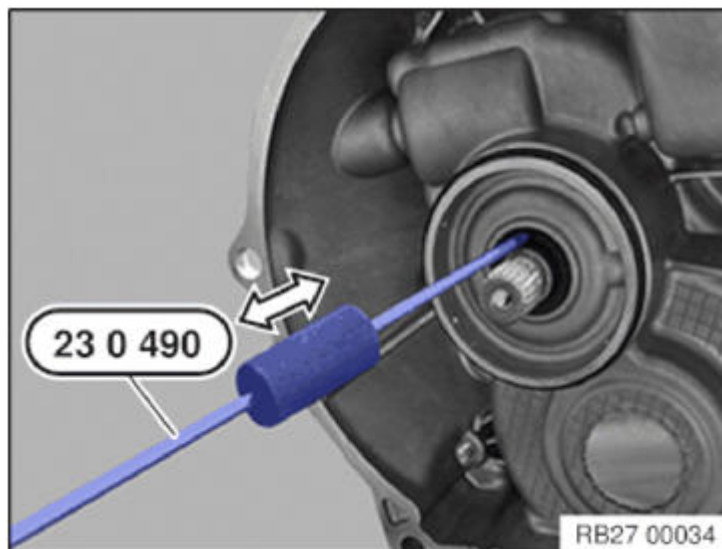
IMPORTANT: Do not use a drill as metallic shavings may result in transmission malfunction.



**Fig. 26: Driving Hole Into Radial Shaft Seal Using Center Punch**  
Courtesy of BMW OF NORTH AMERICA, INC.

Screw special tool 23 0 490 into radial shaft seal.

Withdraw radial shaft seal from transmission housing with aid of impact weight.



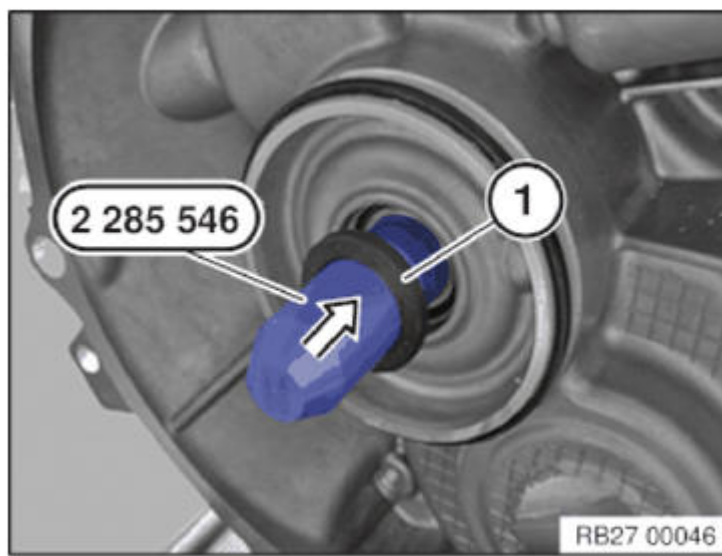
**Fig. 27: Installing Special Tool (23 0 490) Into Radial Shaft Seal**  
Courtesy of BMW OF NORTH AMERICA, INC.

Apply a light coat of grease SYN-setral - INT/250 A-2 all around the sealing lips of the radial shaft seal.

Push radial shaft seal (1) onto guide sleeve of special tool [2 285 546](#).

Slide guide sleeve with radial shaft seal all the way onto transmission input shaft.

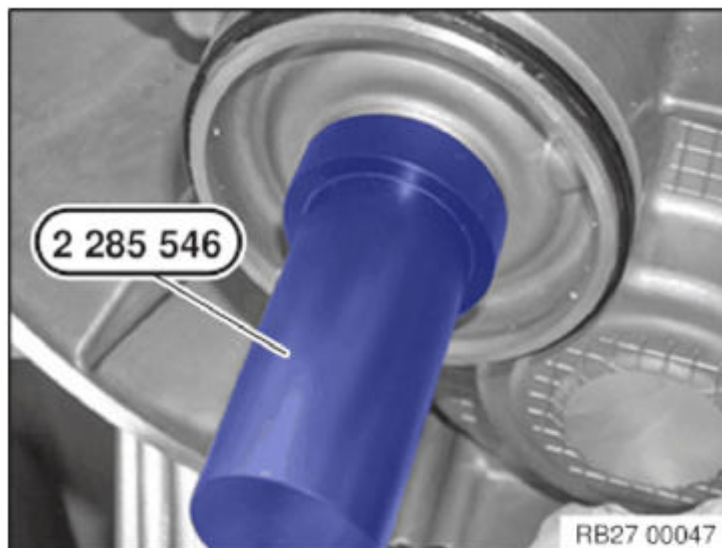




**Fig. 28: Pushing Radial Shaft Seal Onto Guide Sleeve Of Special Tool (2 285 546)**  
Courtesy of BMW OF NORTH AMERICA, INC.

Slide impactor of special tool [2 285 546](#) onto guide sleeve.

Drive in radial shaft seal with plastic hammer as far as it will go.



**Fig. 29: Installing Special Tool (2 285 546) Impactor Onto Guide Sleeve**  
Courtesy of BMW OF NORTH AMERICA, INC.

### **27 21 631 REPLACING SEALING RING BETWEEN E-TRANSMISSION AND E-MACHINE (VEHICLES WITH RANGE EXTENDER)**

**WARNING:** High-voltage system - danger to life!

The following points must be strictly observed prior to starting work and during work:

- Observe [SAFETY INFORMATION](#) for working with electric vehicles.

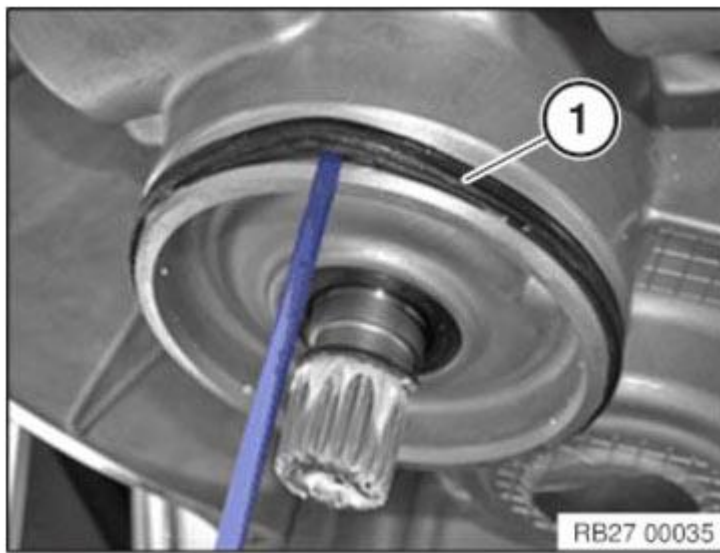
**Necessary preliminary tasks:**

- Remove [E-TRANSMISSION](#)

Release sealing ring (1) from groove with suitable tool.

**IMPORTANT:** The E-transmission must not be damaged when the sealing ring is removed.

Damage can lead to failure of the E-transmission or E-machine.



**Fig. 30: Applying Grease To Sealing Ring**  
Courtesy of BMW OF NORTH AMERICA, INC.

*Installation note:*

Clean sealing ring groove. All existing grease must be removed entirely.

Apply grease SYN-setral-INT/250 A-2 all around sealing ring (1).

Install sealing ring.

**(27 00 015 REMOVING AND INSTALLING E-TRANSMISSION (VEHICLES WITHOUT RANGE EXTENDER))**

See **27 00 015 REMOVING AND INSTALLING E-TRANSMISSION (VEHICLES WITHOUT RANGE EXTENDER)** .

**(27 00 065 REPLACE E-TRANSMISSION (VEHICLES WITHOUT RANGE EXTENDER))**

See **27 00 065 REPLACE E-TRANSMISSION** .

**(27 00 020 REMOVING AND INSTALLING E-TRANSMISSION (VEHICLES WITH RANGE EXTENDER))**

See **27 00 020 REMOVING AND INSTALLING E-TRANSMISSION (VEHICLES WITH RANGE EXTENDER)** .

**(27 00 070 REPLACING E-TRANSMISSION (VEHICLES WITH RANGE EXTENDER))**

See **27 00 070 REPLACING E-TRANSMISSION (VEHICLES WITH RANGE EXTENDER)** .

**(33 10 027 REPLACING BOTH RADIAL SHAFT SEALS FOR OUTPUT SHAFTS ON E-TRANSMISSION)**

See **33 10 027 REPLACING BOTH RADIAL SHAFT SEALS FOR OUTPUT SHAFTS ON E-TRANSMISSION** .

**(22 11... REPAIR INSTRUCTIONS FOR BROKEN ENGINE MOUNTING BRACKET/ENGINE MOUNT SCREW CONNECTION)**

See **22 11... REPAIR INSTRUCTIONS FOR BROKEN ENGINE MOUNTING BRACKET/ENGINE MOUNT SCREW CONNECTION** .

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## TRANSMISSION

### Gear Shift Mechanism Operating Fluids

#### GREASING AND ASSEMBLING

Components of the gear shift mechanism located outside of the transmission housings, such as ball cups, bearing bushings, gearshift joints, etc. may be lubricated with Polylub GLY 801.

##### Greasing:

Tradename	Manufacturer/Supplier	BMW Part Number
Polylub GLY 801	Kluber	81 22 9 407 647

##### Assembling:

Tradename	BMW Part Number
Circolight lubricant	83 19 9 407 771

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[Back To Article](#)

## TRANSMISSION

### Transfer Box - Special Tools - All I3 Models - i3\_I01

## TRANSFER BOX

### 2285547 FITTING AID AM

**NOTE:** For mounting of O-ring at the transmission input. Contour-graphic silhouette foil is included in delivery specification.

#### Storage Location

C35

C36

#### SI number

01 03 14 (070)



**Fig. 1: Identifying Fitting Aid (2285547).**

Courtesy of BMW OF NORTH AMERICA, INC.

### 2285545 GUIDE AM

**NOTE:** For positioning the transmission during the installation (2 pieces). Contour-graphic silhouette foil is included in delivery specification.

#### Storage Location

C35

#### SI number

01 03 14 (070)



**Fig. 2: Identifying Fitting Aid (2285545)**  
Courtesy of BMW OF NORTH AMERICA, INC.

**2285546 MANDREL AM**

**NOTE:** For mounting the RWD on the transmission input. Contour-graphic silhouette foil is included in the delivery specification.

**Storage Location**

C35

**SI number**

01 03 14 (070)



**Fig. 3: Identifying Mandrel (2285546)**  
Courtesy of BMW OF NORTH AMERICA, INC.



## TRANSMISSION

### Transmission And Mounting - Tightening Torques - All I3 Models - i3

#### E-TRANSMISSION, COMPLETE

#### 27 00 E-TRANSMISSION, COMPLETE

	Type	Thread	Tightening specs	Dimension
1AZ E-transmission to electrical machine  (Aluminium screws/bolts are not magnetic).	I0	M1	Replace aluminium screws.  Jointing torque and angle of rotation must be observed without fail.  Jointing torque Angle of rotation	25 Nm 90°
2AZ E-transmission to range extender	I0	M10		56 Nm
3AZ Transmission mounting bracket, right to transmission	I0	M1	Replace screws  Jointing torque Angle of rotation	56 Nm 90°
4AZ Transmission mounting bracket, right to alternator, range extender	I0	M1		6 Nm
5AZ Transmission mounting bracket, left to electrical machine	I0	M1		6 Nm
6AZ Bearing journal, right to transmission mounting bracket (Battery Electric Vehicle)	I0	1	Replace screw  Jointing torque Torque	6 Nm 45°
		M14		165 Nm
7AZ Journal bearing, right to transmission mounting bracket (range extender)	I0	1	Replace screw  Jointing torque Angle of rotation	96 Nm 45°
		M14		165 Nm
8AZ Bearing journal, left to transmission mounting bracket (electrical machine)	I0	1	Replace screw  Jointing torque Angle of rotation	96 Nm 120°
		M14		165 Nm
9AZ Anti-roll bar link to electrical machine	I0	12		100 Nm
10AZ Anti-roll bar link to Drive module or electrical machine	I0	12		100 Nm
11AZ HV holder to transmission	I0	6		12 Nm
12AZ Parking lock actuator to transmission	I01			19 Nm
13AZ Oil drain plug / oil filler plug	I0	22x1.5	Replace gasket	35 Nm

**Fig. 1: Transmission And Mounting Torque Specifications**  
 Courtesy of BMW OF NORTH AMERICA, INC.



## UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

### Brake Systems

## BRAKE SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

### MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

#### **I. Our recommendations are based upon the following definitions.**

**System Failure** - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

**Preventive/Scheduled Maintenance** - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

**Improved System Performance** - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

**II. Training/Criteria** Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

#### **III. Appropriate Company Approved Inspection**

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

#### **IV. Written Estimates**

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

#### **V. Work Authorization**

No work will be performed without the customer's prior approval.

#### **VI. Limited Warranty**

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

#### **VII. Returned Parts**

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

## **VIII. Classification of Parts**

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

## **THE MAP PROCESS - OVERVIEW**

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site [www.motorist.org](http://www.motorist.org) or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 \* Fax: (202) 318-0378

## **THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS**

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p>A. Part no longer performs intended purpose</p> <p>B. Part does not meet a design specification (regardless of performance)</p> <p>C. Part is missing</p>	<p>1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.)</p> <p>2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)</p> <p>3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)</p> <p>4. Technician's recommendation based on substantial and informed experience</p> <p>5. To comply with maintenance recommended by AMRA / MAP</p>

Reasons to Require Repair or Replacement

Reasons to Suggest Repair or Replacement

**NOTE:**

When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

**NOTE:**

Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

## BRAKE SYSTEM CHECKSHEET



### BRAKE SYSTEM CHECKSHEET

Date: \_\_\_\_\_  
 Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
 Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_  
 Mileage: \_\_\_\_\_ License: \_\_\_\_\_ VIN: \_\_\_\_\_ Eng Code: \_\_\_\_\_

Customer Interview:

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*Reason Code Explanation*

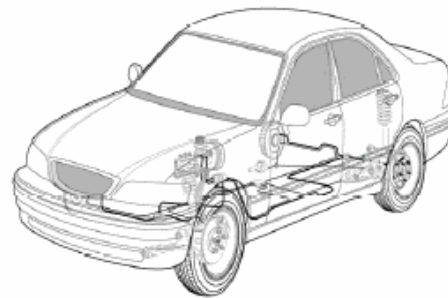
Code      Reason

Required

- A Part No Longer Performs Intended Purpose
- B Part Does Not Meet A Design Specification ( Regardless Of Performance)
- C Part Is Missing

Suggested/Optional

- 1 Part Is Close To The End Of Its Useful Life
- 2 To Address A Customer Need, Convenience Or Request
- 3 To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
- 4 Technician's Recommendation Based On Substantial And Informed Experience
- 5 To Comply With Maintenance Recommended By AMRAMAP



Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: [www.motorist.org](http://www.motorist.org)

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

**Fig. 1: Brake System Checksheet (1 Of 2)**




## BRAKE SYSTEM CHECKSHEET



SECONDARY CUP    PRIMARY CUP

UNDERHOOD				
	OK	S	R	Condition
Brake Fluid				
Copper ppm				
Moisture %				
Master Cylinder				
Aux. Reservoir				
Power Booster				
Valves				
Hoses / Fittings				
Steel Brake Lines				
Other				


LEFT FRONT				
	OK	S	R	Condition
Lugs / Studs				
Hose				
Brake Hardware				
Caliper / Wheel Cyl.				
ABS Sensor / Wire / Tone Ring				
Drum / Rotor Thickness				Spec. _____ Actual _____
Rotor Runout				Spec. _____ Actual _____
Pad / Shoe				Spec. _____ Actual _____
Wheel Bearings / Seals				

RIGHT FRONT				
	OK	S	R	Condition
Lugs / Studs				
Hose				
Brake Hardware				
Caliper / Wheel Cyl.				
ABS Sensor / Wire / Tone Ring				
Rotor / Drum Thickness				Spec. _____ Actual _____
Rotor Runout				Spec. _____ Actual _____
Pad / Shoe				Spec. _____ Actual _____
Wheel Bearings / Seals				

LEFT REAR				
	OK	S	R	Condition
Lugs / Studs				
Hose				
Brake Hardware				
Caliper / Wheel Cyl.				
ABS Sensor / Wire / Tone Ring				
Rotor / Drum Thickness				Spec. _____ Actual _____
Rotor Runout				Spec. _____ Actual _____
Pad / Shoe				Spec. _____ Actual _____
Wheel Bearings / Seals				

RIGHT REAR				
	OK	S	R	Condition
Lugs / Studs				
Hose				
Brake Hardware				
Caliper / Wheel Cyl.				
ABS Sensor / Wire / Tone Ring				
Rotor / Drum Thickness				Spec. _____ Actual _____
Rotor Runout				Spec. _____ Actual _____
Pad / Shoe				Spec. _____ Actual _____
Wheel Bearings / Seals				

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C	
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**Fig. 2: Brake System Checksheet (2 Of 2)**

## BRAKE SYSTEMS

**NOTE:** Some states may have specifications that differ from OEM. Check your local/state regulations. Where state or local laws are stricter, they take precedence over these guidelines.

## ACCELEROMETERS

Condition	Code	Procedure
Broken	A	Require replacement
Connector loose	A	Require repair or replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Out of position	B	Require re-positioning to vehicle manufacturer's specifications
Output signal incorrect	B	Require replacement

## ACCUMULATORS

Condition	Code	Procedure
Leaking	A	Require replacement
Missing	C	Require replacement
Pre-charge incorrect	B	Require replacement

## ANCHOR PINS

Condition	Code	Procedure
Anchor pin bent	B	Require repair or replacement
Anchor pin broken	A	Require replacement
Anchor pin worn, affecting structural integrity	B	Require replacement

## ANTI-LOCK BRAKE CONTROL ASSEMBLY(MODULE)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.		
Missing	C	Require replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ANTI-LOCK BRAKE CONTROLLER

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
<b>NOTE:</b> <b>Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).</b>		
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
Electro Magnetic Brake Inoperative	A	Require repair or replacement
Expansion Spring Brake Inoperative	A	Require repair or replacement
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Pulse Width Modulation Valve Inoperative	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ANTI-LOCK BRAKE SYSTEMS

**NOTE:** Anti-lock brakes are an integral part of the brake system. It is essential that the Anti-lock brakes function properly when brake service is performed. Anti-lock brake systems are commonly referred to as ""ABS"" and will be referred to as ABS throughout these guidelines. Some ABS components also function as part of a traction control system (TCS). When diagnosing and servicing high pressure components, observe safety procedures and equipment requirements established by the vehicle manufacturer to reduce the possibility of serious personal injury.

**NOTE:** Intermittent electrical conditions are often caused by a loss of ground, poor connection, or water intrusion into the wiring harness. Electro-magnetic interference (EMI) may be caused by incorrect installation of accessories or components. EMI can result in improper system operation.

## AXLE SEAL

Condition	Code	Procedure
Leaking	A	Require repair or replacement

## BACKING PLATES

Condition	Code	Procedure
Anchor pin bent	B	Require repair or replacement
Anchor pin broken	A	Require replacement
Anchor pin worn, affecting structural integrity	B	Require replacement
Backing plate bent	B	Require repair or replacement
Backing plate broken	A	Require replacement
Backing plate cracked	B	Require repair or replacement
Corroded, affecting structural integrity	A	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Shoe lands worn	A	Require repair or replacement

## BLEEDER SCREW

Condition	Code	Procedure
Bent	A	Require replacement

Condition	Code	Procedure
Broken	A	Require replacement
Incorrect	B	Require replacement of stud
Loose	A	Require repair or replacement of affected component
Nut flats rounded	A	Require replacement of nut
seized	A	Require replacement of nut and/or stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

### **BRAKE ABS ACTIVE LIGHT (BLUE)**

Condition	Code	Procedure
Bulb burned out	A	Require replacement
Light does not come on during bulb check	Â	Further inspection required to determine cause
Light flashes	Â	Further inspection required to determine cause
Light stays on after initial bulb check	Â	Further inspection required to determine cause

### **BRAKE FLUID**

**NOTE:** Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS. DOT 3, DOT 4, and DOT 5.1 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid type is normally stamped on the master cylinder cover.

**NOTE:** Fluid Flush - a process using a sufficient volume of fluid to help remove contaminants and replacing the contaminated fluid with new fluid of the same type and specification. At times a chemical may be used to enhance removal.

**NOTE:** Fluid Exchange/Replace - draining (evacuating) old fluid and replacing it with new fluid of the correct type and specification.

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
At or beyond OEM service interval	3	Suggest fluid exchange/replacement
Brake fluid type incorrect	B	Require flushing and refilling
<b>NOTE:</b> For example, DOT fluid lower than specified for the vehicle or silicone brake fluid (DOT 5) in an ABS system		
Contaminated, for example, fluid other than brake fluid present	A	Require service
<b>NOTE:</b> If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.		
Contaminated, for example, fluid other than brake fluid present	B	Require service

Condition	Code	Procedure
<b>NOTE:</b> If a fluid other than brake fluid is present in the brake system which <b>DOES NOT</b> affect the rubber parts, the required service is to flush and fill with the correct brake fluid.		
Corrosion inhibitors depleted	B	Require fluid exchange/replacement
<b>NOTE:</b> A copper content of 200 ppm or greater indicates a depletion of corrosion inhibitors in the brake fluid.		
Fluid discolored	Â	No service suggested or required
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Hydraulic component overhaul or replacement	3	Suggest flushing and refilling
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of gasket
<b>NOTE:</b> This condition may indicate contaminated brake fluid. Further inspection required.		

## BRAKE FRICTION MATERIAL

**NOTE:** Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
<b>NOTE:</b> Identify and repair cause of contamination prior to replacing friction material.		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
<b>NOTE:</b> When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.		
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement



Condition	Code	Procedure
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	Ā	Further inspection required
<p><b>NOTE:</b> Some vehicles use friction materials that are tapered by design. Refer to specific vehicle application. If not normal, require replacement of friction materials and correction of cause.</p>		
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	Ā	Replacement of friction material not suggested or required Further inspection required. See Calipers and Caliper Hardware.
<p><b>NOTE:</b> Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.</p>		
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
<p><b>NOTE:</b> The pad-wear indicator light may come on due to other electrical problems.</p>		
Wear indicator device (mechanical ) broken	Ā	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is Suggested.</p>		
Wear indicator device (mechanical) bent	Ā	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material, must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is Suggested.</p>		
Wear indicator device (mechanical) contacts rotor	Ā	Further inspection required
<p><b>NOTE:</b> The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested.</p>		
Wear indicator device (mechanical) contacts rotor	Ā	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured.</p>		
Worn close to minimum specifications	1	Suggest replacement
<p><b>NOTE:</b> When the part appears to be close to the end of its useful life, replacement may be suggested.</p>		
Worn to, or below minimum specifications	B	Require replacement

## BRAKE ON - OFF SWITCH

Condition	Code	Procedure
Bent, affecting performance	B	Require replacement
Broken	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector missing	C	Require replacement
Missing	C	Require replacement
Out of adjustment	B	Require adjustment or replacement
Output signal incorrect	B	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## BRAKE PADS

**NOTE:** Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
<b>NOTE:</b> <b>Identify and repair cause of contamination prior to replacing friction material.</b>		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
<b>NOTE:</b> <b>When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.</b>		
Out of Adjustment	B	Require Adjustment or Repair
<b>NOTE:</b> <b>Determine cause and correct prior to adjustment or repair</b>		

Condition	Code	Procedure
Out of Adjustment	B	Require Adjustment or Repair
<b>NOTE:</b> Determine cause and correct prior to adjustment or repair		
Out of Adjustment	B	Require Adjustment or Repair
<b>NOTE:</b> Determine cause and correct prior to adjustment or repair		
Out of Adjustment	B	Require Adjustment or Repair
<b>NOTE:</b> Determine cause and correct prior to adjustment or repair		
Out of Adjustment	B	Require Adjustment or Repair
<b>NOTE:</b> Determine cause and correct prior to adjustment or repair		
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	B	Suggest replacement
<b>NOTE:</b> Some vehicles use pads that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of pads.		
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	Â	Replacement of friction material not suggested or required Further inspection required See Calipers and Caliper Hardware
<b>NOTE:</b> Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.		
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
<b>NOTE:</b> The pad-wear indicator light may come on due to other electrical problems.		
Wear indicator device (mechanical ) broken	Â	Further inspection required
<b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested		
Wear indicator device (mechanical) bent	Â	Further inspection required

Condition	Code	Procedure
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested</p>		
Wear indicator device (mechanical) contacts rotor	Ā	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested</p>		
Worn close to minimum specifications	1	Suggest replacement
<p><b>NOTE:</b> When the part appears to be close to the end of its useful life, replacement may be suggested.</p>		
Worn to, or below minimum specifications	B	Require replacement

## BRAKE PEDALS

Condition	Code	Procedure
Bent, affecting performance	A	Require repair or replacement
Broken	A	Require repair or replacement
Pedal pad missing	C	Require replacement of pedal pad
Pedal pad worn	1	Suggest replacement
Pivot bushings worn, affecting performance	A	Require replacement of pivot bushings

## BRAKE SHOE HARDWARE

**NOTE:** See also Self-Adjusting Systems.

Condition	Code	Procedure
Broken	A	Require replacement
Distorted	A	Require replacement
Missing	C	Require replacement
Surfaces rust-pitted	1	Suggest replacement
Worn, affecting performance	A	Require replacement

## BRAKE SHOES

**NOTE:** Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
<p><b>NOTE:</b> Identify and repair cause of contamination prior to replacing friction material.</p>		

Condition	Code	Procedure
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
<b>NOTE:</b> When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.		
Out of Adjustment	B	Require adjustment or repair
<b>NOTE:</b> Determine cause and correct prior to adjustment or repair		
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	Â	Further inspection required
<b>NOTE:</b> Some vehicles use shoes that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of shoes.		
Thickness of one shoe is greater than opposite shoe in the same drum (uneven wear)	Â	Replacement of friction material not suggested or required. Further inspection required.
Worn close to minimum specifications	1	Suggest replacement
<b>NOTE:</b> When the part appears to be close to the end of its useful life, replacement may be suggested.		
Worn to, or below minimum specifications	B	Require replacement

## BRAKE STOPLIGHT SWITCHES

Condition	Code	Procedure
Bent, affecting performance	B	Require replacement
Broken	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Connector missing	C	Require replacement
Leaking	B	Require Repair or Replacement

Condition	Code	Procedure
Missing	C	Require replacement
Out of adjustment	B	Require adjustment or replacement
Output signal incorrect	B	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### **BRAKE WARNING LIGHT (AMBER)**

Condition	Code	Procedure
Bulb burned out	A	Require replacement
Warning light does not come on during bulb check	Â	Further inspection required to determine cause
Warning light flashes	Â	Further inspection required to determine cause
Warning light stays on after initial bulb check	Â	Further inspection required to determine cause

### **BRAKE WARNING LIGHT (RED)**

Condition	Code	Procedure
Bulb burned out	A	Require replacement
Warning light does not come on during bulb check	Â	Further inspection required to determine cause
Warning light flashes	Â	Further inspection required to determine cause
Warning light stays on after initial bulb check	Â	Further inspection required to determine cause

### **BULB SOCKETS**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Bulb seized in socket	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of socket.</b>		
Burned, not affecting performance	2	Suggest repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of socket</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Leaking	B	Require repair or replacement
Melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## BULBS AND LEDS

**NOTE:** Does not include soldered-in components.

Condition	Code	Procedure
Application incorrect	B	Require replacement
<b>NOTE:</b> <b>Application incorrect includes wrong bulb coating or color.</b>		
Base burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Burned out	A	Require replacement
Intermittent	A	Require replacement

Condition	Code	Procedure
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## CALIPER HARDWARE

Condition	Code	Procedure
Bent	A	Require repair or replacement
Broken	A	Require repair or replacement
Corroded, affecting performance	A	Require repair or replacement
Dust boots on slider pin (bolt) missing	C	Require replacement of boots
Dust boots on slider pin (bolt) torn	A	Require replacement of boots
Missing	C	Require replacement
Shim (OE standard) missing	C	Require replacement
<b>NOTE:</b> <b>Aftermarket shims may be suggested to reduce noise.</b>		
Shim bent	A	Require removal or replacement
<b>NOTE:</b> <b>Removal is acceptable if shim is not OEM.</b>		
Shim out of position	B	Require removal or replacement
<b>NOTE:</b> <b>Removal is acceptable if shim is not OEM.</b>		
Shim worn	A	Require removal or replacement
<b>NOTE:</b> <b>Removal is acceptable if shim is not OEM.</b>		
Slider pin (bolt) bent	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) rust-pitted	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) worn	A	Require replacement of slider pin or bolt and lubricants
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

## CALIPER MOUNTING PIN

Condition	Code	Procedure
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Condition	Code	Procedure
Slider pin (bolt) bent	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) rust-pitted	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) worn	A	Require replacement of slider pin or bolt and lubricants

### CALIPER PISTON

Condition	Code	Procedure
Broken	A	Require repair or replacement
Corroded, affecting performance	A	Require repair or replacement
Worn, affecting performance	A	Require replacement

### CALIPER SHIM

Condition	Code	Procedure
Shim (OEM standard) missing	C	Require replacement
Shim bent	A	Require removal or replacement
Shim out of position	B	Require removal or replacement
Shim worn	A	Require removal or replacement

### CALIPER SLIDER PIN (BOLT) DUST BOOT

Condition	Code	Procedure
Dust boots on slider pin (bolt) missing	C	Require replacement of boots
Dust boots on slider pin (bolt) torn	A	Require replacement of boots
Missing	C	Require replacement

### CALIPER SLIDER PIN (BOLT)

Condition	Code	Procedure
Broken	A	Require repair or replacement
Missing	C	Require replacement
Slider pin (bolt) bent	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) rust-pitted	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) worn	A	Require replacement of slider pin or bolt and lubricants
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

### CALIPERS

**NOTE:** You are not required to replace or rebuild calipers in axle sets. However, when replacing or rebuilding a caliper due to the conditions that follow, you may suggest servicing, rebuilding, or replacement of the other caliper (on the same axle) for improved performance and preventive maintenance (for example, the part is close to the end of its useful life, replacing the caliper may extend pad life, or contribute to more balanced braking). When installing loaded calipers, it is required that friction material be matched in axle sets for consistent braking characteristics.

Condition	Code	Procedure

Condition	Code	Procedure
Bleeder port damaged	A	Require repair or replacement of caliper
Bleeder screw broken off in caliper	A	Require repair or replacement of caliper
<b>NOTE:</b> Only required if hydraulic system must be opened.		
Bleeder screw plugged	A	Require repair or replacement of bleeder screw
<b>NOTE:</b> Only required if hydraulic system must be opened.		
Bleeder screw seized	A	Require replacement of caliper
<b>NOTE:</b> Seized is defined as a bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.		
Casting corroded, affecting structural integrity	A	Require replacement
Casting damaged, affecting structural integrity	A	Require replacement
Dust boot around caliper piston torn	A	Require replacement of dust boot
Leaking	A	Require repair or replacement
Mounting pin threads damaged	A	Require repair or replacement of component with damaged threads
Mounting pin threads stripped (threads missing)	A	Require repair or replacement of component with stripped threads
Mounting pin threads stripped in caliper bracket (threads missing)	A	Require repair or replacement of caliper bracket
Mounting pin threads stripped in steering knuckle (threads missing)	A	Require repair or replacement of steering knuckle
Parking brake cable support, lever, or return spring bent	A	Require replacement of parts
Parking brake cable support, lever, or return spring broken	A	Require replacement of parts
Parking brake mechanism in caliper inoperative	A	Require repair or replacement
Piston corroded (pitted or peeling chrome plating)	B	Require replacement of piston and rebuilding or replacement of caliper
Piston damaged, affecting performance	B	Require replacement of piston and rebuilding or replacement of caliper
Piston damaged, not affecting performance	Â	No service suggested or required
Piston finish worn off	B	Require replacement of piston and rebuilding or replacement of caliper
Piston sticking	A	Require rebuilding or replacement of caliper
Slide mechanism sticking	A	Require repair or replacement of slide mechanism

## COMBINATION VALVE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## CONTROLLERS

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
<b>NOTE:</b> <b>Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).</b>		
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
Electro Magnetic Brake Inoperative	A	Require repair or replacement
Expansion Spring Brake Inoperative	A	Require repair or replacement
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Pulse Width Modulation Valve Inoperative	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### DIGITAL RATIO AXLE CONTROLLERS AND BUFFERS (DRAB AND DRAM)

Condition	Code	Procedure
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector missing	C	Require replacement
Electro Magnetic Brake Inoperative	A	Require repair or replacement
Expansion Spring Brake Inoperative	A	Require repair or replacement
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Pulse Width Modulation Valve Inoperative	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### DISABLE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware



Condition	Code	Procedure
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## DRUMS

**NOTE:** Determine the need to recondition based upon individual drum conditions that follow. Friction material replacement does not require drum reconditioning unless other justifications exist. Do not recondition new drums unless they are being pressed or bolted onto an existing hub. It is not necessary to replace drums in axle sets. However, when replacing or reconditioning a drum due to the conditions that follow, you may suggest reconditioning of the other drum on the same axle to eliminate uneven braking behavior. Always wash drums after servicing or before installing.

Condition	Code	Procedure
Balance weight missing Affecting performance	A	Require repair or replacement
Balance weight missing Not affecting performance	Â	No service suggested or required

Condition	Code	Procedure
Bell-mouthed, affecting performance	A	Require reconditioning or replacement
Cooling fin broken	Â	No service suggested or required
Cracked	B	Require replacement
Drum diameter is greater than OEM ""machine to"" specifications but less than ""discard at"" specifications, and the drum does not require reconditioning	1	Suggest replacement
<p><b>NOTE:</b>  <b>Only applies to vehicles for which OEM ""machine to"" specifications exist. If OEM does not supply ""machine to"" specifications, the drum may be worn to discard specifications</b></p>		
Drum diameter will exceed OEM ""machine to"" specifications after required reconditioning	B	Require replacement
<p><b>NOTE:</b>  <b>If OEM does not supply ""machine to"" specifications, you may machine to discard specifications.</b></p>		
Hard -spotted	2	Suggest reconditioning or replacement
Measured diameter is greater than OEM discard specifications	B	Require replacement
Out-of-round (runout), affecting performance	A	Require reconditioning or replacement
Out-of-round (runout), exceeding manufacturer's specifications	B	Require reconditioning or replacement
Scored	B	Require reconditioning or replacement
Surface threaded due to improper machining	B	Require reconditioning or replacement
Tapered, affecting performance	A	Require reconditioning or replacement

## ELECTRICAL BRAKE PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<p><b>NOTE:</b>  <b>Determine cause and correct prior to repair or replacement of part.</b></p>		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
<p><b>NOTE:</b>  <b>Determine cause and correct prior to repair or replacement of part.</b></p>		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ELECTRICAL PARK MOTOR

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ELECTRICAL PUMPS AND MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ELECTRO-MAGNETIC INTERFERENCE

**NOTE:** An engineering term used to designate interference in a piece of electronic equipment caused by another piece of electronic or other equipment.

## ELECTRONIC BRAKE CONTROL MODULATOR

**NOTE:** Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not possible, then replace the modulator assembly.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Connector missing	C	Require replacement
Disabled	A	Require repair or replacement
Electrical failure	A	Require repair or replacement
External leak	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Internal leak	A	Require repair or replacement
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Valve stuck	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ELECTRONIC BRAKE DISTRIBUTION

**NOTE:** EBD adjusts braking pressure front-to-rear, based on the weight distribution of passengers and/or cargo. Weight distribution is typically determined via the relative difference in rotational speed of the front and rear wheels. Greater braking pressure, (and subsequently stopping power), is directed to the rear wheels when loads in the rear are heavier. This contributes to a more controlled stop, and minimizes ""brake dive"" during hard braking.

## ELECTRONIC BRAKE TRACTION CONTROL MODULE

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ELECTRONIC CONTROLLERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
<b>NOTE:</b> <b>Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).</b>		
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
Electro Magnetic Brake Inoperative	A	Require repair or replacement
Expansion Spring Brake Inoperative	A	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Pulse Width Modulation Valve Inoperative	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ELECTRONIC TRACTION CONTROL

**NOTE:** The further development of the electronic locking differential. It electronically reduces engine torque, preventing engine and wheel braking from working against each other. (Example: a driver continues to apply the accelerator while the electronic traction control is attempting to redistribute excess engine torque through braking). This system works in unison with some OEM's stability control systems.

## EXTERNAL BRAKE CABLE

Condition	Code	Procedure
Cable improperly adjusted	B	Require cable adjustment
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly
Cable sticking	A	Require cable lubrication
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly

## FLOW CONTROL VALVE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

### NOTE:

**Determine cause and correct prior to repair or replacement of part.**

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## FLUID LEVEL SENSOR SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Float saturated	A	Require replacement
Leaking	A	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement

Condition	Code	Procedure
Worn	1	Suggest replacement

## FLUID

**NOTE:** Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS. DOT 3, DOT 4, and DOT 5.1 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid type is normally stamped on the master cylinder cover.

**NOTE:** Fluid Flush - a process using a sufficient volume of fluid to help remove contaminants and replacing the contaminated fluid with new fluid of the same type and specification. At times a chemical may be used to enhance removal.

**NOTE:** Fluid Exchange/Replace - draining (evacuating) old fluid and replacing it with new fluid of the correct type and specification.

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
At or beyond OEM service interval	3	Suggest fluid exchange/replacement
Brake fluid type incorrect	B	Require flushing and refilling
<p><b>NOTE:</b> For example, DOT fluid lower than specified for the vehicle or silicone brake fluid (DOT 5) in an ABS system.</p>		
Contaminated, for example, fluid other than brake fluid present	B	Require service
<p><b>NOTE:</b> If a fluid other than brake fluid is present in the brake system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct brake fluid.</p>		
Contaminated, for example, fluid other than brake fluid present	A	Require service
<p><b>NOTE:</b> If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</p>		
Corrosion inhibitors depleted	B	Require fluid exchange/replacement
<p><b>NOTE:</b> A copper content of 200 ppm or greater indicates a depletion of corrosion inhibitors in the brake fluid.</p>		
Fluid discolored	Â	No service suggested or required
<p><b>NOTE:</b> Further testing necessary to determine condition of fluid.</p>		
Hydraulic component overhaul or replacement	3	Suggest flushing and refilling with correct fluid
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of gasket

Condition	Code	Procedure
<b>NOTE:</b> This condition may indicate contaminated brake fluid.		

#### FOUR WHEEL DRIVE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

**FRICION MATERIAL**

**NOTE:** Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
<b>NOTE:</b> Identity and repair cause of contamination prior to replacing friction material.		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
<b>NOTE:</b> When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.		
Out of Adjustment	B	Require Adjustment or Repair
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	B	Suggest replacement
<b>NOTE:</b> Some vehicles use pads that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of pads.		
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	Â	Replacement of friction material not suggested or required. Further inspection required.
<b>NOTE:</b> Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.		
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
<b>NOTE:</b> The pad-wear indicator light may come on due to other electrical problems.		
Wear indicator device (mechanical) bent	Â	Further inspection required



Condition	Code	Procedure
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is Suggested.</p>		
Wear indicator device (mechanical) broken	Â	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured.</p>		
Wear indicator device (mechanical) broken	Â	Further inspection required
<p><b>NOTE:</b> The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested.</p>		
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is Suggested.</p>		
Worn close to minimum specifications	1	Suggest replacement
<p><b>NOTE:</b> When the part appears to be close to the end of its useful life, replacement may be suggested.</p>		
Worn to, or below minimum specifications	B	Require replacement

## G SENSORS

Condition	Code	Procedure
Broken	A	Require replacement
Connector loose	A	Require repair or replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Out of position	B	Require re-positioning to vehicle manufacturer's specifications
Output signal incorrect	B	Require replacement

## GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<p><b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.</p>		

## GRAVITATIONAL SWITCHES

Condition	Code	Procedure
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Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## GREASE SEAL

Condition	Code	Procedure
Leaking	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

### HEIGHT SENSING PROPORTIONING VALVE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### HIGH PRESSURE ACCUMULATOR

Condition	Code	Procedure
Leaking	A	Require replacement
Missing	C	Require replacement
Pre-charge incorrect	B	Require replacement

### HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blistered	B	Require replacement

Condition	Code	Procedure
Expansion affecting performance	A	Require Replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Incorrectly secured	B	Require repair
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require repair

## HUB

Condition	Code	Procedure
Worn or damaged affecting performance	A	Require repair or replacement

## HYDRAULIC CONTROL UNIT

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement

### NOTE:

**Determine cause and correct prior to replacement of part.**

Connector missing	C	Require replacement
Disabled	A	Require repair or replacement
Electrical failure	A	Require repair or replacement
External leak	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Inoperative	A	Require repair or replacement

### NOTE:

**Inoperative includes intermittent operation.**

Internal leak	A	Require repair or replacement
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement

### NOTE:

**Determine cause and correct prior to repair or replacement of part.**

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Valve stuck	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## HYDRAULIC MODULATORS

**NOTE:** Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not possible, then replace the modulator assembly.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Connector missing	C	Require replacement
Disabled	A	Require repair or replacement
Electrical failure	A	Require repair or replacement
External leak	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Internal leak	A	Require repair or replacement
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Valve stuck	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## HYDRO-BOOSTERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector missing	C	Require replacement
Does not apply assist, or inadequate assist	A	Require repair or replacement
Leaking	B	Require repair or replacement
Leaks fluid at fitting	B	Require tightening or replacement
Leaks fluid at unit	B	Require repair or replacement
Leaks fluid from pressure hose(s)	B	Require replacement of hose(s)
Leaks fluid into passenger compartment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### **HYDRO-ELECTRIC BOOSTERS (POWERMASTER)**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Does not apply assist, or inadequate assist	A	Require repair or replacement
Leaking	B	Require repair or replacement
Leaks fluid at fitting	B	Require tightening or replacement
Leaks fluid at unit	B	Require repair or replacement
Leaks fluid from pressure hose(s)	B	Require replacement of hose(s)
Leaks fluid into passenger compartment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## IGNITION DISABLE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

### LAMP DRIVER RELAY

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### LATERAL ACCELERATION SWITCHES

Condition	Code	Procedure
Broken	A	Require replacement
Connector loose	A	Require repair or replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Out of position	B	Require re-positioning to vehicle manufacturer's specifications
Output signal Incorrect	B	Require replacement

### LEDS

**NOTE:** Does not include soldered-in components.

Condition	Code	Procedure
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Condition	Code	Procedure
Application incorrect	B	Require replacement
<b>NOTE:</b> <b>Application incorrect includes wrong bulb coating or color.</b>		
Base burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Burned out	A	Require replacement
Intermittent	A	Require replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## LENSES

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Cracked	B	Require replacement
Discolored	A	Require replacement
Leaking	B	Require repair or replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	2	Suggest replacement
Missing	C	Require replacement

## LOW PRESSURE ACCUMULATOR

Condition	Code	Procedure
Leaking	A	Require replacement
Missing	C	Require replacement
Pre-charge incorrect	B	Require replacement

## LUG NUT

Condition	Code	Procedure
Lug nut flats rounded	A	Require replacement of nut
Lug nut installed backward	B	Require repair
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut seized	A	Require replacement of nut and/or stud
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

## MASTER CYLINDER COVER GASKET

Condition	Code	Procedure
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of the gasket
<p><b>NOTE:</b> This condition may indicate contaminated brake fluid. See Brake Fluid.</p>		

## MASTER CYLINDERS

Condition	Code	Procedure
Brake fluid leaking from rear of master cylinder bore	B	Require repair or replacement
Brake pedal drops intermittently	A	Require repair or replacement
<p><b>NOTE:</b> This condition may be normal on some vehicles equipped with anti-lock brakes.</p>		
Fluid level low	Â	Further inspection required
<p><b>NOTE:</b> Refer to OEM procedures for adjusting low fluid level. Inspect for brake hydraulic leaks and friction material wear.</p>		
Internal valve failure	A	Require repair or replacement
Master cylinder leaking brake fluid internally	A	Require repair or replacement
Piston does not return	A	Require repair or replacement
Ports plugged	A	Require repair or replacement
Pushrod out of adjustment	B	Require Repair or Replacement
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of the gasket
<p><b>NOTE:</b> This condition may indicate contaminated brake fluid. See Brake Fluid.</p>		

## MODULATORS

**NOTE:**

Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not

Condition	Code	Procedure
possible, then replace the modulator assembly.	Â	Â
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Disabled	A	Require repair or replacement
Electrical failure	A	Require repair or replacement
External leak	A	Require repair or replacement
Housing cracked	A	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Internal leak	A	Require repair or replacement
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Valve stuck	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

**MOTOR PACK**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, not affecting performance	2	Require repair or replacement
Terminal loose not affecting performance	1	Suggest repair or replacement
Terminal Loose, Affecting Performance	B	Require repair or replacement

## MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
<b>NOTE:</b> <b>Determine source of contamination. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## PADS

**NOTE:** Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
<b>NOTE:</b> Identify and repair cause of contamination prior to replacing friction material.		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
<b>NOTE:</b> When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.		
Out of Adjustment	A	Require Repair or Replacement
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement

Condition	Code	Procedure
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	Â	Further inspection required
<p><b>NOTE:</b> Some vehicles use pads that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of pads.</p>		
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	Â	Replacement of friction material not suggested or required Further inspection required. See Calipers and Caliper Hardware.
<p><b>NOTE:</b> Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.</p>		
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
<p><b>NOTE:</b> The pad-wear indicator light may come on due to other electrical problems.</p>		
Wear indicator device (mechanical ) broken	Â	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested</p>		
Wear indicator device (mechanical) bent	Â	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested</p>		
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required
<p><b>NOTE:</b> Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested</p>		
Worn close to minimum specifications	1	Suggest replacement
<p><b>NOTE:</b> When the part appears to be close to the end of its useful life, replacement may be suggested.</p>		
Worn to, or below minimum specifications	B	Require replacement

## PARKING BRAKE CABLE

Condition	Code	Procedure
Cable improperly adjusted	B	Require cable adjustment
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly
Cable sticking	A	Require cable lubrication
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly

### PARKING BRAKE MECHANISM

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement of inoperative parts
Parking brake parts bent	B	Require repair or replacement of bent parts
Parking brake parts broken	A	Require replacement of broken parts
Parking brake parts missing	C	Require replacement of missing parts
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### PARKING BRAKE SHOES

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
<b>NOTE:</b> <b>Identify and repair cause of contamination prior to replacing friction material.</b>		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
<b>NOTE:</b> <b>When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.</b>		
Out of Adjustment	B	Require adjustment or repair
<b>NOTE:</b> <b>Determine cause and correct prior to adjustment or repair</b>		
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement

Condition	Code	Procedure
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	Â	Further inspection required
<p><b>NOTE:</b> Some vehicles use shoes that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of shoes.</p>		
Thickness of one shoe is greater than opposite shoe in the same drum (uneven wear)	Â	Replacement of friction material not suggested or required Further inspection required
Worn close to minimum specifications	1	Suggest replacement
<p><b>NOTE:</b> When the part appears to be close to the end of its useful life, replacement may be suggested.</p>		
Worn to, or below minimum specifications	B	Require replacement

### PARKING BRAKE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Burned, not affecting performance	2	Suggest repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<p><b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.</p>		
Melted, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Melted, not affecting performance	2	Suggest repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Missing	C	Require replacement

Condition	Code	Procedure
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## PARKING BRAKE SYSTEMS

**NOTE:** The parking brake is an integral part of the brake system. It is important that the parking brake function properly when brake service is performed.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cable improperly adjusted	B	Require cable adjustment
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly
Cable sticking	A	Require cable lubrication
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly
Inoperative	A	Require replacement of inoperative parts
<b>NOTE:</b> <b>Inoperative Includes intermittent operation.</b>		
Parking brake parts bent	B	Require repair or replacement of bent parts
Parking brake parts broken	A	Require replacement of broken parts
Parking brake parts missing	C	Require replacement of missing parts
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## PEDAL TRAVEL SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement

Condition	Code	Procedure
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## PEDALS

Condition	Code	Procedure
Bent, affecting performance	A	Require repair or replacement
Broken	A	Require repair or replacement
Pedal pad missing	C	Require replacement of pedal pad
Pedal pad worn	1	Suggest replacement
Pivot bushings worn, affecting performance	A	Require replacement of pivot bushings

## POWER DISTRIBUTION CENTER

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware



Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of fuse box.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of fuse box.</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Melted, not affecting performance	2	Suggest replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## POWERMASTER

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Does not apply assist, or inadequate assist	A	Require repair or replacement
Leaking	B	Require repair or replacement
Leaks fluid at fitting	B	Require tightening or replacement
Leaks fluid at unit	B	Require repair or replacement
Leaks fluid from pressure hose(s)	B	Require replacement of hose(s)
Leaks fluid into passenger compartment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### PRESSURE DIFFERENTIAL SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		

Condition	Code	Procedure
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

### PRESSURE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## PRESSURE TRANSDUCERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Drive mechanism damaged, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Further inspection required to determine cause.		
Drive mechanism damaged, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Further inspection required to determine cause.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation or out of specification.		
Leaking (vacuum/fluid/air)	A	Require replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	Â	No service suggested or required
Linkage binding, affecting performance	A	Require repair or replacement of linkage

Condition	Code	Procedure
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Out of adjustment	B	Further inspection required
<b>NOTE:</b> <b>Follow OEM recommended adjustment procedures. Repair or replace if out of specification.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## PROPORTIONING VALVE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
<b>NOTE:</b> <b>Determine source of contamination. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## RELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware



Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## RELUCTOR (SPEED) RING

**NOTE:** If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

## ROTORS

**NOTE:** Determine the need to recondition based upon individual rotor conditions that follow. Friction material replacement does not require rotor reconditioning unless other justifications exist. Do not recondition new rotors unless it does not meet installed OEM specifications. It is not necessary to replace rotors in axle sets unless required by the vehicle manufacturer. However, when replacing or reconditioning a rotor due to the conditions that follow, you may suggest reconditioning of the other rotor on the same axle to eliminate uneven braking behavior. Determine the need to replace based upon the individual rotor conditions that follow. Reconditioning is defined as machining and block sanding, or block sanding only. Block sanding is defined as using 120-150 grit sandpaper with moderate to heavy force for 60 seconds per side. Always wash rotors after servicing or before installing.

Condition	Code	Procedure

Condition	Code	Procedure
Corrosion affecting structural integrity	A	Require replacement
<p><b>NOTE:</b>  <b>Examples of severe corrosion are: composite plate separated from friction surfaces and cooling fins cracked or missing.</b></p>		
Cracked	B	Require replacement
Hard spots	2	Suggest reconditioning or replacement of rotor according to OEM specifications
Lateral runout (wobble) exceeds OEM specifications	B	Require re-indexing, reconditioning, or replacement according to specifications
Measured thickness is less than OEM discard specifications	B	Require replacement
Rotor thickness is less than OEM "machine to" specifications but thicker than "discard at"	1	Suggest replacement
specifications, and rotor does not require reconditioning	Â	Â
<p><b>NOTE:</b>  <b>Only applies to vehicles for which OEM "machine to" specifications exist. If OEM does not supply "machine to" specifications, the rotor may be worn to discard specifications.</b></p>		
Rotor thickness will be less than OEM "machine to" specifications after required reconditioning	B	Require replacement
<p><b>NOTE:</b>  <b>If OEM does not supply "machine to" specifications, you may machine to discard specifications.</b></p>		
Surface finish incorrect	B	Require recondition or replacement
Surface is rust-pitted	B	Require reconditioning or replacement of rotor according to OEM specifications
Surface is scored	B	Require reconditioning or replacement of rotor according to OEM specifications
<p><b>NOTE:</b>  <b>Scoring is defined as grooves or ridges in the friction contact surface. Some vehicle manufacturers require machining when scoring exceeds their allowable specifications.</b></p>		
Tapered affecting performance	A	Require reconditioning or replacement
Thickness variation (parallelism) exceeds OEM specifications	B	Require reconditioning or replacement of rotor according to OEM specifications

### SELF-ADJUSTING SYSTEMS

Condition	Code	Procedure
Bent	A	Require repair or replacement of bent part
Broken	A	Require repair or replacement of broken part

Condition	Code	Procedure
Inoperative	A	Require repair or replacement of inoperative parts
<b>NOTE:</b> Inoperative includes intermittent operation.		
Missing	C	Require replacement of missing part
Star wheel does not turn freely	A	Require repair or replacement

## SHOE HARDWARE

**NOTE:** See also Self-Adjusting Systems.

Condition	Code	Procedure
Broken	A	Require replacement
Distorted	A	Require replacement
Missing	C	Require replacement
Surfaces rust-pitted	1	Suggest replacement
Worn, affecting performance	A	Require replacement

## SHOES

**NOTE:** Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
<b>NOTE:</b> Identify and repair cause of contamination prior to replacing friction material.		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
<b>NOTE:</b> When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.		
Out of Adjustment	B	Require Adjustment or Repair
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	B	Suggest replacement

Condition	Code	Procedure
<b>NOTE:</b> Some vehicles use shoes that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of shoes.		
Thickness of one shoe is greater than opposite shoe in the same drum (uneven wear)	Â	Replacement of friction material not suggested or required. Further inspection required.
<b>NOTE:</b> Uneven shoe thickness is normal on some vehicles. Refer to specific vehicle applications.		
Worn close to minimum specifications	1	Suggest replacement
<b>NOTE:</b> When the part appears to be close to the end of its useful life, replacement may be suggested.		
Worn to, or below minimum specifications	B	Require replacement

## SOCKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Bulb seized in socket	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Leaking	B	Require repair or replacement
Melted	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### **SPEED SENSOR (RELUCTOR) RING**

**NOTE:** If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

### **SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE)**

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment or replacement
<b>NOTE:</b> If a sensor is not adjustable, further inspection is required to identify and correct cause.		
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as metal particles or water. Require repair or replacement		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Leaking	B	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Sensor housing cracked	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### STAR WHEEL

Condition	Code	Procedure
Bent	A	Require repair or replacement of bent part
Broken	A	Require repair or replacement of broken part
Inoperative	A	Require repair or replacement of inoperative parts
Missing	C	Require replacement of missing part
Star wheel does not turn freely	A	Require repair or replacement

### STEEL BRAKE LINES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting structural integrity	A	Require replacement
Fitting incorrect (for example, compression fitting)	B	Require replacement
Flare type incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement



Condition	Code	Procedure
Line material incorrect (copper, etc.)	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require routing correction
Rust-pitted	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## STOPLIGHT SWITCHES

Condition	Code	Procedure
Bent, affecting performance	B	Require replacement
Broken	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Leaking	B	Require Repair or Replacement
Missing	C	Require replacement
Out of adjustment	B	Require adjustment or replacement
Output signal incorrect	B	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## STROKE SENSOR

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	A	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## TIRES

**NOTE:** Consult the vehicle owner's manual or vehicle placard for correct size, speed ratings, and inflation pressure of the original tires.

Condition	Code	Procedure
Tire diameter incorrect, affecting ABS or TCS	A	Require replacement
Tire pressure incorrect, affecting ABS or TCS	A	Require repair or replacement
Tire size incorrect, affecting ABS or TCS	A	Require replacement

## TONE RING

**NOTE:** If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

## TOOTHED RINGS (TONE WHEEL)

**NOTE:** If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

## TRACTION CONTROL SYSTEM (TCS)

**NOTE:** The further development of the electronic locking differential. It electronically reduces engine torque, preventing engine and wheel braking from working against each other. (Example: a driver continues to apply the accelerator while the electronic traction control is attempting to redistribute excess engine torque through braking). This system works in unison with some OEM's stability control systems.

## TRANSFER TUBES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting structural integrity	A	Require replacement
Fitting incorrect (for example, compression fitting)	B	Require replacement
Flare type incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Line material incorrect (copper, etc.)	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require routing correction
Rust-pitted	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## VACUUM BOOSTERS

Condition	Code	Procedure
Applies too much assist (oversensitive)	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Auxiliary vacuum pump inoperative	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Check valve grommet deteriorated, affecting performance	A	Require replacement of grommet
Check valve grommet deteriorated, not affecting performance	1	Suggest replacement of grommet
Check valve inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Check valve leaking	A	Require replacement of check valve
Check valve missing	C	Require replacement of check valve
Check valve noisy	2	Suggest replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector missing	C	Require replacement
Leaking	A	Require replacement
Pushrod out of adjustment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Vacuum hose filter leaking	A	Require replacement of filter
Vacuum hose filter restricted	A	Require replacement of filter
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## VACUUM HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Incorrectly secured	B	Require repair

Condition	Code	Procedure
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require repair

## VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b>		
<b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## WEAR INDICATOR

Condition	Code	Procedure
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
Wear indicator device (mechanical ) broken	Â	Further inspection required
Wear indicator device (mechanical) bent	Â	Further inspection required
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required

## WHEEL ATTACHMENT HARDWARE

**NOTE:** For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow manufacturer's torque



specifications and tightening sequence. **DO NOT** lubricate threads unless specified by the vehicle manufacturer.

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement
<b>NOTE:</b> Some manufacturers require replacement of all studs on any wheel if two or more studs or nuts on the same wheel are broken or missing.		
Loose	A	Require repair or replacement of affected component
Lug nut flats rounded	A	Require replacement of nut
Lug nut installed backward	B	Require repair
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut seized	A	Require replacement of nut and/or stud
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

### WHEEL BEARINGS, RACES AND SEALS

**NOTE:** When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions.

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible If proper adjustment cannot be obtained, require replacement of bearing and race assembly.
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly or other damage affecting performance.	B	Require replacement of bearing and race assembly
Seal leaking	A	Require replacement of seal and inspection of bearings
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.		
Seal missing	C	Require replacement

### WHEEL CYLINDERS

**NOTE:** You are not required to replace or rebuild wheel cylinders in axle sets. However, when rebuilding or replacing a wheel cylinder due to the conditions that follow, you may suggest rebuilding or replacement of the other wheel cylinder (on the same axle) for preventive maintenance, for

example, the part is close to the end of its useful life. Determine the need to rebuild or replace based upon the individual wheel cylinder conditions.

Condition	Code	Procedure
Attaching hardware bent	B	Require replacement of bent parts
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded parts
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bleeder port damaged (if non-repairable)	A	Require replacement
Bleeder screw broken off in wheel cylinder (if non-repairable)	A	Require replacement
<b>NOTE:</b> Only required if the hydraulic system must be opened.		
Bleeder screw plugged	A	Require repair or replacement
<b>NOTE:</b> Only required if the hydraulic system must be opened.		
Bleeder screw seized	A	Require replacement
<b>NOTE:</b> Seized is defined as bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.		
Bore corroded (pitted)	B	Require replacement
Bore grooved	A	Require replacement
Bore oversized	B	Require replacement
Dust boot missing	C	Require replacement of dust boot
Dust boot torn	A	Require replacement of dust boot
Leaking	A	Require rebuilding or replacement
<b>NOTE:</b> Leaking is defined as a drop or more. Dampness is normal.		
Loose	B	Require repair or replacement
Piston corroded, affecting performance	B	Require replacement of piston and rebuilding or replacement of wheel cylinder
Piston finish worn off	B	Require replacement of piston and rebuilding or replacement of wheel cylinder
Piston stuck in bore	A	Require replacement of wheel cylinder
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## WIRING HARNESES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## YAW RATE SENSOR

Condition	Code	Procedure
Broken	A	Require replacement
Connector loose	A	Require repair or replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Out of position	B	Require re-positioning to vehicle manufacturer's specifications
Output signal incorrect	B	Require replacement

## REASON CODE EXPLANATION

Code	Reason
<b>Required</b>	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification ( Regardless Of Performance)
C	Part Is Missing
<b>Suggested/Optional</b>	

Code	Reason
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

## **AUTOMOTIVE TERMINOLOGY & DEFINITIONS**

### **ABS**

see 'anti-lock brake system "

### **ANCHOR PIN**

a component located on the brake backing plate, on which the brake shoes rotate and to which the return springs are secured.

### **ANTI-LOCK BRAKE SYSTEM (ABS)**

a computer controlled system that allows the vehicle to be controlled under heavy braking by releasing hydraulic pressure to wheels that are about to lock up and skid. Sensors located at the wheels, monitor rotating wheel speed in relation to other wheels and send the information to a control module that in turn controls a hydraulic modulator, which regulates hydraulic fluid pressure to each brake assembly.

### **ANTI-LOCK BRAKING SYSTEM (ABS)**

ABS keeps the wheels from fully locking up while braking to allow the driver to maintain steering control. Without ABS, too much force applied to the brake pedal can cause one or more wheels to stop turning (lockup) and begin skidding, greatly reducing the capability of the driver to steer. With ABS, maximum force on the brake pedal slows each wheel to the point of maximum braking - without skidding.

Since all wheels are still rolling, the driver maintains steering control within the limits of traction. Many light trucks use rear-wheel ABS to prevent rear wheel lockup.

### **BACKING PLATE**

the component to which the brake shoes, wheel cy/inder and related components are attached.

### **BLEEDER VALVE**

a valve located on disc brake calipers, wheel cylinders and some master cylinders that allows air and fluid to be removed from the brake system.

### **BRAKE DRAG**

a condition that occurs when brake pads or shoes are in continuous contact with the disc brake rotors or brake drums.

### **BRAKE DRUM**

a round cast iron housing attached to an axle shaft or spindle, on which the brake shoes press to stop its rotation.

### **BRAKE FADE**

phenomenon that takes place when the temperature of the friction surfaces increases to a point where the application of heavy pedal pressure results in little braking action.

## **BRAKE FLUID**

the hydraulic fluid used to transmit hydraulic pressure through the brake lines in a brake system.

## **BRAKE FLUSHING**

a procedure to clean the brake hydraulic system with fresh, clean fluid that should be performed whenever new parts are installed, if there is any doubt as to the grade of fluid in the system, if a glycol fluid has been mixed with a silicone-based fluid, or if the fluid has been contaminated with petroleum or mineral based fluids.

## **BRAKE HOSE**

flexible hoses that connect the brake lines on the chassis with the calipers or wheel cylinders, or the junction block on a solid axle.

## **BRAKE LINE**

metal tubing that carries the brake fluid from the master cylinder to other brake system components.

## **BRAKE PAD**

see 'disc brake pad'.

## **BRAKE ROTOR**

see 'disc brake rotor'.

## **BRAKE SHOE**

friction material that is bonded or riveted to curved metal structures and attached to the backing plate. The brake shoes press on the brake drum to stop its rotation.

## **BURNISH**

the process of polishing a part using the pressure of a sliding tool.

## **BURR**

a ragged metal edge left on a part during machining.

## **CALIPER**

see 'disc brake caliper'.

## **CHAFING**

damage or wearing away caused by friction and rubbing.

## **CHAMFER**

a bevel or taper at the edge of a hole or corner, usually cut at 45 degrees.

## **CLEARANCE**

the specified distance between two components.

## **COMBINATION VALVE**

a single unit in the hydraulic brake system that incorporates the metering and proportioning valves in conjunction with the pressure differential switch. Combination valves are categorized as being either two-function or three-function devices, depending on the number of functions they perform. A threefunction valve provides all of the aforementioned capabilities of metering, proportioning

and warning. However, the two-function unit combines either the proportioning and warning light functions or the metering and warning light operations into a single component.

## **COMPENSATING PORT**

an opening between the master cylinder bore and reservoir that allows brake fluid to return to the reservoir.

## **CONTRACTION**

a reduction in size, drawing together, narrowing, shrinking or shortening; the opposite of expansion.

## **DATA LINK CONNECTOR**

a means through which information about the state of the vehicle control system can be extracted with a scan tool. This information includes actual readouts on each sensor's input circuit and some actuator signals. It also includes any trouble codes stored. The data link connector is also used to disable the computer's ignition timing adjustments on some engines so base or reference timing can be measured with a timing light. Before OBD II, each OEM had a unique Data link Connector (DLC) and called it by a different name. With the advent of OBD-II, the DLC became standardized as a 16-pin connector to which the scan tool could be connected to read data and sometimes control outputs of the PCM.

## **DISC BRAKE CALIPER**

a hydraulically actuated device in a disc brake system that is mounted straddling the brake disc. The caliper contains at least one piston and is used to provide clamping force of the brake pads on the disc.

## **DISC BRAKE PAD**

friction material that is bonded or riveted to metal plates and mounted in the disc brake caliper. The brake pads are clamped against the disc brake rotor to stop its rotation.

## **DISC BRAKE ROTOR**

a cast iron disc mounted on the wheel hub, which is clamped by the caliper and disc brake pads to slow and stop its rotation.

## **DISC BRAKE**

a braking system that uses cast iron discs mounted on the wheel hubs, over which brake calipers are mounted. Hydraulic pressure from the brake system forces the caliper piston(s) against friction pads mounted in the calipers, which in turn clamp the brake discs, stopping their rotation.

## **DISTORTION**

warp, twist or other deformation in a part.

## **DOT**

department of transportation.

## **DRUM BRAKE**

a braking system that uses cast iron drums mounted to the wheel hubs. Hydraulic pressure from the brake system forces pistons in the wheel cylinder to press friction lined brake shoes against the inside of the drum, stopping its rotation.

## **DUAL MASTER CYLINDER**

a master cylinder that has one cylinder bore, but two pistons and two fluid reservoirs. Each piston applies hydraulic pressure to two wheels only. In the event one of the hydraulic circuits fails, the



other provides enough braking power to stop the vehicle.

## **DUO-SERVO DRUM BRAKES**

a drum brake design that provides increased stopping power due to the servo or self-energizing action of the brake shoes.

## **ELECTRONIC BRAKE-FORCE DISTRIBUTION**

operates in conjunction with ABS to balance the force applied to brakes at front and rear wheels. Can prevent over-braking, improve brake-pad life, reduce "brake fade" caused by excessive heat, and ensure peak braking efficiency in all conditions.

## **ELECTRONIC CONTROL MODULE (ECM)**

the computer in an electronic control system, also known as an electronic control unit (EGU).

## **ELECTRONIC CONTROL UNIT (ECU)**

see 'electronic control module (ECM)'.

## **ELECTRONIC STABILITY CONTROL**

the next logical evolution of ABS and traction control. It has ABS's hardware and two additional sensors: steering-wheel angle sensor, which measures the position and rate the steering-wheel is turning, and a yaw sensor, which measures the rate the vehicle is actually turning. By comparing them, the on-board computer will know if the vehicle is oversteering or understeering.

## **FEELER GAUGE**

thin metal strip manufactured in precise thickness and used to measure clearance between parts; usually part of a set.

## **FIXED CALIPER**

a brake caliper design that contains one or two pistons positioned on either side of the rotor. The caliper is rigidly attached to the spindle and the pads are applied with equal hydraulic pressure from both sides..

## **FIXED SEAL**

a type of brake caliper seal that is installed in a groove in the caliper bore.

## **FLOATING CALIPER**

a brake caliper design that uses an adapter, or anchor plate, which is bolted to the spindle. The caliper floats laterally across a pair of special bolts that are screwed into the adapter. As hydraulic pressure is applied to the piston, the inboard pad is forced against the rotor. This pressure causes the caliper to move inboard until an equal pressure is applied by the outside pad to the outer disc surface.

## **FRICTION**

the resistance to the motion of two moving objects in contact with each other.

## **GO/NO-GO GAUGE**

a measuring tool that tells if a tolerance is met or not.

## **HARD SPOT**

in area in a casting which has become harder (more dense) than the surrounding material; areas in the friction surface of a brake drum or rotor that have become harder than the surrounding metal.

## **HOLD-DOWN SPRINGS**

springs that are used to keep the brake shoes secured to the backing plate.

## **HYDRAULIC PRESSURE**

pressure exerted through a liquid.

## **HYDRO-BOOST**

a power brake system that uses power steering pump fluid pressure rather than intake manifold vacuum.

## **HYGROSCOPIC**

the ability of a material or substance to attract water.

## **ID**

inside diameter.

## **INNER BEARING RACE**

inner part of a ball or roller bearing that provides a surface for the balls or rollers to rotate.

## **INTEGRAL ABS**

an anti-lock braking system that substitutes the traditional master cylinder and power booster with a self-contained hydraulic modulator and high-pressure accumulator.

## **LEADING-TRAILING DRUM BRAKES**

a non-servo drum brake system where both brake shoes are held in place against a solidly attached anchor mounted to the bottom of the backing plate.

## **MASTER CYLINDER**

the primary fluid pressurizing device in some hydraulic systems. In automotive use, it is found in the brake and hydraulic clutch systems and is pedal-activated, either directly or through a vacuum assist unit.

## **METERING VALVE**

a valve used on front disc/rear drum brake systems for the purpose of providing a simultaneous application of the front and rear friction materials. Located in the front brake hydraulic circuit, the metering valve delays front disc brake operation until the rear brakes shoes overcome the return spring tension.

## **MILLIMETER**

the base of metric size measurement. One millimeter equals 0.039370-in. One inch is equal to 25.4 m m.

## **MODULATOR**

a component in the ABS system that contains the solenoid valves that regulate hydraulic fluid pressure to the calipers or wheel cylinders.

## **NORMAL WEAR**

the average expected wear when operating under normal conditions.

## **OEM**

original equipment manufacturer.

## **OXIDATION**

the process of combining with oxygen, resulting in rusting or burning. Rust is slow oxidation; fire is rapid oxidation.

## **PARKING BRAKE**

a system that applies the brakes mechanically through a series of linkages and cables. Depending on the vehicle, the parking brake system will either be actuated using a foot pedal or a hand-operated lever.

## **PASCAL'S LAW**

the law of physics stating that liquids are noncompressible, and that a force applied to the top of a liquid in a closed container is exerted equally in all directions.

## **PERMEABILITY**

ability of a membrane or other material to permit a substance to pass through it.

## **PITTING**

surface irregularities caused by corrosion or excess wear.

## **PLAY**

the relative movement between or among parts.

## **POWER BOOSTER**

a device that uses a diaphragm, engine vacuum and atmospheric pressure to assist the driver with brake application. Also known as a vacuum booster.

## **POWER BRAKES**

a system that uses vacuum or hydraulic pressure to assist the driver with brake application.

## **PRELOAD**

tightening a bearing a specified amount past zero lash to eliminate axial play.

## **PRESSURE DIFFERENTIAL SWITCH**

a valve and switch assembly installed in dual circuit brake systems to alert the driver in the event of a pressure loss in one of the hydraulic circuits.

## **PRIMARY SHOE**

the brake shoe in a duo-servo drum brake system that transfers part of its force to the secondary shoe. The brake shoe facing the front of the vehicle when the vehicle is moving forward.

## **PROPORTIONING VALVE**

the proportioning valve is used to control hydraulic pressure to the rear brakes. When the pressure to the rear brakes reaches a predetermined level, the proportioning valve overcomes the force of its spring-loaded piston and stops the flow of fluid to the rear brakes. This action maintains rear brake system pressure at a lower level than the front brakes, keeping the rear brakes from locking during hard stops.

## **QUICK TAKE-UP MASTER CYLINDER**

a master cylinder design that is used to prevent excessive brake pedal travel. The quick take-up master cylinder uses a larger rear cylinder bore and quick take-up valve. This arrangement provides a large volume of fluid at low pressure (light pedal application) during the initial part of the pedal stroke. Also called a step-bore master cylinder.

## **RACE**

a channel in the inner or outer ring of an anti-friction bearing in which the balls or rollers operate.

## **REGENERATIVE BRAKING**

process of recovering some of a hybrid or electric vehicle's kinetic energy by allowing the wheels to drive a traction motor as a generator, thereby producing electric power that is stored for later use. When the driver brakes, the motor becomes a generator, using the kinetic energy of the vehicle to generate electricity that can be stored in the battery for later use. Traditional friction brakes are also necessary, as well as a strategy for smoothly blending the two braking mechanisms. Regenerative and friction brakes need to be controlled electronically so that stopping ability is maximized to make the dual brake operation transparent to the driver.

## **RESIDUAL PRESSURE**

remaining or leftover pressure.

## **RETURN SPRINGS**

springs that secure the tops of the brake shoes to an anchor pin on the backing plate. These springs allow the shoes to move in and out laterally.

## **SECONDARY SHOE**

the brake shoe in a duo-servo drum brake system that receives force from the primary shoe when the brakes are applied. The secondary shoe does most of the braking when the vehicle is traveling forward, so its lining is larger than that of the primary shoe.

## **SENDING UNIT**

a mechanical, electrical, hydraulic or electromechanical device which transmits information to a gauge or other receiving unit.

## **SERVO**

a device, such as an electric motor or hydraulic piston, that is controlled by an amplified signal from a low power command device.

## **SLIDING CALIPER**

a brake caliper design that operates similarly to the floating design, however, it attaches to the anchor plate using only one attachment point.

## **SPONGINESS**

the feel of a soft or mushy brake pedal usually caused by trapped air in the hydraulic system.

## **STAR WHEEL**

the star shaped wheel that is attached to the screw of a drum brake shoe adjuster. If brake shoe-to-drum clearance is excessive, the wheel is turned by the self-adjuster lever when the brakes are applied with the vehicle in reverse, moving the brake shoes closer to the drum.

## **TAPER**

a gradual decrease in width or thickness; the difference in diameter between the cylinder bore at the bottom of the hole and the bore at the top of the hole, just below the ridge.

## **TECHNICAL SERVICE BULLETIN (TSB)**

information published by vehicle manufacturers that describe updated service procedures and service procedures that should be used to handle vehicle defects.

## **TENSION**

stress exerted on an object by pulling that tends to extend the material.

## **TOLERANCE**

the difference between the allowable maximum and minimum dimensions of a mechanical part; the basis for determining the accuracy of a fitting.

## **TORQUE SEQUENCE**

a specified order in which a component's mounting bolts should be tightened

## **TORQUE WRENCH**

a breaker bar or ratchet wrench with an indicator that measure the twisting effort applied to a fastener during tightening.

## **TORQUE**

twisting effort on a shaft or bolt.

## **UNDERSIZE**

when an inside or outside diameter has been machined to a dimension smaller than standard. Undersized bearings are used to compensate.

## **VACUUM BOOSTER**

see 'power booster'.

## **VALVE**

a device that controls the pressure, direction or rate of flow of a liquid or gas.

## **WARPAGE**

a condition that exists when a part is bent or twisted; the degree to which a part deviates from flatness.

## **WHEEL CYLINDER**

a cylinder connected to a drum brake hydraulic system. Hydraulic pressure in the system applies piston(s) in the wheel cylinder against the brake shoes, forcing the shoes against the inside of the brake drum and stopping its rotation.

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## UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

### Drive Train & Transmission Systems

## DRIVE TRAIN & TRANSMISSION SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

### MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

#### **I. Our recommendations are based upon the following definitions.**

**System Failure** - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

**Preventive/Scheduled Maintenance** - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

**Improved System Performance** - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

**II. Training/Criteria** Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

#### **III. Appropriate Company Approved Inspection**

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

#### **IV. Written Estimates**

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

#### **V. Work Authorization**

No work will be performed without the customer's prior approval.

#### **VI. Limited Warranty**

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

#### **VII. Returned Parts**

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to



honor the warranty, the customer will be allowed to examine the parts.

## **VIII. Classification of Parts**

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

## **THE MAP PROCESS - OVERVIEW**

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site [www.motorist.org](http://www.motorist.org) or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 \* Fax: (202) 318-0378

## **THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS**

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p>A. Part no longer performs intended purpose</p> <p>B. Part does not meet a design specification (regardless of performance)</p> <p>C. Part is missing</p>	<p>1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.)</p> <p>2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)</p> <p>3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)</p> <p>4. Technician's recommendation based on substantial and informed experience</p> <p>5. To comply with maintenance recommended by AMRA / MAP</p>

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p><b>NOTE:</b> When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.</p>	<p><b>NOTE:</b> Suggested services are <i>always</i> optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.</p>

## DRIVETRAIN AND TRANSMISSION

**NOTE:** When a procedure states that a required or suggested repair or replacement is recommended, the basis for the recommendation **MUST** be explained to the customer. If the customer asks whether there are alternatives to the recommendation, generally acceptable repair/replacement options must be explained, whether performed or not by the shop.

**NOTE:** Whenever transmission or drive-train service is performed that affects the suspension alignment, for example, removing the engine cradle, it is required that the alignment be checked and corrected if necessary.

**NOTE:** The conditions listed for the components included in this section assume that the problem has been isolated to the specific component through proper testing.

## ACTUATORS (ELECTRICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, not affecting performance	2	Require repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### ACTUATORS (VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement

Condition	Code	Procedure
Out of adjustment	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### **AUTOMATIC TRANSMISSION / TRANSAXLE ASSEMBLIES/CVTS**

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the automatic transmission / transaxle assembly.
<b>NOTE:</b> <b>It is required that the torque converter and all other failure-related components be inspected for cause and condition. For components not requiring removal of the assembly, refer to the component listing</b>		

### **AUTOMATIC TRANSMISSION FLUID**

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<b>NOTE:</b> <b>Determine and correct cause.</b>		
Burned	Ā	Further inspection required
<b>NOTE:</b> <b>Fluid that is burned indicates a serious problem. Determine and correct the cause.</b>		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> <b>If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.</b>		
Contaminated, for example, fluid other than the specified fluid present	A	Require service

Condition	Code	Procedure
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Ā	No service suggested or required
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Varnish deposits present on system components affecting performance	Ā	Further inspection required

## AXLES

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement
Bent, beyond specification	B	Require repair or replacement
Broken	A	Require replacement
End play exceeds specifications	B	Require repair or replacement
Flange bent	A	Require replacement
Flange threads stripped	A	Require repair or replacement
Twisted	A	Require replacement
Worn, affecting performance	A	Require repair or replacement

## BEARINGS AND RACES

**NOTE:** When replacing or re-packing bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

Condition	Code	Procedure
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible
<b>NOTE:</b> If proper adjustment can't be obtained, require replacement of bearing assembly.		
Bearing rollers, balls or races are worn, pitted, noisy, or feel rough when rotated as an assembly	B	Require replacement of bearing assembly

## BELL CRANKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware



Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require repair or replacement
Broken	A	Require repair or replacement
Cracked	A	Require repair or replacement
Missing	C	Require replacement
Worn, affecting performance	A	Require repair or replacement

## BELL HOUSINGS

Condition	Code	Procedure
Bearing race loose in bore	A	Require repair or replacement
Broken, affecting performance	A	Require repair or replacement
Cracked	A	Require repair or replacement
Dowel pin holes worn, affecting performance	Â	See Dowel Pins, Guides, and Pilot Holes
Leaking Coolant	B	Require Repair or Replacement
<b>NOTE:</b> <b>This condition is found mostly on Hybrid vehicles with a liquid cooled inverter.</b>		
Machined surfaces damaged, affecting performance	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require repair or replacement

## BUSHINGS (EXTERNAL)

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available, otherwise, replace bushing
Attaching hardware broken	A	Require repair or replacement of broken part if available, otherwise, replace bushing
Attaching hardware corroded, affecting structural Integrity	A	Require repair or replacement of corroded part if available, otherwise, replace bushing
Attaching hardware incorrect	B	Require repair or replacement of incorrect part if available, otherwise, replace bushing
Attaching hardware loose	A	Require repair or replacement of loose part if available, otherwise, replace bushing
Attaching hardware missing	C	Require repair or replacement of missing part if available, otherwise, replace bushing
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available, otherwise, replace bushing
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of part with damaged threads if available, otherwise, replace bushing
Binding	A	Require repair or replacement
Contaminated	1	Suggest replacement
Deteriorated, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Distorted, affecting performance	A	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement
Seized	A	Require replacement
Shifted out of position	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	À	No service suggested or required
Worn affecting performance	A	Require repair or replacement
Worn, close to the end of Its useful life	1	Suggest replacement

### CABLES (SPEEDOMETER)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	2	Suggest repair or replacement of bracket
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	2	Suggest repair or replacement of bracket
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Routed incorrectly, affecting performance	B	Require repair
Seized	A	Require repair or replacement

### CABLES (TV, DETENT AND SHIFT)

Condition	Code	Procedure
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<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement

### **CARRIER BEARINGS**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing rollers, balls or races are worn, pitted, noisy, or feel rough when rotated as an assembly	A	Require replacement of bearing assembly
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	2	Suggest repair or replacement of bracket
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Cracked	B	Require replacement
Rough (brinelling, spalling)	A	Require replacement
Rubber deteriorated, affecting performance	A	Require replacement
Seized	A	Require replacement

### **CLUTCH CABLES AND CABLE HOUSINGS**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Broken	A	Require replacement
Cable bent	A	Require replacement
Cable binding	A	Require repair or replacement
Cable mounting loose	B	Require repair or replacement
Cable out of adjustment	B	Require repair or replacement
Frayed	B	Require replacement
Housing heat -damaged	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

## CLUTCH DISCS (MANUAL TRANSMISSIONS)

Condition	Code	Procedure
Backing plate cracked	B	Require replacement
Broken	A	Require replacement
Contaminated with oil	A	Require replacement
<b>NOTE:</b> <b>Determine source of oil and correct prior to repair or replacement of clutch disc.</b>		
Damper cushion broken	A	Require replacement
Damper cushion collapsed	A	Require replacement
Damper spring collapsed	A	Require replacement
Damper spring missing	C	Require replacement
<b>NOTE:</b> <b>Not all clutch discs have springs in all spring chambers on the disc.</b>		
Friction material cracked through	B	Require replacement
Friction material flaking or chunking	B	Require replacement
Friction material surface cracking	A	No service suggested or required
Grooved	B	No service suggested or required unless the pressure plate or flywheel is being resurfaced or replaced. In this case, replacement of clutch disc is required
Ridged	B	No service suggested or required unless the pressure plate or flywheel is being resurfaced or replaced. In this case, replacement of clutch disc is required
Splines worn, affecting performance	A	Require replacement
Warped, affecting performance.	A	Require replacement
Wear exceeds specifications (where applicable)	B	Require replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance yet close to the end of its useful life	1	Suggest replacement

## CLUTCH FORKS

Condition	Code	Procedure
Bent, affecting performance	B	Require replacement
Broken	A	Require repair or replacement
Cracked	B	Require repair or replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance yet close to the end of its useful life	1	Suggest replacement

## CLUTCH LINKAGES (MECHANICAL)

Condition	Code	Procedure
Components missing	C	Require replacement of missing components
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage

Condition	Code	Procedure
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

### CLUTCH MASTER CYLINDERS

Condition	Code	Procedure
Cover gasket distorted	A	Require replacement of cover gasket
Cover gasket gummy	A	Require replacement of cover gasket
<b>NOTE:</b> <b>This condition may indicate contaminated fluid. Further inspection required.</b>		
Cylinder leaking fluid from rear of bore	A	Require repair or replacement
Cylinder leaking fluid internally	A	Require replacement
Dust boot missing	C	Require replacement of dust boot
Dust boot punctured	A	Require replacement of dust boot
Dust boot torn	A	Require replacement of dust boot
Fluid level incorrect	B	Require fluid level adjustment
Housing damaged, affecting performance	A	Require repair or replacement
Master cylinder has residue in reservoir	2	Further inspection required
<b>NOTE:</b> <b>Do not replace master cylinder unless it exhibits conditions listed for replacement.</b>		
Pushrod out of adjustment	B	Require Repair or Replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### CLUTCH PEDALS

Condition	Code	Procedure
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Pedal pad missing	C	Require replacement of pedal pad
Pivot bushings worn, affecting performance	A	Require replacement of pivot bushings

### CLUTCH PIVOTS

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement

Condition	Code	Procedure
Broken	A	Require repair or replacement
Cracked	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance, but close to the end of its useful life	2	Suggest replacement

### CLUTCH PRESSURE PLATES

Condition	Code	Procedure
Balance weight missing	C	Require replacement
Broken	A	Require replacement
Contact surface distorted	B	Require replacement
Cracks	B	Require replacement
Fingers bent	A	Require replacement
Hard spots	B	Require replacement
Scored	B	Require replacement
Spring rate less than specifications	B	Require replacement
Worn beyond specifications	B	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

### CLUTCH RELEASE BEARINGS

Condition	Code	Procedure
Collar broken	A	Require replacement
Cracked	B	Require replacement
Rough when rotated as an assembly	B	Require replacement
Seized	A	Require replacement
Wear exceeds specifications	B	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

### CLUTCH SLAVE CYLINDERS (CONCENTRIC)

Condition	Code	Procedure
Bearing rough when rotated as an assembly	B	Require replacement
Bearing seized	A	Require replacement
Bleeder pipe leaks	A	Require repair or replacement
Carrier assembly worn, affecting performance	A	Require replacement
Collar broken	A	Require replacement
Cracked	B	Require replacement
Housing leaks	A	Require replacement
Inoperative	A	Require replacement
Release binding	A	Require replacement
Spring broken	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

### CLUTCH SLAVE CYLINDERS (CONVENTIONAL OR EXTERNAL)

Condition	Code	Procedure



Condition	Code	Procedure
Binding	A	Require repair or replacement
Bleeder port damaged (not repairable)	A	Require replacement
<b>NOTE:</b> Only required if the hydraulic system must be opened.		
Bleeder port damaged (repairable)	A	Require repair
<b>NOTE:</b> Only required if the hydraulic system must be opened.		
Bleeder screw broken off in slave cylinder	A	Require replacement
<b>NOTE:</b> Only required if the hydraulic system must be opened.		
Bleeder screw seized	A	Require replacement
<b>NOTE:</b> Seized is defined as a bleeder screw that cannot be removed after a practical attempt at removing it has been made. Only required if the hydraulic system must be opened.		
Bore corroded (pitted)	B	Require replacement
Bore grooved	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## COMPANION FLANGES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent, affecting performance	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement

## CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Transmission connector leaking	See Transmission Assembly	Â
Voltage drop out of specification	A	Require repair or replacement

## COOLER BYPASS VALVES

Condition	Code	Procedure
Inoperative	A	Require replacement
Installed incorrectly	A	Require repair
Leaking	A	Require repair or replacement
Restricted	A	Require repair or replacement

## COOLER LINES

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
<b>NOTE:</b> <b>If clamp removed, require replacement.</b>		
Connected incorrectly	A	Require repair
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	B	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## COOLERS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Contaminated	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required
Internal restrictions	B	Require repair or replacement
Leaking	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Â	No service suggested or required

## CV JOINTS

Condition	Code	Procedure
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Condition	Code	Procedure
Bearing, bushing or seal surface worn, affecting performance	A	Require repair or replacement
Boot clamp broken	A	Require repair or replacement of clamp
Boot clamp loose	A	Require repair or replacement of clamp
Boot clamp missing	C	Require repair or replacement of clamp
Boot leaking	A	Require replacement of CV boot
<b>NOTE:</b> <b>Further inspection of joint required before replacing boot.</b>		
Boot surface cracked, not leaking	2	Suggest replacement of CV boot
Cage broken	A	Require repair or replacement of CV joint
Housing damaged to the extent that it no longer performs its intended function	A	Require repair or replacement of CV joint
<b>NOTE:</b> <b>Housing assembly may appear blue in color from normal manufacturing process of heat treating the housing.</b>		
Housing worn to the extent that it no longer performs its intended function	A	Require repair or replacement
<b>NOTE:</b> <b>Housing assembly may appear blue in color from normal manufacturing process of heat treating the housing.</b>		
Internal parts binding	A	Require repair or replacement
Internal parts worn	A	Require repair or replacement
Lubricant missing	C	Require cleaning, inspection, and repacking of CV joint
Mounting holes elongated	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## DIFFERENTIAL AND FINAL DRIVE ASSEMBLIES

**NOTE:** Does not include half shafts.

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the differential assembly
<b>NOTE:</b> <b>For components not requiring removal of the assembly, refer to the component listing.</b>		

## DIFFERENTIAL FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine and correct cause.		
Burned	Â	Further inspection required
<b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Varnish deposits present on system components affecting performance	Â	Further inspection required

## DIP STICK TUBES

Condition	Code	Procedure
Broken	A	Require repair or replacement
Check ball missing	C	Require repair or replacement
Cracked	B	Require repair or replacement
Hold down bracket broken	A	Require repair or replacement
Hold down bracket missing	C	Require replacement
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### DIP STICKS (FLUID LEVEL INDICATORS)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Broken	A	Require replacement
Compressed	A	Require repair or replacement
Missing	C	Require replacement
Modified	A	Require replacement
Stretched	A	Require repair or replacement

### DOWEL PINS, GUIDES AND PILOT HOLES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Cracked	A	Require repair or replacement
Distorted	A	Require repair or replacement
Missing	C	Require replacement
Positioned incorrectly	B	Require repair or replacement
Stepped	A	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

### DRAIN PLUGS AND GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		
Missing	C	Require replacement
Threads Damaged	A	Require repair or replacement

### DRIVE SHAFT FLANGES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent, affecting performance	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts



Condition	Code	Procedure
Yoke damaged, affecting performance	A	Require repair or replacement

## DRIVE SHAFTS AND HALF SHAFTS

Condition	Code	Procedure
Balance weight missing	C	Require repair or replacement
Bearing cap bore distorted	A	Require repair or replacement
Bent	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke
Out of balance	A	Require repair or replacement
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn, affecting performance	A	Require repair or replacement
Splines worn, not affecting performance, but close to the end of their useful life	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement of Yoke

## DUST BOOTS

Condition	Code	Procedure
Cracked, not leaking	1	Suggest replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Torn	A	Require replacement
Weather checked, surface cracked	Â	No service suggested or required

## ENGINE MOUNTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## EXCITER RINGS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement

Condition	Code	Procedure
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	B	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

### FILLER TUBES

Condition	Code	Procedure
Broken	A	Require repair or replacement
Check ball missing	C	Require repair or replacement
Cracked	B	Require repair or replacement
Hold down bracket broken	A	Require repair or replacement
Hold down bracket missing	C	Require replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### FILTERS AND SCREENS

Condition	Code	Procedure
At service interval	3	Suggest replacement
Bent, affecting performance	A	Require repair or replacement
Exceeding service interval	3	Suggest replacement
Missing	C	Require replacement
Near service interval	3	Suggest replacement
Restricted	A	Require repair or replacement
<b>NOTE:</b> <b>Further inspection may be required to determine the source of restriction or contamination.</b>		
Torn	A	Require replacement
Worn, affecting performance (metal or nylon screen type)	A	Require repair or replacement

### FLANGES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent, affecting performance	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement

## FLEX PLATES

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement
Bent, not affecting performance	Â	No service suggested or required
Bolt or stud holes elongated	B	Require replacement
Broken	A	Require replacement
Cracked	B	Require replacement
Ring gear worn close to the end of its useful life	1	Suggest replacement
Ring gear worn to the extent that it no longer performs its intended function	A	Require replacement
Weights missing	A	Require repair or replacement

## FLUID LEVEL INDICATORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Broken	A	Require replacement
Compressed	A	Require repair or replacement
Missing	C	Require replacement
Modified	A	Require replacement
Stretched	A	Require repair or replacement

## FLUIDS AND LUBRICANTS

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<b>NOTE:</b> Determine and correct cause.		
Burned	Â	Further inspection required
<b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.		

Condition	Code	Procedure
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Ā	No service suggested or required
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Varnish deposits present on system components affecting performance	Ā	Further inspection required

## FLYWHEELS

**NOTE:** Clutch disc replacement does not necessitate flywheel reconditioning, unless other conditions justify the reason to do so.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked (other than mounting area)	A	Require repair or replacement of hardware
<b>NOTE:</b> Some manufacturers allow slight surface cracking in the friction surface.		
Cracks in mounting area	B	Require replacement
Hard spots	B	Require repair or replacement
Ring gear teeth worn, affecting performance	A	Require replacement of ring gear
Runout exceeds specifications	B	Require repair or replacement
Scored	B	Require repair or replacement
Surface cracks after resurfacing to manufacturer's minimum specifications	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wear exceeds specifications	B	Require replacement
Worn, affecting performance	A	Require repair or replacement
Worn, not affecting performance, but close to the end of its useful life	1	Suggest repair or replacement

## FORCE MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	1	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> <b>Require inspection of mating and sealing surface and repair or replace as necessary.</b>		

## GUIDES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Cracked	A	Require repair or replacement
Distorted	A	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Positioned incorrectly	B	Require repair or replacement
Stepped	A	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

## HALF SHAFTS

Condition	Code	Procedure
Balance weight missing	C	Require repair or replacement
Bearing cap bore distorted	A	Require repair or replacement
Bent	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Out of balance	A	Require repair or replacement
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn, affecting performance	A	Require repair or replacement
Splines worn, not affecting performance, but close to the end of their useful life	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement of yoke

## HOSES, LINES, AND TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	2	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	2	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement
Swollen	B	Require replacement



Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	1	Suggest repair or replacement

### HOUSINGS (BELL, CASE, TAIL(EXTENSION) AND AUXILIARY)

Condition	Code	Procedure
Bearing race loose in bore	A	Require repair or replacement
Broken, affecting performance	A	Require repair or replacement
Cracked	B	Require repair or replacement
Dowel pin holes worn, affecting performance	A	Require repair or replacement
Machined surfaces damaged, affecting performance	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require repair or replacement

### HYDRAULIC FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<b>NOTE:</b> Determine and correct cause.		
Burned	Â	Further inspection required
<b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
Fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service

Condition	Code	Procedure
<p><b>NOTE:</b>  <b>If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.</b></p>		
Varnish deposits present on system components affecting performance	Â	Further inspection required

### INTERMEDIATE SHAFT SUPPORT BEARINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing rollers, balls or races are worn, pitted, noisy, or feel rough when rotated as an assembly	A	Require replacement of bearing assembly
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	2	Suggest repair or replacement of bracket
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Cracked	B	Require replacement
Rough (brinelling, spalling)	A	Require replacement
Rubber deteriorated, affecting performance	A	Require replacement
Seized	A	Require replacement

### KEY INTERLOCK SYSTEMS

**NOTE:** See: Actuators (Electrical), Cables, Linkages (External), Switches

### LIMITED SLIPS

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the differential assembly.
<p><b>NOTE:</b>  <b>For components not requiring removal of the assembly, refer to the component listing.</b></p>		

### LINES

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<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	I	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

### **LINKAGES (EXTERNAL)**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Components missing	C	Require replacement of missing components
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

### **LOCKING HUB ASSEMBLIES**

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Loose	B	Require repair or replacement
Seized in any position	A	Require repair or replacement

### LOCKING HUB CONTROL KNOBS

Condition	Code	Procedure
Damaged, affecting performance	A	Require replacement
Missing	C	Require replacement
Worn, affecting performance	A	Require replacement

### LUBRICANTS

Condition	Code	Procedure
Additive Depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<b>NOTE:</b> Determine and correct cause.		
At service interval	3	Suggest replacement
Beyond service interval	3	Suggest replacement
Burned	Â	Further inspection required
<b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correctly specified hydraulic fluid.		
Fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.		
Level incorrect	B	Require correction of fluid level
Near service interval	3	Suggest replacement
Oxidized	A	Require replacement of fluid
Rubber master cylinder cover gasket distorted and gummy	A	Require service
<b>NOTE:</b> If a fluid other than brake fluid is present in the system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.		

### MANUAL TRANSMISSION FLUID

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Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<b>NOTE:</b> Determine and correct cause.		
Burned	Â	Further inspection required
<b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid discolored	Â	No service suggested or required
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Varnish deposits present on system components affecting performance	Â	Further inspection required

## MANUAL TRANSMISSION/TRANSAXLE ASSEMBLIES

Condition	Code	Procedure
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Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the manual transmission / transaxle assembly.
<b>NOTE:</b> For components not requiring removal of the assembly, refer to the component listing.		

### METAL CLAD SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.		

### METALASTIC JOINTS

**NOTE:** These joints may be found on half and/or drive shafts. They are usually found on European vehicles featuring a three-lug drive flange. They may be equipped with a centering ball or pin.

Condition	Code	Procedure
Drive flange bent	A	Require replacement
Drive flange damaged, affecting performance	A	Require replacement
Rubber drive joint cracked	2	Suggest replacement
Rubber drive joint damaged, affecting performance	A	Require replacement
Rubber drive joint split between mounting holes	A	Require replacement
Rubber drive joint torn at mounting holes	A	Require replacement
Rubber drive joint weather-cracked	Â	No service suggested or required

### MODULATOR PINS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Missing	C	Require replacement

### MODULATORS

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement
Contaminated (water, fuel, etc. )	A	Require replacement
<b>NOTE:</b> Further inspection is required to determine the cause of the contamination.		
Housing cracked	A	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking fluid externally	A	Require repair or replacement
Leaking fluid internally	A	Require replacement
Leaking vacuum	A	Require replacement



Condition	Code	Procedure
Nipple broken	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### **MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION)**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### **ODOMETER DRIVES (MECHANICAL)**

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Teeth broken	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

### **ODOMETER HEADS (MECHANICAL)**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Lens broken	A	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only.		

Condition	Code	Procedure
Lens cloudy	2	Suggest repair or replacement
<b>NOTE:</b> If lens is available as a separate part, suggest replacement of lens only.		
Lens missing	C	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only.		
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.		
Noisy	2	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### OIL PANS

Condition	Code	Procedure
Bent, interfering with filter or other internal components	A	Require repair or replacement
Leaking	A	Require repair or replacement

### PANS

Condition	Code	Procedure
Bent, interfering with filter or other internal components	A	Require repair or replacement
Leaking	A	Require repair or replacement

### PILOT HOLES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Cracked	A	Require repair or replacement
Distorted	A	Require repair or replacement
Missing	C	Require replacement
Positioned incorrectly	B	Require repair or replacement
Stepped	A	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

### PRESSURE PLATES

Condition	Code	Procedure
Balance weight missing	C	Require replacement
Broken	A	Require replacement
Contact surface distorted	B	Require replacement
Cracks	B	Require replacement
Fingers bent	A	Require replacement
Hard spots	B	Require replacement
Scored	B	Require replacement
Spring rate less than specifications	B	Require replacement

Condition	Code	Procedure
Worn beyond specifications	B	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

## PRESSURE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## RACES

**NOTE:** When replacing or re-packing bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

Condition	Code	Procedure
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible If proper adjustment cannot be obtained, require replacement of bearing assembly
<b>NOTE:</b> When replacing or re-packing bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions		
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly	B	Require replacement of bearing assembly
<b>NOTE:</b> When replacing or re-packing bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions		

## RUBBER JOINTS (METALASTIC)

**NOTE:** These joints may be found on half and/or drive shafts. They are usually found on European vehicles featuring a three-Jug drive flange. They may be equipped with a centering ball or pin.

Condition	Code	Procedure
Drive flange bent	A	Require repair or replacement
Drive flange damaged, affecting performance	A	Require replacement
Rubber drive joint cracked	2	Suggest replacement
Rubber drive joint damaged, affecting performance	A	Require replacement
Rubber drive joint split between mounting holes	A	Require replacement
Rubber drive joint torn at mounting holes	A	Require replacement
Rubber drive joint weather-cracked	Â	No service suggested or required

## SCREENS

Condition	Code	Procedure
At service interval	3	Suggest replacement
Bent, affecting performance	A	Require repair or replacement
Exceeding service interval	3	Suggest replacement
Missing	C	Require replacement
Near service interval	3	Suggest replacement
Restricted	A	Require repair or replacement
<b>NOTE:</b> Further inspection may be required to determine the source of restriction or contamination.		
Torn	A	Require replacement
Worn, affecting performance (metal or nylon screen type)	A	Require repair or replacement

## SEALS (METAL CLAD)

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.		

## SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.		

## SELECTOR INTERLOCK SYSTEMS

**NOTE:** See: Actuators (Electrical), Cables, Linkages (External), Switches

Condition	Code	Procedure
Binding	A	Require repair or replacement
Broken	A	Require repair or replacement
Components missing	C	Require replacement of missing components
Loose, affecting performance	A	Require repair or replacement
Out of adjustment	B	Require repair
Worn, affecting performance	A	Require repair or replacement

## SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation or out of specification.		
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required

Condition	Code	Procedure
<b>NOTE:</b> Follow OEM recommended adjustment procedures. Repair or replace if out of specification.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## SERVOS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage



Condition	Code	Procedure
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### SHIFT INTERLOCK SYSTEMS (SELECTOR AND KEY INTERLOCK SYSTEMS)

**NOTE:** See: Actuators (Electrical), Cables, Linkages (External), Switches

Condition	Code	Procedure
Binding	A	Require repair or replacement
Broken	A	Require repair or replacement
Components missing	C	Require replacement of missing components
Loose, affecting performance	A	Require repair or replacement
Out of adjustment	B	Require repair
Worn, affecting performance	A	Require repair or replacement

### SIDE COVERS

Condition	Code	Procedure
Bent, interfering with filter or other internal components	A	Require repair or replacement
Leaking	A	Require repair or replacement

### SLIP YOKES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap

Condition	Code	Procedure
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement

## SOLENOIDS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector melted, affecting performance	A	Require repair or replacement.
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement.
Inoperative	A	Require replacement.
<b>NOTE:</b> Inoperative includes intermittent operation.		
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	Require repair or replacement.
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement.
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	1	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

## SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE)

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment or replacement

Condition	Code	Procedure
<b>NOTE:</b> If a sensor is not adjustable, further inspection is required to identify and correct cause.		
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as metal particles or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Sensor housing cracked	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### **SPEEDOMETER- DRIVEN GEAR HOUSING**

Condition	Code	Procedure
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Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Teeth broken	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

### **SPEEDOMETER/ODOMETER DRIVES (MECHANICAL)**

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Teeth broken	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

### **SPEEDOMETER/ODOMETER HEADS (MECHANICAL)**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Lens broken	A	Require repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, require replacement of lens only.</b>		
Lens cloudy	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> If lens is available as a separate part, suggest replacement of lens only.		
Lens missing	C	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only.		
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.		
Noisy	2	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### **SPEEDOMETERS/ODOMETERS (ELECTRONIC)**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only.		
Lens cloudy	2	Suggest repair or replacement
<b>NOTE:</b> If lens is available as a separate part, suggest replacement of lens only.		
Lens missing	C	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only .		
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement



Condition	Code	Procedure
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## -tone wheels

**NOTE:** If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

## toothed rings (tone wheel)

**NOTE:** If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

## torque converters

Condition	Code	Procedure
Converter clutch lock-up operation is faulty	A	Require replacement
Cover shell damaged, affecting performance	A	Require replacement
Does not meet stall speed specification	B	Require replacement
End play exceeds specifications	B	Require replacement
Hub broken	A	Require replacement
Hub cracked	A	Require replacement
Internal component failure	A	Require replacement
Leaking	B	Require repair or replacement
Pilot broken	A	Require replacement
Pilot worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Weights missing	C	Require replacement

## TRANSAXLE MOUNTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## TRANSDUCERS (TRANSMISSION)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation or out of specification.</b>		
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required
<b>NOTE:</b> <b>Follow OEM recommended adjustment procedures. Repair or replace if out of specification.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### TRANSFER CASE ASSEMBLIES

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the transfer case differential assembly
<p><b>NOTE:</b> For components not requiring removal of the assembly, refer to the component listing.</p>		

### TRANSFER CASE FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<p><b>NOTE:</b> Determine and correct cause.</p>		
Burned	Â	Further inspection required
<p><b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.</p>		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<p><b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.</p>		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<p><b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</p>		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
<p><b>NOTE:</b> Further testing necessary to determine condition of fluid.</p>		
Fluid incorrect	B	Require service
<p><b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.</p>		
Level incorrect	B	Require correction of fluid level

Condition	Code	Procedure
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Varnish deposits present on system components affecting performance	Â	Further inspection required

### TRANSMISSION COOLERS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Contaminated	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required
Internal restrictions	B	Require repair or replacement
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Â	No service suggested or required

### TRANSMISSION MOUNTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### TRANSMISSION PANS

Condition	Code	Procedure
Bent, interfering with filter or other Internal components	A	Require repair or replacement

Condition	Code	Procedure
Leaking	A	Require repair or replacement

### TRANSMISSION RANGE INDICATORS (PRNDL)

Condition	Code	Procedure
Binding	A	Require repair or replacement
Broken	A	Require repair or replacement
Components missing	C	Require replacement of missing components
Loose, affecting performance	A	Require repair or replacement
Out of adjustment	B	Require repair
Worn, affecting performance	A	Require repair or replacement

### TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

### UNIVERSAL JOINTS (CARDAN OR CROSS TYPE)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing cap distorted	B	Require replacement
Binding	A	Require replacement

Condition	Code	Procedure
Cross (trunion) worn, affecting performance	A	Require replacement
Double cardan centering ball damaged	A	Require replacement
Double cardan centering ball worn, affecting performance	A	Require replacement
Double cardan centering spring broken	A	Require replacement
Double cardan centering spring missing	C	Require replacement
Double cardan centering spring weak	A	Require replacement
End cap seal cracked	2	Suggest replacement
End cap seal missing	C	Require replacement of seal
Grease fitting broken	A	Require replacement of grease fitting
<b>NOTE:</b> <b>A broken grease fitting does not require replacement of the U-Joint.</b>		
Grease fitting missing	C	Require replacement of grease fitting
<b>NOTE:</b> <b>A missing grease fitting does not require replacement of the U-Joint.</b>		
Rust-colored powder around end cap seals	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

## VACUUM CONTROLS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage



Condition	Code	Procedure
Linkage binding, not affecting performance	1	Require repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## VACUUM HOSES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted, affecting performance	B	Require repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## VACUUM MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal corroded, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### VACUUM-OPERATED SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn affecting performance	B	Require replacement

## VEHICLE SPEED SENSORS

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment or replacement
<p><b>NOTE:</b> If a sensor is not adjustable, further inspection is required to identify and correct cause.</p>		
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<p><b>NOTE:</b> Determine source of contamination, such as metal particles or water. Require repair or replacement.</p>		
Inoperative	B	Require repair or replacement
<p><b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</p>		
Leaking	A	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Sensor housing cracked	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## VENTS

Condition	Code	Procedure
Broken	A	Require replacement
Missing	C	Require replacement
Plugged	A	Require repair or replacement
<b>NOTE:</b> A plugged vent may force fluid past the seal.		

## VIBRATION DAMPERS

Condition	Code	Procedure
Broken	A	Require replacement
Missing	C	Require replacement
Out of position	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## WHEEL ATTACHMENT HARDWARE

**NOTE:** For conditions noted below, also check conditions of wheel stud holes. Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. **DO NOT** lubricate threads unless specified by the vehicle manufacturer.

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement
<b>NOTE:</b> Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.		
Loose	A	Require repair or replacement of affected component
Lug nut installed backward	B	Require repair or replacement
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut rounded	A	Require replacement of nut
<b>NOTE:</b> Only required if removing wheel.		
Lug nut seized	A	Require replacement of nut

Condition	Code	Procedure
<b>NOTE:</b> Only required if removing wheel.		
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## WHEEL SPEED SENSORS

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment or replacement
<b>NOTE:</b> If a sensor is not adjustable, further inspection is required to identify and correct cause.		
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as metal particles or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Sensor housing cracked	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement



Condition	Code	Procedure
Wire lead corroded	A	Require repair or replacement
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## WIRING HARNESSES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, not affecting performance	1	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Transmission connector leaking	See Transmission Assembly	Ā
Voltage drop out of specification	A	Require repair or replacement

## YOKES AND SLIP YOKES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement

## REASON CODE EXPLANATION

Code	Reason
<b>Required</b>	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification ( Regardless Of Performance)
C	Part Is Missing
<b>Suggested/Optional</b>	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

## AUTOMOTIVE TERMINOLOGY & DEFINITIONS

### ACTUATOR

a control device that delivers mechanical action in response to a vacuum or electrical signal; anything that the engine control computer uses to do something, such as trigger fuel injection or fire a spark plug. Most actuators on a computercontrolled engine system are activated by grounding their circuits rather than by actively powering them, since that protects the computer from short circuits.

### ADDITIVE

in automotive terminology, a substance added to a liquid, such as engine oil, transmission fluid, gear oil or coolant to enhance its properties.

### AUTO SHIFT MANUAL TRANSMISSION AND SELECT SHIFT MANUAL TRANSMISSION

select shift manual (SSM) and auto shift manual (ASM) use a combination of auto-clutch and shift-by-wire electronic control system technology to provide the customer a fun-to-shift experience along with significant fuel economy improvements over a base manual transmission. The Select Shift Manual mode allows a customer to command gear changes according to his/her

personal preference like a conventional manual transmission. The Auto Shift Manual mode provides the customer automatic gear shifting much like an automatic transmission.

## **AUTOMATIC TRANSMISSION FLUID (ATF)**

the oil that is used in an automatic transmission.

## **AUTOMATIC TRANSMISSION**

a transmission that changes forward gears automatically.

## **AXLE HOUSING**

an enclosure for the differential and drive axles.

## **AXLE**

a rotating shaft that rotates another part, such as a wheel.

## **BALL BEARING**

a friction-reducing bearing that uses a series of steel balls held between inner and outer bearing races such as in a roller clutch.

## **BAND**

in an automatic transmission, a device used to prevent members of a planetary gearset from rotating.

## **BEARING RACE**

the machined surface of a bearing assembly against which the needles, balls or rollers ride. The outer race is also called a cup.

## **BEARING**

part that supports and reduces friction between a stationary and moving part or two moving parts.

## **BELL HOUSING**

connects the engine to the transmission and encloses the clutch assembly. It also provides mounting points for part of the clutch release mechanism.

## **CARDAN UNIVERSAL JOINT**

the most common type of universal joint used. Consists of a center cross, four bearing cups, each containing a set of needle roller bearings, grease seals and snap rings.

## **C-CLIP**

part used to retain the axle shaft in a drive axle assembly

## **CLUTCH DISC**

the part of a clutch that receives the driving motion from the flywheel and pressure plate assembly and transmits that motion to the transmission input shaft.

## **CLUTCH FACING**

the friction material on a clutch disc.

## **CLUTCH FORK**

also known as the release fork. The device which moves the throwout (release) bearing, activating the pressure plate.

## **CLUTCH PACK**

in an automatic transmission, an assembled series of clutch friction discs and clutch plates that are alternately layered.

## **CLUTCH PRESSURE PLATE**

the part of a clutch assembly that is used to hold the driven disc against the flywheel. The pressure plate is composed of a cover and coil springs, driving disc and release levers, or a diaphragm spring.

## **CLUTCH RELEASE BEARING**

a sealed ball or roller bearing unit that rides on a sleeve over the transmission input shaft, and acts on the pressure plate to disengage the clutch disc when the clutch release mechanism is applied. Also called a throwout bearing.

## **CLUTCH THROWOUT BEARING**

see 'clutch release bearing'.

## **CLUTCH**

in a manual transmission, a device that allows the driver to engage and disengage the engine from the drivetrain; in an automatic transmission, a device capable of both holding and turning members of a planetary gearset; a device used to engage and disengage and A/C compressor.

## **CONSTANT MESH**

in a transmission, where all gears are constantly in contact and turning with one another.

## **CONTINUOUSLY VARIABLE TRANSMISSION (CVT)**

a continuously variable transmission is an automatic that can select any desired drive ratio within its operating range. Unlike a traditional three-, four-, or fivespeed automatic transmission the CVT is an "infinite speed" transmission, the CVT continually selects an optimum overall drive ratio between engine and drive wheels for all operating conditions, whether accelerating or cruising. Unlike conventional automatics, there are no perceptible shifts. During maximum acceleration, the drive ratio is adjusted to maintain peak engine horsepower. At a constant vehicle speed, the ratio is set to maintain an engine rpm which will support the required power. A CVT provides smooth, fast acceleration and high cruising efficiency with the convenience of an automatic transmission.

## **COUNTERGEAR**

a set of different size gears incorporated in one casting, used in a manual transmission.

## **DIFFERENTIAL CARRIER**

enclosure for the differential and ring and pinion gears. Can be removable or integral part of axle housing. Also called differential housing.

## **DIFFERENTIAL CASE**

housing for the differential pinion gears and side gears. Mounting point for ring gear.

## **DIFFERENTIAL PINION GEARS**

gears that are meshed with the differential side gears and rotate on the differential pinion shaft inside the differential case.

## **DIFFERENTIAL PINION SHAFT**

a shaft mounted inside the differential case, provides support and pivot for the differential pinion gears.

## **DIFFERENTIAL SIDE GEARS**

gears that are meshed with the pinion gears inside the differential case and splined to the axle shafts.

## **DIFFERENTIAL**

gear assembly that transmits power from the driveshaft to the wheels; allows the outside wheel to turn faster than the inside when cornering.

## **DIRECT DRIVE**

downward gear engagement in which the input shaft and output shaft are locked together; the gearing in a drivetrain in which one turn of the crankshaft equals one turn of the wheels.

## **DOUBLE CARDAN UNIVERSAL JOINT**

two cardan universal joints connected by a yoke; also called a constant velocity (CV) joint.

## **DOUBLE OFFSET JOINT**

a Rzeppa type plunger CV-joint used on the inboard side of the interconnecting shaft.

## **DOWEL**

a peg or pin which fits into corresponding holes used for holding two parts together or to locate two parts in a set position.

## **DRIVE MEMBER**

a gear that drives or provides power for other gears in a planetary gearset.

## **DRIVELINE ANGLE**

see 'driveshaft angle'.

## **DRIVELINE**

all of the parts connecting the engine to the drive axle.

## **DRIVESHAFT ANGLE.**

the installation angle of the driveshaft off the true horizontal; also called driveline angle.

## **DRIVESHAFT**

transfers power from the transmission to the differential on a rear-wheel drive vehicle. Consists of a hollow metal tube with universal joints at each end, each of which is attached to yokes at the transmission and differential.

## **DRIVETRAIN**

all of the components that generate power and transfer it to the vehicle's wheels.

## **ELECTRONIC AUTOMATIC TRANSMISSION**

an electronic automatic transmission utilizes an electronic control module to signal when to shift. The module also determines when to lock and unlock the torque converter. By controlling these functions electronically rather than mechanically, the transmission can be tuned for better driveability.

## **ENDPLAY**

the amount of axial or end-to-end movement in a shaft due to clearance in the bearings; the regulated movement of a component, usually a shaft, during operation.

## **EXCESSIVE WEAR**

in mechanical terms, wear of a component that exceeds designed limits; wear caused by overloading a part that is in an out-of-balance condition, resulting in lower-than-normal life expectancy of the part being subjected to the adverse operating condition.

## **EXTENSION HOUSING**

aluminum or cast iron enclosure for the transmission output shaft and bearings, speedometer drive and driven gears. Provides support for driveshaft slip yoke.

## **FLANGE**

a projecting rim or collar on a component used for holding it in place, giving it strength or guiding it into place or attaching it; a part mounted on the pinion gear that provides the mounting point for the rear universal joint of the driveshaft.

## **FLYWHEEL**

a cast iron or steel wheel mounted to the end of the crankshaft; helps to smooth the engine's power delivery, the teeth around its circumference provide an engagement for the starter, and it provides the mounting points for the pressure plate and friction surface for the clutch disc.

## **FOUR WHEEL DRIVE (4WD)**

system that supplies power to both the front and rear wheels of the vehicle when activated.

## **FREE PLAY**

the measurable travel in a mechanical device between the time force is applied and work is accomplished; looseness in a linkage between the start of application and the actual movement of the device, such as the movement in the steering wheel before the wheels start to turn.

## **FREE TRAVEL**

distance a clutch pedal moves before it begins to take up slack in the clutch linkage; essentially the same as free play, usually applied to shaft movement.

## **FREEWHEEL**

a mechanical device that engages the driving member to impart motion to a driven member in one direction but not the other; in automotive terms, a device that permits the driveshaft to continue turning when its speed exceeds that of the crankshaft, thus allowing free coasting with the gear train engaged.

## **FRONT WHEEL DRIVE**

the entire drivetrain is located at the front of and drives the front wheels of the vehicle.

## **FULL FLOATING AXLE**

system where the weight of the vehicle is supported by the axle housing and the axle bearing is located outside of the axle housing; most often used on trucks.

## **FULLY SYNCHRONIZED**

in a manual transmission, where gears are changed using synchronizers.

## **GEAR PITCH**

number of teeth per given unit of pitch diameter. Gear pitch is determined by dividing the number of teeth by the pitch diameter of the gear.

## **GEAR RATIO**



the number of revolutions a driving gear must turn to rotate the driven gear through one revolution. Numerical value determined by dividing the number of teeth on the driven gear by the number of teeth on the driving gear; the ratio between the number of teeth on meshing gears.

## **GEAR REDUCTION**

when a smaller gear drives a larger gear, there is a speed reduction but an increase in torque.

## **GEAR**

a toothed wheel, disc, etc. designed to mesh with another or with the thread of a worm; used to transfer or change motion.

## **GOVERNOR PRESSURE**

the change in line pressure that takes place as a result of an increase in vehicle speed.

## **GOVERNOR**

a device used on non-electronic automatic transmissions, which regulates the operation of the shift valves inside the valve body according to vehicle speed.

## **HELICAL GEAR**

a gear in which the teeth are cut so as to form a spiral; gear with teeth that are cut at an angle or are spiral to the gear's axis of rotation.

## **HUNTING GEARSET**

differential gearset where any one pinion gear tooth contacts all ring gear teeth.

## **HYPOID GEAR**

bevel-cut gear in a system in which the driven gear is not in the same plane as the drive gear. A type of spiral, beveled ring and pinion gearset in a differential. Hypoid gears mesh below the ring gear centerline.

## **INPUT SHAFT**

the shaft that is splined to the clutch disc and transfers power from the engine into the transmission; the shaft to which torque is applied, usually carrying the drive gear or gears.

## **INSERT SPRING.**

exerts pressure on the inserts in a synchronizer assembly.

## **INSERT**

a part of the synchronizer assembly that fits between the hub and sleeve, also called key or plate. The insert spring pushes the inserts into the sleeve, helping to center the sleeve on the hub.

## **LIMITED SLIP DIFFERENTIAL**

a type of differential that uses clutches to supply a major portion of the drive torque to the wheel that has better traction when one wheel is slipping,

## **LINE PRESSURE**

in an automatic transmission, the hydraulic pressure of the fluid after it leaves the pump and is regulated by the pressure regulator.

## **LIVE AXLE**

an axle on which the wheels are firmly affixed, with the axle driving the wheels.

## **MAINLINE PRESSURE**

in an automatic transmission, pressure that is regulated in the hydraulic system.

## **MESH**

to fit closely together or interlock, as the fit of gear teeth.

## **NEEDLE BEARING**

an anti-friction device that consists of a number (usually a large number) of thin rollers riding within races.

## **NEUTRAL START SWITCH**

a switch that prevents starter engagement if the transmission is in another gear besides Park or Neutral.

## **NONHUNTING GEARSET**

differential gearset in which one drive pinion gear tooth contacts only three ring gear teeth after several rotations.

## **OIL COOLER**

device used to remove heat from the engine or transmission oil. There are oil-to-air coolers and oil coolers that are incorporated into the vehicle's cooling system.

## **ORIGINAL EQUIPMENT MANUFACTURER (OEM)**

the original manufacturer of a vehicle or engine.

## **OUTER BEARING RACE**

outer part of a ball or roller bearing that provides a surface for the balls or rollers to rotate. Can be integral with the bearing or a separate part.

## **OUT-OF-ROUND**

when a previously round hole or bore has different diameters when measured at different points due to wear or distortion.

## **OUTPUT SHAFT**

the shaft that delivers the power that has come through the transmission or transaxle.

## **OVERDRIVE**

a gear assembly that outputs more shaft revolutions than were input.

## **OVERRUNNING CLUTCH**

a clutch that locks in one direction and overruns or freewheels in the other.

## **PINION GEAR**

the smaller, drive gear of the ring and pinion gearset; one of the gears inside the differential that rotates on the differential pinion shaft; rotates around the sun gear in a planetary gearset.

## **PINION**

the smaller of two meshing gears.

## **PLANETARY CARRIER**

houses the pinion gears in a planetary gearset.

## **PLANETARY GEARSET**

a gear system consisting of three primary components: a sun gear, a planetary pinion carrier and a ring or internal gear.

## **POWERTRAIN CONTROL MODULE (PCM)**

on vehicles with computer control systems, the main computer that determines engine operation based on sensor inputs and by using its actuator outputs. The PCM may also control transmission operation.

## **PRESSURE PLATE**

the driving member of the clutch assembly. Coil springs or a diaphragm spring in the pressure plate exert pressure on the clutch disc, holding it against the flywheel.

## **REAR WHEEL DRIVE**

system where the driveline drives the rear wheels of the vehicle. Most often the engine is located in the front of the vehicle and a transmission and drive shaft connect to a drive axle, however there are also systems where the entire drive line is located toward the rear of the vehicle.

## **RELEASE BEARING**

see 'clutch release bearing'.

## **REVERSE IDLER GEAR**

a gear used to reverse the direction of power in a transmission.

## **RING GEAR**

the larger, driven gear of the ring and pinion gearset; the largest member in a planetary gearset, also known as the internal gear or annulus. The internal teeth of the gear mesh with and rotate on the planetary pinions.

## **ROTARY FLOW**

torque converter oil flow associated with the coupling stage of operation.

## **SEAL**

a part, usually made of rubber or plastic, installed around a moving part or shaft to prevent leaks.

## **SEMI-FLOATING AXLE**

system where the axle bearing is located inside the axle housing and the weight of the vehicle is supported by the axle.

## **SHIFT FORK**

a device in a manual transmission that moves the synchronizer assembly sleeve, in response to movement from the shift linkage.

## **SHIFT RAILS**

the parts of transmission shift linkage that transfer motion from the driver-controlled gear shift lever to the shift forks.

## **SHIFTER**

the lever operated by the driver to shift the transmission. The shifter is attached directly to internal linkage in the transmission or it is mounted on the outside of the transmission or on the frame or

vehicle floor, and connected to the transmission or trans axle by external linkage rods or cables.

## **SLAVE CYLINDER**

a device that is connected to the release bearing in a hydraulic clutch system. When the clutch pedal is depressed, hydraulic fluid flows from the master cylinder through the hydraulic fluid line to the slave cylinder. Pressure in the system causes the slave cylinder to act on the release bearing, disengaging the clutch

## **SLIP YOKE**

a driveline component that is splined to the transmission output shaft and connected to the driveshaft front U-joint. Allows in and out movement on the transmission extension housing in response to rear suspension movement.

## **SLIP**

condition caused when a driving part rotates faster than a driven part.

## **SPLINES**

grooves cut into the outside or inside surface of a component to enable it to fit with another component having corresponding grooves. Commonly used to keep a component secured on a rotating shaft.

## **SPRAG CLUTCH**

a type of overrunning clutch.

## **SUMP**

the reservoir that holds the oil for the pump.

## **SYNCHRONIZER**

a type of clutch assembly used in a manual transmission to shift gears. Consists of a hub splined to the main shaft, inserts (keys) and insert springs, outer sleeve and blocking rings. There are grooves machined into the sleeves to capture the shift forks, which transfer the motion from the gearshift linkage. The sleeve moves along the splined inner hub in response to the shift fork, forcing the blocking ring against the gear cone and then, when the gear is at the same speed, slides over the blocking ring and gear engagement teeth, locking the gear to the synchronizer hub and shaft.

## **THROWOUT BEARING**

see 'clutch release bearing'.

## **THRUST BEARING**

a bearing that separates rotating parts from each other and non-rotating parts, and absorb thrust loads; a bearing with side surfaces that controls the fore and aft movement of a shaft.

## **TORQUE CONVERTER CLUTCH**

a device located inside the torque converter that mechanically links the engine and transmission together.

## **TORQUE CONVERTER**

a fluid coupling device used to transfer engine torque from the crankshaft to the transmission.

## **TORQUE STEER**

the tendency of many front -wheel-drive vehicles with half-shafts of unequal length, to turn somewhat from the desired direction when accelerating, especially in a curve, or when

decelerating in a curve.

## **TRANSFER CASE**

attached to or connected to the transmission in a four-wheel drive vehicle. Transfers power to both front and rear axles.

## **TRANSMISSION CONTROL MODULE (TCM)**

the computer that controls the transmission.

## **TRANSMISSION**

transfers the engine's power to the driveshaft and the rear wheels. Contains a series of gears that provide torque multiplication, so the vehicle can be moved from a standstill and also cruise at highway speeds at lower engine rpms.

## **TRANSVERSE**

perpendicular or at a right angle to a front-to-back centerline.

## **TRIPOD JOINT**

a type of CV-joint consisting of a spider, which is splined to the interconnecting shaft of the halfshaft, three rollers that turn on needle roller bearings located between the spider and rollers, a housing, or yoke, that is part of the stub shaft, and a boot. Used on the inboard side of the halfshaft.

## **UNIVERSAL JOINT (U-JOINT)**

a joint that allows the driveshaft to transmit torque at different angles as the suspension moves up and down.

## **VACUUM MODULATOR**

a device used to vary line pressure according to engine load in an automatic transmission.

## **VALVE BODY**

in an automatic transmission, the housing that contains most of the valves used for transmission operation.

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## UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

### Electrical Systems

## ELECTRICAL SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

### MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

#### **I. Our recommendations are based upon the following definitions.**

**System Failure** - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

**Preventive/Scheduled Maintenance** - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

**Improved System Performance** - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

**II. Training/Criteria** Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

#### **III. Appropriate Company Approved Inspection**

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

#### **IV. Written Estimates**

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

#### **V. Work Authorization**

No work will be performed without the customer's prior approval.

#### **VI. Limited Warranty**

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

#### **VII. Returned Parts**

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to



honor the warranty, the customer will be allowed to examine the parts.

## **VIII. Classification of Parts**

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

## **THE MAP PROCESS - OVERVIEW**

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site [www.motorist.org](http://www.motorist.org) or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 \* Fax: (202) 318-0378

## **THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS**

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p>A. Part no longer performs intended purpose</p> <p>B. Part does not meet a design specification (regardless of performance)</p> <p>C. Part is missing</p>	<p>1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.)</p> <p>2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)</p> <p>3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)</p> <p>4. Technician's recommendation based on substantial and informed experience</p> <p>5. To comply with maintenance recommended by AMRA / MAP</p>

Reasons to Require Repair or Replacement

Reasons to Suggest Repair or Replacement

**NOTE:**

When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

**NOTE:**

Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

## BATTERY, STARTING & CHARGING SYSTEM CHECKSHEET



### BATTERY, STARTING & CHARGING SYSTEM CHECKSHEET

Date: \_\_\_\_\_

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_

Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_

Mileage: \_\_\_\_\_ License: \_\_\_\_\_ VIN: \_\_\_\_\_ Eng Code: \_\_\_\_\_

Customer Interview:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

*Reason Code Explanation*

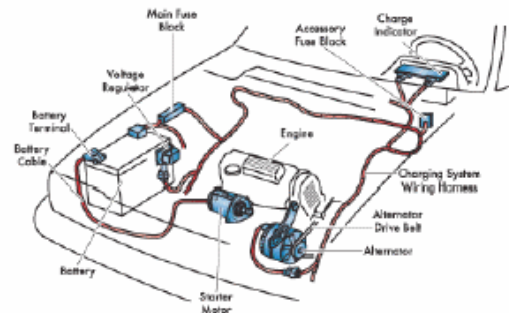
Code      Reason

Required

- A Part No Longer Performs Intended Purpose
- B Part Does Not Meet A Design Specification (Regardless Of Performance)
- C Part Is Missing

Suggested/Optional

- 1 Part Is Close To The End Of Its Useful Life
- 2 To Address A Customer Need, Convenience Or Request
- 3 To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
- 4 Technician's Recommendation Based On Substantial And Informed Experience
- 5 To Comply With Maintenance Recommended By AMRA/MAP



Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: [www.motorist.org](http://www.motorist.org)

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

**Fig. 1: Battery, Starting & Charging System Checksheet (1 Of 2)**

## BATTERY, STARTING & CHARGING SYSTEM CHECKSHEET

Battery				
	OK	S	R	Condition
Battery				
Fluid Level				
Case				
Posts				
Voltage				
CCA				Minimum OE Spec _____ Actual _____
Battery Box				
Battery Hold Down				
Battery Bolts				
Heat Shield				

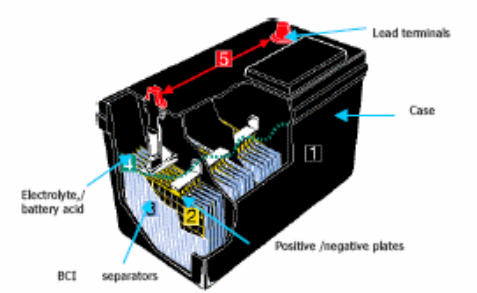
  

Alternator / Generator				
	OK	S	R	Condition
Alternator				
Volts				Spec _____ Actual _____
Voltage Regulator				
Pulleys				
Belt				
Tensioner				
Brackets				

Starter Motor				
	OK	S	R	Condition
Starter				
Cranking Amperage or Voltage				Spec _____ Actual _____
Starter Drive				
Solenoid				
Cables				

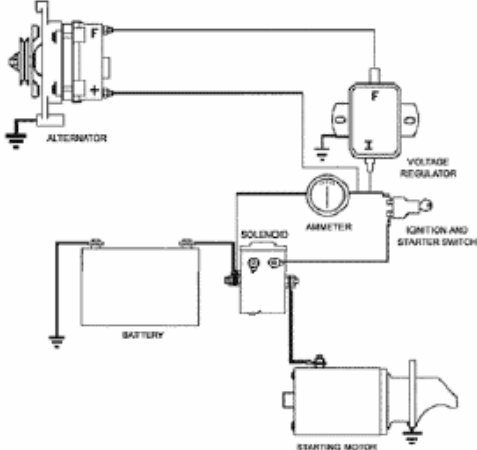
  



Wire, Cables, Fuse Block				
	OK	S	R	Condition
Cables				
Positive				
Negative				
Ground Straps				
Cable Ends				
Wiring				
Fuse Blocks				
Fuses / Circuit Breakers				
Indicator Lights / Gauges				
Battery Cooling Fan				
Terminals / Connectors				



Generic Starting & Charging System

OK

Suggested  
1, 2, 3, 4, 5

Required  
A, B, C

Automotive Maintenance & Repair Assn © 2009

**Fig. 2: Battery, Starting & Charging System Checksheet (2 Of 2)**

## ELECTRICAL SYSTEMS

### ACTUATOR MOTORS (ELECTRIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### ACTUATOR MOTORS (VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement

Condition	Code	Procedure
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement

## AIR BAGS

**NOTE:** For all air bag components and conditions, refer to vehicle manufacturer's specifications for diagnosis and parts replacement.

## ALTERNATORS AND GENERATORS

**NOTE:** If components have been added that increase vehicle electrical load requirement ( for example, sound systems, air conditioning, alarm systems, etc.), charging system output must meet the increased demand.

Condition	Code	Procedure
Alternator output meets OEM specification but is insufficient for add on electrical load	2	Suggest upgrade of alternator or removal of excess electrical load
Alternator's rated output is below OEM specification	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware non-functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Diode inoperative	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		
Housing broken, affecting performance	A	Require repair or replacement
Housing broken, not affecting performance	A	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Noisy	2	Suggest repair or replacement
Pulley incorrect	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Terminal resistance (voltage drop) out of specification	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Voltage drop out of specification	A	Require repair or replacement

## AMPLIFIERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.		
Missing	C	Require replacement
Sound quality poor	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ANTENNAS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	2	Suggest repair or replacement
Binding	2	Suggest repair or replacement
Broken	A	Require replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation or out of specification.		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Missing	C	Require replacement
Motor runs continuously	A	Require or replacement
Power antenna noisy	2	Suggest repair or replacement
Sticking	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## BATTERIES

**NOTE:** Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.

### Definition of Terms

**Battery Performance Testing - Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.**

**Cold Cranking Amp (CCA) Rating - The number of amperes a new, fully charged battery at 0Â° F ( -17.8Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).**

**Cranking Amps (CA) - The number of amperes a new, fully charged battery, typically at 32Â° F (0Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12volt battery).**

**OEM Cranking Amps - The minimum CCA required by the original vehicle manufacturer for a specific vehicle.**

Condition	Code	Procedure
Battery frozen	Â	Further inspection required
<p><b>NOTE:</b> Do not attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.</p>		
Battery tests near the ""end of its useful life"" utilizing a tester or on-board monitor able to accurately determine this condition	1	Suggest Replacement
Case leaking	A	Require replacement
Casing swollen	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Circuit open internally	A	Require replacement
Electrolyte contamination	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Electrolyte discoloration	A	Further inspection required

Condition	Code	Procedure
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Fails to accept and hold charge	A	Require replacement
<p><b>NOTE:</b> This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.</p>		
Fluid level low	B	Further inspection required
<p><b>NOTE:</b> Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test.</p>		
<p><b>NOTE:</b> If battery does not meet specifications, require replacement.</p>		
<p><b>NOTE:</b> If battery is sealed type (non-removable filler caps), require replacement.</p>		
Out of performance specification for battery	B	Require replacement
<p><b>NOTE:</b> The battery may meet vehicle's OEM specifications for that vehicle but test below the minimum specifications defined by the battery manufacturer.</p>		
Out of specification for application	B	Require replacement
<p><b>NOTE:</b> The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.</p>		
Post (top or side) burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Post (top or side) burned, not affecting performance	2	Suggest repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Post (top or side) corroded, affecting performance	A	Require repair
Post (top or side) corroded, not affecting performance	2	Suggest repair
Post (top or side) loose	A	Require replacement
Post (top or side) melted, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Post (top or side) melted, not affecting performance	2	Suggest repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		

Condition	Code	Procedure
Specific gravity low	B	Further inspection required
<b>NOTE:</b> Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.		
State of charge low	A	Further inspection required
<b>NOTE:</b> Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.		
Top dirty	2	Suggest cleaning battery
Top wet	A	Require cleaning battery Further inspection required
<b>NOTE:</b> Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.		
Vent cap loose	A	Require repair or replacement of vent cap
Vent cap missing	C	Require replacement of vent cap

### BATTERY CABLES, WIRES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
<b>NOTE:</b> Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## BATTERY CABLES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
<b>NOTE:</b> <b>Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.</b>		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement



Condition	Code	Procedure
Voltage drop out of specification	A	Require repair or replacement

### BATTERY TRAYS AND HOLD DOWN HARDWARE

Condition	Code	Procedure
Battery improperly secured	2	Suggest repair
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Â	No service suggested or required
Broken, affecting performance	A	Require repair or replacement
Broken, not affecting performance	Â	No service suggested or required
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Water drain clogged	A	Require repair

### BATTERY WIRES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
<b>NOTE:</b> <b>Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.</b>		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> <b>Determine cause of incorrect alignment and require repair.</b>		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>Determine cause of noise and suggest repair.</b>		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

## BULB SOCKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Bulb seized in socket	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of socket.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of socket.</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		

Condition	Code	Procedure
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Leaking	B	Require repair or replacement
Melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### **BULBS, SEALED BEAMS AND LEDS**

**NOTE:** Does not include soldered-in components.

Condition	Code	Procedure
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement
<b>NOTE:</b> <b>Application incorrect includes wrong bulb coating or color.</b>		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		

Condition	Code	Procedure
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## CD PLAYERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Missing	C	Require replacement
Skips	A	Require repair or replacement
Sound quality poor	A	Require repair or replacement
<b>NOTE:</b> <b>Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.</b>		
Speed incorrect	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## CIGARETTE LIGHTER ASSEMBLIES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Loose	B	Require repair or replacement
Missing	2	Suggest replacement
Sticking	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## CLUTCH SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware



Condition	Code	Procedure
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement

Condition	Code	Procedure
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest repair or replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
<b>NOTE:</b> <b>Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).</b>		
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require repair

Condition	Code	Procedure
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### CRUISE CONTROL BRAKE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## CRUISE CONTROL CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
<b>NOTE:</b> Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

### CRUISE CONTROL CLUTCH SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

### CRUISE CONTROL LINKAGES AND CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
<b>NOTE:</b> Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

### CRUISE CONTROL RESERVOIRS

Condition	Code	Procedure



Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

### CRUISE CONTROL TUBES

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

### CRUISE CONTROL VACUUM DUMP RELEASE VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Suggest replacement
Out of adjustment	B	Further inspection required
<b>NOTE:</b> Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.		

### CRUISE CONTROL VACUUM HOSES, TUBES AND

Condition	Code	Procedure
Reservoirs	Â	Â
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

### CRUISE CONTROL VEHICLE SPEED SENSORS

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment to vehicle manufacturer's specifications

Condition	Code	Procedure
<b>NOTE:</b> If a sensor is not adjustable, further inspection is required to identify and correct cause.		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Housing cracked	B	Require replacement
Internal resistance does not meet specifications	B	Require replacement
<b>NOTE:</b> Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance.		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
<b>NOTE:</b> Some integral bearing assemblies with sensors may require replacement.		
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
<b>NOTE:</b> Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance.		
Surface contaminated	2	Suggest cleaning; identify and correct source
Tip bent	B	Require replacement
Tip broken	B	Require replacement
Tip missing	B	Require replacement
Wire lead burned	A	Require replacement
Wire lead conductors exposed	B	Require replacement
Wire lead corroded	A	Require replacement
Wire lead open	A	Require replacement
Wire lead shorted	A	Require replacement

## DEFOGGERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## DEFROSTERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## DELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## DIMMERS

Condition	Code	Procedure
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Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## **ELECTRIC HEATERS**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement

Condition	Code	Procedure
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## EQUALIZERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Missing	C	Require replacement
Sound quality poor	A	Require repair or replacement
<b>NOTE:</b> <b>Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## FUSE BLOCKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of fuse box.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of fuse box.		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Melted, not affecting performance	2	Suggest replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## FUSE BOXES AND BLOCKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	À	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of fuse box.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of fuse box.</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Melted, not affecting performance	2	Suggest replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

## FUSIBLE LINKS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement

Condition	Code	Procedure
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

## GAUGES

**NOTE:** Includes odometers, speedometers, and tachometers (except cable-driven).

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only.		
Lens cloudy	2	Suggest repair or replacement
<b>NOTE:</b> If lens is available as a separate part, suggest replacement of lens only.		
Lens missing	C	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only.		
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## GENERATORS

**NOTE:** If components have been added that increase vehicle electrical load requirement ( for example, sound systems, air conditioning, alarm systems, etc.), charging system output must meet the increased demand.

Condition	Code	Procedure
Alternator output meets OEM specification but is insufficient for add on electrical load	2	Suggest upgrade of alternator or removal of excess electrical load
Alternator's rated output is below OEM specification	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware non-functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Diode inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Housing broken, affecting performance	A	Require repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Noisy	2	Suggest repair or replacement
Pulley incorrect	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Terminal resistance (voltage drop) out of specification	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Voltage drop out of specification	A	Require repair or replacement

## GROUND CABLES AND STRAPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Insulation damaged, exposing conductors	2	Suggest replacement
Loose	A	Require repair
Missing	C	Require replacement
Open	A	Require repair or replacement
Resistance high	A	Require repair or replacement
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement
Voltage drop out of specification	B	Require repair or replacement

## GROUND STRAPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Insulation damaged, exposing conductors	2	Suggest replacement
Loose	A	Require repair
Missing	C	Require replacement
Open	A	Require repair or replacement
Resistance high	A	Require repair or replacement
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement
Voltage drop out of specification	B	Require repair or replacement

## HEADLIGHT ADJUSTERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware



Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, preventing adjustment	A	Require repair or replacement
Broken	A	Require repair or replacement
Indicator broken	A	Require replacement
Indicator missing	C	Require replacement
Missing	C	Require replacement of adjusters
Seized	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## HEATING ELEMENTS (DEFROSTERS, DEFOGGERS, ELECTRIC HEATERS AND SEATS)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## HORNS AND SIRENS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Out of adjustment	B	Require adjustment
Sound quality poor	A	Require repair or replacement. Further inspection required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## IGNITION SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## INDICATOR LIGHTS

Condition	Code	Procedure
Does not come on during bulb check	Â	Further inspection required
<b>NOTE:</b> See service manual for further information.		
Fails to function properly during test mode	Â	Further inspection required
<b>NOTE:</b> See service manual for further information.		
On constantly	Â	Further inspection required
<b>NOTE:</b> See service manual for further information.		
On intermittently	Â	Further inspection required
<b>NOTE:</b> See service manual for further information.		

## KEYLESS ENTRY KEYPADS AND TRANSMITTERS

Condition	Code	Procedure

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### KEYLESS ENTRY TRANSMITTERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Terminal broken	A	Require repair or replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## LEDS

**NOTE:** Does not include soldered-in components.

Condition	Code	Procedure
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement
<b>NOTE:</b> <b>Application incorrect includes wrong bulb coating or color.</b>		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## LENSES

Condition	Code	Procedure
Adjustment out of specification	B	Require repair
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required



Condition	Code	Procedure
Cracked	B	Require replacement
Discolored	A	Require replacement
Leaking	B	Require repair or replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	2	Suggest replacement
Missing	C	Require replacement

## MICROPHONES

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Membrane torn	A	Require replacement
Missing	C	Require replacement
Polarity reversed	A	Require repair
Sound quality poor	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## MIRRORS (ELECTROCHROMATIC AND HEATED)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Cracked	B	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## MOTORS

Condition	Code	Procedure
Amperage draw out of specification	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bracket bent	A	Require repair or replacement
Bracket broken	A	Require repair or replacement
Bracket cracked	A	Require repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket missing	C	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Drive mechanism damaged, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Further inspection required to determine cause.</b>		
Drive mechanism damaged, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Further inspection required to determine cause.</b>		
Fails to disengage	A	Require repair or replacement
Housing broken, affecting performance	A	Suggest repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	Â	No service suggested or required
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Further inspection required
<b>NOTE:</b> <b>Follow OEM recommended adjustment procedures. Repair or replace if out of specification.</b>		
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement

Condition	Code	Procedure
Wire lead shorted	A	Require repair or replacement

## NEUTRAL SAFETY SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## ODOMETERS, SPEEDOMETERS AND TACHOMETERS (CABLE DRIVEN)

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Drive cable broken	A	Require replacement
Drive cable noisy	2	Suggest repair or replacement
Inoperative	A	Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation, out of OEM specification, or out of range.</b>		
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, require replacement of lens only.</b>		
Lens cloudy	2	Suggest repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, suggest replacement of lens only.</b>		
Lens missing	C	Require repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, require replacement of lens only.</b>		
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## **ODOMETERS**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, require replacement of lens only.</b>		
Lens cloudy	2	Suggest repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, suggest replacement of lens only.</b>		
Lens missing	C	Require repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, require replacement of lens only.</b>		
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.</b>		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## **POWER DISTRIBUTION CENTER**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of fuse box.</b>		
Burned, not affecting performance	2	Suggest repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of fuse box.</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Melted, not affecting performance	2	Suggest replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## **PULLEYS**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require replacement
Cracked	B	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Pulley damaged, affecting belt life	A	Require replacement

## **RECEIVERS, AMPLIFIERS, EQUALIZERS AND SUB-WOOFER VOLUME CONTROLS**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Missing	C	Require replacement
Sound quality poor	A	Require repair or replacement
<b>NOTE:</b> <b>Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## RELAY BOXES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of relay box.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of relay box.</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Cover missing	C	Require replacement of cover
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Melted, not affecting performance	2	Suggest replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## RELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

Condition	Code	Procedure
Terminal loose, not affecting performance	1	Suggest repair or replacement

## SEALED BEAMS

**NOTE:** Does not include soldered-in components.

Condition	Code	Procedure
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Base burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## SEAT HEATERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## SECURITY ALARM SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## SIRENS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Out of adjustment	B	Require adjustment
Sound quality poor	A	Require repair or replacement. Further inspection required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## SOLENOIDS

**NOTE:** For starter solenoids that are integral to the starter assembly, see Starters. For starter relays, see Relays.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage

Condition	Code	Procedure
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## SPEAKERS AND MICROPHONES

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Membrane torn	A	Require replacement
Missing	C	Require replacement
Polarity reversed	A	Require repair
Sound quality poor	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### SPEEDOMETER AND TACHOMETER LINKAGES AND CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement

<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

### SPEEDOMETER CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement

Condition	Code	Procedure
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

## SPEEDOMETERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only.		
Lens cloudy	2	Suggest repair or replacement
<b>NOTE:</b> If lens is available as a separate part, suggest replacement of lens only.		
Lens missing	C	Require repair or replacement
<b>NOTE:</b> If lens is available as a separate part, require replacement of lens only.		

Condition	Code	Procedure
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## STARTERS

**NOTE:** To prevent misdiagnosis, care should be taken to eliminate the possibilities of mechanical problems or high resistance in power and/or ground circuits.

Condition	Code	Procedure
Amperage draw does not meet OEM specifications	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
<b>NOTE:</b> Inspect block or bell housing mounting surface.		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Drive gear damaged, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Further inspection required to determine cause. Require inspection of ring gear.		
Drive gear damaged, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Further inspection required to determine cause. Require inspection of ring gear and service as needed.		
Fails to disengage	A	Require repair or replacement
Housing broken, affecting performance	A	Require repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Noisy	2	Suggest repair or replacement
Shimmed incorrectly	B	Require repair
Starter shaft bushing missing	C	Require replacement
<b>NOTE:</b> Bushings may be in bell housing.		
Starter shaft bushing worn, affecting performance	A	Require replacement
Starter shaft bushing worn, not affecting performance	1	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## SUB-WOOFER VOLUME CONTROL

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.		
Missing	C	Require replacement



Condition	Code	Procedure
Sound quality poor	A	Require repair or replacement
<b>NOTE:</b> Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement

## SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## TACHOMETER CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

## TACHOMETERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, require replacement of lens only.</b>		
Lens cloudy	2	Suggest repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, suggest replacement of lens only.</b>		
Lens missing	C	Require repair or replacement
<b>NOTE:</b> <b>If lens is available as a separate part, require replacement of lens only.</b>		
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.</b>		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

### TAPE PLAYERS AND CD PLAYERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement

Condition	Code	Procedure
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Missing	C	Require replacement
Skips	A	Require repair or replacement
Sound quality poor	A	Require repair or replacement
<b>NOTE:</b> <b>Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.</b>		
Speed incorrect	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## TENSIONERS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Cracked	B	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

## TIMERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## TRANSCEIVERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.		
Missing	C	Require replacement
Sound quality poor	A	Require repair or replacement
<b>NOTE:</b> Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## TRANSDUCERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Drive mechanism damaged, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Further inspection required to determine cause.		
Drive mechanism damaged, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Further inspection required to determine cause.		
Inoperative	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation or out of specification.		
Leaking (vacuum/fluid/air)	A	Require replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	Å	No service suggested or required
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Out of adjustment	B	Further inspection required
<b>NOTE:</b> Follow OEM recommended adjustment procedures. Repair or replace if out of specification.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### VACUUM ACCUMULATORS (RESERVOIRS)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement

### VOLTAGE REGULATORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### WASHER FLUID LEVEL SENDERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### WASHER PUMPS

Condition	Code	Procedure

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## WIPER ARMS AND BLADES

**NOTE:** Windshield coatings or waxes can cause blades to not function as intended. Clean surface before making final judgment about blade replacement.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching socket stripped	A	Require replacement
Bent	A	Require repair or replacement
Loose	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement

Condition	Code	Procedure
Size incorrect	2	Suggest replacement
Tension insufficient	B	Require repair or replacement
Torn	A	Require replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance	1	Suggest replacement

## WIPER BLADES

**NOTE:** Windshield coatings or waxes can cause blades to not function as intended. Clean surface before making final judgment about blade replacement.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching socket stripped	A	Require replacement
Bent	A	Require repair or replacement
Loose	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Size incorrect	2	Suggest replacement
Tension insufficient	B	Require repair or replacement
Torn	A	Require replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance	1	Suggest replacement

## WIPER HOSES AND NOZZLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blocked	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Spray pattern incorrect	2	Suggest repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

## WIPER LINKAGES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching stud stripped	A	Require replacement
Bent	A	Require repair or replacement
Inoperative	A	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		
Loose	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Tension insufficient	B	Require repair or replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance	1	Suggest replacement

### WIPER NOZZLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blocked	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Spray pattern incorrect	2	Suggest repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

### WIPER PUMP RESERVOIRS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cap missing	C	Require replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement

### WIRING HARNESES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement

Condition	Code	Procedure
Insulation damaged, conductors not exposed	1	Suggest repair or replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b>		
<b>Determine cause and correct prior to repair or replacement of part.</b>		
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## REASON CODE EXPLANATION

Code	Reason
<b>Required</b>	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification ( Regardless Of Performance)
C	Part Is Missing
<b>Suggested/Optional</b>	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

## AUTOMOTIVE TERMINOLOGY & DEFINITIONS

### ACTUATOR

a control device that delivers mechanical action in response to a vacuum or electrical signal; anything that the engine control computer uses to do something, such as trigger fuel injection or fire a spark plug. Most actuators on a computercontrolled engine system are activated by grounding their circuits rather than by actively powering them, since that protects the computer from short circuits.

### AEMD (AUTOMOTIVE ELECTRIC DRIVE MOTOR)

a U.S. Department of Energy program to develop low-cost traction drive motors for automotive applications.

### AIR BAGS

air bags are fabric bags that are filled quickly with a gas to provide supplemental protection for vehicle passengers during some collisions. Side-impact air bags are becoming increasingly



available. Air bags are most effective in protecting vehicle occupants who are properly belted.

## **ALTERNATING CURRENT (A C)**

electrical current that flows in one direction, from positive to negative, and then reverses direction, from negative to positive.

## **ALTERNATOR**

a belt driven device that provides electrical current for the vehicle's charging system.

## **AMMETER**

an instrument for measuring the strength of electrical current flow in a circuit in terms of amperes.

## **AMPERAGE**

the amount of electrical current flowing in a circuit.

## **AMPERE (AMP)**

a unit for measuring the strength (rate of flow) of an electrical current.

## **AMPLIFIER**

a device with electron tubes or semiconductors used to increase the voltage or current of a signal.

## **AMPLIFY**

to enlarge or strengthen original characteristics. Usually used in reference to electronics.

## **ANION**

negative ion. Alkali, molten carbonate, and solid oxide fuel cells are "anion-mobile" cells - anions migrate through the electrolyte toward the anode.

## **ANODE**

one of two electrodes in a fuel cell or battery. The anode, the negative post of the fuel cell, conducts the electrons that are freed from the hydrogen molecules so that they can be used in an external circuit. It has channels etched into it that disperse the hydrogen gas equally over the surface of the catalyst.

## **ARCING**

the ability of electrical energy to jump across an air gap.

## **ARMATURE**

a laminated, soft iron core wrapped by wire that converts electrical energy to mechanical energy.

## **BATTERY ACID**

the sulfuric acid solution used as the electrolyte in a battery.

## **BATTERY CELL**

the part of a battery made from two dissimilar metals and an acid solution. A cell stores chemical energy to be used later as electrical energy.

## **BATTERY SAVER**

the battery saver system is an effective way to prevent complete battery discharge when the engine is shut down. Based on the preset time-limit, the system automatically disconnects the battery load when the battery is not being charged. Depressing the reset push button will enable the battery to

be reconnected for additional periods of time. Critical systems can be set up to have battery power maintained.

## **BATTERY**

a device that produces electricity through, electrochemical action.

## **BENDIX DRIVE**

the starter drive gear that is attached to the starter motor armature and engages the gear teeth on the flywheel.

## **BRUSH**

a bar of conductive material that rides on the commutator of a generator or motor.

## **CAPACITOR**

a device, made up of two or more conducting plates, separated by an insulator, used to store an electric surge or charge of current.

## **CATHODE**

one of two electrodes in a fuel cell or battery. The cathode, the positive post of the fuel cell, has channels etched into it that distribute the oxygen to the surface of the catalyst. It also conducts the electrons back from the external circuit to the catalyst, where they can recombine with the hydrogen ions and oxygen to form water.

## **CATION**

positive ion. Phosphoric acid and proton exchange membrane (PEM) fuel cells are "cation-mobile" cells - the cation migrates through the electrolyte toward the cathode.

## **CHARGING SYSTEM**

the system that supplies electrical power for vehicle operation and recharges the battery.

## **CIRCUIT BREAKER**

a device used in an electrical circuit to interrupt current flow in the event of an overload or short.

## **CIRCUIT**

a path through which electricity flows before returning to its source.

## **COLD CRANKING AMPS**

the amount of cranking amperes that a battery can deliver in 30 seconds at  $0^{\circ}\text{F}$  ( $-18^{\circ}\text{C}$ ).

## **COMMUTATOR**

a slotted ring located at the end of the armature of a generator or motor. The commutator provides the electrical connection between the armature and brushes.

## **CONDUCTIVITY**

transmission of electricity by metallic substances. Metals have high electrical conductivity, and with few exceptions, their conductivity decreases with increasing temperature.

## **CONDUCTOR**

a material that provides a path for the flow of electrical current or heat.

## **CONTINUITY**

the condition that exists in a working electrical circuit. A circuit that is unbroken, not open.

## **CORRODE**

gradual loss from a metal surface from chemical action.

## **CORROSION**

deteriorative loss of a metal as a result of environmental reactions.

## **CORROSIVITY**

the characteristic of a material that enables it to dissolve metals and other materials or burn the skin.

## **DELAYED ACCESSORY POWER**

delayed accessory power continues electric power temporarily to certain convenience features after vehicle power has been turned off. For example, the feature allows the customer to close a window without reinserting the key. Delayed accessories include radio and power windows, power moon roof and message center.

## **DIGITAL SIGNAL PROCESSING AUDIO SYSTEM**

a Digital Signal Processing (DSP) system modifies audio signals digitally to achieve better control of sound quality. DSP can be used for standard functions such as volume, balance, fade and tone control, as well as AM and FM stereo decoding. It also allows advanced audio processing such as concert hall emulation, sound shaping and adaptive noise reduction filtering.

## **DIGITAL VOLT/OHMMETER (DVOM)**

an instrument that measures volts, ohms and amps and displays the results numerically.

## **DIGITAL**

a voltage signal that uses on and off pulses.

## **DISCHARGE**

the flow of current from a battery; to remove the refrigerant from an air conditioning system.

## **DIVERSITY ANTENNA**

a diversity antenna system uses two antennas mounted at different locations on the vehicle and automatically chooses one that provides the better FM radio signal.

## **DUTY CYCLE**

a signal that varies the ratio of on time to off time, resulting in a square wave that can range between zero and 100 percent or may be high or low, and off may be high or low; in a process, the ratio of on time to total cycle time; in fuel injectors, the percentage of on-time to total cycle time; in solenoids, the percentage of on-time to total cycle time.

## **ELECTRICITY**

electric current used as a power source. Electricity can be generated from a variety of feedstocks, including oil, coal, nuclear, hydro, natural gas, wind, and solar. In electric vehicles, onboard rechargeable batteries power electric motors.

## **ELECTROCHEMISTRY**

science that deals with the relation of electricity to chemical changes and with the interconversion of chemical and electrical energy.

## **ELECTRODE**

electrical terminal that conducts an electric current into or out of a fuel cell.

## **ELECTRODE**

a terminal that conducts an electric current into or away from the conducting part of a circuit, such as the terminal of a battery; firing terminals found in a spark plug.

## **ELECTROLYSIS**

chemical and electrical decomposition process that can damage metals such as brass, copper and aluminum in the cooling system; the decomposition of an electrolyte by the action of an electric current passing through it.

## **ELECTROLYTE**

chemical compound that conducts electricity from one electrode to the other inside a fuel cell.

## **ELECTROLYTE**

a material whose atoms become ionized (electrically charged) in solution. In automobiles, the battery electrolyte is a mixture of sulfuric acid and water.

## **ELECTROMAGNET**

an iron core surrounded by a coil of wire that temporarily becomes a magnet when an electric current flows through the wire.

## **ELECTROMAGNETIC INDUCTION**

moving a wire through a magnetic field to create current flow in the wire.

## **ELECTROMECHANICAL**

refers to a device that incorporates both electrical and mechanical principles together in its operation.

## **ELECTRONIC**

pertaining to the control of systems or devices by the use of small electrical signals and various semiconductor devices and circuits.

## **EMITTER**

in a transistor, the region or layer of semiconductor material from which electrons are injected into the base region.

## **ENERGY**

the capacity for doing work and overcoming resistance.

## **FIELD COIL**

a wire coil on an alternator rotor or starter motor frame; a field coil produces a magnetic field when energized.

## **FLUX DENSITY**

the degree of concentration of the magnetic lines of force that emanate from a magnetic sensor; when the tooth of a reluctor aligns with the sensor tip, the magnetic lines of force are squeezed together, which increases flux density.

## **FLYWHEEL**

a mechanical battery that stores kinetic energy. A flywheel is essentially a spinning wheel with a motor. Flywheels can be more responsive than chemical batteries, and they are less susceptible to

the effects of weather.

## **FREQUENCY**

the number of cycles of a periodic waveform typically measured in one second intervals or hertz (cycles per second).

## **FUSE**

a metal circuit protection device that melts when there is a circuit overload or short.

## **FUSIBLE LINK**

a smaller gauge wire that is included in an electrical circuit to provide circuit protection. The smaller gauge wire will melt when the circuit is overloaded.

## **GENERATOR**

a device that converts mechanical energy into electrical energy; SAE J1930 nomenclature for an alternator; a generating device that uses diode rectifiers to convert ac to dc.

## **GROUND CIRCUIT**

that part of the circuit that is connected electrically to the negative terminal of the battery. Every electric circuit has a power and ground side. Most computer actuations consist of completing the ground side of an actuator's circuit; this protects the computer from short circuits. Resistance in a ground circuit will reduce the current through it and cause deterioration in the function of the circuit.

## **GROUND**

a connecting body whose electrical potential is zero to which an electrical circuit can be connected.

## **HALL EFFECT**

when current flows through a thin wafer of semiconductor material, and a magnetic field crosses it at a right angle, a voltage known as a Hall effect voltage will be generated at the edge of the material. Interrupting the magnetic field turns off the voltage. This is the principle used by Hall effect sensors.

## **HEAT SINK**

part of a system designed to be at a lower temperature than its surroundings, used to dissipate heat from that system; device to dissipate heat and protect parts.

## **HIGH INTENSITY DISCHARGE HEADLAMPS**

high intensity discharge (HID) headlamps provide a brighter, whiter light for increased forward visibility. They produce about 2 times as much light as conventional halogen bulbs and have a distinct appearance. Also, they are more durable than filament bulbs and require 37 percent less power to operate.

## **HIGH TENSION**

that part of a system that operates under or carries high voltage; in an ignition system, voltages in the secondary circuit of the system as opposed to the low, primary circuit voltage.

## **HYDROMETER**

an instrument used to measure the specific gravity of a solution.

## **IMPEDANCE**

the total resistance of an electrical device measured in ohms.

## **INDUCTION**

the process by which an electric or magnetic effect is produced in an electrical conductor or magnetic body, when it is exposed to variation of a field of force. Induction is the principle used in an ignition coil to increase voltage.

## **INSULATED CIRCUIT.**

a circuit that includes all of the high-current cables and connections from the battery to the starter motor.

## **INSULATOR**

a non-conductive material used to insulate wires in an electrical circuit.

## **INTEGRATED CIRCUIT**

an electrical circuit containing many interconnected amplifying devices and circuit elements formed on a single body or chip of semiconductor material; diodes, transistors and other electronic components mounted on semiconductor material and able to perform numerous functions.

## **ION CHROMATOGRAPHY**

a form of liquid chromatography that uses ion-exchange resins to separate atomic or molecular ions based on their interaction with the resin.

## **ION**

atom that carries a positive or negative charge because of the loss or gain of an electron.

## **KEEP-ALIVE MEMORY**

a series of vehicle battery-powered memory locations in the microcomputer that store information on input failure, identified in normal operations for use in diagnostic routines; adapts some calibration parameters to compensate for changes in the vehicle system.

## **LIGHT EMITTING DIODE (LED)**

a digital electronic display device which can be used as a simple signal light or arranged to show letters and/or numbers.

## **LIQUID CRYSTAL DIODE (LCD)**

a digital electronic display device made of a special glass and liquid, which requires a separate light source.

## **MAGNET**

any substance that attracts iron or an iron, steel or any ferrous metal alloy.

## **MAGNETIC FIELD**

the areas surrounding the poles of a magnet which are affected by its forces of attraction or repulsion; the region of space in which there is a measurable magnetic force.

## **MAGNETIC GAUGES**

electrical analog gauges that use magnetic forces to move the needle left or right.

## **MAGNETIC PULSE GENERATOR**

a sensor used to monitor the position of any point on a rotating part such as a crankshaft or input shaft.

## **MEMORY PROFILE SYSTEM**



the Memory Profile System offers different drivers the ability to set into memory their preferred positions for several comfort and convenience features. A driver is identified by a unique key fob or entry code, and the vehicle systems automatically adjust to his or her settings. Depending on the vehicle, some of the following features can be included in the memory profile: Seat position Steering wheel position (tilt/telescope) Mirror positions Safety belt "D" ring height Pedal positions Radio stations Power steering assist level Ride firmness

## **MEMORY**

part of a computer that stores or holds programs and other data.

## **MERCURY SWITCH**

a type of switch that uses the flow of liquid metal, Mercury, to complete the electrical circuit. Mercury switches are frequently used to control trunk and underhood lights.

## **MICROPROCESSOR**

the portion of a microcomputer that receives sensor input and handles calculations.

## **MODULE**

an electronic control unit.

## **MOTOR**

a machine that converts electrical energy into mechanical energy.

## **MOTOR**

in an HEV, an electric traction motor converts electrical energy from the energy storage unit to mechanical energy that drives the wheels of the vehicle. Unlike a traditional vehicle, where the engine must "ramp up" before full torque can be provided, an electric motor provides full torque at low speeds. This characteristic gives the vehicle excellent "off the line" acceleration.

## **OHM**

a unit of electrical resistance of a circuit in which an electromotive force of one volt maintains a current of one ampere, named after German physicist Georg Ohm.

## **OHMMETER**

an instrument that measures electrical resistance in ohms.

## **OHM'S LAW**

a basic law of electricity expressing the relationship between current, resistance and voltage in any electrical circuit. Ohm's law states that the voltage in a circuit is equal to the current multiplied by the resistance.

## **PARALLEL CIRCUIT**

a circuit with more than one path for the current to follow.

## **PARALLEL CONFIGURATION**

a hybrid electric vehicle (HEV) with a parallel configuration has a direct mechanical connection between the power unit and the wheels, as in a conventional vehicle, but also has an electric motor that drives the wheels. For example, a parallel vehicle could use the power created from an internal combustion engine for highway driving and the power from the electric motor for accelerating.

## **PERIOD**

in an electrical signal the period is the amount of time it takes for one cycle of an electrical signal to repeat itself; the number of periods that occur in one second is the frequency of the signal.

## **PHASE**

any point or points of parallel movements or oscillations, in or out of synchronization; the rotational positions of the U-joints and yokes in a driveline.

## **PHOTOVOLTAIC PANEL**

photovoltaic panels contain cells that convert sunlight into electricity. While solar-powered vehicles are not currently feasible for production, solar panels could be used to power vehicle components, such as a fan to exhaust hot interior air when the vehicle is parked in the sun or to recharge the vehicle battery. Photovoltaic panels can be integrated into the hood, roof, sunroof, deck lid or spoiler.

## **PICKUP COIL**

a weak, permanent magnet-and-wire assembly which forms a position sensor.

## **PIEZOELECTRIC SENSOR**

a sensor that generates voltage from physical shock or motion, a knock sensor.

## **POLARITY**

the condition of being positive or negative relative to a reference point or object; the particular state (positive or negative) with reference to the two magnetic poles.

## **POTENTIOMETER**

a device that changes voltage by varying its internal resistance.

## **PROGRAM**

a set of instructions or procedures that a computer must follow when controlling a system.

## **PULSE WIDTH MODULATED**

electronic control of a solenoid that rapidly cycles it on and off many times per second in order to achieve a specific output.

## **PULSE WIDTH**

the length of time during which a circuit is energized.

## **RANDOM ACCESS MEMORY (RAM)**

a type of memory used in a computer to store information temporarily.

## **READ-ONLY MEMORY (ROM)**

a type of memory used in a computer to store information permanently, as opposed to the temporary storage provided by random-access memory (RAM).

## **RECTIFIER**

a device that changes alternating current (AC) into direct current (DC).

## **RECTIFY**

to change one type of voltage to another.

## **REFERENCE PULSE**

a voltage signal generated by the crankshaft position sensor (or distributor, or camshaft position sensor - all equivalent components for this purpose). The voltage signal is sent to the computer as a fixed number of degrees BTDC for each cylinder, with the signal for cylinder No.1 distinguishable from the signal for the others.

## **REFERENCE VOLTAGE**

the voltage supplied by the system computer to certain sensors. The sensors reduce the voltage by a specific amount, according to their function, and send the signal back to the computer. The computer then uses the reduced voltage signal to interpret the information sent.

## **RELAY**

an electromagnetic switch that uses low amperage current to control a circuit with high amperage.

## **RELUCTOR**

in an electronic ignition, the trigger wheel mounted on the distributor shaft that triggers the pickup coil, which in turn signals the control module to fire the coil.

## **REMOTE LIGHTING SYSTEM**

the Remote Lighting System removes the sources of light from the lamp fixture. Instead, light for all fixtures is generated from a single "light battery". Light is transmitted to the various fixtures and accessories via fiber optics or light pipes. The advantages of remote lighting include reduced power consumption, greater durability and more flexibility in packaging and styling lamp fixtures.

## **RESISTANCE**

the opposition offered by a substance or body to the passage of electric current through it.

## **RESISTOR**

an electrical device installed in a circuit to lower voltage and current flow.

## **RHEOSTAT**

a variable resistor used to control current flow in a circuit.

## **SATURATION**

point at which current flowing through a coil or wire has built up the maximum magnetic field.

## **SEMICONDUCTOR**

a material that is neither a good conductor of electricity nor a good insulator.

## **SENSOR**

any mechanism by which the engine control computer can measure some variable on the engine, such as coolant temperature or engine speed. Each sensor works by sending the computer a signal of some sort, a coded electronic message that corresponds to some point on the range of the variable measured by that sensor.

## **SERIES CIRCUIT**

a circuit that has only one path for current to follow.

## **SERIES CONFIGURATION**

some hybrid electric vehicles (HEVs) use a series configuration, in which the heat engine or fuel cell together with a generator produce electricity for the battery pack and electric motor. Series HEVs have no mechanical connection between the hybrid power unit and the wheels; this means that all motive power is transferred from chemical energy to mechanical energy, to electrical energy, and back to mechanical energy to drive the wheels.

## **SERIES-PARALLEL CIRCUIT**

a circuit that combines series and parallel circuits.

## **SHORT CIRCUIT**

a condition that occurs in an electrical circuit when the current bypasses the intended load and takes a path with little or no resistance, such as another circuit or ground.

## **SHUNT**

an alternate path through which electrical current or fluids may flow.

## **SOLENOID**

a coil of wire that becomes an electromagnet when current flows through it. It then loses its magnetism when the current flow is turned off. The solenoid contains an iron plunger inside the wire coil that is spring loaded to one position. When the solenoid is energized, the plunger moves to the other position.

## **SOLID STATE**

an electrical device with no moving parts.

## **SPECIFIC GRAVITY**

the ratio of the weight or mass of the given volume of a substance to that of an equal volume of another substance, e.g. - water for liquids and solids; air or hydrogen for gases, are used as standards.

## **SPLICE**

to join or unite by weaving, binding, soldering, cementing, etc., usually at the ends of two objects.

## **SQUARE WAVE/SINE WAVE**

voltage fluctuations of different shapes in an electric circuit. The square wave goes immediately from one voltage to the other; the sine wave gradually changes, going through the intervening values. An electromagnetic pulse generator like a wheel speed sensor or a reluctor-type distributor pickup produces a sine wave. Hall Effect sensors, photoelectric switches, and other on-off signal generators produce square waves. For many purposes, square waves are easier for computers to work with, so on many vehicles there are electronic devices to modify sine waves into square waves.

## **STARTER**

the electric motor that is used to start an engine.

## **STATOR**

a device located between the impeller and turbine in a torque converter. It contains specifically angled blades around both sides of its circumference to redirect the flow of fluid coming off the turbine, which increases the force of the fluid driving the turbine, resulting in torque multiplication.

## **STEPPER MOTOR**

an electric motor that can move to a specific position on its range of travel.

## **SWITCH**

a device used to open, close or direct the current in an electrical circuit.

## **THERMISTOR**

a temperature sensitive variable resistor in which the resistance decreases as its temperature increases.

## **TRANSDUCER**

a device that changes a force into an electrical signal.

## **TRANSDUCER**

device that converts variations in one energy form into corresponding variations in another, usually electrical.

## **TRANSISTOR**

an electronic device produced by joining three sections of semiconductor materials. Used as a switching or amplifying device.

## **ULTRACAPACITOR**

ultracapacitors are higher specific energy and power versions of electrolytic capacitors-devices that store energy as an electrostatic charge. They are electrochemical systems that store energy in a polarized liquid layer at the interface between an ionically conducting electrolyte and a conducting electrode. Energy storage capacity increases by increasing the surface area of the interface. Ultracapacitors are being developed as primary energy devices for power assist during acceleration and hill climbing, as well as recovery of braking energy.

## **VARIABLE RELUCTANCE SENSOR**

a magnetic sensor that generates its own alternating current voltage based on the interference of a moving object across its tip.

## **VARIABLE RESISTOR**

a resistor that can be adjusted so the amount of resistance produced in the circuit changes.

## **VOLT**

unit of electromotive force. One volt of electromotive force applied steadily to a conductor of one-ohm resistance produces a current of one ampere.

## **VOLTAGE DROP**

voltage lost by the passage of electrical current through resistance.

## **VOLTAGE REGULATOR**

a device used to control the output of an alternator or generator.

## **VOLTMETER**

an instrument used to measure voltage in a circuit.

## **WATT**

a unit of measurement of electrical power. One volt multiplied by one amp equals one watt.

## **ZENER DIODE**

a silicone diode that allows current to flow in the opposite direction, once an applied voltage reaches a certain level.

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## UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

### Engine Performance And Maintenance

## ENGINE PERFORMANCE AND MAINTENANCE (INCLUDING EXHAUST SYSTEMS)

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

### MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

#### I. Our recommendations are based upon the following definitions.

**System Failure** - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

**Preventive/Scheduled Maintenance** - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

**Improved System Performance** - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

**II. Training/Criteria** Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

#### III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

#### IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

#### V. Work Authorization

No work will be performed without the customer's prior approval.

#### VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

#### VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to honor the warranty, the customer will be allowed to examine the parts.

## **VIII. Classification of Parts**

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

### **THE MAP PROCESS - OVERVIEW**

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site [www.motorist.org](http://www.motorist.org) or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 \* Fax: (202) 318-0378

### **THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS**

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p>A. Part no longer performs intended purpose</p> <p>B. Part does not meet a design specification (regardless of performance)</p> <p>C. Part is missing</p>	<ol style="list-style-type: none"> <li>1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.)</li> <li>2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)</li> <li>3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)</li> <li>4. Technician's recommendation based on substantial and informed experience</li> <li>5. To comply with maintenance recommended by AMRA / MAP</li> </ol>
<p><b>NOTE:</b> When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.</p>	<p><b>NOTE:</b> Suggested services are <i>always</i> optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.</p>

## ENGINE PERFORMANCE & MAINTENANCE CHECKSHEET



## ENGINE PERFORMANCE & MAINTENANCE CHECKSHEET

Date: \_\_\_\_\_  
 Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
 Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_  
 Mileage: \_\_\_\_\_ License: \_\_\_\_\_ VIN: \_\_\_\_\_ Eng Code: \_\_\_\_\_

### Customer Interview:

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### Reason Code Explanation

Code      Reason

#### Required

- A      Part No Longer Performs Intended Purpose
- B      Part Does Not Meet A Design Specification ( Regardless Of Performance)
- C      Part Is Missing

#### Suggested/Optional

- 1      Part Is Close To The End Of Its Useful Life
- 2      To Address A Customer Need, Convenience Or Request
- 3      To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
- 4      Technician's Recommendation Based On Substantial And Informed Experience
- 5      To Comply With Maintenance Recommended By AMRAMAP



Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: [www.motorist.org](http://www.motorist.org)

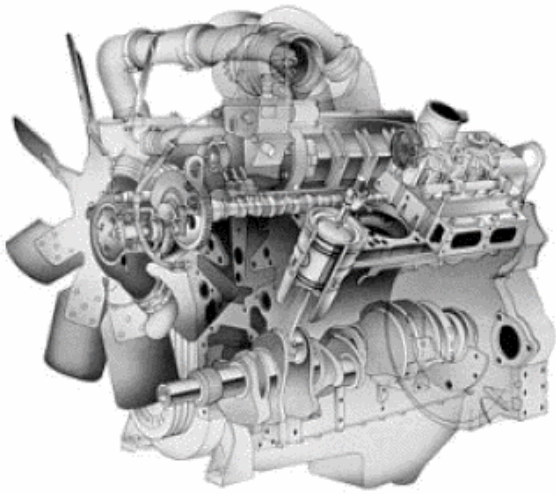
DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

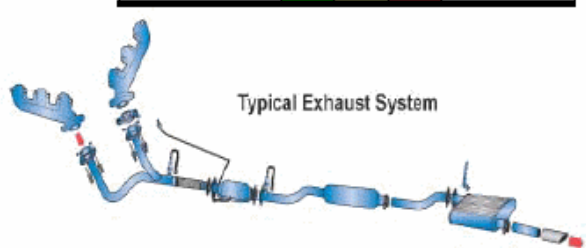
**Fig. 1: Engine Performance & Maintenance Checksheet (1 Of 2)**

## ENGINE PERFORMANCE & MAINTENANCE CHECKSHEET

Engine					Cooling System				
	OK	S	R	Condition		OK	S	R	Condition
Drive Belts					Belts				
Timing Belt					Coolant Protection				Spec _____ Actual _____
Air Filter					pH / Concentration / Reserve Alkalinity				
Engine Oil					Radiator Cap				Spec _____ Actual _____
Engine Oil Filter					Radiator				
Fuel Filter					Coolant Reservoir				
Fuel Injectors					Upper Radiator Hose				
Fuel Rails					Lower Radiator Hose				
Fuel Regulators					Heater Hoses				
Spark Plugs					Heater Core				
Ignition Coil(s)					Cooling Fan/ Fan Clutch				
Ignition Wires									
Idle Air Controls									
Ignition Modules									
Wiring Harnesses									
Vacuum Hoses									





Typical Exhaust System

Exhaust & Emission				
	OK	S	R	Condition
Exhaust Manifolds				
EGR Valve & Components				
EFE Valve (Heat Riser)				
Catalytic Converters				
Oxygen Sensors				
Exhaust Pipes				
Mufflers / Resonators				
Tailpipes / Extensions				
EVAP Canister Filter				
PCV Breather Element				
PCV Valve				
Fuel Cap				

OK

Suggested  
1, 2, 3, 4, 5

Required  
A, B, C

Automotive Maintenance & Repair Assn © 2009

**Fig. 2: Engine Performance & Maintenance Checksheet (2 Of 2).**

### ENGINE PERFORMANCE AND MAINTENANCE

**NOTE:** **CHEMICAL ENGINE DECARBONIZATION** is a process utilizing chemicals to remove soft and semi-hardened gum, varnish, resin and carbon deposits from the air/fuel delivery systems and combustion chambers of gasoline internal combustion engines, providing benefits that include improved fuel economy, performance and driveability and reduced emissions. This process is performed to remove deposits preferably prior to deposit accumulation and hardening which may require costly mechanical deposit removal or component replacement.

**NOTE:** **SUGGEST** Chemical Engine Decarbonization service every 15,000 miles or 12 months.

**NOTE:** **CONTAMINATED OIL SYSTEM SERVICE** is an event based process



(beyond that of a normal oil and filter change) performed to remove coolant, water or fuel contamination. Contamination increases oil's oxidation rate and has been shown to result in increased engine wear and reduced oil flow.

**CAUTION:** Some OEM's (including GM and Honda) have issued Technical Service Bulletins advising that Chemical Crankcase Flushing may damage some engine components and that such damage will not be covered by the manufacturer's new car warranty.

## ACCELERATOR PEDAL POSITION SENSOR

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	B	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ACCESSORY BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> Determine cause of incorrect alignment and require repair.		

Condition	Code	Procedure
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>Determine cause of noise and suggest repair.</b>		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

### ACCESSORY PULLEYS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require replacement
Cracked	A	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Pulley damaged, affecting belt life	A	Require replacement

### AIR CONDITIONING CYCLING SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### AIR CONDITIONING PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### AIR DUCTS AND TUBES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

### AIR FILTER ELEMENTS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Leaking	A	Require replacement
Melted	A	Required replacement
Missing	C	Require replacement
Paper filter element oil-soaked	A	Require replacement
<b>NOTE:</b> <b>Further inspection required to determine cause.</b>		
Restricted, affecting performance	A	Require replacement
Water-contaminated	A	Require replacement
<b>NOTE:</b> <b>Further inspection required to determine cause.</b>		

### AIR FILTER GASKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement

### AIR FILTER HOUSINGS AND GASKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement

### AIR FUEL RATIO SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

**NOTE:**

**Determine cause and correct prior to repair or replacement of part.**

Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement

**NOTE:**

**Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**

Inoperative	A	Require repair or replacement. Further inspection required
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**NOTE:**

**Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**

Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

**NOTE:**

**Determine cause and correct prior to repair or replacement of part.**

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

Condition	Code	Procedure
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### AIR INJECTION CONTROL SOLENOIDS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### AIR PLENUMS

Condition	Code	Procedure



Condition	Code	Procedure
Integrated air or fuel control components inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Internal air or fuel components damaged, affecting performance	A	Require repair or replacement of component
Internal air or fuel components damaged, not affecting performance	Ã, Â	No service suggested or required
Internal air or fuel components missing	C	Require replacement of component
Leaking	A	Require repair or replacement
Restricted	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

### AIR PUMP BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> <b>Determine cause of incorrect alignment and require repair.</b>		
At or beyond service interval	3	Suggest replacement to comply with vehicle OEM recommended service intervals
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>Determine cause of noise and suggest repair.</b>		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

### AIR PUMPS (ELECTRIC DRIVEN)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Require replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

### AIR TUBES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

### ASPIRATOR, CHECK AND DECEL VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	A	Require replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	Ã, Â	No service suggested or required
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

### BAFFLES

Condition	Code	Procedure

Condition	Code	Procedure
Application incorrect, affecting cooling system performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting cooling system performance	A	Require repair or replacement
Blocked, affecting cooling system performance	A	Require repair or replacement
Broken, affecting cooling system performance	A	Require repair or replacement
Cracked, affecting cooling system performance	A	Require repair or replacement
Loose, affecting cooling system performance	A	Require repair
Loose, not affecting cooling system performance	2	Suggest repair
Missing, affecting cooling system performance	C	Require replacement

### BALLAST PRIMARY SUPPLY RESISTOR WIRES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Conductor exposed	A	Require replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Insulation overheated	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### BALLAST RESISTORS AND PRIMARY SUPPLY RESISTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Conductor exposed	A	Require replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Insulation overheated	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## BAROMETRIC PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## BATTERIES

**NOTE:** Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.

### Definition of Terms

**Battery Performance Testing - Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.**

**Cold Cranking Amp (CCA) Rating - The number of amperes a new, fully charged battery at 0°F (-17.8°C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).**

**Cranking Amps (CA) - The number of amperes a new, fully charged battery, typically at 32°F (0°C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12volt battery).**

**OEM Cranking Amps - The minimum CCA required by the original vehicle manufacturer for a specific vehicle.**

Condition	Code	Procedure
Battery frozen	A, A	Further inspection required
<b>NOTE:</b> <b>Do not attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.</b>		
Battery tests near the "end of its useful life" utilizing a tester or on-board monitor able to accurately determine this condition	1	Suggest Replacement
Case leaking	A	Require replacement
Casing swollen	A	Further inspection required

Condition	Code	Procedure
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Circuit open internally	A	Require replacement
Electrolyte contamination	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Electrolyte discoloration	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Fails to accept and hold charge	A	Require replacement
<p><b>NOTE:</b> This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.</p>		
Fluid level low	B	Further inspection required
<p><b>NOTE:</b> Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test. If battery does not meet specifications, require replacement. If battery is sealed type (non-removable filler caps), require replacement.</p>		
Out of performance specification for battery	B	Require replacement
<p><b>NOTE:</b> The battery may meet vehicle's OEM specifications for that vehicle but test below the minimum specifications defined by the battery manufacturer.</p>		
Out of specification for application	B	Require replacement
<p><b>NOTE:</b> The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.</p>		
Post (top or side) burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Post (top or side) burned, not affecting performance	2	Suggest repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Post (top or side) corroded, affecting performance	A	Require repair
Post (top or side) corroded, not affecting performance	2	Suggest repair
Post (top or side) loose	A	Require replacement
Post (top or side) melted, affecting performance	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Post (top or side) melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Specific gravity low	B	Further inspection required
<b>NOTE:</b> Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.		
State of charge low	A	Further inspection required
<b>NOTE:</b> Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.		
Top dirty	2	Suggest cleaning battery
Top wet	A	Require cleaning battery Further inspection required
<b>NOTE:</b> Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.		
Vent cap loose	A	Require repair or replacement of vent cap
Vent cap missing	C	Require replacement of vent cap

## BATTERY CABLES, WIRES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
<b>NOTE:</b> Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## BATTERY CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
<b>NOTE:</b> <b>Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.</b>		
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## BATTERY TRAYS AND HOLD DOWN HARDWARE

Condition	Code	Procedure
Battery improperly secured	2	Suggest repair
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã, Â	No service suggested or required
Broken, affecting performance	A	Require repair or replacement
Broken, not affecting performance	Ã, Â	No service suggested or required
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Water drain clogged	A	Require repair

## BATTERY WIRES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
<b>NOTE:</b> <b>Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.</b>		
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

### **BELT IDLER ASSEMBLIES (ACCESSORY AND CAM BELTS)**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Cracked	2	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Seized	A	Require repair or replacement

### **BELT TENSIONERS (ACCESSORY AND CAM BELT)**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Cracked	B	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

### **BELT-DRIVEN AIR PUMPS**

Condition	Code	Procedure
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Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	A	Require replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley alignment incorrect	B	Require repair or replacement
Pulley bent	A	Require replacement
Pulley cracked	A	Require replacement
Pulley loose	A	Require repair or replacement
Pulley missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

### BOOST CONTROL MECHANISM

Condition	Code	Procedure
Boost pressure incorrect	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Incorrect boost pressure includes intermittent operation.		
Leaking	A	Require repair or replacement

### CAMSHAFT POSITION SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## CARBURETORS AND CHOKES

**NOTE:** Proper operation of a carburetor includes the ability to control air/fuel mixtures during all phases of driving operation to comply with all federal and local emissions standards. Adjustments are to be considered repairs.

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Air/fuel control incorrect	B	Require repair or replacement
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Components binding	A	Require repair or replacement
Components damaged, affecting operation or performance	A	Require repair or replacement
Components missing	C	Require replacement of components
Contaminated	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Some components may be serviceable; check for accepted cleaning procedure. Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Controlling linkages binding	A	Require repair or replacement of linkage
Leaking	B	Require repair or replacement
Mechanical operation incorrect	B	Require repair or replacement
Operating incorrectly	B	Require repair or replacement



## CASTING CORE PLUGS AND EXPANSION PLUGS

Condition	Code	Procedure
Leaking	A	Require replacement
Material type incorrect	2	Suggest replacement

## CHARGE AIR COOLERS ""INTERCOOLERS"" (CAC)

Condition	Code	Procedure
Air-to-air intercooler leaking, affecting boost performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking coolant	A	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

## CHECK VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	A	Require replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	Ã,Â	No service suggested or required
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

## CHEMICAL ENGINE DECARBONIZATION

**NOTE:** CHEMICAL ENGINE DECARBONIZATION is a process utilizing chemicals to remove soft and semi-hardened gum, varnish, resin and carbon deposits from the air/fuel delivery systems and combustion chambers of gasoline internal combustion engines, providing benefits that include improved fuel economy, performance and driveability and reduced emissions. This process is performed to remove deposits preferably prior to deposit accumulation and hardening which may require costly mechanical deposit removal or component replacement.

**NOTE:** SUGGEST Chemical Engine Decarbonization service every 15,000 miles or 12 months.

## CHOKES

Condition	Code	Procedure
Air/fuel control incorrect	B	Require repair or replacement

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Components binding	A	Require repair or replacement
Components damaged, affecting operation or performance	A	Require repair or replacement
Components missing	C	Require replacement of components
Contaminated	A	Require repair or replacement. Further inspection required
<p><b>NOTE:</b> Some components may be serviceable; check for accepted cleaning procedure. Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</p>		
Controlling linkages binding	A	Require repair or replacement of linkage
Leaking	B	Require repair or replacement
Mechanical operation incorrect	B	Require repair or replacement
Operating incorrectly	B	Require repair or replacement

### CLUTCH PEDAL POSITION SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
<p><b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</p>		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

Condition	Code	Procedure
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## COLD START INJECTORS

**NOTE:** You are not required to replace injectors in sets. However, you may suggest replacement of all injectors for preventive maintenance.

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

**NOTE:**

**Determine cause and correct prior to repair or replacement of part.**

Connector missing	C	Require replacement
Flow restricted	B	Require repair or replacement
Inoperative	A	Require repair or replacement. Further inspection required

**NOTE:**

**Inoperative includes intermittent operation, out of OEM specification. Some components may be serviceable.**

Leaking	A	Require repair or replacement
Resistance out of specification	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

**NOTE:**

**Determine cause and correct prior to repair or replacement of part.**

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## COMBUSTION CHAMBER CLEANING

**NOTE:** See [CHEMICAL ENGINE DECARBONIZATION](#).

## CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

**NOTE:**

**Determine cause and correct prior to repair or replacement of part.**

Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement

**NOTE:**

**Determine cause and correct prior to repair or replacement of part.**

Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

**NOTE:**

**Determine cause and correct prior to repair or replacement of part.**

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## COOLANT RECOVERY TANKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing (if original equipment)	C	Require replacement

## COOLANT

Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement
At or beyond service interval	3	Suggest replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>The system should be drained and/ or flushed and refilled with correct coolant according to OEM recommended service interval and procedures.</b>		
Contaminated	B	Require replacement or recycling Further inspection required
<b>NOTE:</b> <b>Determine source of contamination and require correction prior to coolant replacement.</b>		
Fluid discolored	Ã,Â	No service Suggested or Required
<b>NOTE:</b> <b>Further testing necessary to determine condition of fluid.</b>		
Level incorrect	B	Require correction of fluid level
<b>NOTE:</b> <b>Determine source of incorrect level and suggest repair.</b>		
Mixture incorrect	B	Require correction or replacement
Type incorrect	B	Require replacement

## COOLING FAN MOTOR MODULES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Housing cracked	2	Suggest repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation or failure to perform all functions.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### COOLING FAN MOTOR RELAYS AND MODULES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Housing cracked	2	Suggest repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation or failure to perform all functions.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### COOLING FAN MOTOR RESISTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Missing	C	Require replacement
Open	A	Require replacement
Resistance out of specification	B	Require repair or replacement
Shorted	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### COOLING FAN MOTOR SENSORS AND SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## COOLING FAN MOTOR SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement

Condition	Code	Procedure
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## COOLING FAN MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Hydraulic fan motor leaking	A	Require repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Check fan motor/controls. Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## CRANKSHAFT POSITION SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## CYLINDER DEACTIVATION SOLENOID

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## CYLINDER HEAD ASSEMBLIES

**NOTE:** A Cylinder Head Assembly is a cylinder head fitted with valves, associated springs, retainers, and on overhead camshaft cylinder heads (ORC), camshaft, camshaft bearings, lash adjusters, tappets and rockers.

Condition	Code	Procedure
Adjustable valve lash is out of specification	B	Require repair
Combustion efficiency is reduced due to carbon deposits in the combustion chamber	2	Suggest repair
Combustion efficiency is reduced due to carbon deposits on the intake valve	2	Suggest repair
Internal component failure (any component)	A	Require repair or replacement of cylinder head assembly

**NOTE:**

It is Required that all other failure-related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement, such as a water pump on a short block ( reason code 4, technician's recommendation based on substantial and informed experience ). For example: If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be suggested that additional inspections be performed, such as the other head gasket on a V - type engine.

## DECEL VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	Ã, Â	No service suggested or required
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

## DEFLECTORS

Condition	Code	Procedure
Application incorrect, affecting cooling system performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting cooling system performance	A	Require repair or replacement
Blocked, affecting cooling system performance	A	Require repair or replacement
Broken, affecting cooling system performance	A	Require repair or replacement
Cracked, affecting cooling system performance	A	Require repair or replacement
Loose, affecting cooling system performance	A	Require repair
Loose, not affecting cooling system performance	2	Suggest repair
Missing, affecting cooling system performance	C	Require replacement

## DIP STICK TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Bent	2	Suggest repair or replacement
Broken, affecting performance (for example, fuel mixture)	A	Require repair or replacement
Broken, not affecting performance	2	Suggest repair or replacement
Leaking, affecting performance (for example, fuel mixture)	A	Require repair or replacement
Leaking, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement

## DIP STICKS AND TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Bent	2	Suggest repair or replacement



Condition	Code	Procedure
Broken, affecting performance (for example, fuel mixture)	A	Require repair or replacement
Broken, not affecting performance	2	Suggest repair or replacement
Leaking, affecting performance (for example, fuel mixture)	A	Require repair or replacement
Leaking, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement

### **DISTRIBUTOR ADVANCES AND RETARDERS (MECHANICAL AND VACUUM)**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	A	Require replacement
Out of specification	B	Require repair or replacement

### **DISTRIBUTOR BOOTS AND SHIELDS**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Deteriorated	A	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Torn	A	Require replacement

### **DISTRIBUTOR CAPS**

Condition	Code	Procedure
Application incorrect	B	Require replacement
Arcing	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Burned	A	Require replacement
Carbon button missing	A	Require replacement
Carbon button worn, affecting performance	A	Require replacement
Carbon button worn, not affecting performance	1	Suggest replacement
Carbon-tracked	A	Require replacement
Cracked	B	Require replacement
Loose	B	Suggest repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal eroded, affecting performance	A	Require repair or replacement
Terminal eroded, not affecting performance	Ã, Â	No service suggested or required
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### DISTRIBUTOR RETARDERS (MECHANICAL AND VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require replacement
Out of specification	B	Require repair or replacement

### DISTRIBUTOR ROTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Carbon-tracked	A	Require replacement
Contact burned	A	Require replacement
Corroded	1	Suggest replacement
Eroded	1	Suggest replacement
Loose	B	Require repair or replacement
Out of specification	B	Require replacement

### DISTRIBUTOR SHIELDS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require repair or replacement
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	A	Require replacement
Out of specification	B	Require repair or replacement

## DISTRIBUTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bushings worn, affecting performance	A	Require repair or replacement
Bushings worn, not affecting performance	1	Suggest repair or replacement
Cam lobes worn, affecting performance	A	Require repair or replacement
Cam lobes worn, not affecting performance	1	Suggest repair or replacement
Gear broken	A	Require repair or replacement
Gear worn, affecting performance	A	Require replacement
Gear worn, not affecting performance	Ã, Â	No service suggested or required
Integrated pickup triggering device loose	A	Require repair or replacement
Integrated pickup triggering device magnetism incorrect	A	Require repair or replacement
Leaking oil internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pickup triggering device (reluctor ) broken	A	Require repair or replacement
Pickup triggering device (reluctor ) loose	A	Require repair or replacement
Pickup triggering device (reluctor) weak	A	Require repair or replacement
Reluctor (pickup triggering device) broken	A	Require repair or replacement
Reluctor (pickup triggering device) loose	A	Require repair or replacement
Reluctor (pickup triggering device) weak	A	Require repair or replacement
Shaft bent	A	Require replacement
Thrust washer broken	A	Require repair or replacement
Thrust washer missing	C	Require repair or replacement
Thrust washer worn, affecting performance	A	Require repair or replacement
Thrust washer worn, not affecting performance	1	Suggest repair or replacement

## EARLY FUEL EVAPORATION VALVES (HEAT RISER ASSEMBLIES)

Condition	Code	Procedure
Broken	A	Require replacement of affected parts
Diaphragm inoperative	A	Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. If the inoperative diaphragm is separate from the heat riser, then require replacement of the inoperative diaphragm. If the inoperative diaphragm is part of the heat riser, then replace the heat riser.		
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Seized	A	Require replacement of affected parts
Spring broken	B	Require replacement of spring(s)
Spring inoperative	A	Require replacement of spring(s)

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		

### EGR COOLERS

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

### EGR EXHAUST MANIFOLD PASSAGES

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement

### EGR INTAKE AND EXHAUST MANIFOLD PASSAGES

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement

### EGR PLATES AND COOLERS

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

### ELECTRONIC SPARK CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

#### **NOTE:**

**Determine cause and correct prior to repair or replacement of part.**

Connector missing	A	Require repair
Contaminated	A	Require repair or replacement

#### **NOTE:**

**Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement of source.**

Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Includes inoperative, intermittent operation or failure to perform all functions.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ELECTRONIC TRANSMISSION CONTROL DEVICES

Condition	Code	Procedure
Application Incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation or failure to perform all functions.		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### ELECTRONIC TRANSMISSION FEEDBACK DEVICES

Condition	Code	Procedure
Application Incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement



Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ENGINE COOLANT TEMPERATURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement

Condition	Code	Procedure
Wire lead shorted	A	Require repair or replacement

## ENGINE COOLING SYSTEMS

**NOTE:** Overheating, poor engine performance, and insufficient cabin heat can be affected by, but are not limited to, all of the components in the engine cooling system

## ENGINE COVERS (OIL PAN, VALVE COVER, TIMING COVER)

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement
Baffle loose	2	Suggest repair or replacement
Baffle missing	C	Require replacement
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã, Â	No service suggested or required
Cracked (not leaking)	2	Suggest repair or replacement
Leaking externally	A	Require repair or replacement
Leaking internally, causing fluid contamination	A	Require repair or replacement
Missing	C	Require replacement
Restricted passage	A	Require repair or replacement
Threads damaged	A	Require repair or replacement

## ENGINE DECARBONIZATION

**NOTE:** See [CHEMICAL ENGINE DECARBONIZATION](#).

## ENGINE OIL CANISTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Bulged	A	Require replacement. Further inspection required
<b>NOTE:</b> Inspect pressure relief valve.		
Canister attaching hardware broken	A	Require repair or replacement of hardware
Canister attaching hardware loose	A	Require repair
Canister attaching hardware missing	C	Require replacement
Canister attaching hardware not functioning	A	Require repair or replacement of hardware
Center tube collapsed	A	Require replacement. Further inspection required
<b>NOTE:</b> Inspect bypass.		
Dented	2	Suggest replacement. Further inspection required

Condition	Code	Procedure
<b>NOTE:</b> Determine cause, such as broken motor mount.		
Leaking	B	Require repair or replacement

### ENGINE OIL COOLERS (EXTERNAL)

Condition	Code	Procedure
Air flow restriction	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bypassed	A	Require repair or replacement
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	2	Suggest repair or replacement
Fluid flow restrictions	A	Require repair or replacement
Internal restrictions, affecting performance	A	Require repair or replacement
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### ENGINE OIL DRAIN PLUGS AND GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
<b>NOTE:</b> Some OEMs require replacement of drain plug gasket when removing drain plug. Inspect threads in oil pan for damage.		

### ENGINE OIL FILTERS AND CANISTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Bulged	A	Require replacement. Further inspection required
<b>NOTE:</b> Inspect pressure relief valve.		
Canister attaching hardware broken	A	Require repair or replacement of hardware
Canister attaching hardware loose	A	Require repair
Canister attaching hardware missing	C	Require replacement
Canister attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Center tube collapsed	A	Require replacement. Further inspection required
<b>NOTE:</b> Inspect bypass.		
Dented	2	Suggest replacement. Further inspection required
<b>NOTE:</b> Determine cause, such as broken motor mount.		
Leaking	B	Require repair or replacement

### ENGINE OIL GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
<b>NOTE:</b> Some OEMs require replacement of drain plug gasket when removing drain plug. Inspect threads in oil pan for damage.		

### ENGINE OIL PRESSURE GAUGES (MECHANICAL)

Condition	Code	Procedure
Indicates out of range	B	Further inspection required
<b>NOTE:</b> Gauge may indicate problem with contaminated oil, level, pressure, or temperature, or problem with gauge.		
Inoperative	A	Further inspection required
<b>NOTE:</b> Gauge may indicate problem with contaminated oil, level, pressure, or temperature, or problem with gauge. Inoperative includes intermittent operation, out of OEM specification, or out of range. Further inspection required to determine cause.		
Leaking	B	Require repair or replacement
Reads inaccurately	2	Suggest repair or replacement

### ENGINE OIL

Condition	Code	Procedure
Additive Depletion	A	Require replacement of fluid
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Contaminated	A	Require replacement of oil and filter; Further Inspection Required
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water when changing oil.		

Condition	Code	Procedure
Fluid discolored	Ã,Â	No Service Suggested or Required
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid incorrect	B	Require service
Level Incorrect	B	Adjust to correct level. Further Inspection Required.
<b>NOTE:</b> Determine cause of incorrect level such as leaking gaskets or contamination by engine coolant, fuel or water.		
Oxidized	A	Require replacement of fluid

### EVAPORATIVE EMISSIONS (EVAP) CANISTER FILTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with OEM recommended service interval
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	A	Require replacement

### EVAPORATIVE EMISSIONS (EVAP) CANISTER PURGE DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### EVAPORATIVE EMISSIONS (EVAP) CANISTERS

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require replacement
Missing	C	Require replacement
Saturated	A	Require replacement

### EVAPORATIVE EMISSIONS (EVAP) FEEDBACK DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## EXHAUST GAS RECIRCULATION DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	1	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## EXHAUST GAS RECIRCULATION FEEDBACK DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	1	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### EXPANSION PLUGS

Condition	Code	Procedure
Leaking	A	Require replacement
Material type incorrect	2	Suggest replacement

### FAN CONTROL SENSOR

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### FUEL ACCUMULATORS AND DAMPERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connections leaking	A	Require repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require replacement

### FUEL AND COLD START INJECTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Flow restricted	B	Require repair or replacement
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation, out of OEM specification. Some components may be serviceable.</b>		

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Resistance out of specification	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## FUEL CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Fails to maintain proper pressure	A	Require replacement
Gaskets missing	C	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Plugged (vacuum and pressure relief)	A	Require replacement
Seals missing	C	Require replacement

## FUEL DAMPERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connections leaking	A	Require repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require replacement

## FUEL DELIVERY CHECK VALVES

Condition	Code	Procedure
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking externally	A	Require repair or replacement
Missing	C	Require replacement
Pressure leaking (bleeds down)	A	Require repair or replacement

## FUEL DISTRIBUTORS (BOSCH CIS)

Condition	Code	Procedure
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Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	A	Require repair or replacement
Out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Some components may be serviceable; check for accepted cleaning procedure.		

### FUEL FILLER NECKS AND RESTRICTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Restricted	2	Suggest repair or replacement

### FUEL FILTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with OEM recommended service interval
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	2	Suggest replacement

### FUEL INJECTOR CLEANING

**NOTE:** See [CHEMICAL ENGINE DECARBONIZATION](#).

### FUEL INJECTORS

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware



Condition	Code	Procedure
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## FUEL LEVEL SENDERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### FUEL PRESSURE REGULATORS

Condition	Code	Procedure
Contaminated	2	Suggest repair or replacement. Further inspection required
<b>NOTE:</b> <b>Some components may be serviceable; check for accepted cleaning procedure. Determine source of contamination. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking (internally or externally)	A	Require repair or replacement
Pressure out of specification	B	Require repair or replacement
Vapor bypass restricted	A	Require repair or replacement

### FUEL PUMPS (IN-TANK, EXTERNAL, ELECTRICAL OR MECHANICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
<b>NOTE:</b> <b>Determine source of contamination. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking externally (includes pulsator)	A	Require repair or replacement
Leaking internally (includes pulsator)	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## FUEL RAILS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Contaminated	A	Require replacement
<b>NOTE:</b> Determine source of contamination. Require repair or replacement.		
Leaking	A	Require repair or replacement
Restricted	A	Require repair or replacement
Rust-pitted	1	Suggest replacement

## FUEL RESTRICTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted	2	Suggest repair or replacement

## FUEL SYSTEM CLEANING SERVICE

**NOTE:**

See **CHEMICAL ENGINE DECARBONIZATION.**

### FUEL TANKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Baffles loose	A	Require repair or replacement
Contaminated	A	Require repair
<b>NOTE:</b> Determine source of contamination. Require repair or replacement.		
Corroded internally	A	Require repair or replacement
Distorted, affecting performance	B	Require replacement
Distorted, not affecting performance	Ã,Â	No service suggested or required
Leaking	A	Require repair or replacement

### FUEL

Condition	Code	Procedure
Contaminated	B	Require repair or replacement
<b>NOTE:</b> Determine of source of contamination. Require repair or replacement.		
Fuel incorrect	B	Require flushing of system
<b>NOTE:</b> If a fuel other than specification fuel is present in the system, the required service is to flush and fill with the correct fuel.		

### GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

### GROMMETS (VALVE COVER)

Condition	Code	Procedure
Leaking	A	Suggest repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

### HARMONIC DAMPERS

Condition	Code	Procedure
Application incorrect	B	Require replacement

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	B	Require replacement
Dented (fluid type only)	A	Require replacement
Keyway distorted	A	Require repair or replacement
Leaking (fluid damper only)	A	Require replacement
Loose	A	Require replacement
Noisy	A	Require replacement
Outer ring slipped out of position	A	Require replacement
Positioned incorrectly	A	Require repair or replacement
Rubber damping material deteriorated	1	Suggest replacement
Seal surface worn, causing a leak	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### HEATER CONTROL VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bypassed	A	Require replacement
Coolant leak	A	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Missing	C	Require replacement
Restricted	A	Require repair or replacement
Vacuum leak	A	Require repair or replacement

### HEATER CORES

Condition	Code	Procedure
Air flow restriction	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bypassed	A	Require repair or replacement
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	2	Suggest repair or replacement
Internal restrictions, affecting performance	A	Require repair or replacement
Leaking	B	Require repair or replacement
Missing	C	Require replacement

## HOSE CLAMPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

## HOSE CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

## HOSE COUPLERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

## HOSES AND TUBE COUPLERS, CONNECTORS AND CLAMPS

**NOTE:** When replacing fuel lines and hoses, replace with product that meets or exceeds OEM design specifications.

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement



## HOSES AND TUBES (FUEL LINES, RADIATOR, VACUUM, BY-PASS, HEATER, RECOVERY TANK AND OIL COOLERS)

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Dry-rotted	1	Suggest repair or replacement
Hard	1	Suggest repair or replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## HOUSINGS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing corroded	1	Suggest replacement of housing
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Installation incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Thermostat missing	C	Require replacement of thermostat
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

## IDLE AIR CONTROLS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### **IDLE SPEED CONTROL ACTUATORS**

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement

Condition	Code	Procedure
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## IGNITION BOOTS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Routed incorrectly	B	Suggest repair

Condition	Code	Procedure
<b>NOTE:</b> If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### IGNITION COIL TOWERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### IGNITION COILS

Condition	Code	Procedure
Arcing	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require replacement
Corroded, not affecting performance	2	Suggest replacement
Distorted	Ã,Â	No service suggested or required
<b>NOTE:</b> <b>Distortion may be the result of overheating; coil should be tested.</b>		
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Oil leaking	A	Require replacement
Out of specification	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## IGNITION CONTROL MODULES (ICM)

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
<b>NOTE:</b> <b>Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	A	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## IGNITION SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement



Condition	Code	Procedure
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## IGNITION TERMINALS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Routed incorrectly	B	Suggest repair
<b>NOTE:</b> If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### IGNITION WIRES (SECONDARY)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Routed incorrectly	B	Suggest repair
<b>NOTE:</b> <b>If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### INERTIA FUEL SHUT-OFF SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## INTAKE AIR TEMPERATURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## INTAKE CLEANING

**NOTE:** See [CHEMICAL ENGINE DECARBONIZATION](#).

## INTAKE MANIFOLDS

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Corroded, affecting sealability	A	Require repair or replacement
Integrated air or fuel control components inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Internal air or fuel components damaged, affecting performance	A	Require repair or replacement of component
Internal air or fuel components damaged, not affecting performance	Ã, Â	No service suggested or required
Internal air or fuel components missing	C	Require replacement of component
Leaking	A	Require repair or replacement
Out of specification	B	Require replacement
Restricted	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Warped	B	Require repair or replacement

## IN-TANK FUEL STRAINERS

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Condition	Code	Procedure
Missing	C	Require replacement
Restricted	A	Require repair or replacement
Torn	A	Require replacement

## INTERCOOLERS

Condition	Code	Procedure
Air-to-air intercooler leaking, affecting boost performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking coolant	A	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

## KNOCK SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

### NOTE:

**Determine cause and correct prior to repair or replacement of part.**

Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required

### NOTE:

**Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**

Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

### NOTE:

**Determine cause and correct prior to repair or replacement of part.**

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## LIQUID VAPOR SEPARATORS

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Require replacement
Missing	C	Require replacement
Restricted	A	Require repair or replacement

## LONG BLOCK ASSEMBLIES

**NOTE:** A Long Block Assembly is a short block assembly together with a cylinder head assembly and all those components fitted within the rocker or cam cover, and timing cover ( the whole presented as an assembly). A rebuilt or new oil pump, or kit shall be supplied or fitted as appropriate.

Condition	Code	Procedure
Combustion efficiency is reduced due to carbon deposits in the combustion chamber	2	Suggest repair
Internal component failure (any component)	A	Require repair or replacement of the long block assembly
<b>NOTE:</b> It is Required that all other failure-related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement such as a water pump on a short block (reason code 4, technician's recommendation based on substantial and informed experience ). For example: If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be Suggested that additional inspections be performed, such as the other head gasket on a V -type engine.		

## MANIFOLD ABSOLUTE PRESSURE (MAP) SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement



Condition	Code	Procedure
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### MASS AIR FLOW (MAF) SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### METAL AIR MANIFOLDS AND PIPES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair of injection tube or replacement of manifold
Corroded, affecting structural integrity	1	Suggest replacement of injection tube or manifold
Leaking	A	Require repair of injection tube or replacement of manifold
Loose	A	Require repair
Missing	C	Require replacement
Restricted	A	Require replacement of injection tube or manifold
Threads damaged	A	Require repair
Threads stripped (threads missing)	A	Require replacement

### METAL AIR PIPES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Broken	A	Require repair of injection tube or replacement of manifold
Corroded, affecting structural integrity	1	Suggest replacement of injection tube or manifold
Leaking	A	Require repair of injection tube or replacement of manifold
Loose	A	Require repair
Missing	C	Require replacement
Restricted	A	Require replacement of injection tube or manifold
Threads damaged	A	Require repair
Threads stripped (threads missing)	A	Require replacement

## MIX CONTROL SOLENOIDS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## MOTOR MOUNTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Ã,Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Ã,Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## O2 SENSORS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	A	Require repair or replacement

Condition	Code	Procedure
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## OIL PANS

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement
Baffle loose	2	Suggest repair or replacement
Baffle missing	C	Require replacement
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã, Â	No service suggested or required
Cracked (not leaking)	2	Suggest repair or replacement
Leaking externally	A	Require repair or replacement
Leaking internally, causing fluid contamination	A	Require repair or replacement
Missing	C	Require replacement
Restricted passage	A	Require repair or replacement
Threads damaged	A	Require repair or replacement

## OIL PRESSURE SENDING UNITS

Condition	Code	Procedure
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	B	Require replacement
Output signal incorrect	B	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### OIL PUMP PICK-UP SCREENS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bypass stuck	A	Require repair or replacement
Cracked	A	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Positioned incorrectly	A	Require repair or replacement
Restricted	A	Require repair or replacement
Screen torn	A	Require replacement

### OIL PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Leaking	B	Require repair or replacement
Pressure relief valve stuck	A	Require repair or replacement
Seized	A	Require repair or replacement
Worn beyond specifications	B	Require repair or replacement

### O-RINGS, GASKETS, SEALS AND SPRING LOCKS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> <b>Require inspection of mating and sealing surface and repair or replace as necessary.</b>		

### PARK NEUTRAL POSITION SWITCHES



Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### PCV BREATHER ELEMENTS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require replacement
Melted	A	Required replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	A	Require replacement

### PCV ORIFICES

Condition	Code	Procedure
At or beyond service interval	3	Suggest repair or replacement to comply with OEM recommended service intervals
Leaking	A	Require replacement
Missing	C	Require replacement
Restricted	A	Require repair or replacement

### PCV VALVES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Grommet broken	A	Require repair or replacement of grommet
Grommet missing	C	Require replacement of grommet
Grommet not functioning	A	Require repair or replacement of grommet
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require replacement
Missing	C	Require replacement
Restricted	A	Require replacement

### PICK-UP ASSEMBLIES (INCLUDES MAGNETIC, HALL EFFECT AND OPTICAL)

Condition	Code	Procedure
Adjustment incorrect	B	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement

Condition	Code	Procedure
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Refer to OEM recommended service procedures.		
Oil-soaked	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## POWER STEERING PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### POWERTRAIN CONTROL MODULES (PCM) AND PROM

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
<b>NOTE:</b> <b>Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation or failure to perform all functions.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## POWERTRAIN CONTROL PROM

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
<b>NOTE:</b> <b>Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).</b>		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation or failure to perform all functions.</b>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### PRESSURIZED EXPANSION TANK CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Coolant recovery check valve inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Fails to maintain proper pressure	B	Require replacement
Gasket missing	C	Require replacement of gasket
Missing	C	Require replacement
Seal missing	C	Require replacement of seal

### RADIATOR / COOLING FAN BLADES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require replacement
Broken	A	Require replacement
Cracked	B	Require replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement

### RADIATOR / COOLING FAN CLUTCHES

**NOTE:** Some lateral movement, measured at the fan blade tip, may be normal.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing noisy	A	Require replacement



Condition	Code	Procedure
Bearing worn	A	Require replacement
Fastener loose	A	Require repair or replacement of fastener
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Suggest replacement
Seized	A	Require replacement
Slips (insufficient fan speed)	A	Require replacement
Thermal control incorrect	B	Require repair or replacement

### RADIATOR CAPS AND PRESSURIZED EXPANSION TANK CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Coolant recovery check valve inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Fails to maintain proper pressure	B	Require replacement
Gasket missing	C	Require replacement of gasket
Missing	C	Require replacement
Seal missing	C	Require replacement of seal

### RADIATORS

Condition	Code	Procedure
Air flow restriction	A	Require repair
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	2	Suggest repair or replacement
Internal oil cooler leaking	A	Require repair or replacement
Internal restrictions, affecting performance	A	Require repair or replacement
Internal restrictions, not affecting performance	2	Suggest repair or replacement
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Ã,Â	No service suggested or required

### ROLL OVER VALVES

Condition	Code	Procedure
Inoperative	A	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Require replacement
Missing	C	Require replacement

### SEALING COMPOUNDS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

### SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

### SECONDARY AIR INJECTION SYSTEM MANAGEMENT DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b>		
<b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## SHORT BLOCK ASSEMBLIES

**NOTE:** A Short Block Assembly is a cylinder block and all those components contained within the limits of the block deck or decks, the pan rail, the block rear face and the timing cover ( where fitted), including the crankshaft.

Condition	Code	Procedure
Combustion efficiency is reduced due to carbon deposits in the combustion chamber	2	Suggest repair
Internal component failure (any component)	A	Require repair or replacement of the short block assembly

Condition	Code	Procedure
<p><b>NOTE:</b> It is Required that all other failure-related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement, such as a water pump on a short block (reason code 4, technician's recommendation based on substantial and informed experience ). For example: If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be Suggested that additional inspections be performed, such as the other head gasket on a V -type engine.</p>		

### SHROUDS, BAFFLES AND DEFLECTORS

Condition	Code	Procedure
Application incorrect, affecting cooling system performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting cooling system performance	A	Require repair or replacement
Blocked, affecting cooling system performance	A	Require repair or replacement
Broken, affecting cooling system performance	A	Require repair or replacement
Cracked, affecting cooling system performance	A	Require repair or replacement
Loose, affecting cooling system performance	A	Require repair
Loose, not affecting cooling system performance	2	Suggest repair
Missing, affecting cooling system performance	C	Require replacement

### SPARK PLUGS

**NOTE:** You are not required to replace spark plugs in sets. However, you may suggest replacement of the other plugs for preventive maintenance.

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Electrode eroded	1	Suggest replacement
Fouled	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause of fouling and suggest repair.</p>		
Gap incorrect	B	Require repair or replacement
Improperly Indexed	Ã, Â	Remove and Reinstall following manufacturers installation requirements
Insulation broken	A	Require replacement
Insulator cracked	A	Require replacement
Leaking compression	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### SPRING LOCKS

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Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

## SUPER CHARGERS

Condition	Code	Procedure
Attaching hardware damaged, affecting operation or performance	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Bearing noisy	A	Require replacement
Bearing worn	A	Require replacement
Boost pressure incorrect	A	Require repair or replacement
<b>NOTE:</b> Boost pressure problems may be caused by other systems or components.		
Clearance out of specification	B	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

## SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

### THERMAL VACUUM VALVES

Condition	Code	Procedure
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		



Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### THERMOSTATIC AIR DOOR ASSEMBLIES

Condition	Code	Procedure
Attaching hardware damaged, affecting operation or performance	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Binding	A	Require repair or replacement
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized	A	Require repair or replacement

### THERMOSTATS AND HOUSINGS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing corroded	1	Suggest replacement of housing
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Installation incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Thermostat missing	C	Require replacement of thermostat
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

### THROTTLE BODIES

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Deposits on throttle body components	A	Require repair
<b>NOTE:</b> Some throttles are coated by manufacturer; follow OEM-recommended procedures.		
Leaking	A	Require repair or replacement
Restricted, affecting performance	A	Require repair
<b>NOTE:</b> Some components may be serviceable; check for accepted cleaning procedure.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Throttle shaft binding, affecting performance	A	Require repair or replacement
Throttle shaft worn, affecting performance	A	Require repair or replacement
Throttle shaft worn, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## THROTTLE BODY CLEANING

**NOTE:** See **CHEMICAL ENGINE DECARBONIZATION.**

## THROTTLE CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement

Condition	Code	Procedure
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Ã, Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Ã, Â	No service suggested or required
Bracket Corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
<b>NOTE:</b> Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

## THROTTLE LINKAGES AND CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Ã, Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Ã, Â	No service suggested or required
Bracket Corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
<b>NOTE:</b> Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

## THROTTLE POSITION SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## THROTTLE POSITION SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## TIMING BELT SPROCKETS

Condition	Code	Procedure
Alignment incorrect	B	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require replacement
Cracked	B	Require replacement
Key damaged	A	Require replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Pulley damaged, affecting belt life	A	Require replacement
Sprocket damaged, affecting belt life	A	Require repair or replacement
Sprocket loose	B	Require repair or replacement
Sprocket-to-shaft alignment incorrect	B	Require repair or replacement

## TIMING BELTS

Condition	Code	Procedure
Adjustment incorrect	B	Suggest adjustment
<b>NOTE:</b> <b>Inspect belt tensioners, pulleys, and cover.</b>		
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> <b>Determine cause of incorrect alignment and require repair.</b>		
At or beyond service interval	3	Suggest replacement to comply with vehicle OEM recommended service intervals
Broken	A	Require replacement
Cam timing out of specification	B	Require repair
Cracked	1	Suggest replacement
Fluid-soaked	1	Suggest replacement. Further inspection required
Frayed	1	Suggest replacement
Missing	C	Require replacement
<b>NOTE:</b> <b>Internal engine damage may result from timing belt damage/failure.</b>		
Noisy	2	Further inspection required
<b>NOTE:</b> <b>Determine cause of noise and suggest repair.</b>		
Plies separated	A	Require replacement
Teeth missing	A	Require replacement
Tension out of specification	B	Require adjustment or replacement

## TIMING COVERS

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement
Baffle loose	2	Suggest repair or replacement
Baffle missing	C	Require replacement
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã,Â	No service suggested or required
Cracked (not leaking)	2	Suggest repair or replacement
Leaking externally	A	Require repair or replacement
Leaking internally, causing fluid contamination	A	Require repair or replacement
Missing	C	Require replacement
Restricted passage	A	Require repair or replacement
Threads damaged	A	Require repair or replacement



## TORQUE STRUTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require replacement
Body dented	A	Further inspection required
<b>NOTE:</b> <b>Require replacement of units where dents restrict strut piston rod movement. If dents don't restrict movement, no service is suggested or required.</b>		
Body punctured	A	Require replacement
Bushing deteriorated, affecting performance	A	Require replacement
Bushing deteriorated, not affecting performance	Ã,Â	No service suggested or required
Bushings missing	C	Require replacement
Bushings separated from mounting eye	1	Suggest replacement
Damping (none)	A	Require replacement
Leaking oil, enough for fluid to be running down the body	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>If noise is isolated to shock or strut, suggest replacement.</b>		
Piston rod bent	A	Require replacement
Piston rod broken	A	Require replacement
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## TRANSMISSION RANGE SWITCHES

Condition	Code	Procedure
Application Incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		

Condition	Code	Procedure
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance .	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### TUBE CLAMPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

### TUBE CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

### TUBE COUPLERS

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<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

## **TUBES**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Application incorrect	B	Require replacement
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Cracked	B	Require replacement
Dry-rotted	1	Suggest repair or replacement
Dry-rotted	1	Suggest repair or replacement
Hard	1	Suggest repair or replacement
Hard	1	Suggest repair or replacement
Inner fabric (webbing) damaged	A	Require replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement

Condition	Code	Procedure
Safety clip missing	C	Require replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Stripped	A	Require replacement
Swollen	B	Require replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement
Type incorrect	2	Suggest repair or replacement

## TURBO CHARGERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Boost pressure incorrect	A	Require repair or replacement
<b>NOTE:</b> <b>Boost pressure problems may be caused by other systems or components.</b>		
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Oil seal (internal) leaking	A	Require repair or replacement
Vibrates	A	Require repair or replacement

## VACUUM CONNECTIONS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

## VACUUM HOSES, TUBES AND CONNECTIONS (NON-METALLIC)

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

## VACUUM REGULATOR SOLENOIDS

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Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## VACUUM TUBES

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

**VALVE COVERS**

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement
Baffle loose	2	Suggest repair or replacement
Baffle missing	C	Require replacement
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã, Â	No service suggested or required
Cracked (not leaking)	2	Suggest repair or replacement
Leaking externally	A	Require repair or replacement
Leaking internally, causing fluid contamination	A	Require repair or replacement
Missing	C	Require replacement
Restricted passage	A	Require repair or replacement
Threads damaged	A	Require repair or replacement

**VEHICLE SPEED SENORS**

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement



Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## VOLUME AIR FLOW SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement

Condition	Code	Procedure
Wire lead shorted	A	Require repair or replacement

### WASTE GATE AND BOOST CONTROL MECHANISMS

Condition	Code	Procedure
Boost pressure incorrect	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Incorrect boost pressure includes intermittent operation.		
Leaking	A	Require repair or replacement

### WASTE GATE CONTROL SOLENOIDS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### WATER PUMPS (ELECTRIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Check fan motor/controls. Inoperative includes intermittent operation.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### WATER PUMPS (NON-ELECTRIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corrosion (internal) is excessive, affecting performance	A	Require replacement
Corrosion (internal) is excessive, not affecting performance	2	Suggest cooling system service
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require replacement
Noisy	A	Require replacement
Rotation incorrect for application	B	Require repair or replacement
Shaft bent	A	Require replacement

## WIRING HARNESSES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Voltage drop out of specification	A	Require repair or replacement

## REASON CODE EXPLANATION

Code	Reason
<b>Required</b>	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification ( Regardless Of Performance)
C	Part Is Missing
<b>Suggested/Optional</b>	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

## AUTOMOTIVE TERMINOLOGY & DEFINITIONS

### ACCELERATION

an increase in velocity or speed.

### ADDITIVE

in automotive terminology, a substance added to a liquid, such as engine oil, transmission fluid, gear oil or coolant to enhance its properties.

### ADVANCED TECHNOLOGY VEHICLE (ATV)

a vehicle that combines new engine/power/drivetrain systems to significantly improve fuel economy. This includes hybrid power systems and fuel cells, as well as some specialized electric vehicles.

### AIR GAP

a specified space between two components. Space or gap between spark plug electrodes, motor and generator armatures Ind field shoes. The space or gap between the compressor drive hub and pulley assembly.

### AIR INJECTION REACTION (AIR) SYSTEM

a system that provides fresh air to the exhaust system under controlled conditions to reduce emissions. The air source can be a pulse-air pump or an electrically or belt driven pump. Upstream air injection goes into the exhaust manifold to assist in after-burning HC laden exhaust gases. Downstream air injection goes into the oxidation bed of the catalytic converter to help oxidize HC and CO emissions.

### AIR PUMP

device to produce a flow of air at higher-thanatmospheric pressure. Normally referred to as a thermactor air supply pump.

### AIR/FUEL RATIO

the proportion of air to fuel by weight in the fuel mixture drawn into the engine.

## **ALLOY**

mixture containing mostly metals. For example, brass is an alloy of copper and zinc. Steel contains iron and other metals, but also carbon

## **ALTERNATIVE FUEL VEHICLE (AFV)**

as defined by the Energy Policy Act, any dedicated, flexible-fuel, or dual-fuel vehicle designed to operate on at least one alternative fuel.

## **ALTERNATIVE FUEL**

alternative fuel, also known as non-conventional fuels, is any material or substance that can be used as a fuel, other than fossil fuels, or conventional fuels of petroleum (oil), coal, propane, and natural gas. The term "alternative fuels" usually refers to a source of which energy is renewable. Methanol, denatured ethanol, and other alcohols; mixtures containing 85% or more by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; non-alcohol fuels (such as biodiesel) derived from biological material; and electricity. 'P-Series' fuels were added to this list since the original definition in EPA Act.

## **AMBIENT TEMPERATURE**

the temperature of the medium surrounding an object

## **ANTIFREEZE**

a material such as ethylene glycol which is added to water to lower its freezing point; used in an automobile's cooling system.

## **B100**

100% (neat) biodiesel.

## **B20**

a blend of biodiesel fuel with petroleum-based diesel where 20% of the volume is biodiesel.

## **BABBITT**

a soft bearing alloy used in engine bearings.

## **BACK PRESSURE**

pressure created by a blockage or restriction in an exhaust system.

## **BACKFIRE**

the sudden combustion of gasses in the intake or exhaust manifold, resulting in a loud explosion.

## **BALANCE SHAFT**

a weighted shaft used on some engines to dampen or reduce vibration.

## **BALLAST RESISTOR**

resistor in the primary side of the ignition system that is used to reduce voltage by approximately 4-5 volts.

## **BATTERY**

batteries are the principal energy storage devices for hybrid electric vehicles (HEVs). Desirable attributes of high-power batteries for HEV applications are high-peak and pulse-specific power, high specific energy at pulse power, a high charge acceptance to maximize regenerative braking utilization, and long calendar and cycle life. Developing methods/designs to balance the packs



electrically and thermally, developing accurate techniques to determine a battery's state of charge, and developing abuse-tolerant batteries, and recyclability are additional technical challenges.

## **BDC**

bottom dead center, when the piston is at its lower limit in the cylinder bore.

## **BEARING CAP**

the lower half of the bearing saddle. It is removable, as in main cap or rod cap.

## **BEARING CLEARANCE**

the space between a bearing and its corresponding component's loaded surface. Bearing clearances are commonly provided to allow lubrication between the parts.

## **BEARING CRUSH**

the bearing is slightly larger at its parting lines so that when the two halves of the bearing are tightened together, the bearing seats firmly in its bore. This keeps the bearing from rotating.

## **BEARING LINING**

the bearing surface area of a bearing, it is usually made up of an alloy of several metals, including lead.

## **BEARING SPREAD**

the condition in which the distance across the outer edges of the bearing insert is slightly greater than the diameter of the housing bore. A bearing is spread slightly apart at its parting halves so that it snaps into place in its bore and remains there during assembly.

## **BEFORE TOP DEAD CENTER (BTDC)**

the degrees of crankshaft rotation just before the piston in a specific cylinder reaches TDC, the highest point in its vertical travel on the compression stroke. On most vehicles, spark occurs a certain number of degrees of crankshaft rotation BTDC.

## **BI-FUEL VEHICLE**

a vehicle with two separate fuel systems designed to run on either an alternative fuel, or gasoline or diesel, using only one fuel at a time. Bi-fuel vehicles are referred to as "dual-fuel" vehicles in the Clean Air Act Amendments and Energy Policy Act.

## **BLOCK**

the casting made up of cylinders and the crankcase.

## **BLOWBY**

the unburned fuel and products of combustion that are forced past the piston rings and into the crankcase during the combustion stroke.

## **BOOST PRESSURE.**

term used when a turbocharger increases the air pressure entering an engine above atmospheric pressure.

## **BORE GAUGE**

a precision measuring instrument used to measure the diameter of a bore.

## **BORE**

a cylindrical hole.

## **BOSS**

the part of a piston that fits around its pin.

## **BOTTOM DEAD CENTER (BDC)**

when the piston is at its lower limit in the cylinder bore.

## **BRAKE HORSEPOWER**

power developed by an engine as measured at the flywheel or crankshaft.

## **BRAKE-SPECIFIC FUEL CONSUMPTION**

the ratio of engine fuel consumption to power output. It is a measure of engine efficiency.

## **BTDC**

see 'before top dead center'.

## **CAMSHAFT BEARING**

a bearing that supports the camshaft journal. On some engines it is full round and pressed in place. On some OHC engines the camshaft bearing is made up of two shells like a connecting rod bearing.

## **CAMSHAFT FOLLOWER**

on OHC engines the equivalent of a rocker arm.

## **CAMSHAFT JOURNAL**

the bearing area of a camshaft.

## **CAMSHAFT LOBE**

the eccentric on a camshaft that acts on lifters or followers and in turn, other valvetrain components as the camshaft is rotated, to open the intake and exhaust valves.

## **CAMSHAFT POSITION SENSOR (CMP)**

a magnetic, hall effect, optical or magneto resistive sensor usually mounted internally in the engine to inform the ECM or PCM of piston position on the intake stroke for timing and synchronization of sequential fuel injection.

## **CAMSHAFT SPROCKET**

the sprocket on a camshaft that is turned by a chain or belt from the crankshaft. The camshaft sprocket has twice as many teeth as the crankshaft sprocket.

## **CARBON DIOXIDE (CO<sub>2</sub>)**

A product of combustion that has become an environmental concern in recent years. CO<sub>2</sub> does not directly impair human health, but is a greenhouse gas that traps the Earth's heat and contributes to the potential for global warming.

## **CARBON MONOXIDE (CO)**

a colorless, odorless gas, which is highly poisonous. CO is produced by incomplete combustion. It is absorbed by the bloodstream 400 times faster than oxygen.

## **CARBON**

a hard or soft nonmetallic element that forms in an engine's combustion chamber when oil is burned.

## **CARBURETOR**

a device that atomizes air and fuel in a proportion that is burnable in the engine.

## **CASTING**

metal that is manufactured by pouring it into a mold. It is more porous than forged metal and does not conduct heat as well. It is less expensive to manufacture, however.

## **CATALYTIC CONVERTER**

an emission control device located in the exhaust system that contains catalysts, which reduce hydrocarbons, carbon monoxide and nitrogen oxides in the exhaust gases.

## **CATALYTIC OXIDATION**

process of oxidizing unburned hydrocarbons and carbon monoxide by means of a catalytic reaction to reduce pollution.

## **CHOKER**

a device used on carbureted vehicles to reduce the amount of air entering the intake manifold while leaving the amount of fuel unchanged. The purpose of a choke is to richen the mixture enough that a cold engine can still get enough vaporized fuel to start.

## **CLOSED LOOP**

electronic feedback system in which sensors provide constant information on what is taking place in the engine; the state of the engine control computer system when it is working normally, at full operating temperature and normal speeds with the oxygen sensor switching. The fuel injection quantity is determined by the set of inputs from the engine control computer's sensors, most specifically the oxygen sensor in the exhaust stream. A closed loop system samples its output and uses that sampling to modify the next inputs.

## **CLOSED-LOOP CARBURETION**

system in which the fuel/air ratio in the engine is carefully controlled to optimize emissions performance. A closed-loop system uses a fuel metering correction signal to optimize fuel metering.

## **COIL-ON-PLUG IGNITION**

a Coil-on-Plug ignition system uses one ignition coil for each cylinder attached to the spark plug. The system replaces remote ignition coils and high-voltage ignition wires in a distributorless ignition system.

## **COLD START**

difficulty of starting an internal combustion engine in cold weather because of gasoline, which evaporates more slowly when it is cold; oil, which gets thicker in cold weather; and the chemical reactions inside the battery, which progress more slowly in cold weather.

## **COMBUSTION CHAMBER**

enclosure formed by a pocket in the cylinder head and the top of the piston, where the spark plug ignites the compressed air/fuel mixture. The volume of the cylinder above the piston when the piston is at TDC.

## **COMBUSTION**

the burning of the air/fuel mixture.

## **COMMON RAIL DIRECT INJECTION (CDI)**

a fuel-injection system that uses a single "rail" (fuel line) that maintains constant fuel pressure regardless of injection sequence (also called common rail injection). The engine's electronic timing regulates fuel-injection timing and quantity according to data from sensors on the camshafts and crankshafts so that compression and injection occur independently. Fuel is injected only as needed, which reduces fuel consumption and emissions.

## **COMPRESSION IGNITION**

the form of ignition that initiates combustion in a diesel engine. The rapid compression of air within the cylinders generates the heat required to ignite the fuel as it is injected.

## **COMPRESSION RATIO**

ratio of the volume in the cylinder above the piston when the piston is at bottom dead center to the volume in the cylinder above the piston when the piston is at top dead center.

## **COMPRESSION RINGS**

usually the top two rings on a piston, they form a seal between the piston and cylinder wall to compress the air fuel mixture in the cylinder.

## **COMPRESSION STROKE**

the second stroke of the 4-stroke engine cycle, in which the piston moves from bottom dead center and the intake valve is closed, trapping and compressing the air/fuel mixture in the cylinder.

## **COMPRESSION**

in a solid material, compression is the opposite of tension. In a gas, compression causes the gas to be confined in a smaller area, raising its temperature and pressure.

## **COMPRESSION-IGNITION DIRECT-INJECTION (CID) ENGINE**

commonly called the diesel engine, has the highest thermal efficiency of any internal combustion engine. Challenges to improvements include a lower specific power than the gasoline engine; significant particulate matter and nitrogen oxides in the exhaust; and the noise, vibration, and smell of the engine.

## **CONNECTING ROD BEARINGS**

the plain bearing shells located in the big end of the connecting rod that support the connecting rod and piston on the crankshaft.

## **CONNECTING ROD CAP**

the removable part of the big end of the connecting rod.

## **CONNECTING ROD**

a rod that connects the crankshaft to the piston and enables the reciprocating motion of the piston to turn the crankshaft.

## **CONTINUOUS INJECTION**

a system that uses fuel under pressure to maintain or change the fuel injection area.

## **COOLANT**

the mixture of water and antifreeze used in an engine's cooling system to maintain the engine's temperature throughout its operating range.

## **COOLING FAN**

a mechanically or electrically driven propeller that draws air through the radiator.

## **COOLING SYSTEM**

the system used to remove excess heat from an engine and transfer it to the atmosphere. Includes the radiator, cooling fan, hoses, water pump, thermostat and engine coolant passages.

## **CORROSION INHIBITORS**

additives used to inhibit corrosion (e.g., rust) in the fuel system.

## **CRANK THROW**

distance from the crankshaft main bearing centerline to the connecting rod journal centerline. The stroke of any engine is the crank throw.

## **CRANK WEB**

unmachined portion of a crankshaft that lies between two crank pins or between a crankpin and main bearing journal.

## **CRANKCASE**

the lower part of an engine block that houses the crankshaft.

## **CRANKPIN**

the part of the crankshaft to which the connecting rod is attached.

## **CRANKSHAFT JOURNALS**

the bearing areas of a crankshaft are the main and rod journals.

## **CRANKSHAFT POSITION SENSOR (CKP)**

a magnetic, hall effect, optical or magneto resistive sensor usually mounted internally in the engine, externally to the engine or in the distributor to inform the ECM or PCM of crankshaft position, location of No.1 piston, and crankshaft speed for ignition timing and other calculations needed by the system where rpm is an input.

## **CRANKSHAFT PULLEY**

the belt drive pulley mounted on the front of the vibration damper.

## **CRANKSHAFT THRUST COLLAR**

a flat machined area that is 90 degrees to the crankshaft main journals. The flange of the thrust main bearing rides against it to control crankshaft end thrust.

## **CRANKSHAFT**

a lower engine part with main and rod bearing journals. It converts reciprocating motion to rotary motion.

## **CROSSFLOW RADIATOR**

a radiator in which coolant enters on one side, travels through tubes, and collects on the opposite side (see downflow radiator).

## **CRUSH**

the bearing is slightly larger at its parting lines so that when the two halves of the bearing are tightened together, the bearing seats firmly in its bore. This keeps the bearing from rotating.

## **CYLINDER HEAD**

the casting that contains the valves and valve springs, and covers the top of the cylinders.

## **CYLINDER LEAKAGE TEST**

in engine diagnostic test where the piston in the cylinder to be tested is brought to top dead center (TDC) on the compression stroke and compressed air is pumped into the cylinder through the spark plug hole. Where the air leaks out shows the location of the compression leak. A leakage tester will compare the air leaking out of the cylinder to the amount of air being put into it, expressed as a percentage.

## **CYLINDER SLEEVE**

a replacement iron liner that fits into a cylinder bore. It can be either wet or dry. The outside diameter of wet sleeves contacts the coolant.

## **CYLINDER WALLS**

the walls of the cylinder bore.

## **CYLINDER**

round hole in the engine block for the piston.

## **DAMPER**

a device mounted on the front of the crankshaft. It reduces the torsional or twisting vibration that occurs along the length of the crankshaft in multiple cylinder engines. It is also called a harmonic balancer.

## **DEAD CENTER**

the extreme upper or lower position of the crankshaft throw at which the piston is not moving in either direction.

## **DECK**

the top of the engine block where the cylinder head is attached.

## **DETONATION**

abnormal combustion of an air fuel mixture. When pressure in the cylinder becomes excessive and the mixture explodes violently, instead of burning in a controlled manner. The sound of detonation can be heard as the cylinder walls vibrate. Detonation is sometimes confused with preignition or ping.

## **DIAGNOSTIC TROUBLE CODE (DTC)**

a code that represents and can be used to identify a malfunction in a computer control system.

## **DIE CASTING**

an accurate casting made by pouring pressurized molten material into a mold or die.

## **DIESEL ENGINE**

any internal-combustion engine in which air is compressed to a sufficiently high temperature to ignite fuel injected into a cylinder. A diesel engine differs from other internal-combustion engines, such as gasoline engines, in that it employs no ignition devices, such as an electric spark. For this reason, it is often called a compression-ignition engine.

## **DIESEL FUEL**

petroleum products normally used as fuel for diesel engines are components of crude oil having heavy hydrocarbons containing at least 12 to 16 carbon atoms per molecule. These heavier fractions are taken from crude oil after the more volatile portions used in gasoline are removed.

## **DIESELING**



a condition by which hot spots in the combustion chamber(s) cause the engine to run on after the key is turned off.

## **DIRECT IGNITION**

distributorless ignition system in which spark distribution is controlled by the computer.

## **DIRECT INJECTION (DI)**

in DI, fuel is injected directly into the cylinder, as is typical in a diesel engine (also called direct fuel injection). Most other internal combustion engines use either carburetion (in which the air and fuel are mixed long before the air enters the cylinder) or port fuel injection (in which the fuel is injected just in front of the cylinder intake valve).

## **DIRECT INJECTION ENGINE**

direct injection (DI) refers to fuel injected directly into the combustion chamber above the piston. Direct Injection has long been used on large diesel engines. Smaller diesels are increasingly adopting direct injection (vs. indirect injection into a pre-chamber). Direct Injection also can be used in spark ignition (generally gasoline) engines instead of port fuel injection - for cleaner emissions, increased full throttle power and potentially for lean-burn operation.

## **DIRECT INJECTION SPARK IGNITION (DISI)**

with direct injection spark ignition (DISI) engines, fuel is injected in one of two ways depending on operating conditions. Lean burn operation (at part throttle), injects fuel after the air has entered, causing higher fuel concentration near the injector and spark plug for easy ignition. This is known as stratified charge. The overall air/fuel ratio is lean for better fuel consumption. At full power, fuel is injected at the same time as air (same as for conventional) to promote good mixing. Fuel evaporating in the combustion chamber cools the air slightly for higher volumetric efficiency and power. Since all fuel being injected goes directly into the cylinder, it can be metered more precisely, promoting cleaner emissions.

## **DIRECT INJECTION**

a fuel injection system wherein fuel is sprayed directly into the combustion chamber, that is, no precombustion chambers or manifold injection.

## **DISPLACEMENT**

the volume of a cylinder displaced by the piston as it moves from TDC to BDC (a complete stroke).

## **DISTILLATION CURVE**

the percentages of gasoline that evaporate at various temperatures. The distillation curve is an important indicator for fuel standards such as volatility (vaporization).

## **DRIVEABILITY**

the degree to which a vehicle operates properly, including starting, running smoothly, accelerating and delivering reasonable fuel mileage.

## **DRY SLEEVE**

a sleeve, that when installed in a cylinder block, does come into contact with coolant.

## **DTC**

see 'diagnostic trouble code',

## **DUAL-FUEL VEHICLE**

vehicle designed to operate on a combination of an alternative fuel and a conventional fuel. This includes (a) vehicles that use a mixture of gasoline or diesel and an alternative fuel in one fuel tank, commonly called flexible-fuel vehicles; and (b) vehicles capable of operating either on an alternative fuel, a conventional fuel, or both, simultaneously using two fuel systems. They are commonly called bi-fuel vehicles.

## **DURATION**

the length of time that a valve remains open, measured in crankshaft degrees.

## **DWELL TIME**

degree of crankshaft rotation during which the primary circuit is on.

## **DYKEM BLUE**

a dye which is painted on a valve seat in order to determine seat concentricity. The valve is inserted into the guide, lightly seated, and rotated about 1/8 in. A continuous blue line should appear all the way around the valve face if the valve and seat are mating properly. Open patches or breaks in the line indicate that the seat is not concentric and the low spots are not making contact.

## **E85**

a mixture of 85% denatured ethanol and 15% gasoline, by volume; an alternative engine fuel.

## **E93**

ethanol mixture that contains 93% ethanol, 5% methanol and 2% kerosene, by volume.

## **E95**

ethanol/gasoline mixture that contains 95% denatured ethanol and 5% gasoline, by volume.

## **EGR VALVE POSITION SENSOR**

a sensor mounted on the EGR valve that signals the engine control computer regarding EGR valve pintle position and EGR flow.

## **EGR VALVE**

see 'exhaust gas recirculation (EGR) valve',

## **EMBEDABILITY**

the ability of the bearing lining material to absorb contaminants.

## **ENGINE BLOCK**

the casting made up of cylinders and the crankcase.

## **ENGINE CONTROL MODULE (ECM)**

the electronic computer that controls engine operation. ECM is synonymous with ECA, ECU, SBEC or SMEC. It is less powerful than the PCM or VCM in that it controls only engine operation.

## **ENGINE COOLANT TEMPERATURE (ECT) SENSOR**

a sensor which works by a negative coefficient thermistor that loses resistance as its temperature goes up (just like the intake air temperature sensor). When the computer applies its 5-volt reference signal to the sensor, this voltage is reduced through a ground circuit by an amount corresponding to the temperature of the engine coolant.

## **ENGINE DISPLACEMENT**

the volume displaced by all of the pistons in all of an engine's cylinders.

## **ENGINE**

a device that converts heat energy into mechanical energy.

## **EQUIVALENCE RATIO**

actual air/fuel ratio divided by the stoichiometric air/fuel ratio. An air/fuel mixture is said to be stoichiometric when fuel combustion consumes all of the initial reacting species in going to completion.

## **ETHANOL**

a liquid alcohol made by fermenting sugars derived from starches in plants, such as corn or sugar cane ( $\text{CH}_3\text{CH}_2\text{OH}$ , ethyl or grain alcohol). When denatured (made unfit for human consumption), it can be used as an engine fuel. Can be produced chemically from ethylene or biologically from the fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. Used in the United States as a gasoline octane enhancer and oxygenate, it increases octane 2.5 to 3.0 numbers at 10% concentration. Ethanol also can be used in higher concentration in alternative fuel vehicles optimized for its use.

## **ETHYL TERTIARY BUTYL ETHER (ETBE)**

a fuel oxygenate used as a gasoline additive to increase octane and reduce engine knock.

## **EVAPORATIVE EMISSION (EVAP) CANISTER PURGE SOLENOID**

"EVAP" canister purging is controlled by the engine control computer, which determines when the canister should be purged based on various sensor inputs. When purging is needed the computer operates the purge solenoid, which controls the vacuum to purge the canister. Generally, the purge solenoid is activated when the engine is running above idle speed and at normal operating temperature.

## **EVAPORATIVE EMISSION (EVAP) CANISTER PURGE VALVE**

a valve on the line between the EVAP canister and the intake manifold. When the engine is running, under certain operating conditions, the valve opens, fresh air is drawn in through the canister air filter and the air and fuel vapors are drawn into the engine and burned, purging the canister.

## **EVAPORATIVE EMISSION (EVAP) CANISTER**

a charcoal-filled container with lines to the top of the fuel tank, to the intake manifold and to the air cleaner. The charcoal element adsorbs fuel vapors from the gas tank and stores them until the engine is running at normal operating temperatures and speeds. Then, a valve between the canister and engine opens, fresh air is drawn in through the canister air filter and the air and fuel vapors are drawn into the engine and burned, purging the canister.

## **EVAPORATIVE EMISSION (EVAP) SYSTEM**

an emission control system that prevents HC emissions from escaping the fuel system to atmosphere.

## **EVAPORATIVE EMISSIONS**

hydrocarbon vapors that escape from a fuel storage tank or a vehicle fuel tank or vehicle fuel system.

## **EXHAUST AFTERTREATMENT**

a method of controlling emissions from internal combustion engines - primarily Nox - by applying air pollution control technologies to engine exhaust (as opposed to treatments applied to the engine's intake air or during in-cylinder combustion stages).

## **EXHAUST GAS RECIRCULATION (EGR) SYSTEM.**

helps prevent the formation of oxides of nitrogen (Nox) by recirculating a certain amount of exhaust as an inert gas through the intake manifold to keep the peak combustion temperatures below what would form those chemical compounds. The computer determines when and how much exhaust to recirculate based on information from all its other sensors. It then actuates the EGR solenoid, which opens a vacuum circuit or operates an electronic circuit or operates an electronic circuit to actually work the EGR valve. The computer uses a duty-cycle (percentage of on-time) signal to activate the solenoid.

## **EXHAUST GAS RECIRCULATION (EGR) VALVE**

component in the EGR system, used to meter a controlled amount of exhaust gas into the intake air stream.

## **EXHAUST GAS RECIRCULATION (EGR)**

an emissions control technique that reuses engine exhaust gases as part of the intake air supply to help reduce harmful emissions (especially Nox).

## **EXHAUST MANIFOLD**

the part of the exhaust system that is fastened to the cylinder head.

## **EXHAUST PIPE**

the pipe between the exhaust manifold and muffler.

## **EXHAUST PORT**

the passage or opening in a four stroke cylinder head for the exhaust valve.

## **EXHAUST STROKE.**

the final stroke in a 4-stroke cycle engine during which the exhaust valve is open and the intake valve is closed, exhausting the combusted gases.

## **EXHAUST VALVE**

poppet valves in the cylinder head that control the flow of exhaust from the engine.

## **FEEDBACK**

a basic concept in the way the engine control system works. 'Feedback' refers to the mechanism whereby the computer is able to measure the Oxygen in the exhaust stream and then modify the amount of fuel injected into the intake manifold to optimize exhaust emissions by keeping the air/fuel ratio at stoichiometry.

## **FLEXIBLE-FUEL VEHICLE (FFV)**

a Vehicle with a common fuel tank designed to run on varying blends of unleaded gasoline with either ethanol or methanol.

## **FLOATING PIN**

a piston pin that moves in the piston and the small end of a connecting rod. It is held in place by retaining clips in the pin bosses.

## **FLOODING**

a condition in which unvaporized fuel in the intake manifold and/or combustion area, prevents the engine from starting.

## **FLUTTER**

as applied to engine valves, refers to a condition wherein the valve is not held tightly on its seat due to a weak valve spring, during the time the cam is not lifting it.

## **FOOT POUND**

a unit of measurement for torque. One foot pound is the torque obtained by a force of one pound applied to a wrench handle that is 12-in. long; a unit of energy required to raise a weight of one pound, a distance of one foot.

## **FOUR STROKE CYCLE ENGINE**

an engine, either gasoline or diesel that uses four strokes: intake, compression, power and exhaust. A firing impulse occurs every two turns of the crankshaft. When this engine is a gasoline engine it is also called an Otto cycle engine after its inventor. A diesel engine is called a Diesel cycle engine for the same reason.

## **FREEZE PLUG**

another name for core plug.

## **FUEL FLEXIBLE**

ability of a vehicle to operate on either (a) a wide range of fuels blends (e.g., blends of gasoline and alcohol) or (b) two different fuels carried aboard the vehicle (e.g., gasoline and compressed natural gas).

## **FUEL INJECTION**

a system that sprays fuel directly into the intake air stream.

## **FUEL INJECTOR**

an electrically-opened nozzle that sprays finely atomized fuel through its aperture into the intake manifold during a cylinder's intake stroke. On some vehicles, these injections are sequential, on others, the injectors are fired all at once or in banks.

## **FUEL PRESSURE REGULATOR**

uses intake manifold vacuum, or more properly intake manifold absolute pressure (MAP), to modify the pressure in the fuel rail. The fuel pump can pump more fuel than the engine can use, so the system routes the extra fuel back to the tank through the fuel pressure regulator.

## **FUEL PUMP (FP) RELAY**

the computer controls the electric fuel pump by energizing the fuel pump relay. It does so by grounding the fuel pump relay coil circuit. The relay then directly supplies power to the fuel pump.

## **FUEL PUMP**

a mechanical or electronic device that draws fuel from the fuel tank and sends it to the carburetor or fuel injection system.

## **FUEL RAIL**

a manifold used to connect fuel injectors to the fuel pump

## **FUEL SHUTOFF**

works by de-energizing the fuel pump relay. This occurs if the engine speed sensor indicates excessive engine speed or if the vehicle speed sensor indicates a certain mph.

## **FUEL TRIM (STFT / LTFT)**

fuel delivery (volume) adjustments based on closed loop feedback. values above the nominal value (0%) indicate increased injector pulse width (IPW); values below 0% indicate decreased injector pulse width. Positive percentages indicate richening air/fuel ratio; negative percentages indicate a leaning air/fuel ratio. Short Term Fuel Trim (STFT) is based on current oxygen sensor switching values. Long Term Fuel Trim (LTFT) is a learned value used to compensate for continual deviation of STFT from the nominal value. For example, if STFT continually signals richening the air/fuel ratio, it will reach a value sufficient to increment the LTFT to a richer value.

## **FUEL, IGNITION OR SPARK MAP**

a multi-dimensional 'map' that correlates engine speed, temperature, load and other factors into a specific spark advance and fuel injection pulse width for that set of conditions. There are several such 'maps' in the computer's hardwired memory. The fine-tuning of the fuel mixture is completed by the signal from the oxygen sensor. On some vehicles, a knock sensor is included to fine-tune the ignition advance to accommodate differences in fuel octane rating and engine wear.

## **GAS TURBINE**

a rotary engine that draws energy from a fuel-air mixture. A compressor raises the pressure and temperature of the inlet air. The air is then moved into a burner, where fuel is injected and combusted to raise the temperature of the air. Power is produced when the heated, high-pressure mixture is expanded and cooled through the turbine.

## **GASKET**

a material such as artificial rubber, cork, or steel used to seal between parts that would otherwise leak fuel, coolant, lubricants or combustion gases.

## **GLOW PLUG**

an electrically heated wire that helps ignite diesel fuel when a compression ignition engine is cold and the compression process may not raise the air to a high enough temperature for ignition.

## **HARMONIC BALANCER**

a device that reduces the torsional or twisting vibration that occurs along the length of the crankshaft in multiple cylinder engines. It is also called a vibration damper.

## **HEATED OXYGEN SENSOR(HO2S)**

an oxygen sensor with a resistance element built into it to shorten the time needed to bring the sensor to operating temperature. Heated oxygen sensors will keep the sensor at operating temperature during idle, low speeds, and in very cold weather. The HO2's heater is on whenever the ignition switch is on.

## **HEMISPHERICAL COMBUSTION CHAMBER**

a combustion chamber shape that resembles a half a globe. The valves are on the sides of the spark plug, which is in the center.

## **HG**

the chemical symbol for the element mercury. Engine vacuum is measured in inches of mercury or in/Hg

## **HONE**

abrasive tool for correcting small irregularities or differences in diameter in a cylinder, such as an engine cylinder or brake caliper; to enlarge or smooth a bore with a rotating tool containing an abrasive material.

## **HORSEPOWER (HP)**



measurement of an engine's ability to perform work. One horsepower is the energy required to lift 550 pounds 1 foot in 1 second.

## **HOUSING BORE**

the machined bore in a block or head where a bearing will be installed.

## **IDLE AIR CONTROL (IAC) VALVE**

controls the amount of air allowed to bypass the closed throttle to keep the engine at the proper idle speed. The computer also controls the idle speed of the engine, depending on engine coolant temperature and the number of accessories such as headlights, air conditioning, etc. that are engaged. The idle air control (IAC) valve controls air flow through a throttle bypass passage by means of a stepper motor, an electric motor that can move to a specific location in its travel. Based on the information from its sensors and the parameters in its memory, the computer sends a duty-cycle (percentage of on-time) signal to the IAC valve motor to open or close the bypass to increase or slow the idle speed. This signal can range from zero to 100 percent, and corresponds to the amount of airflow the computer determines is needed. Displayed on the scan tool as counts or percentage.

## **IGNITABILITY**

characteristic of a solid that enables it to spontaneously ignite. Any liquid with a flash point below 140 $\bar{A}$ , $\bar{A}$  $\text{^\circ}$ F is said to possess ignitability.

## **IGNITION COIL**

transforms the low 12-volt battery ignition primary current into the high voltage secondary current that fires the spark in the plugs. The current through the primary coil windings builds up an electromagnetic field around the ferrous core of the coil. When the current is suddenly shut off, the electromagnetic field collapses and generates the high voltage in the secondary windings.

## **IGNITION CONTROL MODULE (ICM)**

the computer does not directly operate the ignition coil, because of the comparatively high voltages and currents involved. Instead, it signals the ignition control module when to fire the spark. The (ICM) has a power transistor which turns on the ignition primary circuit to charge the coil by building an electromagnetic field around the ferrous core, and fires the spark by shutting off the current to the primary circuit, allowing the field to collapse and generate a high voltage spark current in the coil secondary circuit. The ignition control module typically includes additional internal circuits to perform other functions such as calculating dwell. Some modern systems have dwell and timing control in the PCM regulating the ICM to the duties of an on-off switch for the coil.

## **IGNITION SWITCH**

a key operated switch located on the steering column, that connects and disconnects power to the ignition and electrical systems.

## **IGNITION SYSTEM**

the components that produce the spark to ignite the air/fuel mixture in the combustion chamber.

## **IGNITION TIMING**

refers in crankshaft degrees to the position of the piston in the cylinder when the spark occurs.

## **I-HEAD**

a valve arrangement in most modern engines where the valve is positioned above the piston (in the cylinder head). The engine can be either an OHC (overhead cam) or pushrod type.

## **IMPELLER**

commonly referred to as a pump, the impeller is the rear half of the torque converter shell that drives the turbine; a driving member in a turbine or pump.

## **INCH POUND**

one twelfth of a foot pound.

## **INJECTOR**

a device which receives metered fuel under relatively low pressure and is activated either electrically or mechanically to spray the fuel under relatively high pressure into the engine.

## **INSERT GUIDES**

valve guides that are pressed fit in the cylinder head

## **INSTALLED SPRING HEIGHT**

distance from the valve spring seat to the underside of the valve spring retainer.

## **INSTALLED STEM HEIGHT**

distance from the valve spring seat to the stem tip.

## **INTAKE AIR TEMPERATURE (IAT) SENSOR**

works by a negative coefficient thermistor that loses resistance as its temperature goes up (like the engine coolant temperature sensor). When the computer applies its 5-volt reference signal to the sensor, this voltage is reduced through a ground circuit by an amount corresponding to the temperature of the intake air.

## **INTAKE MANIFOLD**

a part with runners that connect the fuel system to the intake valve ports.

## **INTAKE PORT**

the passage or opening in a cylinder head that is closed by the intake valve.

## **INTAKE STROKE**

the first stroke of a 4-stroke cycle engine in which the intake valve is open and the exhaust valve is closed, during which the downward motion of the piston draws the fuel/air mixture into the cylinder.

## **INTAKE VALVE**

also called inlet valve, it closes off the intake port and opens it at the correct time in response to movement from the cam lobe.

## **INTEGRAL GUIDES**

valve guides that are part of the cylinder head.

## **INTEGRAL SEATS**

valve seats that are part of the head.

## **INTERCOOLER**

a component on some turbocharged engines used to cool the compressed intake air.

## **INTERNAL COMBUSTION ENGINE (ICE)**

engine that converts the energy contained in the fuel inside the engine into motion. Combustion engines use the pressure created by the expansion of the gases to do mechanical work.

## **JET**

precisely-sized, calibrated hole in a hollow passage through which fuel or air can pass.

## **JOURNAL**

the bearing surface on a shaft.

## **KEEPERS**

small locks that hold the valve retainer onto the valve stem. Also called split locks.

## **KNOCK SENSOR(KS)**

a sensor used in the engine control system that detects preignition, detonation and knocking. It contains a piezoelectric crystal that produces an AC voltage under vibration.

## **LAPPING**

the process of fitting one surface to another by rubbing them together with an abrasive material between the two surfaces.

## **LASH ADJUSTER**

a device for adjusting valve lash or maintaining zero lash in certain types of OHC engines. The lash adjuster is stationary in the cylinder head, with one end of a cam follower mounted on top of it. The other end of the follower acts on the valve stem when the camshaft lobe, which is positioned over the center of the follower, pushes the follower down.

## **LASH**

the amount of clearance between components in a geartrain or valvetrain.

## **LEAN BURN ENGINE**

a lean burn engine is designed to operate with a very lean air-fuel ratio during light load conditions. Most modern gasoline engines are controlled to run at a chemically correct (stoichiometric) air fuel ratio (about 14.7:1) to make the three-way catalyst operate at high efficiency, reducing tailpipe emissions. Lean burn engines mix more air with the fuel when full power is not needed, resulting in better fuel economy. Air/fuel ratio in lean burn engines can be as high as 20:1. When full power is needed, such as during acceleration or hill climbing, a lean burn engine reverts to a stoichiometric (14.7:1) ratio or richer.

## **LIFTER BORES**

the holes in an engine block that the lifters fit into.

## **LIFTER**

the valvetrain part that rides on the camshaft lobe.

## **LITER (L)**

a metric measurement used to calculate the volume displacement of an engine. One liter is equal to 1,000 cubic centimeters or 61 cubic inches.

## **LOBE**

the eccentric part of the camshaft that moves the lifter.

## **LOCATING LUG**

the tab on a bearing back that fits into the slot in the main or rod bearing bore to locate it properly.

## **M85**

85% methanol and 15% unleaded gasoline by volume, used as a motor fuel in FFVs.

## **MAF SENSOR**

see 'mass airflow sensor'.

## **MAIN BEARING CAPS**

the lower removable lower halves of the main bearing bores.

## **MAIN BEARING CLEARANCE**

the clearance between the main bearing journal and its bearings.

## **MAIN BEARING JOURNAL**

the central, load-bearing points along the axis of a crankshaft, where the main bearings support the shaft in the block.

## **MAIN BEARING SADDLE BORES**

the housings that are machined for main bearings.

## **MAIN BEARINGS**

the plain bearings that support the crankshaft in the engine block.

## **MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR**

a sensor that measures changes in intake manifold pressure resulting from changes in engine load and speed. The pressure in the intake manifold as referenced to a perfect vacuum. Manifold vacuum is the difference between MAP and atmosphere pressure. For example, in a standard atmosphere (sea level) the pressure is 29.92 inches of mercury, 101 kilopascals, or 0 inches of vacuum.

## **MANIFOLD ABSOLUTE PRESSURE**

measure of the degree of vacuum or pressure within an intake manifold.

## **MANIFOLD VACUUM**

relatively low pressure in an engine's intake manifold just below the throttle plate(s). Manifold vacuum is highest at idle and drops during acceleration.

## **MAP SENSOR**

see 'manifold absolute pressure sensor'.

## **MASS AIRFLOW (MAF) SENSOR**

a sensor in a fuel injection system that measures the mass (weight/density) of the incoming air flowing through a meter. The measurement transmitted to the PCM is usually either a frequency or a voltage.

## **MISFIRE**

failure of an explosion to occur in one or more cylinders while the engine is running; can be continuous or intermittent failure.

## **MISS**

a lack of power observed in one or more cylinders, either regularly or intermittently.

### **MULTI-PORT FUEL INJECTION (MFI)**

a fuel injection system in which there is one fuel injector for each cylinder.

### **MULTIVISCOSITY OIL**

chemically-modified oil that has been tested for viscosity at cold and hot temperatures.

### **MUSHROOM LIFTERS**

lifters with contact faces that are wider than the lifter bore. They must be installed through the bottom of the lifter bores, before the cam is installed.

### **MUSHROOMED VALVE STEM TIP**

a folding over of the metal at the tip of the valve stem in response to pounding from too loose a valve adjustment or a defective hydraulic lifter.

### **NITROGEN OXIDES (NOX)**

a by-product of the combustion process when using petroleum-based fuels; one of the primary causes of acid rain and a contributor to global warming.

### **OHC ENGINE**

overhead cam engine. An engine with the camshaft located in the cylinder head.

### **OIL CLEARANCE**

the difference between the inside bearing diameter and the journal's diameter.

### **OIL GALLERY**

a line that supplies oil to areas of the engine block or cylinder head.

### **OIL GROOVE**

a groove machined in the bearing surface that provides a channel for oil flow.

### **OIL PAN**

the part that encloses the crankcase at the lower end of the block.

### **OIL PRESSURE**

the pressure that results from resistance to flow from the oil pump. As the pump turns faster, it produces more flow. A relief valve limits the amount of pressure it can produce.

### **OIL PUMP PICKUP**

the screen that filters and keeps debris out of the oil pump.

### **OIL PUMP**

the pump that circulates lubricating oil throughout the engine, usually driven by the camshaft (by way of the distributor).

### **OIL RINGS**

the bottom ring on the pistons, scrapes excess oil from the cylinder walls to keep it from entering and burning in the combustion chamber.

### **ON-BOARD DIAGNOSTICS (OBD)**

a diagnostic software system in the ECM or PCM that monitors computer inputs, outputs, and resultant engine/transmission operations for failure. OBD-I is thought of as any of the systems in use before OBD-II, typically 1979 to 1995 systems, although some OEMs started transitioning to OBD-II in 1994 and 1995. OBD-II has been a federally mandated system since 1996, it monitors emission control systems for degradation as well as for failures.

## **OPEN-LOOP FUEL CONTROL**

system in which the air/fuel mixture is preset by design with no feedback correction signal to optimize fuel metering.

## **OSCILLOSCOPE**

an instrument that displays electrical activity in the form of line patterns on a screen.

## **OVERBORE**

the dimension by which a machined hole is larger than the standard size.

## **OVERHEAD CAM (OHC) ENGINE**

an engine with the camshaft located in the cylinder head.

## **OVERHEAD VALVE ENGINE**

an I-head engine. The intake and exhaust valves are located in the cylinder head.

## **OXIDES OF NITROGEN (NOX)**

regulated air pollutants, primarily NO and NO<sub>2</sub> but including other substances in minute concentrations. Under the high pressure and temperature conditions in an engine, nitrogen and oxygen atoms in the air react to form various Nox. Like hydrocarbons, Nox are precursors to the formation of smog. They also contribute to the formation of acid rain.

## **OXYGEN SENSOR (O<sub>2</sub>S)**

a sensor that consists of a ceramic zirconium thimble, coated on each side with a very thin film of platinum. Once it reaches operating temperature of 600 $\hat{A}$ , $\hat{A}$ °F, the oxygen sensor begins to function as a very low current battery, producing between 0 and 1.0 volt with the output corresponding to the difference in oxygen between the exhaust and the ambient air. The signal from the oxygen sensor enables the computer to keep the air/fuel mixture as close as possible to the stoichiometric mixture. Under normal conditions, the oxygen sensor signal should fluctuate above and below 450 millivolts several times a second while the system is in closed loop.

## **PARTICULATE TRAP**

diesel vehicle emission control device that traps and incinerates diesel particulate emissions after they are exhausted from the engine but before they are expelled into the atmosphere.

## **PCV SYSTEM**

see 'positive crankcase ventilation system'.

## **PCV VALVE**

a part of the positive crankcase ventilation system. Meters crankcase vapors into the intake manifold.

## **PISTON HEAD**

the part of the piston that is above the rings.

## **PISTON PIN**

see 'wrist pin',



## **PISTON RING**

an open-ended ring which fits into a groove on the outer diameter of the piston. Its chief function is to form a seal between the piston and cylinder wall. Most automotive pistons have three rings: two for compression sealing, one for oil sealing.

## **PISTON SLAP**

a noise that result from excessive piston to cylinder wall clearance.

## **PISTON**

the cylindrical component that is attached to the connecting rod and moves up and down in the cylinder bore. The top of the piston forms the bottom of the combustion chamber. When combustion occurs, the piston is forced downward in the cylinder, moving the connecting rod which in turn rotates the crankshaft.

## **PLASMA-ASSISTED CATALYSIS**

a diesel exhaust treatment system that uses a small amount of electricity from the engine to generate a nonthermal plasma (NTP) on a ceramic surface. The resulting reaction can reduce Nox and particulates by up to 90% without onboard chemicals or heating.

## **PLASTIGAGE**

a plastic material that is compressed between a bearing and journal, and the resulting compressed material measured to determine the clearance.

## **PORT FUEL INJECTION (PFI)**

port fuel injection (used spark-ignition engines) have injectors in the intake port near the valve. During the intake stroke, fuel sprayed into the port enters the combustion chamber along with the air charge.

## **PORT FUEL INJECTION**

a fuel injection system that uses one injector at each cylinder, making fuel distribution exactly equal among all the cylinders.

## **PORTS**

valve openings in a cylinder head.

## **POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM**

a system that controls crankcase emissions by using a valve to meter crankcase vapors into the intake manifold.

## **POWER STROKE**

the third stroke of a four-stroke cycle engine which begins with the combustion of the fuel/air mixture, driving the piston away from top dead center, which then exerts turning force on the crankshaft.

## **PRECOMBUSTION CHAMBER**

a diesel engine design with a small combustion chamber in the cylinder head that contains the fuel injector. The fuel is ignited in this chamber. This design is often used with automotive diesels because of lower combustion pressures and because fuel quality is not as critical.

## **PREIGNITION**

also called ping, it is abnormal combustion of the air/fuel mixture before it is time to do so. A hot surface or carbon deposit in the combustion chamber ignites the air/fuel mixture before the spark

plug is fired. The sound of preignition can be heard as the cylinder walls vibrate. Detonation is sometimes confused with preignition.

## **PRIMARY CIRCUIT**

the low-voltage circuit of an ignition system.

## **PRUSSIAN BLUE**

a paste used to determine the contact area between two parts, such as the height of the valve seat on the valve face.

## **PUMP OCTANE**

the octane as posted on retail gasoline dispensers as (R+M)/2; same as Antiknock Index.

## **PUSH ROD**

a rod between the lifter and rocker arm. They are sometimes hollow to allow oil distribution to the valves.

## **RADIATOR CAP**

a device that seals the radiator and maintains a set pressure in the cooling system.

## **RADIATOR**

the part of the cooling system that acts as a heat exchanger, transferring heat to atmosphere. It consists of a core and holding tanks connected to the cooling system by hoses.

## **REAR MAIN OIL SEAL**

a seal that fits around the rear of the crankshaft to prevent oil leaks.

## **RECIPROCATING**

an up and down or back and forth motion.

## **RIDGE REAMER**

a tool used to remove the ridge from the top of a cylinder bore.

## **RIDGE**

a raised area at the top of a cylinder bore created by ring wear. The ridge occurs because the piston ring does not travel all the way to the top of the bore, thereby leaving an unused portion of cylinder bore above the limit of ring travel. This ridge will usually be more pronounced on high mileage engines.

## **RIDGED HONE**

a hone that removes metal and imparts a precise finish and crosshatch to the bore.

## **RING END GAP**

the clearance between the ends of a piston ring when installed in the cylinder bore.

## **RING FILE**

a tool used to trim the ends of a piston ring to bring the ring end gap within specification.

## **RING LANDS**

the raised parts between the piston ring grooves.

## **ROCKER ARM**

a pivot lever mounted on a round shaft or a stud. One end of the rocker arm is applied by the push rod and the other end acts upon the valve stem.

## **ROCKER SHAFT**

a round pipe that is mounted parallel on top of the cylinder head. All of the rocker arms on the head are mounted on it.

## **ROCKER STUD**

a stud that is pressed or threaded into a cylinder head on which the rocker arm is mounted.

## **SCAN TOOL DATA**

Information from the ECM, PCM, or VCM that is displayed on the scan tool. This data includes component and system values on the data stream, DTCs, and on some systems, freeze frame data, system monitors and readiness monitors.

## **SEAT**

a surface (Usually machined) upon which another part rests or seats (e.g., valve seat).

## **SEQUENTIAL FUEL INJECTION (SFI)**

a fuel injection system that uses one electronically pulsed fuel injector for each cylinder. The injectors are pulsed in firing-order sequence, ordinarily during the engine's intake stroke for that cylinder.

## **SERPENTINE BELT**

a flat, ribbed drive belt that makes multiple angles, driving several components.

## **SLUDGE**

when oil is not changed often enough, moisture and by products of combustion combine in the engine oil to form sludge.

## **SPARK KNOCK**

engine noise caused by abnormal, uncontrolled combustion due to preignition or detonation.

## **SPARK PLUG**

an electrical device that is connected to a high voltage source. The high voltage travels down an electrode inside the spark plug and arcs across an air gap, thereby creating the spark that starts the combustion process in the combustion chamber.

## **SPARK-IGNITION (SI) ENGINE**

an internal combustion engine in which the fuel mixture is ignited electrically. A spark-ignition engine runs on an Otto cycle - most gasoline engines run on a modified Otto cycle. This cycle uses a homogeneous air-fuel mixture that is combined before it enters the combustion chamber. Once in the combustion chamber, the mixture is compressed, then ignited by a spark plug (spark ignition). The engine is controlled by limiting the amount of air allowed inside through the use of a throttling valve placed on the air intake (carburetor or throttle body).

## **STOICHIOMETRIC.**

chemically correct. An air/fuel mixture is considered stoichiometric when it is neither too rich nor too lean; an ideal mixture is composed of 14.7 parts air to one part fuel.

## **STROKE**

the distance the piston moves from TDC to BDC.

## **SUPERCHARGER**

a compressor, mechanically driven by the engine's crankshaft, that pumps air into the intake manifold.

## **SWIRL COMBUSTION**

a swirling of the air/fuel mixture in a corkscrew pattern that improves combustion.

## **TAILPIPE EMISSIONS**

EPA-regulated vehicle exhaust emissions released through the vehicle tailpipe. Tailpipe emissions do not include evaporative and refueling emissions, which are also regulated by EPA. EPA publishes allowable emission levels and vehicle certification standards in the Code of Federal Regulations.

## **TDC**

see 'top dead center'.

## **TETRAETHYL LEAD OR LEAD**

an octane enhancer. One gram of lead increases the octane of one gallon of gasoline about 6 numbers. The EPA has phased down the use of lead in gasoline as it has been determined to be a health hazard. Lead has been prohibited in highway vehicle gasoline since January 1, 1996.

## **THREE-WAY CATALYTIC CONVERTER (TWC)**

a catalytic converter system that reduces exhaust gas emission levels. Usually consists of two beds of catalyst, the upstream bed (reduction bed) reducing Nox emissions to nitrogen and oxygen and the downstream bed (oxidation bed) reducing HC and CO emissions to CO<sub>2</sub>, O<sub>2</sub>, and H<sub>2</sub>O.

## **THROTTLE BODY INJECTION (TBI)**

also called central fuel injection, it has an intake manifold like that used with a carburetor. One or more fuel injectors are mounted in the throttle body, which resembles a carburetor in physical appearance.

## **THROTTLE POSITION (TP) SENSOR**

a potentiometer that is mechanically connected to the throttle shaft of the throttle body assembly. It provides an input to the vehicle computer control system regarding throttle position. The TP sensor reduces the 5-volt reference voltage supplied by the computer to an amount corresponding to the degree to which the driver is holding the throttle open by foot.

## **THROTTLE VALVE (TV) PRESSURE.**

in an automatic transmission, line pressure that passes through the valve of the throttle pressure spool valve.

## **TIMING BELT**

a toothed reinforced belt used to drive the camshaft from a sprocket on the crankshaft.

## **TIMING CHAIN**

a chain that drives the camshaft from a sprocket on the crankshaft.

## **TIMING GEARS**

gears that drive the camshaft from the crankshaft.

## **TIMING**

refers in crankshaft degrees to the position of the piston in the cylinder. When referring to camshaft timing, it is when the valves open. When referring to ignition timing, it is when the spark occurs.

## **TOP DEAD CENTER (TDC)**

the position of the crankshaft for a specific cylinder when the piston is at the highest point in its vertical travel on the compression stroke.

## **TORQUE**

the turning force produced by an engine.

## **TORQUE-TO-YIELD HEAD BOLTS**

head bolts that are often not reusable. They are torqued into yield, which means that they have purposely stretched beyond the point where they will return to their original length. This provides more uniform clamping force.

## **TP SENSOR**

see 'throttle position sensor'.

## **TURBINE**

machine for generating rotary mechanical power from the energy in a stream of fluid. The energy, originally in the form of head or pressure energy, is converted to velocity energy by passing through a system of stationary and moving blades in the turbine.

## **TURBOCHARGER**

an exhaust driven pump which compresses intake air and forces it into the combustion chambers at higher than atmospheric pressure. The increased air pressure allows more fuel to be burned and results in increased horsepower being produced.

## **UMBRELLA TYPE VALVE SEALS**

valve guide seals that fit tightly on the valve stem. They move up and down with the valve stem acting like an umbrella to shield oil away.

## **VACUUM ADVANCE**

a distributor mounted mechanism that controls spark advance in response to engine vacuum.

## **VALVE COVER**

an enclosure fastened to the top of a cylinder head, over the valvetrain.

## **VALVE DURATION**

the length of time, in degrees of crankshaft rotation, that a valve is open.

## **VALVE FACE**

the area of the valve that contacts the valve seat.

## **VALVE FLOAT**

when valves remain open, usually at high rpm, due to weak or broken valve springs.

## **VALVE GUIDE KNURLING**

a method of refinishing the inside of a valve guide by restoring its original size. This method can be used on guides worn less than 0.007-in.

## **VALVE GUIDE LINER**

a thin bronze bushing installed in a valve guide to restore it to original size.

## **VALVE GUIDE**

a bore in the cylinder head that the valve stem fits into.

## **VALVE KEEPERS**

small locks that hold the valve retainer onto the valve stem. Also called split locks.

## **VALVE LASH**

the amount of clearance in the valvetrain when the lifter is on the base circle of the camshaft lobe.

## **VALVE LIFT**

the distance from the valve seat when the valve is fully open.

## **VALVE LIFTER**

a small cylinder that fits into a bore above the cam lobe. It acts on a push rod and rocker arm to open the valve.

## **VALVE ROTATOR**

a part found at the end of some valve springs that rotates the valve each time it opens. This aids in providing even cooling to the valve.

## **VALVE SEAL**

a seal located over the valve stem, used to prevent oil from leaking down the valve guide and into the combustion chamber.

## **VALVE SEAT**

the machined surface that the valve face seats against.

## **VALVE SPRING COMPRESSOR**

a tool used to compress the valve spring on a cylinder head. When the valve spring is compressed, the valve keepers can be removed, then the spring is released and the spring, valve spring retainer and valve can be removed from the cylinder head.

## **VALVE SPRING INSTALLED HEIGHT**

the specified distance between the machined spring seat on the cylinder head to the underside of the valve spring retainer. Both grinding the valve and grinding the valve seat result in an increase in this dimension. A shim can be installed under the spring to restore the original installed height for proper spring tension.

## **VALVE SPRING RETAINER**

the part that connects the valve spring to the valve and holds the valve against the cylinder head. It is held to the valve by keepers.

## **VALVE SPRING SEATS**

metal shims used, usually on aluminum cylinder heads, to protect the head from the bottom of the valve spring.

## **VALVE SPRING**

a small coil spring used to keep the valve closed against the valve seat.



## **VALVE STEM**

the part of the valve that is inside the valve guide.

## **VALVE TIMING**

set rotations of the camshaft and crankshaft to open/close valves at proper intervals during the piston strokes for optimal operation of an engine.

## **VALVE TRAIN GEOMETRY**

the dynamic relationship between the rocker arm and valve stem during the time when the valve is opening and closing.

## **VALVETRAIN**

parts that convert camshaft movement to valve movement. These include the camshaft, cam timing parts, lifters or cam followers, push rods, rocker arms, valve and spring.

## **VARIABLE FUEL VEHICLE (VFF)**

a vehicle that has the capacity of burning any combination of gasoline and an alternative fuel. Also known as a flexible-fuel vehicle.

## **VARIABLE VALVE TIMING**

variable valve timing allows the point at which an engine's valves open and close to change with operating conditions - such as engine speed and throttle position. In addition to changing the valve timing with respect to the crankshaft, some systems also change the duration the valve is open and the extent to which it opens. Varying these parameters allows the engine to operate more efficiently at all engine speeds while maintaining driveability.

## **VIBRATION DAMPER**

see 'harmonic balancer'.

## **WASTEGATE**

a valve used to limit the boost developed in a turbocharger. A wastegate allows some of an engine's exhaust flow to bypass the turbocharger's turbine under certain conditions.

## **WATER JACKET**

also called a cooling jacket, it is the hollow area of a casting designed for coolant flow.

## **WET SLEEVE**

a sleeve, which when installed in a cylinder block, is exposed to coolant.

## **WRIST PIN**

a hollow metal tube that secures the piston to the connecting rod and allows the piston to swivel on the rod. Also called a piston pin.

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## UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

### Exhaust Systems

## EXHAUST SYSTEMS

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A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

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All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

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## **THE MAP PROCESS - OVERVIEW**

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These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site [www.motorist.org](http://www.motorist.org) or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 \* Fax: (202) 318-0378

## **THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS**

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p>A. Part no longer performs intended purpose</p> <p>B. Part does not meet a design specification (regardless of performance)</p> <p>C. Part is missing</p>	<p>1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.)</p> <p>2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)</p> <p>3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)</p> <p>4. Technician's recommendation based on substantial and informed experience</p> <p>5. To comply with maintenance recommended by AMRA / MAP</p>

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p><b>NOTE:</b> When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.</p>	<p><b>NOTE:</b> Suggested services are <i>always</i> optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.</p>

## EXHAUST SYSTEMS

**WARNING:** Federal EPA rules prohibit altering an exhaust system in any way that defeats the emission reduction components of a vehicle. Be sure to review and adhere to EPA policy on removing and replacing catalytic converters. Where state or local laws are stricter, they take precedence over these guidelines.

**NOTE:** Some exhaust systems are of a welded design. It is not required that the entire system be replaced. Determine the need to replace individual components based on conditions of component.

## CATALYTIC CONVERTERS

Condition	Code	Procedure
Air injection tube broken	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube burnt	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube leaking	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube loose	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube restricted	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube threads damaged	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube threads stripped (threads missing)	A	Require repair or replacement of injection tube or replacement of catalytic converter
Body Cracked	B	Require repair or replacement
Converter empty	A	Require repair or replacement
Converter fill plug missing	C	Require repair or replacement
Converter missing	C	Require repair or replacement
Exhaust gases leaking	A	Require repair or replacement
Flanges leaking	A	Require repair or replacement of flanges
Inlet pipes cracked	B	Require repair or replacement
Internal rattle (except pellet-type)	2	Further Inspection required
<p><b>NOTE:</b> If the converter is breaking up, suggest converter replacement. If an object has fallen into the converter, remove object</p>		
Mounting brackets that are part of converter broken	A	Require repair or replacement
Obvious overheating	Require testing of converter	

Condition	Code	Procedure
<b>NOTE:</b> <b>Overheating is caused by something other than the converter. Further diagnosis is required to determine the cause of the overheating.</b>		
Outlet pipes cracked	B	Require repair or replacement
Pieces of catalyst material found downstream	1	Suggest replacement
Plugged	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct to ensure that new converter will not become plugged.</b>		
Testing has determined that existing converter has been lead-poisoned, contaminated or failed testing	A	Require repair or replacement

### EXHAUST AND TAIL PIPES

Condition	Code	Procedure
Broken bracket	A	Require repair or replacement
Pipe Bent Out Of Position	B	Require repair or replacement
Pipe Broken	A	Require repair or replacement
Pipe Cracked	B	Require repair or replacement
Pipe Leaking	A	Require replacement
Pipe Missing	C	Require replacement
Pipe Plugged	A	Require replacement
Pipe Weak Due To Corrosion, But No Leaks Present	1	Suggest replacement
Weld Broken	A	Require repair or replacement

### EXHAUST CONNECTIONS

Condition	Code	Procedure
Attaching hardware Incorrect	B	Require replacement of hardware
Clamp broken	A	Require replacement
Clamp Loose	A	Require repair or replacement
Clamp missing	C	Require replacement
Corroded, affecting structural integrity	1	Suggest replacement
Incorrect type (i.e. Flange, Ball & Socket, etc.)	B	Require replacement
Leaking	A	Require repair
Loose	A	Require repair

### HANGERS

Condition	Code	Procedure
Broken	A	Require replacement
Corroded, affecting structural integrity	1	Suggest replacement
Incorrect type	B	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Out of position	B	Require repair or replacement



Condition	Code	Procedure
Rubber deteriorated	1	Suggest replacement

### HEAT RISERS (MECHANICAL EFE DEVICES)

Condition	Code	Procedure
Broken	A	Require replacement of affected parts
Diaphragm Inoperative	A	Require replacement
<b>NOTE:</b> If the inoperative diaphragm is separate from the heat riser, then require replacement of the inoperative diaphragm. If the inoperative diaphragm is part of the heat riser, then replace the heateriser		
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement of affected parts
Seized	A	Require repair or replacement of affected parts
Spring broken	B	Require replacement of spring(s)
Spring Inoperative	A	Require replacement of spring(s)

### HEAT SHIELDS

Condition	Code	Procedure
Bent, affecting performance	B	Require repair or replacement
Broken	A	Require replacement
Corroded affecting structural integrity	1	Suggest replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement

### MANIFOLDS (CAST AND TUBE TYPE)

Condition	Code	Procedure
Air injection tube in manifold broken	A	Require repair or replacement of injection tube or replacement of manifold
Air injection tube in manifold corroded, affecting structural integrity	1	Suggest replacement of Injection tube or manifold
Air injection tube in manifold leaking	A	Require repair or replacement of injection tube or replacement of manifold
Air injection tube in manifold loose	A	Require repair
Air injection tube in manifold restricted	A	Require replacement of injection tube or manifold
Air injection tube in manifold threads damaged	A	Require repair of injection tube or manifold
Air injection tube in manifold threads stripped (threads missing)	A	Require replacement of injection tube or manifold
Bolt Broken	A	Require replacement of bolt(s)

Condition	Code	Procedure
Bolt Loose	A	Require tightening or replacement of bolt(s)
Bolt Missing	C	Require replacement of bolt(s)
Corroded, affecting sealability	A	Require repair or replacement
Cylinder head threads stripped	A	Require repair or replacement of cylinder head
Gasket leaking	A	Require tightening or replacement of gasket
Heat Stove Bent	B	Require Repair Or Replacement of Stove
<b>NOTE:</b> Stove may not be available separately. This may require replacement of manifold.		
Heat Stove Broken	A	Require replacement of stove
<b>NOTE:</b> Stove may not be available separately. This may require replacement of manifold.		
Heat Stove Corroded, Affecting Structural Integrity	1	Suggest replacement of stove
<b>NOTE:</b> Stove may not be available separately. This may require replacement of manifold.		
Heat Stove Missing	C	Require replacement of stove
<b>NOTE:</b> Stove may not be available separately. This may require replacement of manifold.		
Manifold Broken	A	Require repair or replacement
Manifold Cracked	B	Require repair or replacement
Manifold Warped	A	Require repair or replacement
Out of specification	B	Require repair or replacement
Stud broken	A	Require replacement of stud
Stud missing	C	Require replacement of stud
Stud threads damaged	A	Require Repair Or Replacement of Stud
Stud threads stripped (threads missing)	A	Require replacement of stud

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Spring broken	B	Require replacement of spring(s)
Spring Inoperative	A	Require replacement of spring(s)

### MUFFLER VALVE

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
<b>NOTE:</b> It may be necessary to replace the muffler assembly to correct this condition.		

### MUFFLERS AND RESONATORS

Condition	Code	Procedure
Body shell distorted, affecting performance or structural integrity	A	Require replacement
Corrosion Hole	A	Require replacement
Missing	C	Require replacement
Mounting bracket broken	A	Require repair or replacement
Mounting bracket cracked	B	Require repair or replacement
Nipple Cracked	A	Require repair or replacement
Nipple Loose	B	Require replacement
Outer wrap peeling (Exhaust Not Leaking)	1	Suggest replacement
Plugged	A	Require replacement
Puncture (other than drain hole)	A	Require replacement
Rattling or knocking noise from inside muffler	B	Require replacement
Seam open (exhaust leaking)	A	Require replacement
Sound quality unsatisfactory	2	Suggest replacement to address customer need and/or request
Split (exhaust leaking)	A	Require replacement
<b>NOTE:</b> Further diagnosis required to determine cause of the split seam (i.e. Backfiring).		
Weak due to corrosion, but no leaks present	1	Suggest replacement

### REASON CODE EXPLANATION

Code	Reason
<b>Required</b>	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification ( Regardless Of Performance)
C	Part Is Missing
<b>Suggested/Optional</b>	
1	Part Is Close To The End Of Its Useful Life
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<b>Code</b>	<b>Reason</b>
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

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## UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

### Heating, Ventilation And Air Conditioning Systems

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Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.



This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p>A. Part no longer performs intended purpose</p> <p>B. Part does not meet a design specification (regardless of performance)</p> <p>C. Part is missing</p>	<p>1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.)</p> <p>2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)</p> <p>3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)</p> <p>4. Technician's recommendation based on substantial and informed experience</p> <p>5. To comply with maintenance recommended by AMRA / MAP</p>

**NOTE:**

When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.

**NOTE:**

Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.

## HEATING, VENTILATION & AIR CONDITIONING SYSTEM CHECKSHEET

Click to show one page at a time



### HEATING, VENTILATION & AIR CONDITIONING SYSTEM CHECKSHEET

Date: \_\_\_\_\_  
 Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
 Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_  
 Mileage: \_\_\_\_\_ License: \_\_\_\_\_ VIN: \_\_\_\_\_ Eng Code: \_\_\_\_\_

#### Customer Interview:

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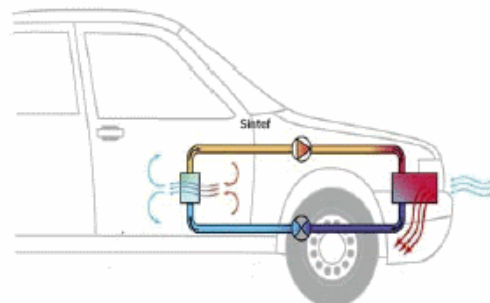
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#### Reason Code Explanation

- | <u>Code</u>               | <u>Reason</u>   |
|---------------------------|---|
| <u>Reasons</u>            |   |
| A                         | Part No Longer Performs Intended Purpose  |
| B                         | Part Does Not Meet A Design Specification ( Regardless Of Performance)                  |
| C                         | Part Is Missing   |
| <u>Suggested/Optional</u> |   |
| 1                         | Part Is Close To The End Of Its Useful Life   |
| 2                         | To Address A Customer Need, Convenience Or Request                                      |
| 3                         | To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer |
| 4                         | Technician's Recommendation Based On Substantial And Informed Experience                |
| 5                         | To Comply With Maintenance Recommended By AMRA/MAP                                      |



Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: [www.motorist.org](http://www.motorist.org)

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

**Fig. 1: Heating, Ventilation & Air Conditioning System Checksheet (1 Of 2)**

## HEATING, VENTILATION & AIR CONDITIONING SYSTEM CHECKSHEET

Underhood				
	OK	S	R	Condition
Drive Belts				
Clutch				
Seals / Connections				
Electrical Connections				
Compressor				
Compressor High Side Pressure				Spec _____ Actual _____
Compressor Low Side Pressure				Spec _____ Actual _____
Expansion Device				
In-line Filters				
Pulleys / Tensioners				
Service Ports				
Refrigerant Type				Spec _____ Actual _____
Refrigerant Oil Type				
Condenser				
Accumulator				
Receiver / Drier				
High Pressure Hoses				
Low Pressure Hoses				
Metal Lines				

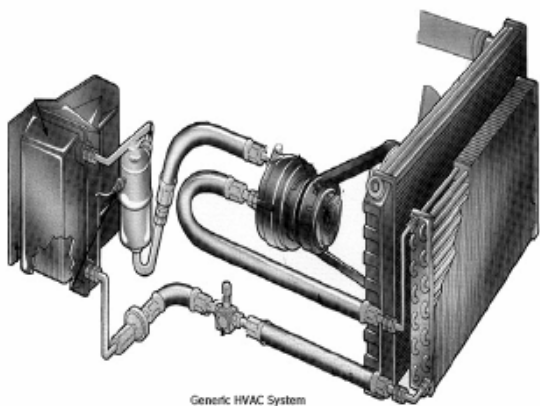
  

Cooling System				
	OK	S	R	Condition
Belts				
Coolant Protection				Spec _____ Actual _____
pH / Concentration / Reserve Alkalinity				
Radiator Cap				Spec _____ Actual _____
Radiator				
Coolant Reservoir				
Upper Radiator Hose				
Lower Radiator Hose				
Heater Hoses				
Heater Core				
Cooling Fan/ Fan Clutch				

Interior Components				
	OK	S	R	Condition
Vents / Ducts				
Controls				
Blower Motor				
Center Outlet Temp				Spec _____ Actual _____
Evaporator				
Evaporator Drain Hose				
Actuators				
Fuses / Circuit Breakers				
Cabin Air Filter				



Generic HVAC System

OK

Suggested  
1, 2, 3, 4, 5

Required  
A, B, C

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**Fig. 2: Heating, Ventilation & Air Conditioning System Checksheet (2 Of 2)**

## HEATING, VENTILATION & AIR CONDITIONING SYSTEMS

**NOTE:**      **AIR CONDITIONING SYSTEM FLUSHING** utilizes chemicals or refrigerant to remove oil, debris and contaminants from the evaporator, condenser, hoses or metal lines.

**NOTE:**      An **INLINE FILTER**, both high and low side, protects a/c components from residual debris in the system. An inline filter or suction screen is suggested when a condenser, evaporator, compressor, expansion valve, accumulator/drier, hoses or metal lines is replaced, or if debris is found in the system during an a/c repair. An inline filter is suggested to help prevent future component damage and increase system longevity.

### ACCUMULATORS

Condition	Code	Procedure
<b>NOTE:</b> When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Beyond vehicle manufacturer's service interval	3	Suggest replacement
Desiccant at the end of its useful life (saturated with moisture)	1	Suggest repair or replacement
Desiccant bag deteriorated	A	Require replacement. Further inspection required
<b>NOTE:</b> Inspect system to determine effects of desiccant bag deterioration.		
Leaking	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Tubing connection leaking	A	Require repair or replacement

### ACTUATORS (ELECTRICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### ACTUATORS (VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement

### AIR CONDITIONING FITTINGS

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	A	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## AIR CONDITIONING HOSES

**NOTE:** When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	A	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement



Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## AIR CONDITIONING METAL LINES

**NOTE:** When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	A	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## AIR CONTROL DOORS

Condition	Code	Procedure

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

### **AIR DAMS (EXTERNAL)**

Condition	Code	Procedure
Application incorrect, affecting air conditioning system performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting air conditioning system performance	A	Require repair or replacement
Blocked, affecting air conditioning system performance	A	Require repair or replacement
Broken, affecting air conditioning system performance	A	Require repair or replacement
Cracked, affecting air conditioning system performance	A	Require repair or replacement
Loose, affecting air conditioning system performance	A	Require repair
Loose, not affecting air conditioning system performance	2	Suggest repair
Missing, affecting air conditioning system performance	C	Require replacement

### **AIR DISTRIBUTION SYSTEM**

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

## BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> <b>Determine cause of incorrect alignment and require repair.</b>		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>Determine cause of noise and suggest repair.</b>		
Plies separated	A	Require replacement
Serpentine belt routed incorrectly	B	Require repair
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

## BLEND DOORS

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement

Condition	Code	Procedure
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

### BLOWER FANS (BLOWER WHEEL OR SQUIRREL CAGE)

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Cracked	B	Require replacement
Distorted	A	Require replacement
Fins missing	C	Require replacement
Hub separated	A	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Mounting loose	A	Require repair or replacement
Noisy	2	Suggest replacement
Out of balance	A	Require repair or replacement

### BLOWER MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Current draw out of specification	B	Require repair or replacement
Inoperative	A	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> Check fan motor/controls. Inoperative includes intermittent operation.		
Missing	C	Require replacement
Motor speed insufficient	2	Suggest repair or replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## BLOWER RESISTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware,
Attaching hardware not functioning	A	Require repair or replacement of hardware
Conductor exposed	A	Require replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	1	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Insulation overheated	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## BLOWER SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Missing	C	Require replacement
<b>NOTE:</b> <b>Missing includes high pressure cut-off switches not installed during a retrofit from R12 to 134a.</b>		
Out of adjustment	B	Require repair or replacement
Pressure switch leaking	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement



Condition	Code	Procedure
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

### CABIN AIR FILTERS

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement
At or beyond service interval	3	Suggest replacement
Microbial growth causing odor	A	Require replacement of filter
Missing	C	Require replacement

### CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Insulation damaged, conductors exposed	A	Suggest repair or replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### COMPRESSOR CLUTCH ASSEMBLIES

Condition	Code	Procedure
Air gap incorrect	B	Require repair or replacement

Condition	Code	Procedure
Bearing seized	A	Require replacement of bearing or assembly
Bearing worn, affecting performance	A	Require replacement of bearing or assembly
Coil shows signs of overheating	1	Suggest replacement of coil
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector missing	C	Require replacement
Hub broken	A	Require replacement
Hub cracked	B	Require replacement
Hub loose on shaft	A	Require replacement
Hub scored, affecting performance	A	Require replacement
Hub warped, affecting performance	A	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Noisy	2	Suggest repair or replacement
Slips	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Will not disengage	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## COMPRESSORS

**NOTE:** When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Housing broken, affecting performance	A	Require repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
<b>NOTE:</b> <b>Compressor noise can also be caused by low oil level, state of charge, air contamination, or type of refrigerant.</b>		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Tubing connection leaking	A	Require repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### CONDENSER AIR SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement

### CONDENSER FAN MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Hydraulic fan motor leaking	A	Require repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Check fan motor/controls. Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement

Condition	Code	Procedure
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## CONDENSERS

**NOTE:** When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Air flow obstruction, affecting performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Â	No service suggested or required
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Leaking	A	Require repair or replacement
Restricted internally	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Circuit open	A	Require repair or replacement
Circuit resistance (voltage drop) out of specification	A	Require repair or replacement

Condition	Code	Procedure
Circuit shorted	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Diode open	A	Require repair or replacement
Diode shorted	A	Require repair or replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Protective shield (conduit) melted	2	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## CONTROL CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket Corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement



Condition	Code	Procedure
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require repair or replacement
Cracked	2	Suggest repair or replacement
Disconnected	A	Require repair or replacement
Kinked	2	Suggest repair or replacement
Melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Out of adjustment	B	Require repair or replacement
<b>NOTE:</b> <b>Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.</b>		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

### CONTROL HEADS (FUNCTION SELECTORS)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	2	Suggest require replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
Melted, not affecting performance	Â	No service suggested or required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement

## CONTROL LINKAGES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
<b>NOTE:</b> <b>Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.</b>		
Seized	A	Require repair or replacement

## CONTROL MODULES

**NOTE:** Includes, but not limited to: IRCM, Coolant Fan Control Module (CFCM), AC Controller, Amplifier, Programmers, Control Heads, Power Modules, etc.

Condition	Code	Procedure
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Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
<b>NOTE:</b> Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).		
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement. Check for accepted cleaning procedure.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## COOLANT

Condition	Code	Procedure
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Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement
At or beyond service interval	3	Suggest replacement
Contaminated	B	Require replacement or recycling. Further inspection required
<b>NOTE:</b> <b>Determine source of contamination and require correction prior to coolant replacement.</b>		
Fluid discolored	Â	No service suggested or required
<b>NOTE:</b> <b>Further testing necessary to determine condition of fluid.</b>		
Level incorrect	B	Require filling to proper level
<b>NOTE:</b> <b>Determine source of incorrect level and suggest repair.</b>		
Mixture incorrect	B	Require correction or replacement
Type incorrect	B	Require replacement

### COOLING FAN BLADES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require replacement
Broken	A	Require replacement
Cracked	B	Require replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement

### COOLING FAN CLUTCHES

**NOTE:** Some lateral movement, measured at the fan blade tip, may be normal.

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing noisy	A	Require replacement
Bearing worn	A	Require replacement
Fastener loose	A	Require repair or replacement of fastener
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	B	Suggest replacement

Condition	Code	Procedure
Seized	A	Require replacement
Slips (insufficient fan speed)	A	Require replacement
Thermal control incorrect	B	Require repair or replacement

## COOLING FAN MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Hydraulic fan motor leaking	A	Require repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Check fan motor/controls. Inoperative includes intermittent operation.</b>		
Missing	C	Require replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## EVAPORATOR DRAIN TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Leaking	A	Require replacement
Missing	C	Require replacement

Condition	Code	Procedure
Restricted	A	Require repair or replacement
Routed incorrectly	B	Require repair

## EVAPORATOR FILTERS

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement
At or beyond service interval	3	Suggest replacement
Microbial growth causing odor	A	Require replacement of filter
Missing	C	Require replacement

## EVAPORATOR PRESSURE REGULATORS (EPRS)

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		

## EVAPORATORS

**NOTE:** When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Air flow obstruction, affecting performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Evaporator foam seal leaking	A	Require replacement
Evaporator foam seal missing	C	Require replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Leaking	B	Require repair or replacement



Condition	Code	Procedure
Microbial growth causing odor	2	Suggest microbial odor removal
<b>NOTE:</b> If the evaporator case is contaminated with debris, it may be necessary to remove the debris before applying microbial odor treatment.		
Restricted internally	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## EXPANSION VALVES

**NOTE:** Expansion valves indicated for use on R134a systems are acceptable for R12 systems.

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded internally	1	Suggest replacement
Filter screen torn	A	Require replacement of screen
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Expansion valve operation may be affected by capillary tube location, corrosion, and insulation tape. Inoperative includes intermittent operation.		
Leaking	B	Require replacement
Restricted	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## FUNCTION SELECTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Contaminated	2	Suggest require replacement
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	Â	No service suggested or required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Insulation damaged, conductors exposed	A	Suggest repair or replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## FUSIBLE LINKS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Insulation damaged, conductors exposed	A	Suggest repair or replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> <b>Require inspection of mating and sealing surface and repair or replace as necessary.</b>		

## HEATER CASES

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Microbial growth causing odor	2	Suggest microbial odor removal
<p><b>NOTE:</b>  <b>If the heater case is contaminated with debris, it may be necessary to remove the debris before applying microbial odor treatment.</b></p>		
Noisy	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

### HEATER CONTROL VALVES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	2	Suggest repair or replacement
Coolant leak	A	Require repair or replacement
Disconnected	A	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<p><b>NOTE:</b>  <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b></p>		
Missing	C	Require replacement
Restricted	A	Require repair or replacement
Seized	A	Require repair or replacement
Vacuum leak	A	Require repair or replacement

### HEATER CORES

Condition	Code	Procedure
Air flow obstruction	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Disconnected	A	Require repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	À	No service suggested or required

Condition	Code	Procedure
Internal restrictions, affecting performance	A	Require repair or replacement
Leaking	B	Require repair or replacement
Missing	C	Require replacement

## HEATER HOSES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require repair or replacement
Hard (brittle)	1	Suggest repair or replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest repair
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracks (dry-rotted)	1	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## HIGH PRESSURE RELIEF VALVES (HPRV)

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## IDLERS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Bracket cracked	A	Require repair or replacement
Housing cracked	A	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

## **IN-LINE FILTERS**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Connection leaking	A	Require repair or replacement
Leaking	B	Require repair or replacement
Restricted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## **METAL FITTINGS**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	B	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	B	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement



**METAL LINES**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	B	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

**MIX AND AIR CONTROL DOORS (BLEND DOORS)**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair

Condition	Code	Procedure
Restricted	A	Require cleaning, repair, or replacement

## ORIFACE TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Bypassing internally	A	Require repair or replacement
Filter screen torn	A	Require replacement
Installation incorrect	B	Require repair
Restricted	A	Require repair or replacement

## O-RINGS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

## PILOT-OPERATED ABSOLUTES (POAS)

Condition	Code	Procedure
Connection damaged	B	Require repair or replacement
Fitting damaged	B	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Threads stripped (threads missing)	A	Require replacement

## PLENUMS

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

### PRESSURE CONTROL VALVES

Condition	Code	Procedure
Connection damaged	B	Require repair or replacement
Fitting damaged	B	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### PRESSURE SENSORS

**NOTE:** Includes, but not limited to, In-Car Temperature, Ambient Air Temperature, Sun Load Sensor, etc.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Calibration incorrect	B	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## PULLEYS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing noisy	2	Suggest replacement
Bearing seized	A	Require repair or replacement
Bearing worn	1	Suggest replacement
Cracked	B	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Pulley damaged, affecting belt life	A	Require replacement

## RADIATORS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Drain inoperative	A	Require repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required
Internal oil cooler leaking	A	Require repair or replacement
Internal restrictions	B	Require repair or replacement
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Â	No service suggested or required

## RECEIVER-DRIERS

**NOTE:** For VIRs, see Valves in Receiver (VIRs). When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component

Condition	Code	Procedure
damage (see Code 5).	Â	Â
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Contaminated, affecting performance	A	Require replacement
Desiccant at the end of its useful life (saturated with moisture)	1	Suggest repair or replacement
Desiccant bag deteriorated	A	Require replacement. Further inspection required
<b>NOTE:</b> <b>Inspect system to determine effects of desiccant bag deterioration.</b>		
Fusible plug leaking	A	Require replacement of plug
Leaking	B	Require replacement
Pressure relief device leaking	A	Require replacement of pressure relief device
Restricted	A	Require repair or replacement
Sight glass no longer transparent	2	Suggest replacement of drier
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Tubing connection leaking	A	Require repair or replacement

## REFRIGERANT OIL

Condition	Code	Procedure
Contaminated	A	Require repair or replacement
Overfilled	B	Require repair
Underfilled	B	Require repair

## REFRIGERANT

**NOTE:** Refrigerants include any SNAP (Significant New Alternative Policy)-approved blends.

Condition	Code	Procedure
Contaminated (other than refrigerant blends)	B	Require service to remove contamination
Different types of refrigerants in the same system (other than refrigerant blends)	B	Require repair
Overcharged	B	Require repair
Refrigerant type does not match fittings and label	B	Require repair
Undercharged	B	Require repair

## RELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement

Condition	Code	Procedure
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

## SERVICE PORTS

Condition	Code	Procedure
Application does not match refrigerant type	B	Require replacement
Leaking	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Valve cap leaking	A	Require repair or replacement of cap
Valve cap missing	C	Require replacement of valve cap
Valve core sticking	B	Require repair or replacement

## SPRING LOCK COUPLINGS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		



## SUCTION THROTTLING VALVES (STVS)

Condition	Code	Procedure
Connection damaged	B	Require repair or replacement
Fitting damaged	B	Require repair or replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## SWITCHES (ELECTRICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, or failure to perform all functions.		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Missing	C	Require replacement
<b>NOTE:</b> Missing includes high pressure cut-off switches not installed during a retrofit from R12 to 134a.		
Out of adjustment	B	Require repair or replacement
Pressure switch leaking	A	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## TENSIONERS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Bracket cracked	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

## THERMISTORS AND PRESSURE SENSORS

**NOTE:** Includes, but not limited to, In-Car Temperature, Ambient Air Temperature, Sun Load Sensor, etc.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Calibration incorrect	B	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## THERMOSTATS AND HOUSINGS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	B	Require replacement
Housing corroded	1	Suggest replacement of housing
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Installation incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Thermostat missing	C	Require replacement of thermostat
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

## VACUUM HOSES AND TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Leaking	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	A	Require repair or replacement

Condition	Code	Procedure
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Routing incorrect	B	Require repair
Surface cracks (dry-rotted)	1	Suggest replacement

### VACUUM RESERVOIRS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Check valve leaking internally	A	Require replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Restricted	A	Require repair or replacement

### VACUUM TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Melted	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Routing incorrect	B	Require repair
Surface cracks (dry-rotted)	1	Suggest replacement

### VALVES IN RECEIVER (VIRS)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Connection damaged	B	Require repair or replacement
Contaminated, affecting performance	A	Require replacement

Condition	Code	Procedure
Corroded internally	1	Suggest replacement
Desiccant at the end of its useful life (saturated with moisture)	1	Suggest repair or replacement
Desiccant bag deteriorated	A	Require replacement. Further inspection required
<b>NOTE:</b> <b>Inspect system to determine effects of desiccant bag deterioration.</b>		
Filter screen torn	A	Require replacement of screen
Fitting damaged	B	Require repair or replacement
Fusible plug leaking	A	Require replacement of plug
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	B	Require repair or replacement
Pressure relief device leaking	A	Require replacement of pressure relief device
Restricted	A	Require repair or replacement
Sight glass no longer transparent	2	Suggest replacement of drier
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Tubing connection leaking	A	Require repair or replacement

### **WATER PUMPS (ELECTRIC AUXILIARY)**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## WIRING HARNESES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Circuit open	A	Require repair or replacement
Circuit resistance (voltage drop) out of specification	A	Require repair or replacement
Circuit shorted	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Diode open	A	Require repair or replacement
Diode shorted	A	Require repair or replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Protective shield (conduit) melted	2	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## REASON CODE EXPLANATION

Code	Reason
<b>Required</b>	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification ( Regardless Of Performance)
C	Part Is Missing
<b>Suggested/Optional</b>	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

## AUTOMOTIVE TERMINOLOGY & DEFINITIONS

### ACCUMULATOR

a servo action device in an automatic transmission that cushions the motion of a clutch; in an air conditioning system, a device that combines the suction throttling valve and POA valves as well as the receiver/dryer; a component used to store or hold liquid refrigerant in an air conditioning system that also contains a desiccant; in a non-integral ABS system, a chamber that temporarily stores fluid during the pressure decrease phase of ABS operation; in an integral ABS system, a sealed vessel containing a thick flexible diaphragm that separates brake fluid from high-pressure nitrogen gas.

### ACTUATOR

a control device that delivers mechanical action in response to a vacuum or electrical signal; anything that the engine control computer uses to do something, such as trigger fuel injection or fire a spark plug. Most actuators on a computercontrolled engine system are activated by grounding their circuits rather than by actively powering them, since that protects the computer from short circuits.

### AERATION

to expose to the air or mix with air, as with a liquid; to charge a liquid with gas.

### AIR CONDITIONING (A/C)

a system that cools and dehumidifies the air entering the passenger compartment of a vehicle.

### AIR DUCT

a tube, channel or other tubular structure used to carry air to a specific location.

## **AMBIENT TEMPERATURE SWITCH**

a switch that prevents air conditioner operation below a certain ambient temperature.

## **AMBIENT TEMPERATURE**

the temperature of the air surrounding an object.

## **ATMOSPHERIC PRESSURE**

the pressure exerted on an object by the weight of the earth's atmosphere. At sea level, 14.7 psi, less at higher altitudes.

## **ATOMIZATION**

the breaking down of a fluid into a fine mist that can be suspended in air.

## **AUTOMATIC TEMPERATURE CONTROL SYSTEM**

a climate control system that uses the heating and air conditioning systems to maintain the interior temperature selected by the vehicle's passengers.

## **AUXILIARY CLIMATE CONTROL DEVICES**

specialized add-on heating units, or combination heating/cooling units, that operate with the truck engine turned off. They eliminate the need to leave engines idling solely to heat or cool the cab and sleeper compartment.

## **BIMETALLIC**

two kinds of metal, with different thermal expansion rates, that when attached to one another, the resulting assembly will bend in the direction of the metal that expands the least.

## **BLEND DOOR**

a door in the heating and air conditioning system that controls the temperature of the air going into the passenger compartment.

## **BLOWER MOTOR.**

the electric motor which drives the fan that circulates air inside the vehicle passenger compartment.

## **BOILING POINT**

the temperature at which a liquid turns to vapor.

## **CAPILLARY TUBE**

a thin, gas-filled tube that senses the temperature of the evaporator and relays this information to the thermostat and/or expansion valve.

## **CARBON DIOXIDE (CO<sub>2</sub>)**

a colorless, odorless, noncombustible gas, heavier than air; can be compressed into a super-cold solid known as dry ice; changes from solid to vapor at  $-78.5^{\circ}\text{C}$ .

## **CELSIUS**

the basis of the metric system of temperature measurement in which water's boiling point is  $100^{\circ}\text{C}$  and its freezing point is  $0^{\circ}\text{C}$ .

## **CHARGE**

the electrical current that passes through the battery to restore it to full power; to fill, or bring up to the specific level, an A/C system with refrigerant; the required amount of refrigerant for an A/C system.

## **CHECK VALVE**

a gate or valve that allows passage of a gas or liquid in one direction only.

## **CHLOROFLUOROCARBON (CFC)**

any organic chemical compounds made up of carbon, chlorine and fluorine atoms, usually used in refrigeration. R12 is a CFC.

## **CLUTCH CYCLING SWITCH**

a device that opens and closes the circuit that engages the air conditioning compressor clutch based on pressure or temperature.

## **COMPRESSOR**

an engine driven device that compresses refrigerant gas and pumps it through the air conditioning system.

## **CONDENSATION**

the process of a vapor becoming a liquid; the opposite of evaporation.

## **CONDENSE**

to cool a vapor to below its boiling point, where it then condenses into a liquid.

## **CONDENSER**

a device, similar to a radiator, in which the refrigerant loses heat and changes state from a high-pressure gas to a high pressure liquid as it dissipates heat to the surrounding air.

## **CORE PLUGS.**

plugs that fill holes in a block or head left from the casting process. Also called freeze, welsh or expansion plugs.

## **CYCLING CLUTCH SYSTEM**

an A/C system that controls temperature by switching the compressor clutch on and off.

## **DEGREE**

used to designate temperature readings or 1 degree as a 1/360 part of a circle.

## **DEHUMIDIFY**

to remove moisture (humidity) from the air.

## **DESICCANT**

any hygroscopic material that removes and traps moisture, usually found in a bag in the accumulator or receiver/drier in air conditioning systems.

## **DIAPHRAGM**

flexible, impermeable membrane on which pressure acts to produce mechanical movement; in automotive terminology, any disc-shaped device; can be as diverse as thin membranes that separate two chambers in a component, and large metal discs that activate clutch pressure plates.

## **DOWNFLOW RADIATOR**

a radiator in which coolant enters the top of the radiator and is drawn downward by gravity (see crossflow radiator).

## **DUAL-ZONE CLIMATE CONTROL**

allows individualized control of heating and air conditioning. Most systems are adjustable for the driver and front passenger; others feature a third adjustment for rear passengers.

## **EVACUATE**

the process of applying vacuum to a closed refrigeration system to remove air and moisture.

## **EVAPORATION**

the process through which a liquid is turned into vapor.

## **EVAPORATOR**

a heat exchanger, in which low-pressure refrigerant flows and changes state, absorbing heat from the surrounding air.

## **EXPANSION TUBE**

used in some air conditioning systems, a component with a fixed opening through which refrigerant passes as it is metered into the evaporator core. Also called an orifice tube.

## **EXPANSION VALVE**

used on some air conditioning systems, a temperature sensitive device that meters the flow of refrigerant into the evaporator core. Also called a thermostatic expansion valve (TXV).

## **FAHRENHEIT**

a scale of temperature measurement with the boiling point of water at 212°F. In the metric system, water's boiling point is 100°C.

## **FAIL-SAFE COOLING SYSTEM**

a fail-safe cooling system allows a vehicle to be driven under limited power in the event that engine coolant is lost. In case of a ruptured hose, the engine operates in an emergency mode with limited power for driving a short distance (10-50 miles depending on the system). This eliminates the cost and inconvenience of having the vehicle towed to a service station and does not leave the customer stranded.

## **FAN CLUTCH**

a device attached to a mechanically driven cooling fan that allows the fan to freewheel when the engine is cold or the vehicle is driven at speed.

## **FAN SHROUD**

an enclosure that routes air through the radiator cooling fins.

## **FAN**

a mechanically or electrically driven propeller that draws or pushes air through the radiator, condenser, heater core or evaporator core.

## **FIXED ORIFICE TUBE**

a method of controlling refrigerant flow in an air conditioning system whereby the rate of flow is determined by the pressure difference across an orifice.

## **FREON**

DuPont registered trade name for R-12 (dichlorodifluoromethane).

## **GREENHOUSE GASES**

gases, such as carbon dioxide, Nox, methane, and water vapor, that help capture heat from the sun in the lower atmosphere of the earth. As the amount of greenhouse gases in the atmosphere increases, more heat is captured, which can lead to global warming (the greenhouse effect).

## **HEAD PRESSURE**

the pressure of the refrigerant at the compressor outlet.

## **HEAT EXCHANGER**

device (e.g., a radiator) that is designed to transfer heat from the hot coolant that flows through it to the air blown through it by the fan.

## **HEATER CORE**

a radiator-like device used to heat the inside of a vehicle. Hot coolant is pumped through it by the water pump, and heat from the coolant moves from the heater core to the passenger compartment as the blower fan forces air through it.

## **HIGH SIDE**

the high-pressure half of an A/C system, usually refers to all components between the compressor outlet and the expansion valve or expansion tube. In this part of the A/C system, the refrigerant is in a liquid form.

## **HUMIDITY**

moisture in air, usually referred to as relative humidity since the amount of moisture air can hold increases as temperature increases.

## **HVAC**

acronym for Heating, Ventilation and Air Conditioning.

## **LATENT HEAT OF CONDENSATION**

the amount of heat given off as a vapor changes state from a gas to a liquid without the temperature changing.

## **LATENT HEAT OF EVAPORATION**

the amount of heat needed for a liquid to change state to a vapor without the temperature changing.

## **LEAK DETECTOR**

a tool used to locate refrigerant leaks.

## **LOW SIDE**

the suction side of an A/C system between the evaporator core inlet (after the expansion valve or expansion tube) and the compressor. In this part of the A/C system, the refrigerant is in a gas form.

## **MANIFOLD GAUGE SET**

the set of gauges that attaches to the high and low side of the A/C system and used for diagnosis.

## **ORIFICE TUBE**

used in some air conditioning systems, a component with a fixed opening through which refrigerant passes as it is metered into the evaporator core. Also called an expansion tube.

## **ORIFICE**

a precisely sized hole that controls the flow of fluid.

## **O-RING SEAL**

a sealing ring, usually made of rubber and installed in a groove; a type of valve seal that fits into a valve stem groove under the valve keepers.

## **PAG**

polyalkylene glycol oil (lubricant) used with A/C systems containing R- 134a refrigerant.

## **PHOSGENE GAS**

a poisonous gas produced when R- 12 refrigerant is burned.

## **POROSITY**

the condition of having pores through which fluids, gases or light can pass; tiny holes in casting caused by air bubbles.

## **POUNDS PER SQUARE INCH (PSI)**

a unit of measure for pressure.

## **PRESSURE**

the exertion of force upon a body, measured in pounds per square inch on a gauge.

## **PSI**

measurement of pressure in pounds per square inch.

## **R12**

the generic term for CFC refrigerant used in older A/C systems. Also called Freon.

## **R134A**

generic term for a modern refrigerant that does not contain CFCs and does not harm the ozone layer.

## **RECEIVER/DRIER**

an A/C system component into which high-pressure liquid refrigerant flows and is temporarily stored and dehydrated, usually located between the condenser outlet and expansion valve.

## **RECLAIM**

to send refrigerant to an off-site facility where it is restored to its original purity so that it may be reused.

## **RECOVER**

to remove refrigerant from a system and store it temporarily.

## **RECYCLE**

to remove contaminants such as moisture, particulates, etc, from refrigerant and re-introduce it into the A/C system.



## **REFRIGERANT CYCLE**

the complete loop or circuit that refrigerant passes through as it changes state from a vapor, to a liquid, then back to a vapor.

## **REFRIGERANT OIL**

either a mineral or synthetic oil designed specifically for A/C systems.

## **REFRIGERANT**

a chemical compound used in an A/C system to remove heat from the evaporator and transfer it to the condenser.

## **SCHRADER VALVE**

a spring operated valve used to open and close the service outlets in an A/C system. They are the service valves used to attach manifold gauges and to charge or evacuate the system.

## **SERVICE PORT**

any of the various designs of fittings that allow service tools such as manifold gauges to be attached to an A/C system. See also Schrader valve.

## **SUCTION LINE**

the low side tube and/or hose leading from the evaporator core outlet to the compressor inlet.

## **SUCTION**

exists in a vessel when the pressure is lower than the atmospheric pressure.

## **SUPERHEAT SWITCH**

a switch, usually mounted on the compressor on certain A/C systems that completes the circuit to the thermal limiter switch.

## **SUPERHEAT**

the addition of more heat to a gas after it has already vaporized; the heat added to vaporized refrigerant after it has changed state from a liquid to a gas controlled by the expansion valve.

## **TENSIONER**

a device used with a timing chain or belt to maintain its tension.

## **THERMOSTAT**

a device installed in the cooling system that allows the engine to come to operating temperature quickly and then maintain a minimum operating temperature.

## **THERMOSTATIC EXPANSION VALVE (TXV)**

used on some air conditioning systems, a temperature sensitive device that meters the flow of refrigerant into the evaporator core. Also called an expansion valve.

## **VACUUM**

a pressure lower than atmospheric.

## **VAPOR**

a substance in a gaseous state. Liquid becomes vapor when brought above the boiling point.

## **WATER PUMP**

a device used to circulate coolant through the engine.

## **WATER VALVE**

a device used to control the flow of hot coolant to the heater core, usually operated by cable or vacuum.

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## UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

### Routine Inspection Reference Guide

## ROUTINE INSPECTION REFERENCE GUIDE

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

### MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

#### I. Our recommendations are based upon the following definitions.

**System Failure** - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

**Preventive/Scheduled Maintenance** - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

**Improved System Performance** - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

**II. Training/Criteria** Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

#### III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

#### IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

#### V. Work Authorization

No work will be performed without the customer's prior approval.

#### VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

#### VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

## **VIII. Classification of Parts**

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

## **THE MAP PROCESS - OVERVIEW**

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site [www.motorist.org](http://www.motorist.org) or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 \* Fax: (202) 318-0378

## **THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS**

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p>A. Part no longer performs intended purpose</p> <p>B. Part does not meet a design specification (regardless of performance)</p> <p>C. Part is missing</p>	<p>1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.)</p> <p>2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)</p> <p>3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)</p> <p>4. Technician's recommendation based on substantial and informed experience</p> <p>5. To comply with maintenance recommended by AMRA / MAP</p>

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p><b>NOTE:</b> When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.</p>	<p><b>NOTE:</b> Suggested services are <i>always</i> optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.</p>

**MAINTENANCE OVERVIEW**

**ANTIFREEZE/COOLANT**

The main function of the Engine Cooling System is to carry heat away from the engine and maintain the desired operating temperature. This is accomplished by circulating antifreeze/coolant through the engine, where heat is generated, and carrying it to the radiator to be cooled.

Over the past decade internal combustion engines have become more fuel efficient; however, most of the energy in the gasoline (perhaps 70%) is converted into heat, and the cooling system keeps the engine from overheating by transferring this heat to the air. But the cooling system also has several other functions.

An automobile engine runs best at a fairly high temperature. When the engine is cold, components wear out faster, and the engine is less efficient and releases more pollutants into the atmosphere. The cooling system is designed to allow the engine to heat up as quickly as possible, and then to keep the engine at a constant temperature.

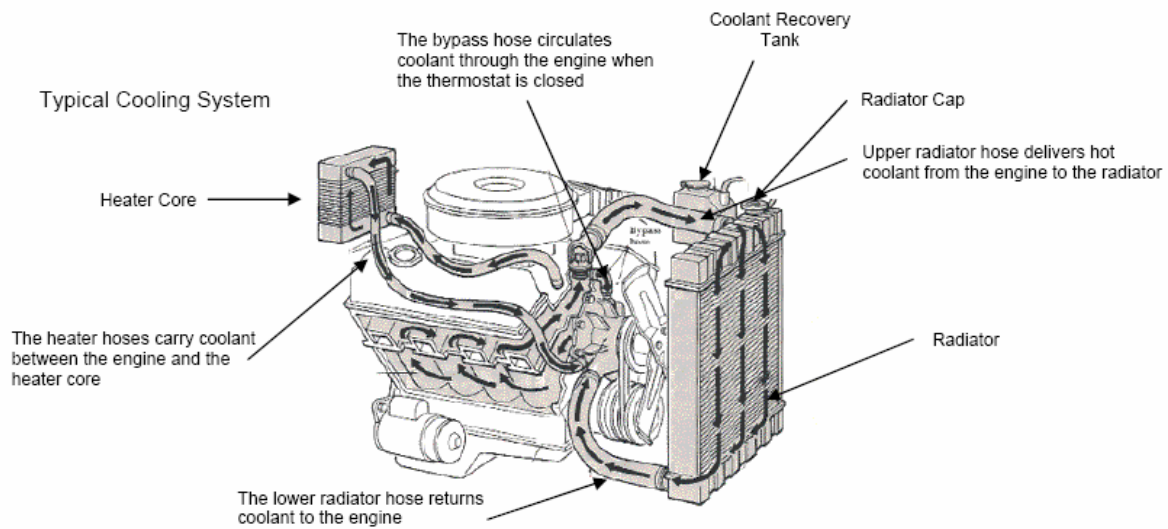
Modern automobiles operate in a wide variety of ambient temperatures, from well below freezing to well over 100 F. The fluid used to cool the engine must have a very low freezing point, a high boiling point, and it must have the ability to transfer a lot of heat.

An adequate amount of an antifreeze/coolant and water mixture is necessary to reduce the possibility of engine overheating and freezing, and to prevent rust and corrosion in the cooling system.

Water is one of the most effective fluids for holding heat, but water freezes at too high a temperature to be used in car engines. The fluid that most cars use is a mixture of water and ethylene glycol, also known as antifreeze. By adding ethylene glycol to water, the boiling and freezing points are improved significantly.

The temperature of the coolant can sometimes reach 250 to 275 F (121 to 135 C). Even with ethylene glycol added, these temperatures would boil the coolant. The cooling system is pressurized, which further raises the boiling point of the coolant. Most automobiles have around 14 to 15 pounds per square inch (psi), which raises the boiling point approximately 45 F so the coolant can endure the high temperatures produced in the engine.





**Fig. 1: Typical Cooling System**

Hoses showing obvious signs of wear such as cracks, cuts, stiffness, bulges, excessive softness or abrasions should be replaced.

The National Automotive Radiator Service Association (NARSA) recommends a seven (7)-point preventative cooling system maintenance check at least once every two years. The program is designed to identify any areas that need attention, and consists of:

- a visual inspection of all cooling system components, including belts and hoses
- a radiator cap test to check for the recommended system pressure level
- a thermostat check for proper opening and closing
- a pressure test to identify any external leaks to the cooling system parts; including the radiator, water pump, engine coolant passages, radiator and heater hoses and heater core
- an internal leak test to check for combustion gas leakage into the cooling system
- an engine fan test for proper operation h a system power flush and refill with car manufacturer's recommended concentration of coolant

### **VISUAL INSPECTION**

What you are looking for is the condition of the belts and hoses. The radiator hoses and heater hoses are easily inspected just by opening the hood and looking. You want to be sure that the hoses have no cracking or splitting and that there is no bulging or swelling at the ends. If there is any sign of problems, the hose should be replaced with the correct part number for the year, make and model of the vehicle. Never use a universal hose unless it is an emergency and a proper molded hose is not available.

Heater hoses are usually straight runs and are not molded, so a universal hose is fine to use and often is all that is available. Make sure that you use the proper inside diameter for the hose being replaced. For either the radiator hoses or the heater hoses, make sure that you route the replacement hose in the same way that the original hose was running. Position the hose away from any obstruction that can possibly damage it and always use new hose clamps. After you refill the cooling system with coolant, do a pressure test to make sure that there are no leaks.

### **RADIATOR CAP TEST**

A radiator cap is designed to maintain pressure in the cooling system at a certain maximum pressure. If the cooling system exceeds that pressure, a valve in the cap opens to bleed the excessive pressure into the reserve tank. Once the engine has cooled off, a negative pressure begins to develop in the cooling system. When this happens, a second valve in the cap allows the coolant to be siphoned back into the radiator from the coolant reservoir. If the cap should fail, the engine can easily overheat. A pressure test of the radiator cap is a quick way to tell if the cap is doing its job. It should be able to hold its rated pressure for two minutes.

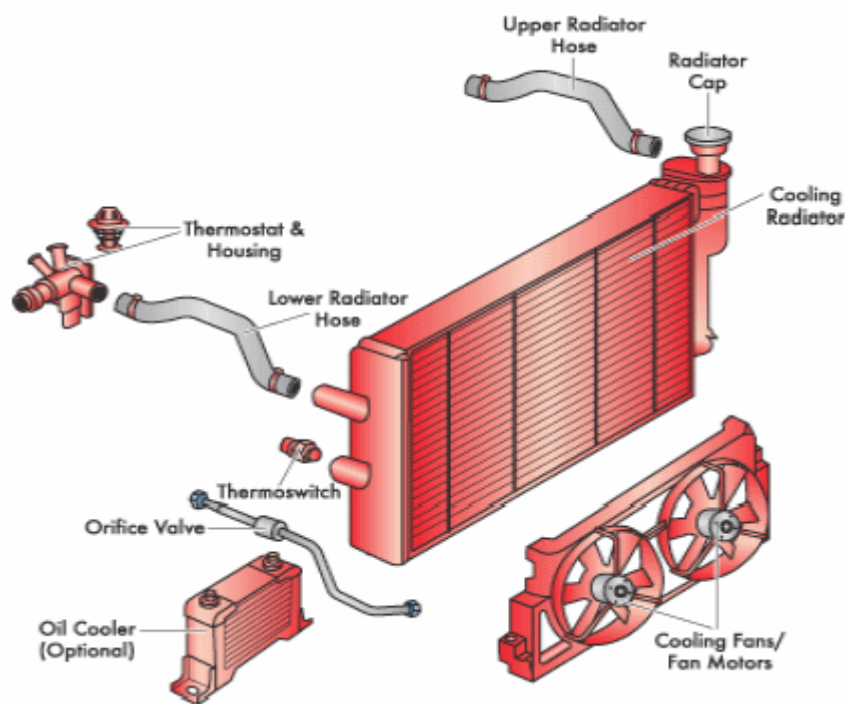
### **ENGINE FAN**

The radiator cooling fan is an important part of the cooling system operation. While a fan is not really needed while a vehicle is traveling down the highway, it is extremely important when driving slowly or stopped with the engine running. In the past, the fan was attached to the engine and was driven by the fan belt. The speed of the fan was directly proportional to the speed of the engine; a viscous fan drive was developed in order to disengage the fan when it was not needed.

With computer controls, the engine-driven fans gave way to electric fans mounted directly on the radiator. A temperature sensor determined when the engine was beginning to run too hot and turned on the fan to draw air through the radiator to cool the engine. On many cars, there were two fans mounted side by side to make sure that the radiator had a uniform air flow for the width of the unit.

When the car is in motion, the speed of the air entering the grill is usually sufficient to keep the coolant at the proper temperature and the fans shut off. When the vehicle is stopped, there is no air flow and the fan is turned on when the engine reaches a designated temperature.

When the A/C is turned on the fan circuit would power the fans regardless of engine temperature. The air conditioning system always requires a good air flow through the condenser mounted in front of the radiator. If the air flow stopped, the air-conditioned air coming through the dash outlets would immediately start warming up.



**Fig. 2: Typical Cooling Fan**

### **COOLING SYSTEM POWER FLUSH AND REFILL**

Old coolant can be replaced by draining it out and replacing it with fresh coolant; however, power flushing will remove all the old coolant and pull out any sediment and scale along with it. Power flushing requires special equipment and generally requires the thermostat to be removed, the lower radiator hose disconnected, and the flush machine connected in line. Water and, sometimes, a cleaning agent are pumped through the cooling system in a reverse path from the normal coolant flow. When completed, the hose is reconnected and a new thermostat is installed. The cooling system is refilled with the appropriate amount of antifreeze to bring the coolant to the proper mixture of antifreeze and water. For most vehicles and most climates, the mixture is 50 / 50. In colder climates, more antifreeze is used, but must never exceed 75 percent antifreeze. Follow the vehicle manufacturers' procedures and recommendations.

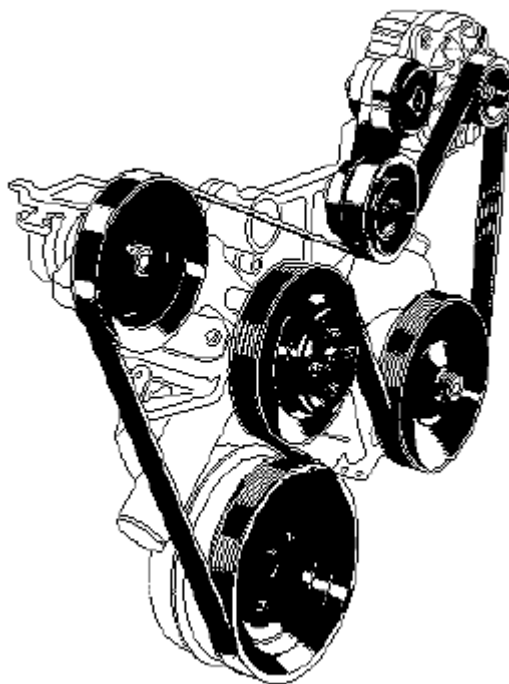
### **BELTS (EXCEPT TIMING BELTS)**

On most older vehicles, the water pump is driven by a V belt or serpentine belt on the front of the engine that is also responsible for driving the alternator, power steering pump and air conditioner compressor. These types of belts are easy to inspect and replace if they are worn. You are looking for dry cracking on the inside surface of the belt.

On later vehicles, the water pump is often driven by the timing belt. This belt usually has a specific life expectancy at which time it must be replaced to insure that it does not fail. Since the timing belt is inside the engine and will require partial engine disassembly to inspect, it is very important to replace it at the correct interval.

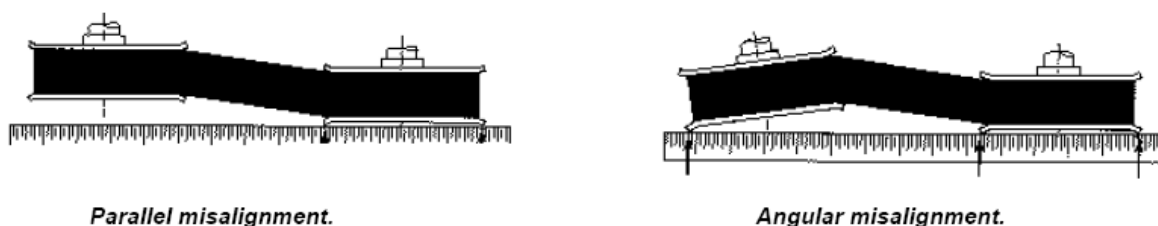
Low belt tension, contamination and belt vibration are common sources of belt noise. A screeching or squealing noise that occurs when pulling away from a stop normally indicates a lack of tension; check belt tension and automatic tensioners.

A grinding noise can result from damaged bearings, which must be replaced, aligned and lubricated to eliminate the noise and further damage. Vibration and noise can develop over time as drive components such as pulleys and spring tensioners wear, bearings and brackets loosen, or belts wear and stretch.



**Fig. 3: Typical Accessory Drive Belt**

The angle between belt span and pulley is the critical factor responsible for causing the "chirp" associated with misalignment noise. The presence of high humidity (or a damp belt) often increases the likelihood for misalignment noise to occur. Misalignment angle can result from many different combinations of pulley positions - parallel and angular are two typical examples.



**Fig. 4: Accessory Drive Belt Misalignment**

Whenever a vehicle owner complains of belt noise, determine the type of noise and under what circumstances it occurs. The correction for a noise problem caused by belt misalignment is not likely to resolve a slip noise problem that may be caused by insufficient tension or other problem. The highest occurrence of belt noise due to misalignment comes from short belt spans entering large diameter pulleys. In the case of severe misalignment, repositioning of drive components may be required. Pulley alignment and tension must be correct for the drive to operate properly.

### **BELT TENSIONER**

Belt tensioners are used to maintain constant tension on the belt, extending both belt and accessory drive bearing life.

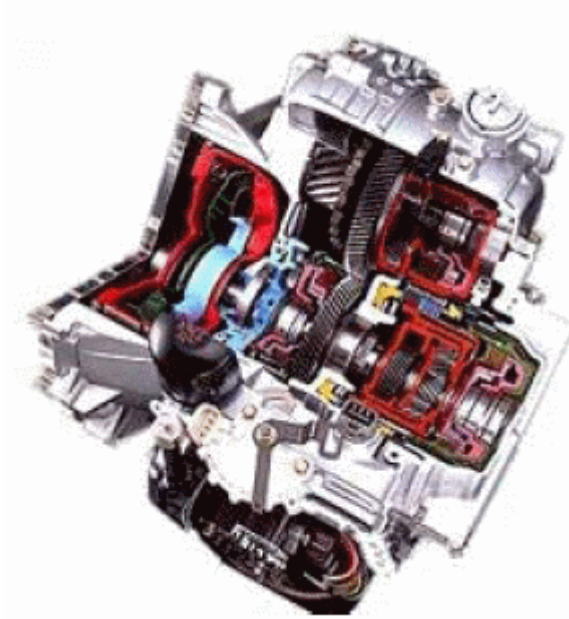
**NOTE:**

A tensioner cannot be rebuilt since internal parts are not available. Never try to disassemble a tensioner unit. Injury may result.



**Fig. 5: Typical Accessory Drive Belt Tensioner**

### **AUTOMATIC TRANSMISSION FLUID**



**Fig. 6: Crosssection Of Automatic Transmission - Typical**

Automatic transmission fluid (ATF) is the fluid used in vehicles with a self-shifting or automatic transmission. It is typically colored red or green to distinguish it from motor oil and other fluids in the vehicle. The fluid is a highly refined mineral oil optimized for the special requirements of an automatic transmission, such as valve operation, clutch and band operation, torque converter and gear lubrication. ATF is also used as a hydraulic medium in some power-assisted steering systems and as a lubricant in some 4WD transfer cases.

ATF usually contains an additive package with anti-foam additives, detergents and dispersants, anti-oxidation compounds, surfactants and petroleum dye. There are many specifications for ATF, such as the DEXRON and MERCON series, and the vehicle manufacturer will identify the ATF specification appropriate for each vehicle. The vehicle's owner's manual will typically list the ATF specification(s) that are recommended by the manufacturer. Some manufacturers will recommend different ATF products for different kinds of vehicle use, such as frequent trailer towing or vehicles that are used for longer periods between routine maintenance.

Overused ATF often has reduced lubrication properties and abrasive friction materials (from clutches and bands) suspended in it; failure to replace such fluid will accelerate transmission wear and could eventually ruin a transmission. Color is not an indication of the service life of an ATF as most ATF products will darken with use. The manufacturer's recommended service interval is a more reliable measure of ATF life.

### **AUTOMATIC TRANSMISSION FLUID EXCHANGE & FILTER REPLACEMENT**

Automatic transmission fluid lubricates, cools and cleans internal components of the transmission. It also helps to maintain the hydraulic pressure necessary for the transmission to function. The additives in the transmission fluid can be depleted over time and should be replaced following the manufacturer's recommended service interval.

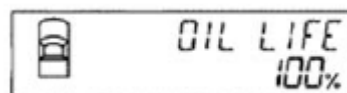
## ENGINE OIL

The temperature range the oil is exposed to in most vehicles can be wide, ranging from cold ambient temperatures in the winter before the vehicle is started up to hot operating temperatures when the vehicle is fully warmed up in hot summer weather. A "specific" oil will have high viscosity when cold and a low viscosity at the engine's operating temperature. The difference in viscosities for any single-grade oil is too large between the extremes of temperature. To bring the difference in viscosities closer together, additives called viscosity index improvers are added to the oil. This creates "multi-grade" oil which has the viscosity of the first number when cold and the viscosity of the second number when hot. This allows one type of oil to be generally used all year.

In engines, there is inevitably some exposure of the oil to products of internal combustion, and microscopic particles from black soot accumulate in the oil during operation. Also the rubbing of metal engine parts inevitably produces some microscopic metallic particles from the wearing of the surfaces. Such particles could circulate in the oil and grind against the part surfaces causing wear. The oil filter removes many of the particles and sludge, but eventually the oil filter can become clogged, if used for extremely long periods. The motor oil and especially the additives also undergo thermal and mechanical degradation. For these reasons, the oil and the oil filter need to be periodically replaced.

Most vehicle manufacturers utilize a time/mileage-based schedule. Time-based intervals account for both the short trip driver who does fewer miles, but builds up more contaminants, as well as the long highway trips that are much easier on the oil. Many vehicle manufacturers list somewhat higher intervals for changing of oil and filter, with "severe" service requiring more frequent changes. This generally applies to vehicles that are mostly used in "Stop-and-Go" driving conditions; experience extended periods of idling; or used for short trips of under 10 miles, where the oil does not get to full operating temperature and other adverse conditions.

Some vehicle manufacturers have installed engine Oil Life Monitors using computer calculations to estimate the oil's condition based on the factors which degrade it. Conditions such as RPMs, temperatures, and trip length are factored in to the equation; and one system adds an optical sensor for determining the clarity of the oil in the engine.



**Fig. 7: Engine Oil Life Monitor Display Example**

## AIR FILTERS

The engine air filter prevents dirt from entering the engine's cylinders, where it would cause mechanical wear and oil contamination. Most fuel injected vehicles use a pleated paper filter element in the form of a flat panel. This filter is usually placed inside a plastic box connected to the throttle body with an intake tube. Older vehicles that use carburetors or throttle body fuel injection typically use a cylindrical air filter, usually a few inches high and between 6 and 16 inches in diameter, positioned above the carburetor or throttle body and may incorporate ducting to provide cool and/or warm inlet air, and secured with a metal or plastic lid.

A Pleated paper filter element is used for most automobile engine air cleaners, because they are efficient, easy to service, and cost-effective. The pleated-paper filter is sized appropriately for the airflow volumes encountered in a particular application and present only minor restriction to air flow until the filter has become clogged with dirt.

## CABIN AIR FILTER

The cabin air filter is typically a pleated-paper filter that is placed in the outside-air intake for the vehicle's passenger compartment. Some of these filters are rectangular and similar in shape to the combustion air filter. Others are uniquely shaped to fit the available space of particular vehicles' outside-



air intakes. Clogged or dirty cabin air filters can significantly reduce airflow from the cabin vents, as well as introduce allergens into the cabin air stream.

## **BRAKE FLUID**

The purpose of brake fluid is to:

1. Utilize hydraulic pressure to apply force on brake components that use a friction material to slow the vehicle
2. Protect the brake system from corrosion

Motor vehicle brake fluids are hygroscopic and absorb moisture when exposed to the atmosphere and in service. Water contamination from any source, including mechanical or accidental additions of free water, will appreciably lower the original boiling point of the brake fluid and increase its viscosity at low ambient temperatures. Water contamination may cause corrosion of brake cylinder bores and pistons, and may seriously affect the braking efficiency and safety of the brake actuating system. While moisture is definitely an issue with brake fluids, no consistent and accurate measurement identifying the percentage of moisture that is detrimental to brake fluid performance has been found in the literature. In addition, no specification exists for an in-use brake fluid boiling point that can be identified by a testing procedure and therefore no recommendation for replacement based on moisture content can be made with confidence.

It has been demonstrated that corrosion inhibitors in brake fluid deplete over time and can be severely depleted by 36 months. The depletion of corrosion inhibitors results in corrosion. Copper is not found in new brake fluid and is used as a brazing alloy in the brake lines, which represent a high surface area for brake fluid contact. Copper is the first metal to corrode in a brake system, and is a principle contaminate in brake fluid. Copper levels increase slowly and stably over time. The slow and steady increase in copper levels provides a means to predict the age of brake fluid under normal conditions. The age of the brake fluid can help determine when brake fluid should be serviced according to OEM recommendations when applicable. Copper can also directly affect ABS components as it can plate to the valve and valve seats.

Iron levels begin to sharply increase when the copper levels reach 150-250 ppm indicating corrosion of iron components. This also allows copper levels to be used to predict when iron levels will increase or the start of component corrosion and the depletion of corrosion inhibitors. Once iron corrosion begins copper acts as a catalyst to speed corrosion. At this point (iron corrosion) it is evident that the brake fluid no longer performs the intended purpose of protecting the system from corrosion.

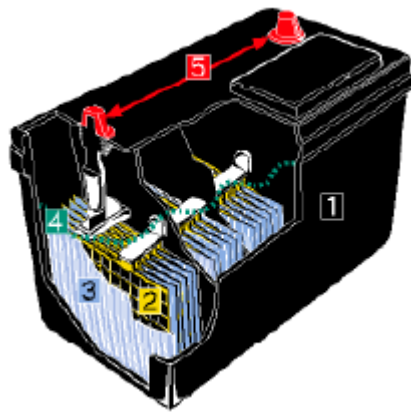
A copper content of 200 ppm or greater indicates a depletion of corrosion inhibitors in the brake fluid and Brake Fluid Replacement is Required.

## **BATTERY**

The automotive battery is an electrochemical device that produces voltage and delivers current. In an automotive battery the electrochemical action can be reversed, recharging the battery, providing many years of service. Batteries emit hydrogen gas while charging and the battery case cannot be completely sealed. Batteries (maintenance free) have small vents on the side forcing the gases to go through baffles to escape. This process allows the liquid to condense and flow back to the bottom of the battery.

The purpose of the battery is to supply current to the starter motor, provide current to the ignition system while cranking, to supply additional current when the demand is higher than the alternator can supply and to act as an electrical reservoir. Batteries are rated in cold cranking amps. This represents the current the battery can produce for 30 seconds at 0 degrees before the battery voltage drops below 7.2 volts.





**Fig. 8: Typical Battery Components**

### **BATTERY CABLES**

Battery cables are large diameter, multi-stranded wire which conveys the high current (250+ amps) necessary to operate the starter motor. Some battery cables will have a smaller wire, soldered to the terminal, which is used to either operate a smaller device or to provide an additional ground. When the smaller cable burns it indicates a high resistance in the heavy cable.

Even maintenance free batteries need periodic inspection and cleaning to insure they stay in good working order. Inspect the battery to see that it is clean and that it is held securely in its carrier. Some corrosion naturally collects around the battery. Electrolyte condensation contains corrosive sulfuric acid, which eats away the metal of battery terminals, cable ends and battery hold-down parts.

### **POWER STEERING**

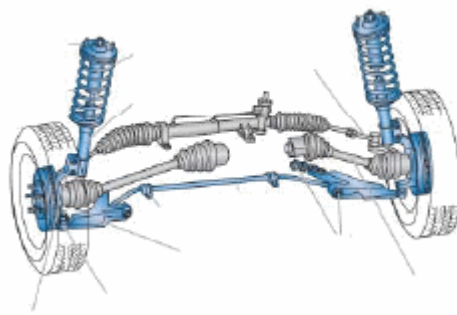
Power steering is a system for reducing the steering effort on cars by using an external power source to assist in turning the wheels. Most vehicles have power steering and the trend to front wheel drive, greater vehicle mass and wider tires means that modern vehicles would be extremely difficult to maneuver at low speeds (e.g. when parking) without assistance.

### **POWER STEERING FLUID**

Power Steering Fluid is the hydraulic component in power steering systems and is charged with pressure transfer and component protection. It fails when it stops performing one of its tasks. When a fluid becomes oxidized, its resistance to flow is greater and it decreases its ability to protect components and transfer pressure. The more common failure mode of PSF is internal and external contamination, and excess particles in fluid promote component wear and can lead to component failures, including seals, shafts and gears.

Most power steering systems work by using a belt driven pump to provide hydraulic pressure to the system. This hydraulic pressure is generated by a rotary-vane pump which is driven by the vehicle's engine. As the speed of the engine increases, the pressure in the hydraulic fluid also increases, hence a relief valve is incorporated into the system to allow excess pressure to be bled away. Some of the hydraulic systems also include an electronic pressure valve which can reduce the hydraulic pressure of the power steering lines as the vehicle's speed increases (Variable assist power steering).

Electric Power Steering uses sensors to detect the motion and torque of the steering column and a computer module applies electric motor to provide power assist. This allows variable assist power steering to be applied depending on driving conditions. In the event of component failure, a mechanical linkage such as a rack and pinion serves as a back-up in a manner similar to that of hydraulic systems. Electric power steering is usually limited to smaller vehicles rather than trucks and SUVs. Electric systems have a significant advantage in fuel efficiency because there is no hydraulic pump constantly running, whether assistance is required or not.



**Fig. 9: Typical Front Suspension & Steering Components**

## **WIPER BLADES**

Worn wiper blades are dangerous. Ozone, airborne contaminants, oil, sunlight and dirt all act to weaken and reduce your wiper blades' ability to keep your view unobstructed. And exposure to sunlight and ozone cause the wiper blades to age, even if they're not used much. Weather also plays a critical role in your windshield wiper blades' deterioration. Freezing temperatures make the rubber in your wiper blades hard and brittle, which increases their tendency to crack or tear. Hot weather warps the rubber and prevents the blade from wiping your windshield cleanly.

Heavy use is hard on the wipers because dust, abrasives, road grime and bug juice wear away the cutting edge the blade needs to wipe cleanly. Even road dirt acts like an abrasive to wear away the flat surface necessary for a good squeegee effect. Rubber also deteriorates over time. As blades age, they lose their flexibility and are less able to wipe cleanly. They may develop a permanent set or curvature, which prevents full contact with your windshield.

A wiper blades ability to clean the glass depends on:

The slope and area of the windshield: Windshields are sloped for improved aerodynamics and a "cab-forward" windshield with a lot of surface area directs more wind against the wipers, and can force the blades away from the windshield at high speeds unless the wiper system is designed to resist lift.

The amount of spring tension on the wiper arm: This is important to keep the wiper blade in tight contact with the windshield and provide a squeegee effect.

The number of pressure points or claws holding the blade: The more claws a blade has, the broader the area over which the pressure of the wiper arm is spread. More claws also provide increased flexibility so the blade can more easily follow the curvature of a large, sloping windshield for full side-to-side contact.

## **ROUTINE INSPECTION CHECKSHEET**



### ROUTINE INSPECTION CHECKSHEET

Date: \_\_\_\_\_  
 Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
 Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_  
 Mileage: \_\_\_\_\_ License: \_\_\_\_\_ VIN: \_\_\_\_\_ Eng Code: \_\_\_\_\_

Customer Interview:

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- Reason Code Explanation*
- | <u>Code</u>               | <u>Reason</u>   |
|---------------------------|---|
| <u>Required</u>           |   |
| A                         | Part No Longer Performs Intended Purpose  |
| B                         | Part Does Not Meet A Design Specification ( Regardless Of Performance)                  |
| C                         | Part Is Missing   |
| <u>Suggested/Optional</u> |   |
| 1                         | Part Is Close To The End Of Its Useful Life   |
| 2                         | To Address A Customer Need, Convenience Or Request                                      |
| 3                         | To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer |
| 4                         | Technician's Recommendation Based On Substantial And Informed Experience                |
| 5                         | To Comply With Maintenance Recommended By AMRA/MAP                                      |

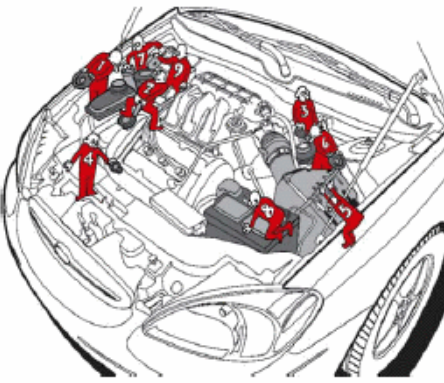


Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: [www.motorist.org](http://www.motorist.org)

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

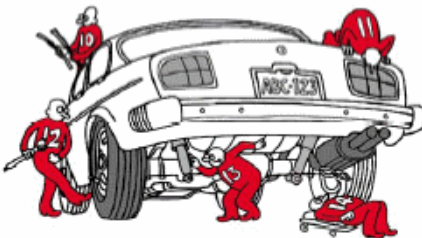
**Fig. 10: Routine Inspection Checksheet (1 Of 2)**

UNDERHOOD				
Component	OK	S	R	Condition
Coolant	OK	S	R	
Coolant Hoses	OK	S	R	
Belts (Except Timing Belt)	OK	S	R	
Tensioner	OK	S	R	
Transmission Fluid	OK	S	R	
Engine Oil	OK	S	R	
Engine Air Filter	OK	S	R	
Cabin Air Filter	OK	S	R	
Brake Fluid	OK	S	R	
Clutch Fluid (M/T)	OK	S	R	
Washer Fluid	OK	S	R	
Battery	OK	S	R	
Battery Hold Down	OK	S	R	
Battery Box	OK	S	R	
Battery Cables / Ends	OK	S	R	
Power Steering Fluid	OK	S	R	
Wiper Blades	OK	S	R	
UNDER VEHICLE				
Shocks / Struts	OK	S	R	
Exhaust	OK	S	R	
Notes: _____				
_____				



- Coolant
- Belts
- Transmission Fluid
- Engine Oil
- Air Filter
- Brake Fluid
- Washer Fluid
- Battery
- Power Steering Fluid

Lights/Lamps	OK	S	R	Location
Headlights	OK	S	R	
Parking	OK	S	R	
Turn Signal	OK	S	R	
Brake	OK	S	R	
License Plate	OK	S	R	



- Wiper Blades
- Lights
- Tire Pressure
- Shocks / Struts
- Exhaust

**CHECK TIRES**

Tire Size (Placard) \_\_\_\_\_ Actual \_\_\_\_\_ TPMS Warning On \_\_\_ Off \_\_\_ n/a \_\_\_



Tire Pressure			Wear Pattern / Damage			
	Before	After	OK	S	R	Wear Type
Front Spec: _____			OK	S	R	
Left Front			OK	S	R	
Right Front			OK	S	R	
Rear Spec: _____			OK	S	R	
Left Rear			OK	S	R	
Right Rear			OK	S	R	
Spare Tire			OK	S	R	

Tread Depth	Left Front	Right Front	Left Rear	Right Rear

**Wear Type**

- Edge wear
- Cupped
- Cut
- Irregular wear
- Other

OK
Suggested 1, 2, 3, 4, 5
Required A, B, C
 Automotive Maintenance & Repair Assn © 2009

**Fig. 11: Routine Inspection Checksheet (2 Of 2)**

**ROUTINE INSPECTION - UICS**

**BRAKE SYSTEMS**

**NOTE:** Some states may have specifications that differ from OEM. Check your local/state regulations. Where state or local laws are stricter, they take precedence over these guidelines.

**BRAKE FLUID**

**NOTE:** Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS. DOT 3, DOT 4, and DOT 5.1 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid type is normally stamped on the master cylinder cover.

**NOTE:** Fluid Flush - a process using a sufficient volume of fluid to help remove

contaminants and replacing the contaminated fluid with new fluid of the same type and specification. At times a chemical may be used to enhance removal.

**NOTE:** Fluid Exchange/Replace - draining (evacuating) old fluid and replacing it with new fluid of the correct type and specification.

Condition	Code	Procedure
At or beyond OEM service interval	3	Suggest fluid exchange/replacement
Brake fluid type incorrect	B	Require flushing and refilling
<p><b>NOTE:</b> For example, DOT fluid lower than specified for the vehicle or silicone brake fluid (DOT 5) in an ABS system</p>		
Contaminated, for example, fluid other than brake fluid present	A	Require service
<p><b>NOTE:</b> If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</p>		
Contaminated, for example, fluid other than brake fluid present	B	Require service
<p><b>NOTE:</b> If a fluid other than brake fluid is present in the brake system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct brake fluid.</p>		
Corrosion inhibitors depleted	B	Require fluid exchange/replacement
<p><b>NOTE:</b> A copper content of 200 ppm or greater indicates a depletion of corrosion inhibitors in the brake fluid.</p>		
Fluid discolored	No Service Suggested or Required	
<p><b>NOTE:</b> Further testing necessary to determine condition of fluid.</p>		
Hydraulic component overhaul or replacement	3	Suggest flushing and refilling
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of gasket
<p><b>NOTE:</b> This condition may indicate contaminated brake fluid. Further inspection required.</p>		

#### BULBS AND LEDS

**NOTE:** Does not include soldered-in components.

Condition	Code	Procedure

Condition	Code	Procedure
Application incorrect	B	Require replacement
<b>NOTE:</b> <b>Application incorrect includes wrong bulb coating or color.</b>		
Base burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Burned out	A	Require replacement
Intermittent	A	Require replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware



<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blistered	B	Require replacement
Expansion affecting performance	A	Require Replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Incorrectly secured	B	Require repair
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require repair

### LENSES

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	No Service Suggested or Required	
Cracked	B	Require replacement
Discolored	A	Require replacement
Leaking	B	Require repair or replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	2	Suggest replacement
Missing	C	Require replacement

### LUG NUT

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Lug nut flats rounded	A	Require replacement of nut
Lug nut installed backward	B	Require repair
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut seized	A	Require replacement of nut and/or stud
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

**MASTER CYLINDER COVER GASKET**

Condition	Code	Procedure
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of the gasket
<b>NOTE:</b> This condition may indicate contaminated brake fluid. See Brake Fluid.		

**PARKING BRAKE CABLE**

Condition	Code	Procedure
Cable improperly adjusted	B	Require cable adjustment
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly
Cable sticking	A	Require cable lubrication
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly

**VACUUM HOSES**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Incorrectly secured	B	Require repair
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require repair

**WHEEL ATTACHMENT HARDWARE**

**NOTE:** For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow manufacturer's torque specifications and tightening sequence. **DO NOT** lubricate threads unless specified by the vehicle manufacturer.

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> Some manufacturers require replacement of all studs on any wheel if two or more studs or nuts on the same wheel are broken or missing.		
Loose	A	Require repair or replacement of affected component
Lug nut flats rounded	A	Require replacement of nut
Lug nut installed backward	B	Require repair
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut seized	A	Require replacement of nut and/or stud
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

### WHEEL BEARINGS, RACES AND SEALS

**NOTE:** When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions.

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require replacement of bearing and race assembly
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly or other damage affecting performance.	B	Require replacement of bearing and race assembly
Seal leaking	A	Require replacement of seal and inspection of bearings
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.		
Seal missing	C	Require replacement

### DRIVETRAIN AND TRANSMISSION

**NOTE:** When a procedure states that a required or suggested repair or replacement is recommended, the basis for the recommendation **MUST** be explained to the customer. If the customer asks whether there are alternatives to the recommendation, generally acceptable repair/replacement options must be explained, whether performed or not by the shop.

**NOTE:** Whenever transmission or drive-train service is performed that affects the suspension alignment, for example, removing the engine cradle, it is required that the alignment be checked and corrected if necessary.

**NOTE:** The conditions listed for the components included in this section assume that the problem has been isolated to the specific component through proper testing.

**AUTOMATIC TRANSMISSION FLUID**

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<b>NOTE:</b> Determine and correct cause.		
Burned	Further inspection required	
<b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Varnish deposits present on system components affecting performance	Further inspection required	

**CLUTCH MASTER CYLINDERS**

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Condition	Code	Procedure
Cover gasket distorted	A	Require replacement of cover gasket
Cover gasket gummy	A	Require replacement of cover gasket
<b>NOTE:</b> <b>This condition may indicate contaminated fluid. Further inspection required.</b>		
Cylinder leaking fluid from rear of bore	A	Require repair or replacement
Cylinder leaking fluid internally	A	Require replacement
Dust boot missing	C	Require replacement of dust boot
Dust boot punctured	A	Require replacement of dust boot
Dust boot torn	A	Require replacement of dust boot
Fluid level incorrect	B	Require fluid level adjustment
Housing damaged, affecting performance	A	Require repair or replacement
Master cylinder has residue in reservoir	2	Further inspection required
<b>NOTE:</b> <b>Do not replace master cylinder unless it exhibits conditions listed for replacement.</b>		
Pushrod out of adjustment	B	Require Repair or Replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### COOLER LINES

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	No Service Suggested or Required	
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
<b>NOTE:</b> <b>If clamp removed, require replacement.</b>		
Connected incorrectly	A	Require repair
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	No Service Suggested or Required	
Cracked	B	Require repair or replacement

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## COOLERS

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Air flow obstruction	A	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Contaminated	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	No Service Suggested or Required	
Internal restrictions	B	Require repair or replacement
Leaking	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	No Service Suggested or Required	

## DIFFERENTIAL FLUID

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement



Condition	Code	Procedure
<b>NOTE:</b> Determine and correct cause.		
Burned	Further inspection required	
<b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which <b>DOES NOT</b> affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which <b>DOES</b> affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which <b>DOES</b> affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Varnish deposits present on system components affecting performance	Further inspection required	

#### DRAIN PLUGS AND GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		
Missing	C	Require replacement
Threads Damaged	A	Require repair or replacement

#### FILTERS AND SCREENS

Condition	Code	Procedure
At service interval	3	Suggest replacement
Bent, affecting performance	A	Require repair or replacement
Exceeding service interval	3	Suggest replacement
Missing	C	Require replacement
Near service interval	3	Suggest replacement
Restricted	A	Require repair or replacement
<b>NOTE:</b> Further inspection may be required to determine the source of restriction or contamination.		
Torn	A	Require replacement
Worn, affecting performance (metal or nylon screen type)	A	Require repair or replacement

#### FLUIDS AND LUBRICANTS

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<b>NOTE:</b> Determine and correct cause.		
Burned	Further inspection required	
<b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.		

Condition	Code	Procedure
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Varnish deposits present on system components affecting performance	Further inspection required	

### HOSES, LINES, AND TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	2	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	2	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement

Condition	Code	Procedure
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	1	Suggest repair or replacement

## HYDRAULIC FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<p><b>NOTE:</b> Determine and correct cause.</p>		
Burned	Further inspection required	
<p><b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.</p>		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<p><b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which <b>DOES</b> affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</p>		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<p><b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which <b>DOES NOT</b> affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.</p>		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	
Fluid incorrect	B	Require service
<p><b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.</p>		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service

Condition	Code	Procedure
<p><b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.</p>		
Varnish deposits present on system components affecting performance		Further inspection required

## LUBRICANTS

Condition	Code	Procedure
Additive Depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<p><b>NOTE:</b> <b>Determine and correct cause.</b></p>		
At service interval	3	Suggest replacement
Beyond service interval	3	Suggest replacement
Burned		Further inspection required
<p><b>NOTE:</b> <b>Fluid that is burned indicates a serious problem. Determine and correct the cause.</b></p>		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<p><b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correctly specified hydraulic fluid.</p>		
Fluid incorrect	B	Require service
<p><b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.</p>		
Level incorrect	B	Require correction of fluid level
Near service interval	3	Suggest replacement
Oxidized	A	Require replacement of fluid
Rubber master cylinder cover gasket distorted and gummy	A	Require service
<p><b>NOTE:</b> If a fluid other than brake fluid is present in the system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</p>		

## MANUAL TRANSMISSION FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement

Condition	Code	Procedure
<p><b>NOTE:</b> Determine and correct cause.</p>		
Burned		Further inspection required
<p><b>NOTE:</b> Fluid that is burned indicates a serious problem. Determine and correct the cause.</p>		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<p><b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</p>		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<p><b>NOTE:</b> If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.</p>		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored		No Service Suggested or Required
<p><b>NOTE:</b> Further testing necessary to determine condition of fluid.</p>		
Fluid discolored		No Service Suggested or Required
<p><b>NOTE:</b> Further testing necessary to determine condition of fluid.</p>		
Fluid incorrect	B	Require service
<p><b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.</p>		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
<p><b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.</p>		
Varnish deposits present on system components affecting performance		Further inspection required



**MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION)**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	No Service Suggested or Required	
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	No Service Suggested or Required	
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

**TRANSFER CASE FLUID**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
<p><b>NOTE:</b>  <b>Determine and correct cause.</b></p>		
Burned	Further inspection required	
<p><b>NOTE:</b>  <b>Fluid that is burned indicates a serious problem. Determine and correct the cause.</b></p>		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
<p><b>NOTE:</b>  <b>If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</b></p>		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
<p><b>NOTE:</b>  <b>If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.</b></p>		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	

Condition	Code	Procedure
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid incorrect	B	Require service
<b>NOTE:</b> If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
<b>NOTE:</b> If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.		
Varnish deposits present on system components affecting performance	Further inspection required	

## VACUUM HOSES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted, affecting performance	B	Require repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement

Condition	Code	Procedure
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## ELECTRICAL SYSTEMS

### BATTERIES

**NOTE:** Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.

#### Definition of Terms

**Battery Performance Testing - Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.**

**Cold Cranking Amp (CCA) Rating - The number of amperes a new, fully charged battery at 0°F (-17.8°C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).**

**Cranking Amps (CA) - The number of amperes a new, fully charged battery, typically at 32°F (0°C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).**

**OEM Cranking Amps - The minimum CCA required by the original vehicle manufacturer for a specific vehicle.**

Condition	Code	Procedure
Battery frozen	Further inspection required	
<p><b>NOTE:</b> Do not attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.</p>		
Battery tests near the "end of its useful life" utilizing a tester or on-board monitor able to accurately determine this condition	1	Suggest Replacement
Case leaking	A	Require replacement
Casing swollen	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Circuit open internally	A	Require replacement
Electrolyte contamination	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Electrolyte discoloration	A	Further inspection required

Condition	Code	Procedure
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Fails to accept and hold charge	A	Require replacement
<p><b>NOTE:</b> This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.</p>		
Fluid level low	B	Further inspection required
<p><b>NOTE:</b> Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test. If battery does not meet specifications, require replacement. If battery is sealed type (non-removable filler caps), require replacement.</p>		
Out of performance specification for battery	B	Require replacement
<p><b>NOTE:</b> The battery may meet vehicle's OEM specifications for that vehicle but test below the minimum specifications defined by the battery manufacturer.</p>		
Out of specification for application	B	Require replacement
<p><b>NOTE:</b> The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.</p>		
Post (top or side) burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Post (top or side) burned, not affecting performance	2	Suggest repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Post (top or side) corroded, affecting performance	A	Require repair
Post (top or side) corroded, not affecting performance	2	Suggest repair
Post (top or side) loose	A	Require replacement
Post (top or side) melted, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Post (top or side) melted, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Specific gravity low	B	Further inspection required
<b>NOTE:</b> Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.		
State of charge low	A	Further inspection required
<b>NOTE:</b> Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.		
Top dirty	2	Suggest cleaning battery
Top wet	A	Require cleaning battery Further inspection required
<b>NOTE:</b> Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.		
Vent cap loose	A	Require repair or replacement of vent cap
Vent cap missing	C	Require replacement of vent cap

#### BATTERY CABLES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
<b>NOTE:</b> Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		

Condition	Code	Procedure
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

#### BATTERY TRAYS AND HOLD DOWN HARDWARE

Condition	Code	Procedure
Battery improperly secured	2	Suggest repair
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	No Service Suggested or Required	
Broken, affecting performance	A	Require repair or replacement
Broken, not affecting performance	No Service Suggested or Required	
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Water drain clogged	A	Require repair

#### BULBS, SEALED BEAMS AND LEDS

**NOTE:** Does not include soldered-in components.

Condition	Code	Procedure
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Application incorrect includes wrong bulb coating or color.</b>		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	No Service Suggested or Required	
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	No Service Suggested or Required	
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement

Condition	Code	Procedure
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

#### FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Corroded, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

### GROUND CABLES AND STRAPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Insulation damaged, exposing conductors	2	Suggest replacement
Loose	A	Require repair
Missing	C	Require replacement
Open	A	Require repair or replacement
Resistance high	A	Require repair or replacement
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement
Voltage drop out of specification	B	Require repair or replacement

**GROUND STRAPS**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Insulation damaged, exposing conductors	2	Suggest replacement
Loose	A	Require repair
Missing	C	Require replacement
Open	A	Require repair or replacement
Resistance high	A	Require repair or replacement
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement
Voltage drop out of specification	B	Require repair or replacement

**LENSES**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Adjustment out of specification	B	Require repair
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	No Service Suggested or Required	
Cracked	B	Require replacement
Discolored	A	Require replacement
Leaking	B	Require repair or replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	2	Suggest replacement
Missing	C	Require replacement

**SEALED BEAMS**

**NOTE:** Does not include soldered-in components.

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	No Service Suggested or Required	
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	No Service Suggested or Required	
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		

Condition	Code	Procedure
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## WASHER PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

#### WIPER ARMS AND BLADES

**NOTE:** Windshield coatings or waxes can cause blades to not function as intended. Clean surface before making final judgment about blade replacement.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching socket stripped	A	Require replacement
Bent	A	Require repair or replacement
Loose	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Size incorrect	2	Suggest replacement
Tension insufficient	B	Require repair or replacement
Torn	A	Require replacement
Worn, affecting performance	A	Require replacement

Condition	Code	Procedure
Worn, not affecting performance	1	Suggest replacement

### WIPER HOSES AND NOZZLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blocked	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Spray pattern incorrect	2	Suggest repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

### WIPER PUMP RESERVOIRS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cap missing	C	Require replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement

### ENGINE PERFORMANCE AND MAINTENANCE

**NOTE:** **CHEMICAL ENGINE DECARBONIZATION** is a process utilizing chemicals to remove soft and semi-hardened gum, varnish, resin and carbon deposits from the air/fuel delivery systems and combustion chambers of gasoline internal combustion engines, providing benefits that include improved fuel economy, performance and driveability and reduced emissions. This process is performed to remove deposits preferably prior to deposit accumulation and hardening which may require costly mechanical deposit removal or component replacement.

**NOTE:** **SUGGEST** Chemical Engine Decarbonization service every 15,000 miles or 12 months.

**NOTE:** **CONTAMINATED OIL SYSTEM SERVICE** is an event based process (beyond that of a normal oil and filter change) performed to remove coolant, water or fuel contamination. Contamination increases oil's oxidation rate and has been shown to result in increased engine wear and reduced oil flow. **CAUTION:** Some OEM's (including GM and Honda) have issued Technical Service Bulletins advising that Chemical Crankcase Flushing may damage some engine components and that such damage will not be covered by the manufacturer's new car warranty.

### ACCESSORY BELTS

Condition	Code	Procedure
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Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> <b>Determine cause of incorrect alignment and require repair.</b>		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>Determine cause of noise and suggest repair.</b>		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

#### AIR FILTER ELEMENTS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Leaking	A	Require replacement
Melted	A	Required replacement
Missing	C	Require replacement
Paper filter element oil-soaked	A	Require replacement
<b>NOTE:</b> <b>Further inspection required to determine cause.</b>		
Restricted, affecting performance	A	Require replacement
Water-contaminated	A	Require replacement
<b>NOTE:</b> <b>Further inspection required to determine cause.</b>		

#### AIR FILTER GASKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement

#### AIR FILTER HOUSINGS AND GASKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement

## AIR PUMP BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> Determine cause of incorrect alignment and require repair.		
At or beyond service interval	3	Suggest replacement to comply with vehicle OEM recommended service intervals
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> Determine cause of noise and suggest repair.		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

## BATTERIES

**NOTE:** Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.

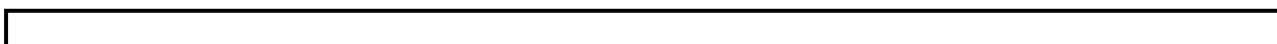
### Definition of Terms

**Battery Performance Testing** - Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.

**Cold Cranking Amp (CCA) Rating** - The number of amperes a new, fully charged battery at 0°F (-17.8°C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

**Cranking Amps (CA)** - The number of amperes a new, fully charged battery, typically at 32°F (0°C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

**OEM Cranking Amps** - The minimum CCA required by the original vehicle manufacturer for a specific vehicle.



Condition	Code	Procedure
Battery frozen		Further inspection required
<p><b>NOTE:</b> Do not attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.</p>		
Battery tests near the "end of its useful life" utilizing a tester or on-board monitor able to accurately determine this condition	1	Suggest Replacement
Case leaking	A	Require replacement
Casing swollen	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Circuit open internally	A	Require replacement
Electrolyte contamination	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Electrolyte discoloration	A	Further inspection required
<p><b>NOTE:</b> No service suggested or required unless the battery fails performance test, in which case, require replacement.</p>		
Fails to accept and hold charge	A	Require replacement
<p><b>NOTE:</b> This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.</p>		
Fluid level low	B	Further inspection required
<p><b>NOTE:</b> Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test. If battery does not meet specifications, require replacement. If battery is sealed type (non-removable filler caps), require replacement.</p>		
Out of performance specification for battery	B	Require replacement
<p><b>NOTE:</b> The battery may meet vehicle's OEM specifications for that vehicle but test below the minimum specifications defined by the battery manufacturer.</p>		
Out of specification for application	B	Require replacement
<p><b>NOTE:</b> The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.</p>		

Condition	Code	Procedure
Post (top or side) burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Post (top or side) burned, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Post (top or side) corroded, affecting performance	A	Require repair
Post (top or side) corroded, not affecting performance	2	Suggest repair
Post (top or side) loose	A	Require replacement
Post (top or side) melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Post (top or side) melted, not affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Specific gravity low	B	Further inspection required
<b>NOTE:</b> Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.		
State of charge low	A	Further inspection required
<b>NOTE:</b> Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.		
Top dirty	2	Suggest cleaning battery
Top wet	A	Require cleaning battery Further inspection required
<b>NOTE:</b> Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.		
Vent cap loose	A	Require repair or replacement of vent cap
Vent cap missing	C	Require replacement of vent cap

#### BATTERY CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware



Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
<b>NOTE:</b> <b>Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.</b>		
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

#### BELT IDLER ASSEMBLIES (ACCESSORY AND CAM BELTS)

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Cracked	2	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Seized	A	Require repair or replacement

#### BELT TENSIONERS (ACCESSORY AND CAM BELT)

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Cracked	B	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

#### CHEMICAL ENGINE DECARBONIZATION

**NOTE:** Chemical engine decarbonization is a process utilizing chemicals to remove soft and semi-hardened gum, varnish, resin and carbon deposits from the air/fuel delivery systems and combustion chambers of gasoline internal combustion engines, providing benefits that include improved fuel economy, performance and driveability and reduced emissions. This process is performed to remove deposits preferably prior to deposit accumulation and hardening which may require costly mechanical deposit removal or component replacement.

**NOTE:** SUGGEST Chemical Engine Decarbonization service every 15,000 miles or 12 months.

#### COMBUSTION CHAMBER CLEANING

**NOTE:** See **CHEMICAL ENGINE DECARBONIZATION**.

#### COOLANT RECOVERY TANKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement

Condition	Code	Procedure
Missing (if original equipment)	C	Require replacement

## COOLANT

Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement
At or beyond service interval	3	Suggest replacement
<p><b>NOTE:</b>  <b>The system should be drained and/ or flushed and refilled with correct coolant according to OEM recommended service interval and procedures.</b></p>		
Contaminated	B	Require replacement or recycling Further inspection required
<p><b>NOTE:</b>  <b>Determine source of contamination and require correction prior to coolant replacement.</b></p>		
Fluid discolored	No Service Suggested or Required	
<p><b>NOTE:</b>  <b>Further testing necessary to determine condition of fluid.</b></p>		
Level incorrect	B	Require correction of fluid level
<p><b>NOTE:</b>  <b>Determine source of incorrect level and suggest repair.</b></p>		
Mixture incorrect	B	Require correction or replacement
Type incorrect	B	Require replacement

## DISTRIBUTOR CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Arcing	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Burned	A	Require replacement
Carbon button missing	A	Require replacement
Carbon button worn, affecting performance	A	Require replacement
Carbon button worn, not affecting performance	1	Suggest replacement
Carbon-tracked	A	Require replacement
Cracked	B	Require replacement
Loose	B	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal eroded, affecting performance	A	Require repair or replacement
Terminal eroded, not affecting performance	No Service Suggested or Required	
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### DISTRIBUTOR ROTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Carbon-tracked	A	Require replacement
Contact burned	A	Require replacement
Corroded	1	Suggest replacement
Eroded	1	Suggest replacement
Loose	B	Require repair or replacement
Out of specification	B	Require replacement

### ENGINE COOLING SYSTEMS

**NOTE:** Overheating, poor engine performance, and insufficient cabin heat can be affected by, but are not limited to, all of the components in the engine cooling system.

### ENGINE DECARBONIZATION

**NOTE:** See [CHEMICAL ENGINE DECARBONIZATION](#).

### ENGINE OIL DRAIN PLUGS AND GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
<b>NOTE:</b> Some OEMs require replacement of drain plug gasket when removing drain plug. Inspect threads in oil pan for damage.		

### ENGINE OIL FILTERS AND CANISTERS

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Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Bulged	A	Require replacement. Further inspection required
<b>NOTE:</b> <b>Inspect pressure relief valve.</b>		
Canister attaching hardware broken	A	Require repair or replacement of hardware
Canister attaching hardware loose	A	Require repair
Canister attaching hardware missing	C	Require replacement
Canister attaching hardware not functioning	A	Require repair or replacement of hardware
Center tube collapsed	A	Require replacement. Further inspection required
<b>NOTE:</b> <b>Inspect bypass.</b>		
Dented	2	Suggest replacement. Further inspection required
<b>NOTE:</b> <b>Determine cause, such as broken motor mount.</b>		
Leaking	B	Require repair or replacement

#### ENGINE OIL

Condition	Code	Procedure
Additive Depletion	A	Require replacement of fluid
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Contaminated	A	Require replacement of oil and filter; Further Inspection Required
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water when changing oil.</b>		
Fluid discolored	No Service Suggested or Required	
<b>NOTE:</b> <b>Further testing necessary to determine condition of fluid.</b>		
Fluid incorrect	B	Require service
Level Incorrect	B	Adjust to correct level. Further Inspection Required.
<b>NOTE:</b> <b>Determine cause of incorrect level such as leaking gaskets or contamination by engine coolant, fuel or water.</b>		
Oxidized	A	Require replacement of fluid

**FUEL FILTERS**

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with OEM recommended service interval
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	2	Suggest replacement

**FUEL INJECTOR CLEANING**

**NOTE:** See **CHEMICAL ENGINE DECARBONIZATION.**

**FUEL INJECTORS**

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement



Condition	Code	Procedure
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## FUEL SYSTEM CLEANING SERVICE

**NOTE:** See **CHEMICAL ENGINE DECARBONIZATION.**

## HOSE CLAMPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

## HOSE CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	A	Require replacement

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

### HOSE COUPLERS

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

### HOSES AND TUBES (FUEL LINES, RADIATOR, VACUUM, BY-PASS, HEATER, RECOVERY TANK AND OIL COOLERS)

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Dry-rotted	1	Suggest repair or replacement
Hard	1	Suggest repair or replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement

Condition	Code	Procedure
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

### IGNITION WIRES (SECONDARY)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Routed incorrectly	B	Suggest repair

#### NOTE:

**If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.**

Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

#### NOTE:

**Determine cause and correct prior to repair or replacement of part.**

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

### INTAKE CLEANING

**NOTE:** See **CHEMICAL ENGINE DECARBONIZATION.**

### O2 SENSORS

Condition	Code	Procedure

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Inoperative	A	Require repair or replacement. Further inspection required
<b>NOTE:</b> <b>Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</b>		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement

Condition	Code	Procedure
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### PCV BREATHER ELEMENTS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require replacement
Melted	A	Required replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	A	Require replacement

### PCV VALVES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Grommet broken	A	Require repair or replacement of grommet
Grommet missing	C	Require replacement of grommet
Grommet not functioning	A	Require repair or replacement of grommet
Inoperative	A	Require replacement
<b>NOTE:</b> <b>Inoperative includes intermittent operation.</b>		
Leaking	A	Require replacement
Missing	C	Require replacement
Restricted	A	Require replacement

### RADIATOR CAPS AND PRESSURIZED EXPANSION TANK CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement

Condition	Code	Procedure
Coolant recovery check valve inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Fails to maintain proper pressure	B	Require replacement
Gasket missing	C	Require replacement of gasket
Missing	C	Require replacement
Seal missing	C	Require replacement of seal

### SPARK PLUGS

**NOTE:** You are not required to replace spark plugs in sets. However, you may suggest replacement of the other plugs for preventive maintenance.

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Electrode eroded	1	Suggest replacement
Fouled	A	Require repair or replacement
<b>NOTE:</b> Determine cause of fouling and suggest repair.		
Gap incorrect	B	Require repair or replacement
Improperly Indexed	Remove and Reinstall following manufacturers installation requirements	
Insulation broken	A	Require replacement
Insulator cracked	A	Require replacement
Leaking compression	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### THERMOSTATS AND HOUSINGS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing corroded	1	Suggest replacement of housing
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Installation incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement



Condition	Code	Procedure
Thermostat missing	C	Require replacement of thermostat
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

### THROTTLE BODY CLEANING

**NOTE:** See **CHEMICAL ENGINE DECARBONIZATION.**

### TIMING BELTS

Condition	Code	Procedure
Adjustment incorrect	B	Suggest adjustment
<b>NOTE:</b> Inspect belt tensioners, pulleys, and cover.		
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> Determine cause of incorrect alignment and require repair.		
At or beyond service interval	3	Suggest replacement to comply with vehicle OEM recommended service intervals
Broken	A	Require replacement
Cam timing out of specification	B	Require repair
Cracked	1	Suggest replacement
Fluid-soaked	1	Suggest replacement. Further inspection required
Frayed	1	Suggest replacement
Missing	C	Require replacement
<b>NOTE:</b> Internal engine damage may result from timing belt damage/failure.		
Noisy	2	Further inspection required
<b>NOTE:</b> Determine cause of noise and suggest repair.		
Plies separated	A	Require replacement
Teeth missing	A	Require replacement
Tension out of specification	B	Require adjustment or replacement

### VACUUM HOSES, TUBES AND CONNECTIONS (NON-METALLIC)

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

### EXHAUST SYSTEMS

**WARNING:**

Federal EPA rules prohibit altering an exhaust system in any way that defeats the emission reduction components of a vehicle. Be sure to review and adhere to EPA policy on removing and replacing catalytic converters. Where state or local laws are stricter, they take precedence over these guidelines.

**NOTE:**

Some exhaust systems are of a welded design. It is not required that the entire system be replaced. Determine the need to replace individual components based on conditions of component.

**EXHAUST AND TAIL PIPES**

Condition	Code	Procedure
Broken bracket	A	Require repair or replacement
Pipe Bent Out Of Position	B	Require repair or replacement
Pipe Broken	A	Require repair or replacement
Pipe Cracked	B	Require repair or replacement
Pipe Leaking	A	Require replacement
Pipe Missing	C	Require replacement
Pipe Plugged	A	Require replacement
Pipe Weak Due To Corrosion, But No Leaks Present	1	Suggest replacement
Weld Broken	A	Require repair or replacement

**HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS****NOTE:**

**AIR CONDITIONING SYSTEM FLUSHING** utilizes chemicals or refrigerant to remove oil, debris and contaminants from the evaporator, condenser, hoses or metal lines.

**NOTE:**

An **INLINE FILTER**, both high and low side, protects a/c components from residual debris in the system. An inline filter or suction screen is suggested when a condenser, evaporator, compressor, expansion valve, accumulator/drier, hoses or metal lines is replaced, or if debris is found in the system during an a/c repair. An inline filter is suggested to help prevent future component damage and increase system longevity.

**BELTS**

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> Determine cause of incorrect alignment and require repair.		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> Determine cause of noise and suggest repair.		
Plies separated	A	Require replacement
Serpentine belt routed incorrectly	B	Require repair
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement

Condition	Code	Procedure
Worn so it contacts bottom of pulley	A	Require replacement

### CABIN AIR FILTERS

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement
At or beyond service interval	3	Suggest replacement
Microbial growth causing odor	A	Require replacement of filter
Missing	C	Require replacement

### COOLANT

Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement
At or beyond service interval	3	Suggest replacement
Contaminated	B	Require replacement or recycling. Further inspection required
<b>NOTE:</b> Determine source of contamination and require correction prior to coolant replacement.		
Fluid discolored	No Service Suggested or Required	
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Level incorrect	B	Require filling to proper level
<b>NOTE:</b> Determine source of incorrect level and suggest repair.		
Mixture incorrect	B	Require correction or replacement
Type incorrect	B	Require replacement

### EVAPORATOR DRAIN TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Leaking	A	Require replacement
Missing	C	Require replacement
Restricted	A	Require repair or replacement
Routed incorrectly	B	Require repair

### EVAPORATOR FILTERS

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement
At or beyond service interval	3	Suggest replacement
Microbial growth causing odor	A	Require replacement of filter
Missing	C	Require replacement

### IN-LINE FILTERS

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Condition	Code	Procedure
Connection leaking	A	Require repair or replacement
Leaking	B	Require repair or replacement
Restricted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### VACUUM HOSES AND TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Leaking	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Routing incorrect	B	Require repair
Surface cracks (dry-rotted)	1	Suggest replacement

### STEERING AND SUSPENSION, WHEEL ALIGNMENT, WHEELS AND TIRES

**NOTE:** Steering and Suspension are complex systems made up of a variety of interdependent components and controls. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed.

**NOTE:** Listed repair conditions assume that the problem has been isolated to the specific component by proper testing procedures. When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications for both ride height and alignment angle tolerances.

**NOTE:** Improper alignment geometry, and/or improper tire/wheel fitment may affect other systems such as Adaptive Cruise Control, Electronic Stability Control, Electronic Traction Control and Variable Ratio Steering. These systems may require attention after an alignment or suspension service is performed. Care must be taken to identify these vehicles/systems before any repair procedures are performed. Failure to follow OEM guidelines when servicing interrelated systems could result in an unsafe condition.

**CAUTION:** Do not use ride height altering or load compensating components, such as variable rate springs or coil over shocks on vehicles with height sensing or load sensing proportioning- valve equipped braking systems, unless these components are supplied as original equipment.

### HYDRAULIC HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

### POWER STEERING BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> <b>Determine cause of incorrect alignment and require repair.</b>		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>Determine cause of noise and suggest repair.</b>		
Plies separated	A	Require replacement
Serpentine belt routed incorrectly	B	Require repair
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

### POWER STEERING FLUID

Condition	Code	Procedure
50,000 miles or greater on OE fluid (in absence of published manufacturer interval)	5	Suggest Replacement
<b>NOTE:</b> <b>One time only fluid exchange</b>		
Additive Depletion	A	Require replacement of fluid
Fluid at or beyond service interval	3	Suggest fluid replacement

Condition	Code	Procedure
Fluid contaminated (i.e. fluid other than power steering fluid present)	B	Require flushing and refilling of the system
<b>NOTE:</b> <b>Determine and correct source of contamination. OEM specifications must be followed for fluid type.</b>		
Fluid discolored	No Service Suggested or Required	
<b>NOTE:</b> <b>Further testing necessary to determine condition of fluid.</b>		
Fluid level incorrect	B	Require adjustment of fluid level
Fluid type incorrect	B	Require flushing and refilling with correct fluid
Oxidized	A	Require replacement of fluid

### POWER STEERING HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

### SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES

**NOTE:** You are not required to replace shocks or struts in axle sets. However, when replacing a shock or strut due to the conditions that follow, you may suggest replacement of the other shock or strut on the same axle for one or more of the following: improved performance or preventive maintenance; part is close to the end of its useful life; to extend tire life; to balance ride and handling; or to improve stopping distance. When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications. Under no circumstances should



a technician bend struts or strut housings. A vehicle's load-carrying and handling abilities are limited by its suspension, tires, brakes, and driveline. Installing coil over shocks or any other load assist device does not increase the vehicle's load capacity. See the vehicle owner's manual for more details. If vehicle is equipped with OEM coil over shocks, apply the conditions for coil springs from the Springs: Coil, Leaf, and Torsion Bar section of the Steering and Suspension guidelines. If the vehicle is equipped with add-on coil over shocks, you may suggest replacement with standard shocks for a spring-related condition.

Condition	Code	Procedure
50,000 miles or greater on OEM Shocks or Struts	1	Suggest Replacement
<p><b>NOTE:</b>  <b>Applies only to OEM hydraulic fluid and/or gas charged shocks and struts, NOT electronically controlled units.</b></p>		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require replacement
Body dented	A	Further inspection required
<p><b>NOTE:</b>  <b>Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.</b></p>		
Body punctured	A	Require replacement
Brake hose bracket bent	B	Require repair or replacement
Brake hose bracket missing	C	Require replacement
Brake hose bracket threads damaged	A	Require repair or replacement
Brake hose bracket threads stripped (threads missing)	C	Require replacement
Compression bumper missing	C	Require replacement of compression bumper
Compression bumper split	1	Suggest replacement of compression bumper
Damping (none)	A	Require replacement
Dust boot (bellows) missing	C	Require replacement of boot
<p><b>NOTE:</b>  <b>If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which causes piston rod seal wear.</b></p>		
Dust boot (bellows) split	A	Require replacement of boot

Condition	Code	Procedure
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust boot (bellows) torn	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust shield broken	2	Suggest replacement
<p><b>NOTE:</b> This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust shield missing	2	Suggest replacement
<p><b>NOTE:</b> This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Gland nut (strut housing cap) is not removable using appropriate tool	A	Require replacement of nut and/or housing
<p><b>NOTE:</b> Only required if replacing cartridge.</p>		
Gland nut (strut housing cap) threads damaged	A	Require repair or replacement of nut
Housing dented	A	Further inspection required
<p><b>NOTE:</b> Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.</p>		
Housing punctured	A	Require replacement
Jounce bumper missing	C	Require replacement of jounce bumper
Jounce bumper split	1	Suggest replacement of jounce bumper
Leaking oil, enough for fluid to be running down the body	A	Require replacement
<p><b>NOTE:</b> If the strut cartridge has been replaced previously, the oil on the strut housing may be filler oil. The technician must identify the source of the oil.</p>		
Noisy	2	Further inspection required
<p><b>NOTE:</b> If noise is isolated to shock or strut, suggest replacement.</p>		
Piston rod bent	A	Require replacement
Piston rod broken	A	Require replacement
Piston rod has surface defect	2	Suggest replacement

Condition	Code	Procedure
Piston rod threads damaged	A	Require repair or replacement
Piston rod threads stripped (threads missing)	A	Require replacement
Seized	A	Require replacement
Shock missing	C	Require replacement
Strut housing bent	A	Require replacement
Strut housing cap (gland nut) is not removable using appropriate tool	A	Require replacement of nut and/or housing
<p><b>NOTE:</b>  <b>Only required if replacing cartridge.</b></p>		
Strut housing cap (gland nut) threads damaged	A	Require repair or replacement of nut
Strut housing cap (gland nut) threads stripped (threads missing)	A	Require replacement of nut
Strut housing severely corroded, affecting structural integrity	A	Require replacement
Strut housing threads damaged	A	Require repair or replacement
Strut housing threads stripped (threads missing)	A	Require replacement
Tire cupping	A	Further inspection required
<p><b>NOTE:</b>  <b>Although shocks or struts may have contributed to tire cupping, an inspection is needed of the entire suspension system. If the shock or strut is found to be contributing to the tire cupping, require replacement.</b></p>		

## STRUT RODS

Condition	Code	Procedure
Adjusting nut seized	A	Require repair or replacement of hardware
<p><b>NOTE:</b>  <b>Only required if an alignment is being performed and adjustment of the strut in question is required.</b></p>		
Attaching (mating) hole oversized	A	Require repair or replacement of bracket or frame
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Attaching point on bracket or frame corroded, affecting structural integrity	A	Require repair of bracket or frame
Bent, affecting performance	A	Require replacement

Condition	Code	Procedure
Mating (attaching) hole oversized	A	Require repair or replacement of bracket or frame
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### TIRE PRESSURE MONITORING SYSTEM

**NOTE:** A Tire Pressure Monitoring System (TPMS) is designed to detect and alert the driver should the air pressure level in one or more of the vehicle's tires, up to all four tires, fall below the manufacturer's recommended inflation pressure or another pre-set level.

**NOTE:** NHTSA does not consider installation of an aftermarket or replacement tire or rim that is not compatible with the TPMS to be a "make inoperative" situation under 49 U.S.C. 30122, provided that the entity does not disable the TPMS malfunction indicator.

### TIRE PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent failure.		
Loose	B	Require repair or replacement
Missing (Non-OE Wheel and/or Tire Applications)	2	Suggest replacement if appropriate sensor is available
Missing (OE Wheel and Tire Applications)	C	Replacement Required
Not Responding	Further inspection required	
<b>NOTE:</b> If sensor does not Wake Up, follow manufacturers recommended diagnostic procedure to determine cause		

### TIRES

**NOTE:** These guidelines do not apply to split rims. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. Consult the vehicle owner's manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association. When replacing tires, it is suggested that the replacement tires match or

exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle. Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule. Do not mix size or type (Run Flat, all season, performance, mud and snow) of tires on the same axle. If any flammable emergency tire inflation product has been used on a tire, consult inflation product, manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death. In some vehicles, changing the tire diameter from factory-equipped size can affect drive ability, as well as the performance of ABS and other vehicle systems. Consult the vehicle manufacturer's specifications.

Condition	Code	Procedure
Air pressure incorrect	B	Require repair
Bead broken	A	Require replacement
Bead leaking, caused by tire	A	Require repair or replacement
Bead wire/cord exposed	A	Require replacement
Cord or belt material exposed	A	Require replacement
Cord ply separations	A	Require replacement
Directional/asymmetrical tires mounted incorrectly	B	Require remounting and/or repositioning
Irregular tread wear, affecting performance	2	Suggest replacement
<b>NOTE:</b> <b>Determine and correct cause of irregular tire wear.</b>		
Load ratings less than OEM specifications	B	Require replacement
Mixed tread types (all season, performance, mud and snow) on same axle	A	Require replacement
Number of punctures exceeds manufacturer's limit	B	Require replacement
Out of balance	B	Require rebalance of tire/wheel assembly
Ply separation	A	Require replacement
Pull or lead, caused by tire	A	Require repair or replacement
Radial and bias or bias-belted ply tires on same axle	B	Require repair or replacement
Radials are on the front and not on the rear	B	Require repair or replacement
<b>NOTE:</b> <b>If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.</b>		
Run flat damage	A	Require replacement
Shoulder cut	A	Require replacement
Shoulder puncture	A	Require replacement
Shoulder with plug	A	Require replacement
Sidewall bulge	A	Require replacement
Sidewall cut	A	Require replacement
Sidewall indentation	No service required or suggested	

Condition	Code	Procedure
Sidewall puncture	A	Require replacement
Sidewall with plug	A	Require replacement
Speed rating designations different on same axle	2	Suggest rotation or replacement
Tire and wheel assembly has excessive run-out	B	Require repair or replacement of appropriate part
<p><b>NOTE:</b>  <b>Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.</b></p>		
Tires with excessive diameter difference on an all-wheel drive vehicle or four-wheel drive vehicle	B	Require replacement
<p><b>NOTE:</b>  <b>Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4" diameter difference.</b></p>		
Tires with excessive diameter difference on the same side of a dual-wheel application	B	Require replacement
<p><b>NOTE:</b>  <b>Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4" diameter difference.</b></p>		
Tread area puncture larger in diameter than manufacturer's specifications	B	Require replacement
Tread missing pieces (chunking), exposing cord	A	Require replacement
Tread missing pieces (chunking), not exposing cord	1	Suggest replacement
Tread separations	A	Require replacement
Tube in tubeless tire	3	Suggest removal of tube
<p><b>NOTE:</b>  <b>Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel . Assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and! Or wheel listed in these guidelines.</b></p>		
Weather-checking	No service required or suggested	
Worn to tread wear indicators	B	Require replacement

## VALVE STEMS

**NOTE:** Most tire manufacturers suggest replacement of non-TPMS valve stems any time a new tire is installed. For TPMS valve stems, the manufacturer may require replacement of the valve stem, o-ring seals, washers, gaskets, valve cores, compression washers and/or locking nut.

Condition	Code	Procedure
Bent	2	Suggest replacement
Broken	A	Require replacement



Condition	Code	Procedure
Cap seized	A	Require repair or replacement
Cut, but not leaking	1	Suggest replacement
Deteriorated (cracking, dry rot)	1	Suggest replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
O-Ring leaking	A	Require replacement of O-Ring
Threads damaged	A	Require repair or replacement
Threads stripped	A	Require replacement
Valve cap missing	C	Require replacement of cap

#### WHEEL ATTACHMENT HARDWARE

**NOTE:** For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. **DO NOT** lubricate threads unless specified by the vehicle manufacturer.

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement
<b>NOTE:</b> Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.		
Locking lug nut locking groove damaged	A	Require replacement
Loose	A	Require repair or replacement of affected component
Lug nut installed backward	B	Require repair or replacement
Lug nut mating surface distorted	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut missing	C	Require replacement
Lug nut rounded	A	Require replacement of nut
<b>NOTE:</b> Only required if removing wheel.		
Lug nut seized	A	Require replacement of nut
<b>NOTE:</b> Only required if removing wheel.		
Stud incorrect	B	Require replacement of stud
Stud missing	C	Require replacement
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped	A	Require replacement of component with stripped threads

#### WHEEL BEARINGS, RACES AND SEALS

**NOTE:** When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets.

Determine the need to replace based upon the individual component conditions that follow.

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible If proper adjustment cannot be obtained, require replacement of bearing and race assembly
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly or other damage affecting performance.	B	Require replacement of bearing and race assembly
Seal leaking	A	Require replacement of seal and inspection of bearings
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.		
Seal missing	C	Require replacement

## WHEEL & TIRE SUPPLEMENT

Steering and suspension are complex systems made up of a variety of interdependent components. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed. Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

**NOTE:** When replacing steering and/or suspension components that may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

**CAUTION:** Do not use ride height altering or load compensating components, such as variable rate springs and coil over shocks, on vehicles with height or load sensing proportioning valve-equipped braking systems, unless these components are original equipment.

**NOTE:** Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.

**WARNING:** These guidelines do not apply to split rims.

## TIRES

When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle.

Consult the vehicle owner's manual or vehicle placard for correct tire size, service description, load index, speed rating and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association ([www.us-tra.org](http://www.us-tra.org))

When replacing fewer than ALL tires on a vehicle, follow the vehicle manufacturer's recommendations as to the placement of the new tires. If it is not possible to follow the vehicle manufacturer's tire replacement recommendations, remember to replace tires on the same axle with the same size, construction, speed rating, and, if possible, similar tread pattern.

Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and non-radial tires are mixed on the same vehicle, the radials must be on the rear. If radial and non-radial tires are used on a vehicle equipped with dual rear tires, radial tires may be used on either axle. High-pressure temporary compact spare tires are exempt from this rule.

Do not mix size or type (all season, performance, mud and snow) of tires on the same axle. When replacing only two tires on front or rear drive vehicles, follow the vehicle manufacturer's recommendations concerning placement. If it is not possible to follow OE recommendations, it is preferable to place the two new tires on the rear for greater stability, greater adhesion affecting steering - on other than dry pavement -- and overall safety, regardless of whether the vehicle is front or rear wheel drive.

It is particularly important to match all tire sizes and constructions on 4-wheel (4x4) and all-wheel (AWD) drive vehicles unless otherwise specified by vehicle manufacturer. Ideally, all four tires should be replaced at the same time. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes.

## **MOUNTING TIRES**

Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels.

Mount tires only on same or approved rim widths.

Attempting to mount a tire of one diameter on a wheel of a different diameter , bead taper or flange type may result in serious injury or death.

If any flammable emergency tire inflation product has been used in a tire, consult inflation product manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death.

## **VEHICLE TIRE PLACARD**

Since 1968, cars and light trucks sold in the United States have been required to have a tire information sticker, called a vehicle tire placard. The vehicle tire placard indicates the size of the original equipment tires (including the spare), cold inflation pressure for the tires on both axles as well as the spare, and load index or range. Depending on the vehicle, the vehicle tire placard will either be located on the edge of any door, the doorpost, glove box, fuel door or inside trunk lid. If the tire placard is missing, consult the owner's manual, vehicle manufacturer, or tire manufacturer regarding applicable tire information.

Always refer to the vehicle manufacturer's recommendations before replacing tires. Tires should always be replaced with the same size designation, or approved options, as recommended. Never choose a smaller size with less load carrying capacity than the size on the tire placard. (Some vehicle manufacturers require different-sized tires for either the front or rear axles.)

**NOTE:**        **It is not always possible to select a replacement tire with exactly the same size as shown on the placard. Consult with a vehicle or tire manufacturer for replacement recommendations.**

# Vehicle Placard



**Fig. 12: Vehicle Tire Placard - Typical**

## TIRE ROTATION

The front tires on most vehicles tend to wear out faster than the rear tires. This is due to the effects of steering the vehicle and the weight transfer that occurs during braking. To ensure that all four tires wear evenly, it is important to rotate them on a regular basis. Tire rotation helps maintain balanced handling because it allows all four tires to wear at the same rate. Keep in mind, as tire wear reduces tread depth, it increases the tires' response to driver inputs. Consequently, by equalizing tire wear at all four corners, dry road performance is actually enhanced. Another advantage of regular rotation is that it allows the tires to be replaced in complete sets rather than in pairs. This maintains handling continuity. It also enables drivers to take advantage of the latest in tire technology, instead of trying to match a pair of older tires.

Most manufacturers list rotation intervals in the scheduled maintenance section of the vehicle service manual and/or the owner's manual. Tire rotation patterns can also be found in these books. If this information is unavailable for a particular vehicle, rotate the tires every 5-7,000 miles following the appropriate rotation sequence shown in the illustrations. After completing a tire rotation, be sure to reset inflation pressures to the manufacturer's recommended specifications indicated on the vehicle tire placard.

To ensure that the proper amount of clamping force is applied to each fastener, follow these guidelines:

- Make sure the area around the lug holes, as well as the wheel and hub mating surfaces are clean and dry. A wire brush can be used to remove corrosion and other debris. Wipe the areas clean using a shop rag.
- Inspect the bolt holes for damage. Do not use a wheel if the bolt holes are deformed.
- Inspect the wheel studs and lug nuts or lug bolts and bolt holes (depending on the vehicle) for damage. Replace or repair any damaged or worn components.
- Always follow a star pattern when tightening lugs.

## WHEEL LUG NUT TORQUE & CLAMPING FORCE

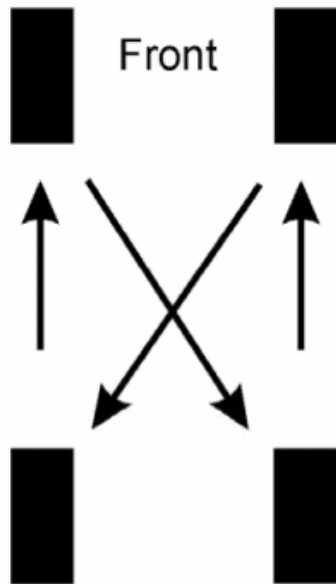
Although proper wheel lug nut torque is important, it does not guarantee that the required clamping force will be achieved. For example, excessive corrosion on the wheel and hub mating surfaces will result in improper clamping force, even when the lugs are tightened with a calibrated torque wrench. Low clamping force can also occur if the threads are dirty. This is because dirt causes interference between the mating threads. As a result, the torque wrench will register the correct reading but the clamping force will be inadequate. To improve the chances of achieving the precise clamping force between the wheel and hub, proper torque must be applied to clean components in good condition. Specifications for wheel lug nut torque can be found in the 'Tire and Wheel' section of most vehicle

service manuals. When specifications are indicated as a range, adjust the torque wrench to the middle of the range to compensate for normal variations in tool calibration.

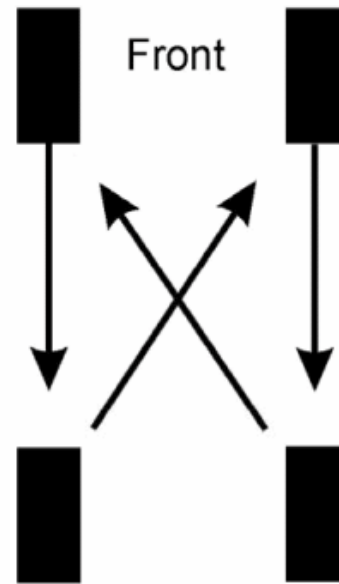
## POPULAR TIRE ROTATION PATTERNS

### POPULAR TIRE ROTATION PATTERNS (Only Where Tires Are Same Type & Size)

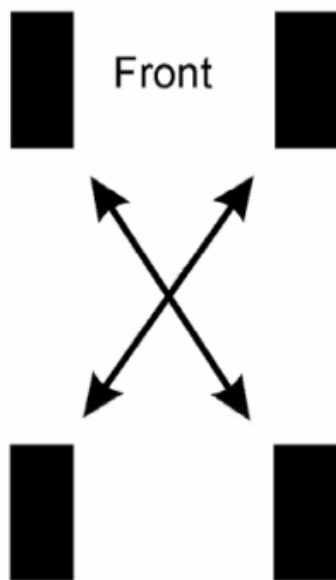
#### Rear- and Four- Wheel-Drive Vehicles



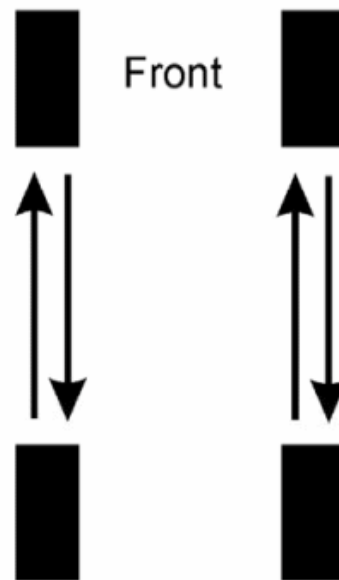
#### Front-Wheel-Drive Vehicles



#### All Vehicles



#### All Vehicles

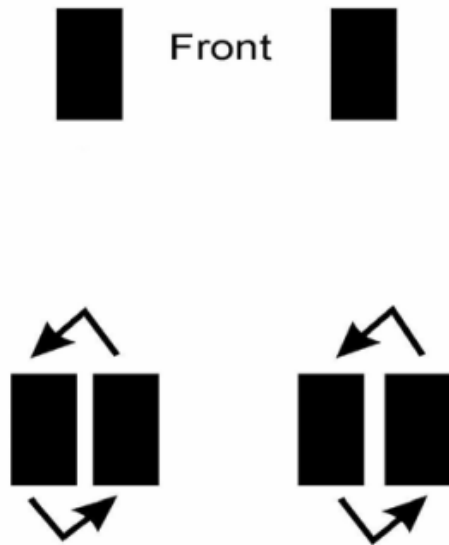


**Fig. 13: Popular Tire Rotation Patterns - Without Dual Rear Wheels**

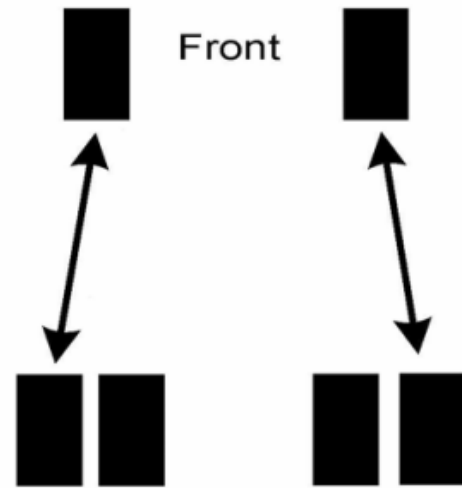
Never rotate directional tires from side-to-side since this will reverse their direction of rotation. Directional tires can only be rotated from front to rear or vice versa. Directional tires are typically used on high-performance cars and can be identified by the arrows imprinted on the sidewall.

# Vehicles With Dual Rear Wheels

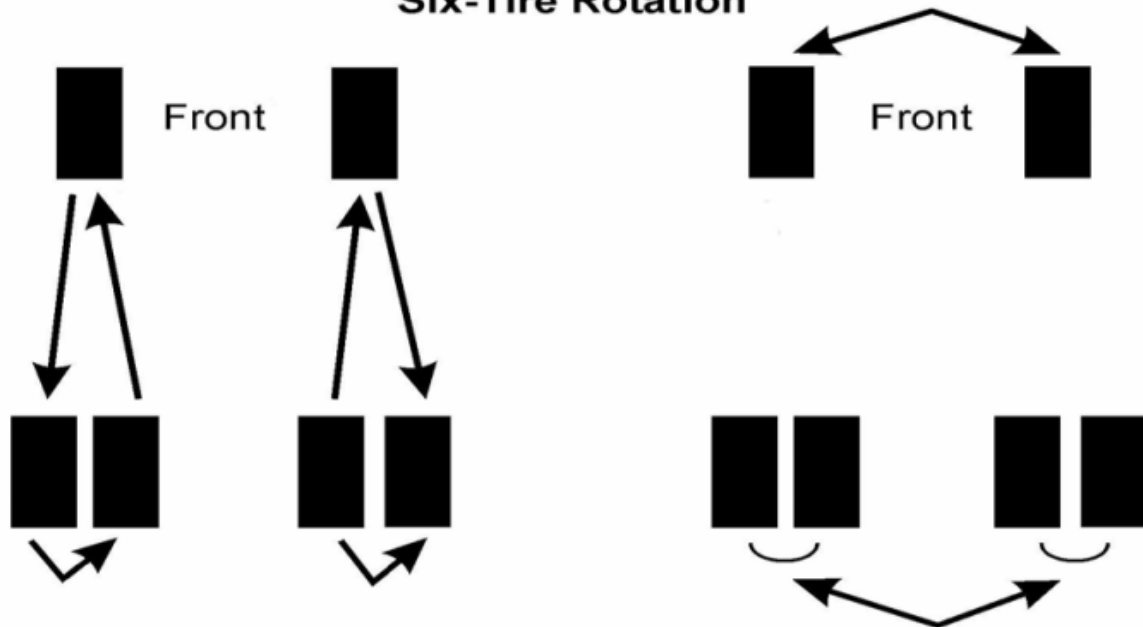
## Rear Tire Irregular Wear



## Front Tire Irregular Wear



## Six-Tire Rotation



**Fig. 14: Popular Tire Rotation Patterns - With Dual Rear Wheels**

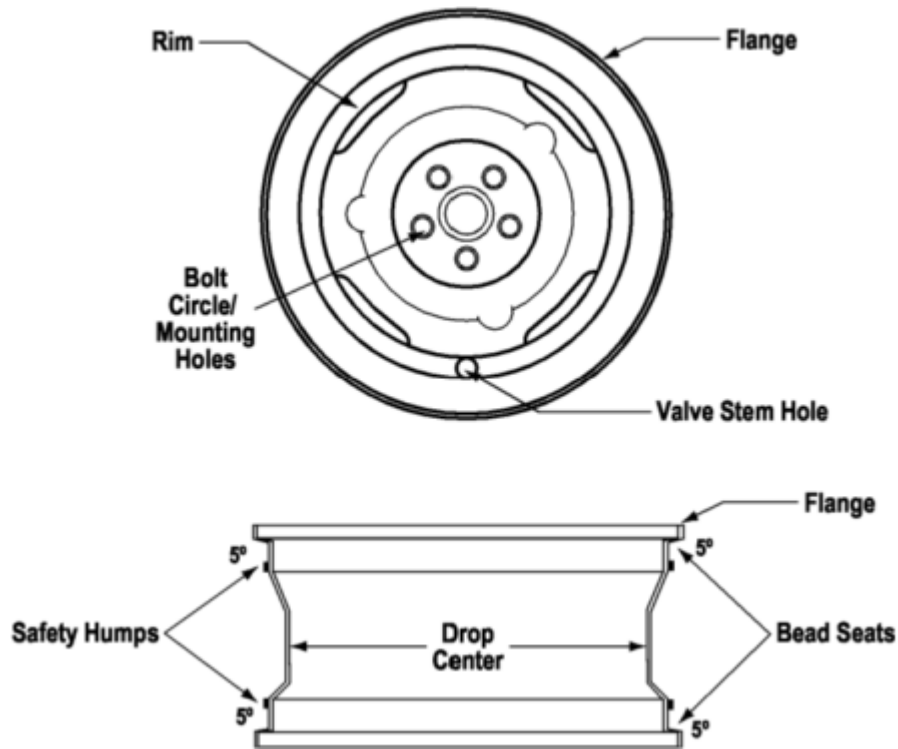
Some tires cannot be rotated in the manners described. Such tires include uni-directional tires and tires with asymmetric tread designs. Also, some vehicles may have different-sized tires mounted on the front and rear axles, and these different-sized tires also have rotation restrictions. Check your owner's manual or with a tire manufacturer or a tire dealer for proper recommendations for these specific cases.

## **WHEELS AND RIMS**

The wheels on today's vehicles are made of steel, aluminum, or aluminum alloy (a combination of two or more metals). Steel wheels are the least expensive to produce, which is why they come as original equipment on many passenger cars and light trucks. The center section includes the bolt circle, or mounting holes, and is used to attach the wheel to the vehicle. The flange is the outermost lip of the rim, and is the area typically used for attaching wheel (balancing) weights. The rim is formed by rolling a strip of metal and then welding the two ends together. The interior section of the rim has a smaller diameter section called a drop center. This area provides the means for removing and installing a tire, since the bead is not designed to stretch. During removal or installation, most of the tire bead is pushed into the drop center so that the exposed portion can be pulled over the rim. The edges of the rim are flared to form the bead seats, which hold the tire and provide the airtight seal. Many rims include safety humps. These are small elevations on the inside of the bead seats. Safety humps help prevent the tire



from falling into the drop center during a blowout. This allows the driver to maintain better directional control of a vehicle running on one or more deflated tires.



**Fig. 15: Steel Wheel**

**WARNING:** Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Mount tires only on approved rim widths. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Load, cold inflation pressure, and tire construction forces imposed on the rim/wheel must not exceed the rim/wheel manufacturer's recommendations, even if the tire is approved for a higher load or inflation. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.

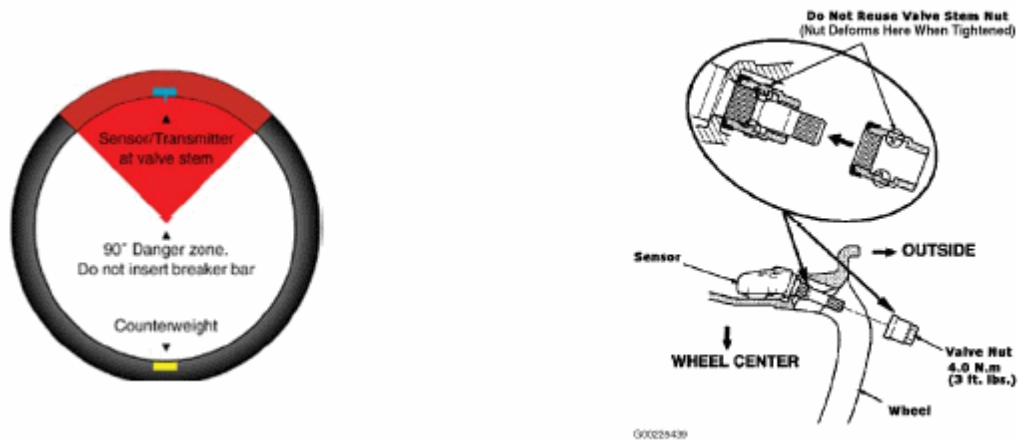
### TIRE PRESSURE MONITORING SYSTEMS

To avoid damaging sensors when mounting and demounting tires, it is beneficial to know where the sensors are located. Sensor assemblies are commonly attached to the valve stem, with the valve stem acting as an antenna to assist with transmitting RF signals. They may also be strapped to the drop center of the wheel. If this is the case, the sensor assembly should be located in-line with the valve stem.



**Fig. 16: Valve Stem Mounted Sensor**

To avoid damaging sensors when demounting tires, do not break the bead within 45° of either side of sensor assembly locations. Be careful not to damage sensors when mounting tires as well. Sensors are not repairable and require replacement if damaged or when their battery is completely drained. It is recommended that the sensor be carefully "dropped into the tire" prior to demounting to avoid damage.



**Fig. 17: Mounting Sensor**

When reinstalling the sensor, it is suggested that the locknut, gasket and valve stem be replaced and torqued to the proper specification. It is also necessary to use the proper valve cap as it is also an integral part of the system.

It may be necessary to reprogram the TPMS when the tires are rotated, when a new sensor is installed, or after the vehicle loses power. This usually requires a scan tool and may involve the use of a special magnet. Refer to the vehicle service manual to properly reprogram the TPMS.

## **WHEELS & TIRES CHECKSHEET**



## WHEELS & TIRES CHECKSHEET

Date: \_\_\_\_\_

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_

Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_

Mileage: \_\_\_\_\_ License: \_\_\_\_\_ VIN: \_\_\_\_\_ Eng Code: \_\_\_\_\_

**Customer Interview:**

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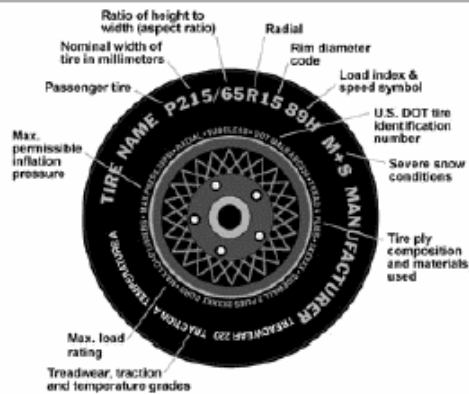
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**Reason Code Explanation**

- | <u>Code</u>                      | <u>Reason</u>   |
|----------------------------------|---|
| <b><u>Required</u></b>           |   |
| A                                | Part No Longer Performs Intended Purpose  |
| B                                | Part Does Not Meet A Design Specification (Regardless Of Performance)                   |
| C                                | Part Is Missing   |
| <b><u>Suggested/Optional</u></b> |   |
| 1                                | Part Is Close To The End Of Its Useful Life   |
| 2                                | To Address A Customer Need, Convenience Or Request                                      |
| 3                                | To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer |
| 4                                | Technician's Recommendation Based On Substantial And Informed Experience                |
| 5                                | To Comply With Maintenance Recommended By AMRAMAP                                       |



Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: [www.motorist.org](http://www.motorist.org)

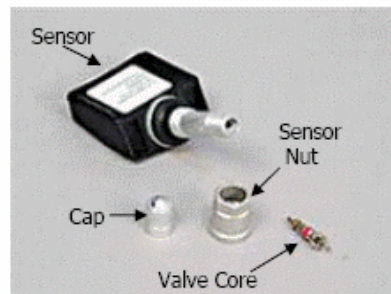
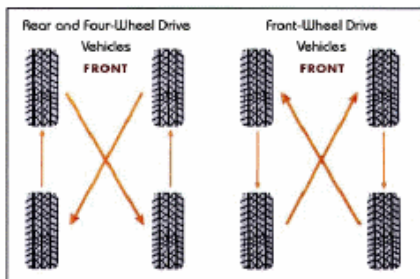
DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

**Fig. 18: Wheels & Tires Checksheet (1 Of 2)**

# WHEELS & TIRES CHECKSHEET

LEFT FRONT				
Component	OK	S	R	Condition
Lugs/Studs				
Tire Size				Spec _____
Speed Rating _____				Actual _____
Run Flat				Y _____ N _____
Tread Depth				_____/32nds
Tire Pressure				Before _____
Placard _____				After _____
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition)				Spec _____
Wheel Size				Actual _____
<input type="checkbox"/> Edge wear <input type="checkbox"/> Cupped <input type="checkbox"/> Cut <input type="checkbox"/> Irregular wear				

RIGHT FRONT				
Component	OK	S	R	Condition
Lugs/Studs				
Tire Size				Spec _____
Speed Rating _____				Actual _____
Run Flat				Y _____ N _____
Tread Depth				_____/32nds
Tire Pressure				Before _____
Placard _____				After _____
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition)				Spec _____
Wheel Size				Actual _____
<input type="checkbox"/> Edge wear <input type="checkbox"/> Cupped <input type="checkbox"/> Cut <input type="checkbox"/> Irregular wear				



LEFT REAR				
Component	OK	S	R	Condition
Lugs/Studs				
Tire Size				Spec _____
Speed Rating _____				Actual _____
Run Flat				Y _____ N _____
Tread Depth				_____/32nds
Tire Pressure				Before _____
Placard _____				After _____
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition)				Spec _____
Wheel Size				Actual _____
<input type="checkbox"/> Edge wear <input type="checkbox"/> Cupped <input type="checkbox"/> Cut <input type="checkbox"/> Irregular wear				

RIGHT REAR				
Component	OK	S	R	Condition
Lugs/Studs				
Tire Size				Spec _____
Speed Rating _____				Actual _____
Run Flat				Y _____ N _____
Tread Depth				_____/32nds
Tire Pressure				Before _____
Placard _____				After _____
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition)				Spec _____
Wheel Size				Actual _____
<input type="checkbox"/> Edge wear <input type="checkbox"/> Cupped <input type="checkbox"/> Cut <input type="checkbox"/> Irregular wear				

OK   
 Suggested 1, 2, 3, 4, 5   
 Required A, B, C   
 Automotive Maintenance & Repair Assn © 2009

**Fig. 19: Wheels & Tires Checksheet (2 Of 2)**

## WHEEL & TIRE - UICS

### TIRE PRESSURE MONITORING SYSTEM

**NOTE:** A Tire Pressure Monitoring System (TPMS) is designed to detect and alert the driver should the air pressure level in one or more of the vehicle's tires, up to all four tires, fall below the manufacturer's recommended inflation pressure or another pre-set level.

**NOTE:** NHTSA does not consider installation of an aftermarket or replacement tire or rim that is not compatible with the TPMS to be a "make inoperative" situation under 49 U.S.C. 30122, provided that the entity does not disable the TPMS malfunction indicator.

### TIRE PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent failure.		
Loose	B	Require repair or replacement
Missing (Non-OE Wheel and/or Tire Applications)	2	Suggest replacement if appropriate sensor is available
Missing (OE Wheel and Tire Applications)	C	Replacement Required
Not Responding	Ã,Â	Further inspection required
<b>NOTE:</b> If sensor does not Wake Up, follow manufacturers recommended diagnostic procedure to determine cause		

## TIRES

**NOTE:** These guidelines do not apply to split rims. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. Consult the vehicle owner's manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association. When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle. Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule. Do not mix size or type (Run Flat, all season, performance, mud and snow) of tires on the same axle. If any flammable emergency tire inflation product has been used on a tire, consult inflation product, manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death. In some vehicles, changing the tire diameter from factory-equipped size can affect drive ability, as well as the performance of ABS and other vehicle systems. Consult the vehicle manufacturer's specifications.

Condition	Code	Procedure
Air pressure incorrect	B	Require repair
Bead broken	A	Require replacement
Bead leaking, caused by tire	A	Require repair or replacement
Bead wire/cord exposed	A	Require replacement
Cord or belt material exposed	A	Require replacement

Condition	Code	Procedure
Cord ply separations	A	Require replacement
Directional/asymmetrical tires mounted incorrectly	B	Require remounting and/or repositioning
Irregular tread wear, affecting performance	2	Suggest replacement
<b>NOTE:</b> <b>Determine and correct cause of irregular tire wear.</b>		
Load ratings less than OEM specifications	B	Require replacement
Mixed tread types (all season, performance, mud and snow) on same axle	A	Require replacement
Number of punctures exceeds manufacturer's limit	B	Require replacement
Out of balance	B	Require rebalance of tire/wheel assembly
Ply separation	A	Require replacement
Pull or lead, caused by tire	A	Require repair or replacement
Radial and bias or bias-belted ply tires on same axle	B	Require repair or replacement
Radials are on the front and not on the rear	B	Require repair or replacement
<b>NOTE:</b> <b>If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.</b>		
Run flat damage	A	Require replacement
Shoulder cut	A	Require replacement
Shoulder puncture	A	Require replacement
Shoulder with plug	A	Require replacement
Sidewall bulge	A	Require replacement
Sidewall cut	A	Require replacement
Sidewall indentation	Ã, Â	No service required or suggested
Sidewall puncture	A	Require replacement
Sidewall with plug	A	Require replacement
Speed rating designations different on same axle	2	Suggest rotation or replacement
Tire and wheel assembly has excessive run-out	B	Require repair or replacement of appropriate part
<b>NOTE:</b> <b>Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.</b>		
Tires with excessive diameter difference on an all-wheel drive vehicle or four-wheel drive vehicle	B	Require replacement
<b>NOTE:</b> <b>Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4" diameter difference.</b>		
Tires with excessive diameter difference on the same side of a dual-wheel application	B	Require replacement
<b>NOTE:</b> <b>Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4" diameter difference.</b>		



Condition	Code	Procedure
Tread area puncture larger in diameter than manufacturer's specifications	B	Require replacement
Tread missing pieces (chunking), exposing cord	A	Require replacement
Tread missing pieces (chunking), not exposing cord	1	Suggest replacement
Tread separations	A	Require replacement
Tube in tubeless tire	3	Suggest removal of tube
<p><b>NOTE:</b>  <b>Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel . Assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and! Or wheel listed in these guidelines.</b></p>		
Weather-checking	Ã, Â	No service required or suggested
Worn to tread wear indicators	B	Require replacement

## WHEEL ALIGNMENT

**NOTE:** Wheel alignment is defined as the measurement, analysis, and adjustment of steering and suspension angles to conform to manufacturer specifications. These angles usually include, but are not limited to: caster, camber, toe, and thrust angle. Where these angles are not adjustable and not in specification, component replacement or correction kits may be required. Errors in set-back and steering axis inclination (SAI) are often attributable to failed or damaged components and must be corrected prior to performing an alignment. Failure to replace or correct suggested parts or service may prevent a proper alignment. Before performing an alignment check, inspect and verify the following: Tire pressure and size . Vehicle loading . Ride height . Steering and suspension parts only if the inspection reveals that all the above are within published specifications, a wheel alignment check and a proper wheel alignment, if needed, may be performed. Under no circumstances should a technician bend or heat any steering or suspension component, unless specified by the vehicle manufacturer. All measurements and specifications must be noted on the inspection report.

Condition	Code	Procedure
Beyond manufacturer's service interval	3	Suggest alignment check
Dog tracking, shown to be caused by faulty alignment	2	Suggest repair
Drift, shown to be caused by faulty alignment	A	Require alignment
Lead, shown to be caused by faulty alignment	A	Require alignment
Outside manufacturer's specifications	B	Require repair
Part has been changed, affecting alignment	A	Require alignment check
Pull, shown to be caused by faulty alignment	A	Require alignment
Steering wheel off-center	2	Suggest alignment
Tire wear, shown to be caused by faulty alignment	A	Require alignment
Wander, shown to be caused by faulty alignment	A	Require alignment

## WHEEL ATTACHMENT HARDWARE

**NOTE:** For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

Condition	Code	Procedure
Bent	A	Require replacement

Condition	Code	Procedure
Broken	A	Require replacement
<b>NOTE:</b> Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.		
Locking lug nut locking groove damaged	A	Require replacement
Loose	A	Require repair or replacement of affected component
Lug nut installed backward	B	Require repair or replacement
Lug nut mating surface distorted	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut missing	C	Require replacement
Lug nut rounded	A	Require replacement of nut
<b>NOTE:</b> Only required if removing wheel.		
Lug nut seized	A	Require replacement of nut
<b>NOTE:</b> Only required if removing wheel.		
Stud incorrect	B	Require replacement of stud
Stud missing	C	Require replacement
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped	A	Require replacement of component with stripped threads

## WHEELS (RIMS)

**NOTE:** Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.

Condition	Code	Procedure
Bead leaking, caused by wheel	A	Require repair or replacement
<b>NOTE:</b> Do not attempt to correct a bent rim.		
Bent hub mounting surface	A	Require replacement
Bent rim, causing vibration	2	Suggest replacement
<b>NOTE:</b> Do not attempt to correct a bent rim.		
Broken	A	Require replacement
Cast wheel porous, causing a leak	A	Require repair or replacement
Clip-on balance weight is incorrect type for rim flange	2	Suggest replacement of weight
Corrosion affecting structural integrity	A	Require replacement
Corrosion build-up on wheel mounting surface	A	Require repair
Cracked	B	Require replacement

Condition	Code	Procedure
Directional/asymmetrical wheels mounted incorrectly	B	Require remounting and/or repositioning
Load capacity less than OEM specifications	B	Require replacement
Mating surface distorted	A	Require replacement
Offset mismatched on same axle	B	Require replacement
Rivets leaking	A	Require replacement
Run-out beyond OEM specs	B	Require replacement
<b>NOTE:</b> <b>Some wire-spoke wheels may be repaired.</b>		
Stud holes elongated	A	Require replacement
<b>NOTE:</b> <b>Inspect wheel attaching hardware for damage.</b>		
Welded or brazed repair	2	Suggest replacement
Welds leaking	A	Require replacement
Wheel centering (pilot) hole incorrect	B	Require replacement

## REASON CODE EXPLANATION

Code	Reason
<b>Required</b>	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification ( Regardless Of Performance)
C	Part Is Missing
<b>Suggested/Optional</b>	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

## AUTOMOTIVE TERMINOLOGY & DEFINITIONS

### ABRASIVE CLEANING

removing contaminants using a cleaning agent containing abrasive material. Cleaning that requires physical abrasion (e.g., glass bead blasting, wire brushing).

### ADDITIVE

in automotive terminology, a substance added to a liquid, such as engine oil, transmission fluid, gear oil or coolant to enhance its properties.

### AEROSOL

a cloud consisting of particles dispersed in a gas or gases

### AFTERMARKET

broad term that applies to any change after the original purchase, such as adding equipment. When applied to AFVs, it refers to conversion devices or kits for conventional fuel vehicles.

## **ALIGNMENT**

an adjustment to bring parts or components into a line or proper coordination.

## **ALTERNATOR**

a belt driven device that provides electrical current for the vehicle's charging system.

## **ANTIFREEZE**

a material such as ethylene glycol which is added to water to lower its freezing point; used in an automobile's cooling system.

## **AQUAPLANING**

the loss of traction that results when a tire loses sufficient grip on a wet roadway, the tire actually loses contact with the road surface and rides on a thin film of water.

## **AUTOMATIC TRANSMISSION FLUID (ATF)**

the oil that is used in an automatic transmission.

## **BATTERY ACID**

the sulfuric acid solution used as the electrolyte in a battery.

## **BATTERY CELL**

the part of a battery made from two dissimilar metals and an acid solution. A cell stores chemical energy to be used later as electrical energy.

## **BATTERY SAVER**

the battery saver system is an effective way to prevent complete battery discharge when the engine is shut down. Based on the preset time-limit, the system automatically disconnects the battery load when the battery is not being charged. Depressing the reset push button will enable the battery to be reconnected for additional periods of time. Critical systems can be set up to have battery power maintained.

## **BATTERY**

batteries are the principal energy storage devices for hybrid electric vehicles (HEVs). Desirable attributes of high-power batteries for HEV applications are high-peak and pulse-specific power, high specific energy at pulse power, a high charge acceptance to maximize regenerative braking utilization, and long calendar and cycle life. Developing methods/designs to balance the packs electrically and thermally, developing accurate techniques to determine a battery's state of charge, and developing abuse-tolerant batteries, and recyclability are additional technical challenges.

## **BEARING RACE**

the machined surface of a bearing assembly against which the needles, balls or rollers ride. The outer race is also called a cup.

## **BEARING**

part that supports and reduces friction between a stationary and moving part or two moving parts.

## **BLEEDER VALVE**

a valve located on disc brake calipers, wheel cylinders and some master cylinders that allows air and fluid to be removed from the brake system.

## **BOILING POINT**

the temperature at which a liquid turns to vapor.

## **BRAKE DRAG**

a condition that occurs when brake pads or shoes are in continuous contact with the disc brake rotors or brake drums.

## **BRAKE FLUSHING**

a procedure to clean the brake hydraulic system with fresh, clean fluid that should be performed whenever new parts are installed, if there is any doubt as to the grade of fluid in the system, if a glycol fluid has been mixed with a silicone-based fluid, or if the fluid has been contaminated with petroleum or mineral based fluids.

## **BRAKE HOSE**

flexible hoses that connect the brake lines on the chassis with the calipers or wheel cylinders, or the junction block on a solid axle.

## **BRAKE LINE**

metal tubing that carries the brake fluid from the master cylinder to other brake system components.

## **CHARGE**

the electrical current that passes through the battery to restore it to full power; to fill, or bring up to the specific level, an A/C system with refrigerant; the required amount of refrigerant for an A/C system.

## **CHARGING SYSTEM**

the system that supplies electrical power for vehicle operation and recharges the battery.

## **CHEMICAL CLEANING**

relies primarily on chemical action to remove dirt, grease, scale, paint or rust.

## **COLD CRANKING AMPS**

the amount of cranking amperes that a battery can deliver in 30 seconds at  $0^{\circ}\text{F}$  ( $-18^{\circ}\text{C}$ ).

## **COLD START**

difficulty of starting an internal combustion engine in cold weather because of gasoline, which evaporates more slowly when it is cold; oil, which gets thicker in cold weather; and the chemical reactions inside the battery, which progress more slowly in cold weather.

## **CONDENSER**

a device, similar to a radiator, in which the refrigerant loses heat and changes state from a high-pressure gas to a high pressure liquid as it dissipates heat to the surrounding air.

## **COOLANT**

the mixture of water and antifreeze used in an engine's cooling system to maintain the engine's temperature throughout its operating range.

## **COOLING FAN**

a mechanically or electrically driven propeller that draws air through the radiator.

## **COOLING SYSTEM**

the system used to remove excess heat from an engine and transfer it to the atmosphere. Includes the radiator, cooling fan, hoses, water pump, thermostat and engine coolant passages.

## **CORE PLUGS**

plugs that fill holes in a block or head left from the casting process. Also called freeze, welsh or expansion plugs.

## **CORE**

in automotive terminology, the main part of a heat exchanger, such as a radiator, evaporator or heater. Usually made of tubes, surrounded by cooling fins, used to transfer heat from the coolant to the air.

## **CORROSION INHIBITORS**

additives used to inhibit corrosion (e.g., rust) in the fuel system.

## **CROSSFLOW RADIATOR**

a radiator in which coolant enters on one side, travels through tubes, and collects on the opposite side (see downflow radiator).

## **DIFFERENTIAL**

gear assembly that transmits power from the driveshaft to the wheels; allows the outside wheel to turn faster than the inside when cornering.

## **DIGITAL VOLT/OHMMETER (DVOM)**

an instrument that measures volts, ohms and amps and displays the results numerically.

## **DIRECTIONAL TIRE**

tire with a tread pattern that is designed to give maximum traction by removing water from under the tread in such a way as to minimize the risk of aquaplaning. Directional tires must be installed to turn in a specific direction.

## **DOWNFLOW RADIATOR**

a radiator in which coolant enters the top of the radiator and is drawn downward by gravity (see crossflow radiator).

## **DRIVETRAIN**

all of the components that generate power and transfer it to the vehicle's wheels.

## **DUAL MASTER CYLINDER**

a master cylinder that has one cylinder bore, but two pistons and two fluid reservoirs. Each piston applies hydraulic pressure to two wheels only. In the event one of the hydraulic circuits fails, the other provides enough braking power to stop the vehicle.

## **DUO-SERVO DRUM BRAKES**

a drum brake design that provides increased stopping power due to the servo or self-energizing action of the brake shoes.

## **EGR VALVE**

see 'exhaust gas recirculation (EGR) valve',

## **ELECTROLYTE**

a material whose atoms become ionized (electrically charged) in solution. In automobiles, the battery electrolyte is a mixture of sulfuric acid and water.

## **ELECTRONIC AIR SUSPENSION**



electronic air suspension provides the comfort of riding on air with adjustable spring rates and capability to change ride height and load-carrying ability. Under normal driving conditions, an electronic air suspension vehicle rides at the same height as a traditionally sprung vehicle. With a heavy load, ride height is increased automatically. On current vehicles, the suspension lowers the ride height by 20 mm at highway speeds for improved aerodynamics, with about 2 percent better fuel economy. Lower ride height also can improve on-center feel of steering due to the change in suspension geometry and increased caster angle.

## **ENGINE COOLANT TEMPERATURE (ECT) SENSOR**

a sensor which works by a negative coefficient thermistor that loses resistance as its temperature goes up (just like the intake air temperature sensor). When the computer applies its 5-volt reference signal to the sensor, this voltage is reduced through a ground circuit by an amount corresponding to the temperature of the engine coolant.

## **EVAPORATOR**

a heat exchanger, in which low-pressure refrigerant flows and changes state, absorbing heat from the surrounding air.

## **EXHAUST GAS RECIRCULATION (EGR)**

component in the EGR system, used to meter a controlled amount of exhaust gas into the intake air stream.

## **EXHAUST GAS RECIRCULATION (EGR) VALVE**

an emissions control technique that reuses engine exhaust gases as part of the intake air supply to help reduce harmful emissions (especially Nox).

## **FAHRENHEIT**

a scale of temperature measurement with the boiling point of water at 212 $\text{Å}$ , $\text{Å}$  $^{\circ}$ F. In the metric system, water's boiling point is 100 $\text{Å}$ , $\text{Å}$  $^{\circ}$ Celsius.

## **FAN CLUTCH**

a device attached to a mechanically driven cooling fan that allows the fan to freewheel when the engine is cold or the vehicle is driven at speed.

## **FAN SHROUD**

an enclosure that routes air through the radiator cooling fins.

## **FAN**

a mechanically or electrically driven propeller that draws or pushes air through the radiator, condenser, heater core or evaporator core.

## **FILTER**

a screen or filter element that can be made to filter specified sizes of particles from air or liquid.

## **FLOODING**

a condition in which unvaporized fuel in the intake manifold and/or combustion area, prevents the engine from starting.

## **FOOT POUND**

a unit of measurement for torque. One foot pound is the torque obtained by a force of one pound applied to a wrench handle that is 12-in. long; a unit of energy required to raise a weight of one pound, a distance of one foot.

## **FOUR STROKE CYCLE ENGINE**

an engine, either gasoline or diesel that uses four strokes: intake, compression, power and exhaust. A firing impulse occurs every two turns of the crankshaft. When this engine is a gasoline engine it is also called an Otto cycle engine after its inventor. A diesel engine is called a Diesel cycle engine for the same reason.

## **FREEZE PLUG**

another name for core plug.

## **FRONT WHEEL DRIVE**

the entire drivetrain is located at the front of and drives the front wheels of the vehicle.

## **FUSE**

a metal circuit protection device that melts when there is a circuit overload or short.

## **FUSIBLE LINK**

a smaller gauge wire that is included in an electrical circuit to provide circuit protection. The smaller gauge wire will melt when the circuit is overloaded.

## **GASKET**

a material such as artificial rubber, cork, or steel used to seal between parts that would otherwise leak fuel, coolant, lubricants or combustion gases.

## **GENERATOR**

a device that converts mechanical energy into electrical energy; SAE J1930 nomenclature for an alternator; a generating device that uses diode rectifiers to convert ac to dc.

## **HALF SHAFT**

transfers power from the transaxle to the front wheels on a front-wheel drive vehicle. Also used on some vehicles with rear-wheel drive and independent rear suspension to transfer power from the differential to the rear wheels. Consists of a stub shaft that is splined into the differential side gear, another stub shaft that is splined into the wheel hub, an interconnecting shaft, and two CV-joints, which connect the interconnecting shaft to the stub shafts.

## **HEATER CORE**

a radiator-like device used to heat the inside of a vehicle. Hot coolant is pumped through it by the water pump, and heat from the coolant moves from the heater core to the passenger compartment as the blower fan forces air through it.

## **HUB**

mounting point for the wheel on an axle or spindle; the part of the synchronizer assembly that is splined to the transmission shaft; the center part of a wheel, gear, etc., that rides on a shaft.

## **HYDRAULIC PRESSURE**

pressure exerted through a liquid.

## **HYDROMETER**

an instrument used to measure the specific gravity of a solution.

## **IMPEDANCE**

the total resistance of an electrical device measured in ohms.

## **INCH POUND**

one twelfth of a foot pound.

## **INDEPENDENT SUSPENSION**

a suspension in which each wheel can travel up and down without directly affecting the position of the opposite wheel.

## **INNER BEARING RACE**

inner part of a ball or roller bearing that provides a surface for the balls or rollers to rotate.

## **INTEGRATED CIRCUIT**

an electrical circuit containing many interconnected amplifying devices and circuit elements formed on a single body or chip of semiconductor material; diodes, transistors and other electronic components mounted on semiconductor material and able to perform numerous functions.

## **INTERCOOLER**

a component on some turbocharged engines used to cool the compressed intake air.

## **INTERNAL COMBUSTION ENGINE (ICE)**

engine that converts the energy contained in the fuel inside the engine into motion. Combustion engines use the pressure created by the expansion of the gases to do mechanical work.

## **JAM NUT**

a locknut.

## **KEEP-ALIVE MEMORY**

a series of vehicle battery-powered memory locations in the microcomputer that store information on input failure, identified in normal operations for use in diagnostic routines; adapts some calibration parameters to compensate for changes in the vehicle system.

## **LEAF SPRING**

a suspension spring consisting of a single flat plate made of steel or composite material or several steel plates bundled together.

## **LIGHT-DUTY VEHICLE**

passenger cars and trucks with a gross vehicle weight rating of 8,500 or less.

## **LIMITED SLIP DIFFERENTIAL**

a type of differential that uses clutches to supply a major portion of the drive torque to the wheel that has better traction when one wheel is slipping,

## **LITER (L)**

a metric measurement used to calculate the volume displacement of an engine. One liter is equal to 1,000 cubic centimeters or 61 cubic inches.

## **LUBRICATION**

the process of introducing a friction reducing substance between moving parts to reduce wear.

## **MACPHERSON STRUT**

the principal device in the suspension of the same name, in which the spring, shock absorber and sometimes the steering knuckle are combined in a single unit.

## **MALFUNCTION INDICATOR LIGHT (MIL)**

also known as the CHECK ENGINE or SERVICE ENGINE SOON light on many vehicles. The MIL comes on when the ignition is first turned on (to check the bulb) and then goes out once the engine is started, unless a trouble code is stored in the computer. If the MIL is on when the vehicle is running, there has been a malfunction on one of the sensor or actuator circuits monitored by the computer, and a diagnosis will have to be made by retrieving the code.

## **MASTER CYLINDER**

the primary fluid pressurizing device in some hydraulic systems. In automotive use, it is found in the brake and hydraulic clutch systems and is pedal-activated, either directly or through a vacuum assist unit.

## **MILLIMETER**

the base of metric size measurement. One millimeter equals 0.039370-in. One inch is equal to 25.4 m m.

## **MULTIVISCOSITY OIL**

chemically-modified oil that has been tested for viscosity at cold and hot temperatures.

## **OFF-ROAD**

any non-stationary device, powered by an internal combustion engine or motor, used primarily off the highways to propel, move, or draw persons or property, and used in any of the following applications: marine vessels, construction/farm equipment, locomotives, utility and lawn and garden equipment, off-road motorcycles, and off-highway vehicles.

## **OHM**

a unit of electrical resistance of a circuit in which an electromotive force of one volt maintains a current of one ampere, named after German physicist Georg Ohm.

## **OHMMETER**

an instrument that measures electrical resistance in ohms.

## **OHM'S LAW**

a basic law of electricity expressing the relationship between current, resistance and voltage in any electrical circuit. Ohm's law states that the voltage in a circuit is equal to the current multiplied by the resistance.

## **OIL COOLER**

device used to remove heat from the engine or transmission oil. There are oil-to-air coolers and oil coolers that are incorporated into the vehicle's cooling system.

## **OIL PAN**

the part that encloses the crankcase at the lower end of the block.

## **OIL PRESSURE**

the pressure that results from resistance to flow from the oil pump. As the pump turns faster, it produces more flow. A relief valve limits the amount of pressure it can produce.

## **ON-CAR BALANCING**

the practice of spinning a wheel on the car to balance the wheel and all other rotational components together.

## **ORIGINAL EQUIPMENT MANUFACTURER (OEM)**

the original manufacturer of a vehicle or engine.

## **OSCILLOSCOPE**

an instrument that displays electrical activity in the form of line patterns on a screen.

## **OUTER BEARING RACE**

outer part of a ball or roller bearing that provides a surface for the balls or rollers to rotate. Can be integral with the bearing or a separate part.

## **OXIDATION**

the process of combining with oxygen, resulting in rusting or burning. Rust is slow oxidation; fire is rapid oxidation.

## **PAG**

polyalkylene glycol oil (lubricant) used with A/C systems containing R-134a refrigerant.

## **PARALLEL CIRCUIT**

a circuit with more than one path for the current to follow.

## **PARKING BRAKE**

a system that applies the brakes mechanically through a series of linkages and cables. Depending on the vehicle, the parking brake system will either be actuated using a foot pedal or a hand-operated lever.

## **PASCAL'S LAW**

the law of physics stating that liquids are noncompressible, and that a force applied to the top of a liquid in a closed container is exerted equally in all directions.

## **PCV SYSTEM**

see 'positive crankcase ventilation system'.

## **PCV VALVE**

a part of the positive crankcase ventilation system. Meters crankcase vapors into the intake manifold.

## **PLAY**

the relative movement between or among parts.

## **POLARITY**

the condition of being positive or negative relative to a reference point or object; the particular state (positive or negative) with reference to the two magnetic poles.

## **POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM**

a system that controls crankcase emissions by using a valve to meter crankcase vapors into the intake manifold.

## **POWER BRAKES**

a system that uses vacuum or hydraulic pressure to assist the driver with brake application.

## **PSI**

measurement of pressure in pounds per square inch.

## **RADIAL RUNOUT**

the out-of-roundness of a wheel or tire.

## **RADIATOR CAP**

a device that seals the radiator and maintains a set pressure in the cooling system.

## **RADIATOR**

the part of the cooling system that acts as a heat exchanger, transferring heat to atmosphere. It consists of a core and holding tanks connected to the cooling system by hoses.

## **REAR WHEEL DRIVE**

system where the driveline drives the rear wheels of the vehicle. Most often the engine is located in the front of the vehicle and a transmission and drive shaft connect to a drive axle, however there are also systems where the entire drive line is located toward the rear of the vehicle.

## **REAR WHEEL STEERING**

a system used on some vehicles to change the toe of the rear wheels to either steepen a sharp turn or enhance cornering on a shallower, faster one.

## **RESISTOR**

an electrical device installed in a circuit to lower voltage and current flow.

## **RIDE HEIGHT**

the dimension between a fixed point on the vehicle and the pavement. The fixed point varies according to vehicle and manufacturer. Also called vehicle height.

## **RUNOUT**

wobble or deflection beyond a rotating part's normal plane of movement.

## **SCAN TOOL**

microprocessor designed to communicate with a vehicle's on-board computer system to perform diagnostic and troubleshooting functions.

## **SEMICONDUCTOR**

a material that is neither a good conductor of electricity nor a good insulator.

## **SENDING UNIT**

a mechanical, electrical, hydraulic or electromechanical device which transmits information to a gauge or other receiving unit.

## **SERIES CIRCUIT**

a circuit that has only one path for current to follow.

## **SERIES-PARALLEL CIRCUIT**

a circuit that combines series and parallel circuits.

## **SERVO**

a device, such as an electric motor or hydraulic piston, that is controlled by an amplified signal from a low power command device.

## **SHOCK ABSORBER**



a device used to dampen the oscillation of the suspension caused by irregularities in the road surface.

## **SHORT CIRCUIT**

a condition that occurs in an electrical circuit when the current bypasses the intended load and takes a path with little or no resistance, such as another circuit or ground.

## **SPECIFIC GRAVITY**

the ratio of the weight or mass of the given volume of a substance to that of an equal volume of another substance, e.g. - water for liquids and solids; air or hydrogen for gases, are used as standards.

## **SPONGINESS**

the feel of a soft or mushy brake pedal usually caused by trapped air in the hydraulic system.

## **SPRUNG WEIGHT**

the weight of all the vehicle components that are supported by the springs; see 'unsprung weight'.

## **STABILIZER BAR**

a torsion-bar spring connecting the suspension on either side of the vehicle. When a vehicle rolls to the side in a turn, the suspension at the outside wheel compresses and the suspension at the inside wheel extends. The stabilizer bar that connects them twists to apply a counteracting force to hold the vehicle closer to level. Also called an anti-roll bar or sway bar.

## **STARTER**

the electric motor that is used to start an engine.

## **STUD**

a fastener that has screw threads at both ends.

## **TECHNICAL SERVICE BULLETIN (TSB)**

information published by vehicle manufacturers that describe updated service procedures and service procedures that should be used to handle vehicle defects.

## **TENSIONER**

a device used with a timing chain or belt to maintain its tension.

## **THERMOSTAT**

a device installed in the cooling system that allows the engine to come to operating temperature quickly and then maintain a minimum operating temperature.

## **TIMING BELT**

a toothed reinforced belt used to drive the camshaft from a sprocket on the crankshaft.

## **TOLERANCE**

the difference between the allowable maximum and minimum dimensions of a mechanical part; the basis for determining the accuracy of a fitting.

## **TORQUE SEQUENCE**

a specified order in which a component's mounting bolts should be tightened

## **TORQUE WRENCH**

a breaker bar or ratchet wrench with an indicator that measure the twisting effort applied to a fastener during tightening.

## **TORQUE**

twisting effort on a shaft or bolt.

## **TWIN I-BEAM SUSPENSION**

a type of independent front suspension and used on light trucks and vans. It consists of two I-beams supported by coil springs, and the steering knuckles/spindles, which are connected by king pins or ball joints. The inner end of the axle connects to the vehicle frame through a rubber bushing. A radius arm also connects to the frame through rubber bushings to control wheelbase and caster.

## **UNIVERSAL JOINT (U-JOINT)**

a joint that allows the driveshaft to transmit torque at different angles as the suspension moves up and down.

## **UNSPRUNG WEIGHT**

the components of a vehicle that rest directly on the road surface without being supported by the suspension springs.

## **VACUUM**

a pressure lower than atmospheric.

## **VOLT**

unit of electromotive force. One volt of electromotive force applied steadily to a conductor of one-ohm resistance produces a current of one ampere.

## **VOLTAGE DROP**

voltage lost by the passage of electrical current through resistance.

## **VOLTMETER**

an instrument used to measure voltage in a circuit.

## **WATER PUMP**

a device used to circulate coolant through the engine.

## **WHEEL ALIGNMENT**

the adjustment of suspension and steering components to optimize steering control and minimize tire wear.

## **WHEEL BALANCE**

the condition in which a wheel/tire assembly has equal weight around its center, preventing vibration at high speeds. Wheel balance can be static, such as on a bubble balancer, or dynamic, such as with a spin balancer.

## **WHEEL WEIGHTS**

small weights, usually made of lead, attached either mechanically or by adhesive to a wheel/tire assembly to correct its balance.

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## UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

### Steering & Suspension Systems

## STEERING & SUSPENSION SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

### MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

#### **I. Our recommendations are based upon the following definitions.**

**System Failure** - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

**Preventive/Scheduled Maintenance** - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

**Improved System Performance** - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

**II. Training/Criteria** Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

#### **III. Appropriate Company Approved Inspection**

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

#### **IV. Written Estimates**

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

#### **V. Work Authorization**

No work will be performed without the customer's prior approval.

#### **VI. Limited Warranty**

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

#### **VII. Returned Parts**

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

## **VIII. Classification of Parts**

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

## **THE MAP PROCESS - OVERVIEW**

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site [www.motorist.org](http://www.motorist.org) or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 \* Fax: (202) 318-0378

## **THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS**

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p>A. Part no longer performs intended purpose</p> <p>B. Part does not meet a design specification (regardless of performance)</p> <p>C. Part is missing</p>	<p>1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.)</p> <p>2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.)</p> <p>3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM)</p> <p>4. Technician's recommendation based on substantial and informed experience</p> <p>5. To comply with maintenance recommended by AMRA / MAP</p>



Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
<p><b>NOTE:</b> When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.</p>	<p><b>NOTE:</b> Suggested services are <i>always</i> optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.</p>

## WHEEL AND TIRE

Steering and suspension are complex systems made up of a variety of interdependent components. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed. Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

**NOTE:** When replacing steering and/or suspension components that may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.

**CAUTION:** Do not use ride height altering or load compensating components, such as variable rate springs and coil over shocks, on vehicles with height or load sensing proportioning valve-equipped braking systems, unless these components are original equipment.

**NOTE:** Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.

**WARNING:** These guidelines do not apply to split rims.

## TIRES

When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle.

Consult the vehicle owner's manual or vehicle placard for correct tire size, service description, load index, speed rating and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association ([www.us-tra.org](http://www.us-tra.org))

When replacing fewer than ALL tires on a vehicle, follow the vehicle manufacturer's recommendations as to the placement of the new tires. If it is not possible to follow the vehicle manufacturer's tire replacement recommendations, remember to replace tires on the same axle with the same size, construction, speed rating, and, if possible, similar tread pattern.

Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and non-radial tires are mixed on the same vehicle, the radials must be on the rear. If radial and non-radial tires are used on a vehicle equipped with dual rear tires, radial tires may be used on either axle. High-pressure temporary compact spare tires are exempt from this rule.

Do not mix size or type (all season, performance, mud and snow) of tires on the same axle. When replacing only two tires on front or rear drive vehicles, follow the vehicle manufacturer's recommendations concerning placement. If it is not possible to follow OE recommendations, it is preferable to place the two new tires on the rear for greater stability, greater adhesion affecting steering - on other than dry pavement -- and overall safety, regardless of whether the vehicle is front or rear wheel drive.

It is particularly important to match all tire sizes and constructions on 4-wheel (4x4) and all-wheel (AWD) drive vehicles unless otherwise specified by vehicle manufacturer. Ideally, all four tires should be replaced at the same time. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes.

## MOUNTING TIRES

Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels.

Mount tires only on same or approved rim widths.

Attempting to mount a tire of one diameter on a wheel of a different diameter, bead taper or flange type may result in serious injury or death.

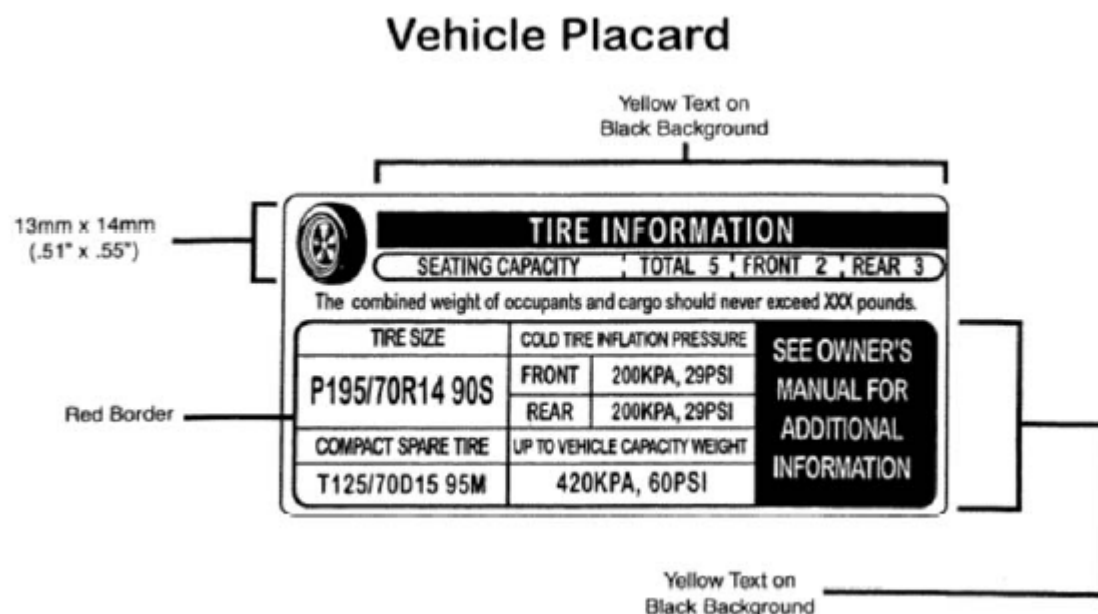
If any flammable emergency tire inflation product has been used in a tire, consult inflation product manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death.

## VEHICLE TIRE PLACARD

Since 1968, cars and light trucks sold in the United States have been required to have a tire information sticker, called a vehicle tire placard. The vehicle tire placard indicates the size of the original equipment tires (including the spare), cold inflation pressure for the tires on both axles as well as the spare, and load index or range. Depending on the vehicle, the vehicle tire placard will either be located on the edge of any door, the doorpost, glove box, fuel door or inside trunk lid. If the tire placard is missing, consult the owner's manual, vehicle manufacturer, or tire manufacturer regarding applicable tire information.

Always refer to the vehicle manufacturer's recommendations before replacing tires. Tires should always be replaced with the same size designation, or approved options, as recommended. Never choose a smaller size with less load carrying capacity than the size on the tire placard. (Some vehicle manufacturers require different-sized tires for either the front or rear axles.)

**NOTE:** It is not always possible to select a replacement tire with exactly the same size as shown on the placard. Consult with a vehicle or tire manufacturer for replacement recommendations.



**Fig. 1: Vehicle Tire Placard - Typical**

## TIRE ROTATION

The front tires on most vehicles tend to wear out faster than the rear tires. This is due to the effects of steering the vehicle and the weight transfer that occurs during braking. To ensure that all four tires wear evenly, it is important to rotate them on a regular basis. Tire rotation helps maintain balanced handling because it allows all four tires to wear at the same rate. Keep in mind, as tire wear reduces tread depth, it increases the tires' response to driver inputs. Consequently, by equalizing tire wear at all four corners, dry road performance is actually enhanced. Another advantage of regular rotation is that it allows the tires to be replaced in complete sets rather than in pairs. This maintains handling continuity. It also enables drivers to take advantage of the latest in tire technology, instead of trying to match a pair of older tires.

Most manufacturers list rotation intervals in the scheduled maintenance section of the vehicle service manual and/or the owner's manual. Tire rotation patterns can also be found in these books. If this information is unavailable for a particular vehicle, rotate the tires every 5-7,000 miles following the appropriate rotation sequence shown in the illustrations. After completing a tire rotation, be sure to reset inflation pressures to the manufacturer's recommended specifications indicated on the vehicle tire placard.

To ensure that the proper amount of clamping force is applied to each fastener, follow these guidelines:

- Make sure the area around the lug holes, as well as the wheel and hub mating surfaces are clean and dry. A wire brush can be used to remove corrosion and other debris. Wipe the areas clean using a shop rag.
- Inspect the bolt holes for damage. Do not use a wheel if the bolt holes are deformed.
- Inspect the wheel studs and lug nuts or lug bolts and bolt holes (depending on the vehicle) for damage. Replace or repair any damaged or worn components.
- Always follow a star pattern when tightening lugs.

### **WHEEL LUG NUT TORQUE & CLAMPING FORCE**

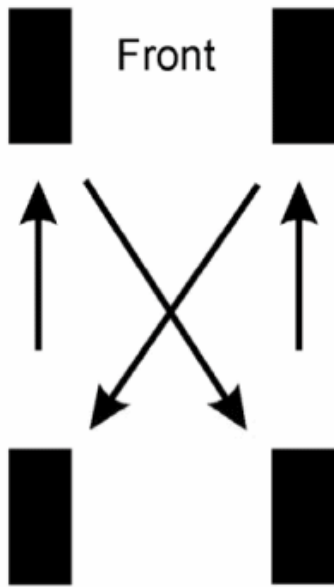
Although proper wheel lug nut torque is important, it does not guarantee that the required clamping force will be achieved. For example, excessive corrosion on the wheel and hub mating surfaces will result in improper clamping force, even when the lugs are tightened with a calibrated torque wrench. Low clamping force can also occur if the threads are dirty. This is because dirt causes interference between the mating threads. As a result, the torque wrench will register the correct reading but the clamping force will be inadequate. To improve the chances of achieving the precise clamping force between the wheel and hub, proper torque must be applied to clean components in good condition. Specifications for wheel lug nut torque can be found in the 'Tire and Wheel' section of most vehicle service manuals. When specifications are indicated as a range, adjust the torque wrench to the middle of the range to compensate for normal variations in tool calibration.

### **POPULAR TIRE ROTATION PATTERNS**

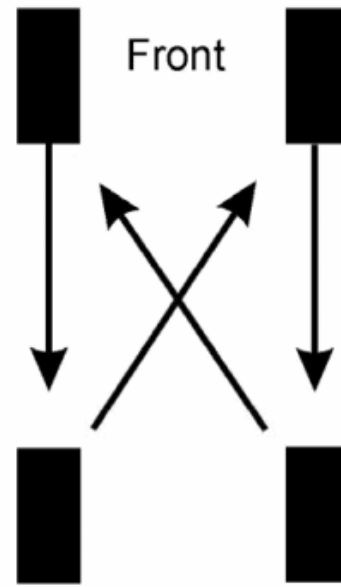
# POPULAR TIRE ROTATION PATTERNS

(Only Where Tires Are Same Type & Size)

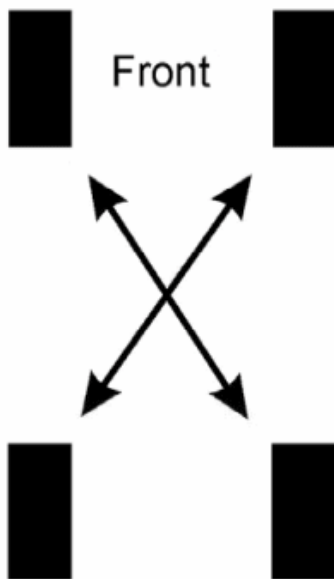
## Rear- and Four-Wheel-Drive Vehicles



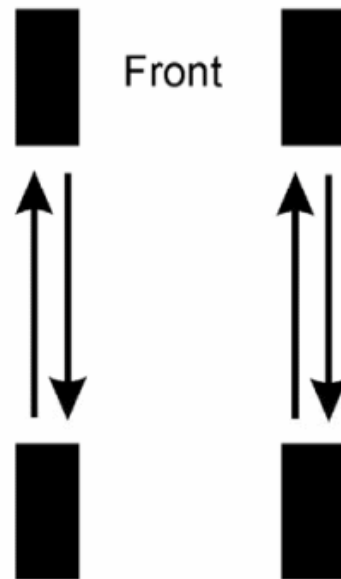
## Front-Wheel-Drive Vehicles



## All Vehicles



## All Vehicles

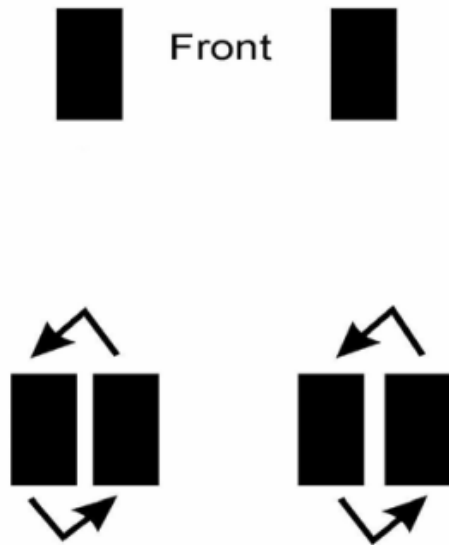


**Fig. 2: Popular Tire Rotation Patterns - Without Dual Rear Wheels**

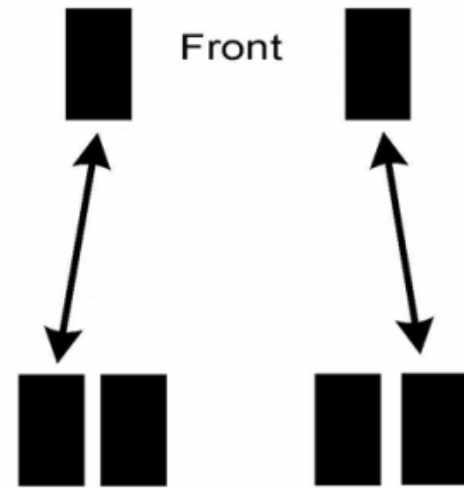
Never rotate directional tires from side-to-side since this will reverse their direction of rotation. Directional tires can only be rotated from front to rear or vice versa. Directional tires are typically used on high-performance cars and can be identified by the arrows imprinted on the sidewall.

# Vehicles With Dual Rear Wheels

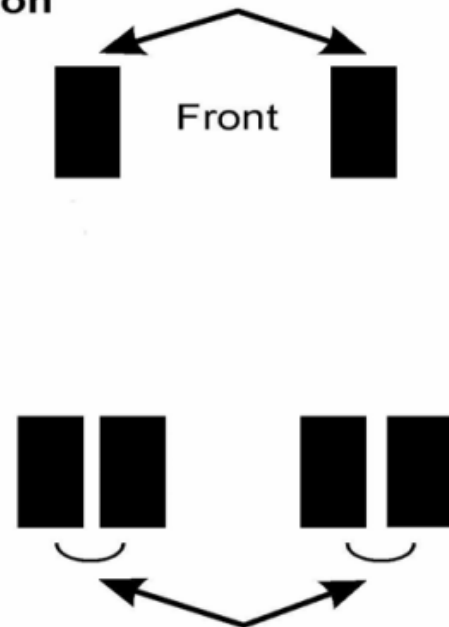
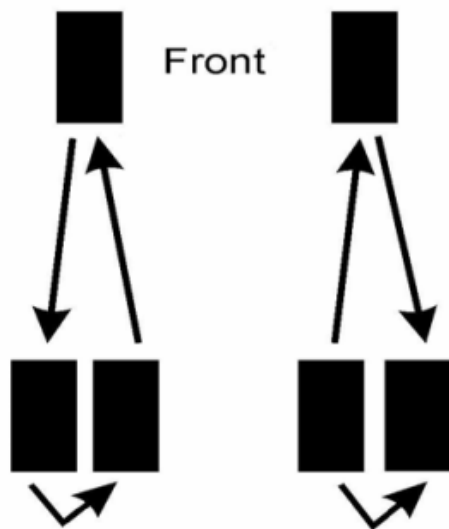
## Rear Tire Irregular Wear



## Front Tire Irregular Wear



## Six-Tire Rotation



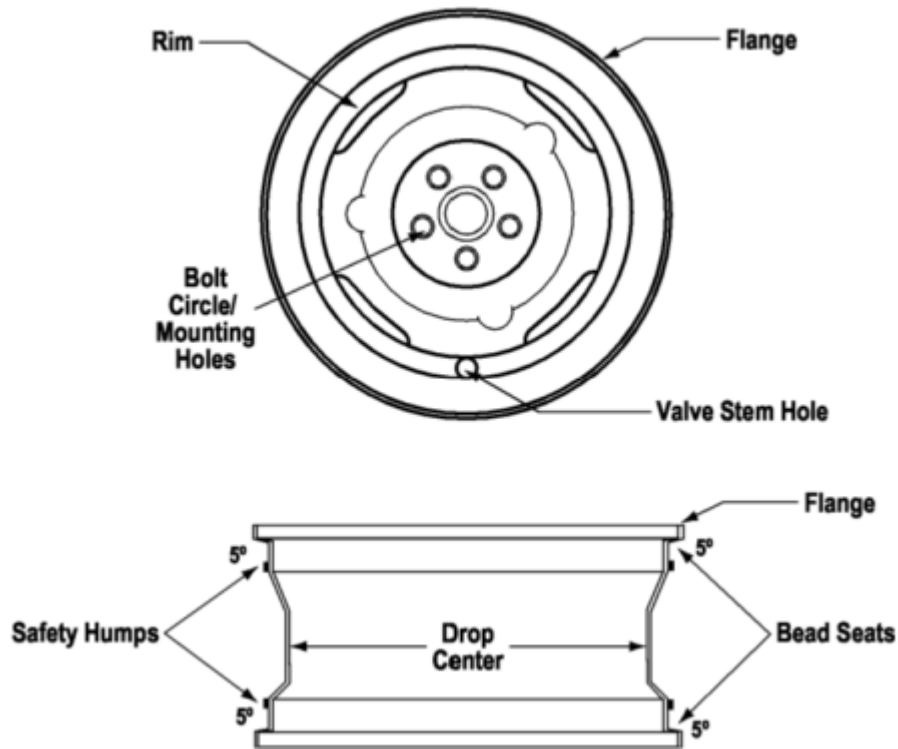
**Fig. 3: Popular Tire Rotation Patterns - With Dual Rear Wheels**

Some tires cannot be rotated in the manners described. Such tires include uni-directional tires and tires with asymmetric tread designs. Also, some vehicles may have different-sized tires mounted on the front and rear axles, and these different-sized tires also have rotation restrictions. Check your owner's manual or with a tire manufacturer or a tire dealer for proper recommendations for these specific cases.

## **WHEELS AND RIMS**

The wheels on today's vehicles are made of steel, aluminum, or aluminum alloy (a combination of two or more metals). Steel wheels are the least expensive to produce, which is why they come as original equipment on many passenger cars and light trucks. The center section includes the bolt circle, or mounting holes, and is used to attach the wheel to the vehicle. The flange is the outermost lip of the rim, and is the area typically used for attaching wheel (balancing) weights. The rim is formed by rolling a strip of metal and then welding the two ends together. The interior section of the rim has a smaller diameter section called a drop center. This area provides the means for removing and installing a tire, since the bead is not designed to stretch. During removal or installation, most of the tire bead is pushed into the drop center so that the exposed portion can be pulled over the rim. The edges of the rim are flared to form the bead seats, which hold the tire and provide the airtight seal. Many rims include safety humps. These are small elevations on the inside of the bead seats. Safety humps help prevent the tire

from falling into the drop center during a blowout. This allows the driver to maintain better directional control of a vehicle running on one or more deflated tires.



**Fig. 4: Steel Wheel**

**WARNING:** Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Mount tires only on approved rim widths. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Load, cold inflation pressure, and tire construction forces imposed on the rim/wheel must not exceed the rim/wheel manufacturer's recommendations, even if the tire is approved for a higher load or inflation. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.

### TIRE PRESSURE MONITORING SYSTEMS

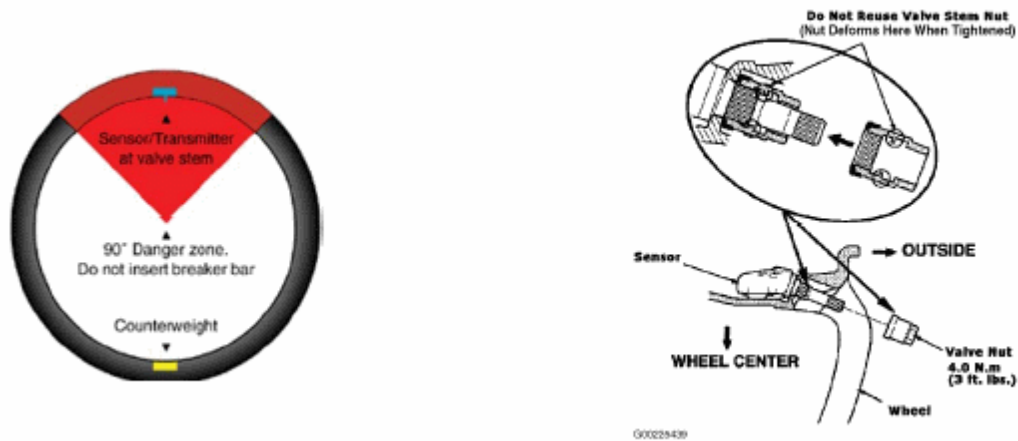
To avoid damaging sensors when mounting and demounting tires, it is beneficial to know where the sensors are located. Sensor assemblies are commonly attached to the valve stem, with the valve stem acting as an antenna to assist with transmitting RF signals. They may also be strapped to the drop center of the wheel. If this is the case, the sensor assembly should be located in-line with the valve stem.



**Fig. 5: Valve Stem Mounted Sensor**



To avoid damaging sensors when demounting tires, do not break the bead within 45° of either side of sensor assembly locations. Be careful not to damage sensors when mounting tires as well. Sensors are not repairable and require replacement if damaged or when their battery is completely drained. It is recommended that the sensor be carefully "dropped into the tire" prior to demounting to avoid damage.



**Fig. 6: Mounting Sensor**

When reinstalling the sensor, it is suggested that the locknut, gasket and valve stem be replaced and torqued to the proper specification. It is also necessary to use the proper valve cap as it is also an integral part of the system.

It may be necessary to reprogram the TPMS when the tires are rotated, when a new sensor is installed, or after the vehicle loses power. This usually requires a scan tool and may involve the use of a special magnet. Refer to the vehicle service manual to properly reprogram the TPMS.

## **STEERING & SUSPENSION CHECKSHEET**



## STEERING & SUSPENSION CHECKSHEET

Date: \_\_\_\_\_  
 Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
 Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_  
 Mileage: \_\_\_\_\_ License: \_\_\_\_\_ VIN: \_\_\_\_\_ Eng Code: \_\_\_\_\_

**Customer Interview:**

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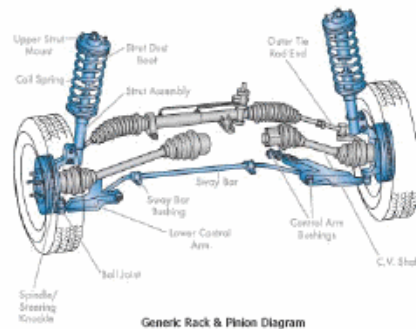
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### Reason Code Explanation

- | <u>Code</u>               | <u>Reason</u>   |
|---------------------------|---|
| <u>Required</u>           |   |
| A                         | Part No Longer Performs Intended Purpose  |
| B                         | Part Does Not Meet A Design Specification ( Regardless Of Performance)                  |
| C                         | Part Is Missing   |
| <u>Suggested/Optional</u> |   |
| 1                         | Part Is Close To The End Of Its Useful Life   |
| 2                         | To Address A Customer Need, Convenience Or Request                                      |
| 3                         | To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer |
| 4                         | Technician's Recommendation Based On Substantial And Informed Experience                |
| 5                         | To Comply With Maintenance Recommended By AMRA/MAP                                      |



Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: [www.motorist.org](http://www.motorist.org)

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

**Fig. 7: Steering & Suspension Checksheet (1 Of 2)**

# STEERING & SUSPENSION CHECKSHEET

## UNDERHOOD/UNDER VEHICLE

Component	OK	S	R	Condition
Rack & Pinion Assy				
P/S Pump				
P/S Hoses				
P/S Fluid				
P/S Cooler				

Component	OK	S	R	Condition
Center / Drag Link				
Steering Gear				
Sway Bar/Bushings				
Idler Arm				
Pitman Arm				

### LEFT FRONT

Component	OK	S	R	Condition
Link Pin / Bushings				
CV Joints				Inner _____ Outer _____
CV Boots				Inner _____ Outer _____
Shock / Strut				_____
Spring / Mount				
Ball Joint Upper				Spec _____
Lower				Actual _____
Control Arm / Shaft				
Bushings				
Tie Rod End				Inner _____ Outer _____
Bearing / Spindle				

### RIGHT FRONT

Component	OK	S	R	Condition
Link Pin / Bushings				
CV Joints				Inner _____ Outer _____
CV Boots				Inner _____ Outer _____
Shock / Strut				_____
Spring / Mount				
Ball Joint Upper				Spec _____
Lower				Actual _____
Control Arm / Shaft				
Bushings				
Tie Rod End				Inner _____ Outer _____
Bearing / Spindle				

### LEFT REAR

Component	OK	S	R	Condition
Link Pin / Bushings				
CV Joints				Inner _____ Outer _____
CV Boots				Inner _____ Outer _____
Shock / Strut				_____
Spring / Mount				
Ball Joint Upper				Spec _____
Lower				Actual _____
Control Arm / Shaft				
Bushings				
Tie Rod End				Inner _____ Outer _____
Bearing / Spindle				

### RIGHT REAR

Component	OK	S	R	Condition
Link Pin / Bushings				
CV Joints				Inner _____ Outer _____
CV Boots				Inner _____ Outer _____
Shock / Strut				_____
Spring / Mount				
Ball Joint Upper				Spec _____
Lower				Actual _____
Control Arm / Shaft				
Bushings				
Tie Rod End				Inner _____ Outer _____
Bearing / Spindle				

OK

Suggested  
1, 2, 3, 4, 5

Required  
A, B, C

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**Fig. 8: Steering & Suspension Checksheet (2 Of 2)**

## WHEELS & TIRES CHECKSHEET



## WHEELS & TIRES CHECKSHEET

Date: \_\_\_\_\_

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_

Year: \_\_\_\_\_ Make: \_\_\_\_\_ Model: \_\_\_\_\_

Mileage: \_\_\_\_\_ License: \_\_\_\_\_ VIN: \_\_\_\_\_ Eng Code: \_\_\_\_\_

**Customer Interview:**

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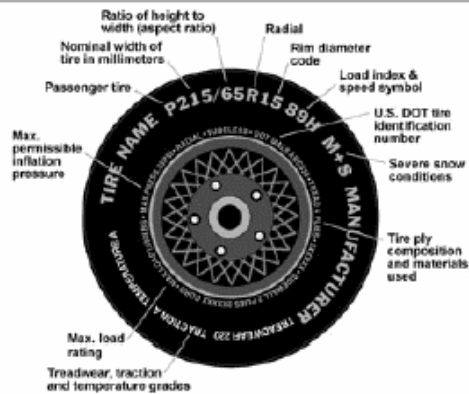
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**Reason Code Explanation**

- | <u>Code</u>                      | <u>Reason</u>   |
|----------------------------------|---|
| <b><u>Required</u></b>           |   |
| A                                | Part No Longer Performs Intended Purpose  |
| B                                | Part Does Not Meet A Design Specification (Regardless Of Performance)                   |
| C                                | Part Is Missing   |
| <b><u>Suggested/Optional</u></b> |   |
| 1                                | Part Is Close To The End Of Its Useful Life   |
| 2                                | To Address A Customer Need, Convenience Or Request                                      |
| 3                                | To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer |
| 4                                | Technician's Recommendation Based On Substantial And Informed Experience                |
| 5                                | To Comply With Maintenance Recommended By AMRAMAP                                       |



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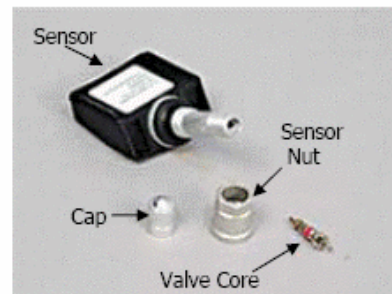
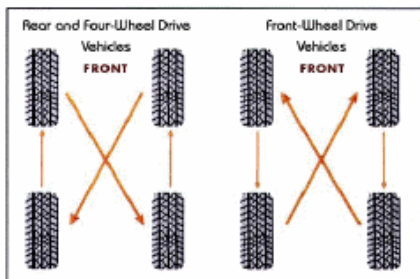
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**Fig. 9: Wheels & Tires Checksheet (1 Of 2)**

# WHEELS & TIRES CHECKSHEET

LEFT FRONT				
Component	OK	S	R	Condition
Lugs/Studs				
Tire Size				Spec _____
Speed Rating _____				Actual _____
Run Flat				Y _____ N _____
Tread Depth				_____/32nds
Tire Pressure				Before _____
Placard _____				After _____
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition)				Spec _____
Wheel Size				Actual _____
<input type="checkbox"/> Edge wear <input type="checkbox"/> Cupped <input type="checkbox"/> Cut <input type="checkbox"/> Irregular wear				

RIGHT FRONT				
Component	OK	S	R	Condition
Lugs/Studs				
Tire Size				Spec _____
Speed Rating _____				Actual _____
Run Flat				Y _____ N _____
Tread Depth				_____/32nds
Tire Pressure				Before _____
Placard _____				After _____
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition)				Spec _____
Wheel Size				Actual _____
<input type="checkbox"/> Edge wear <input type="checkbox"/> Cupped <input type="checkbox"/> Cut <input type="checkbox"/> Irregular wear				



LEFT REAR				
Component	OK	S	R	Condition
Lugs/Studs				
Tire Size				Spec _____
Speed Rating _____				Actual _____
Run Flat				Y _____ N _____
Tread Depth				_____/32nds
Tire Pressure				Before _____
Placard _____				After _____
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition)				Spec _____
Wheel Size				Actual _____
<input type="checkbox"/> Edge wear <input type="checkbox"/> Cupped <input type="checkbox"/> Cut <input type="checkbox"/> Irregular wear				

RIGHT REAR				
Component	OK	S	R	Condition
Lugs/Studs				
Tire Size				Spec _____
Speed Rating _____				Actual _____
Run Flat				Y _____ N _____
Tread Depth				_____/32nds
Tire Pressure				Before _____
Placard _____				After _____
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition)				Spec _____
Wheel Size				Actual _____
<input type="checkbox"/> Edge wear <input type="checkbox"/> Cupped <input type="checkbox"/> Cut <input type="checkbox"/> Irregular wear				

OK   
 Suggested 1, 2, 3, 4, 5   
 Required A, B, C   
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**Fig. 10: Wheels & Tires Checksheet (2 Of 2)**

## STEERING AND SUSPENSION, WHEEL ALIGNMENT, WHEELS AND TIRES

**NOTE:** Steering and Suspension are complex systems made up of a variety of interdependent components and controls. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed.

**NOTE:** Listed repair conditions assume that the problem has been isolated to the specific component by proper testing procedures. When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications for both ride height and alignment angle tolerances.

**NOTE:** Improper alignment geometry, and/or improper tire/wheel fitment may affect other systems such as Adaptive Cruise Control, Electronic Stability Control, Electronic Traction Control and Variable Ratio Steering. These systems may require attention after an alignment or suspension service is performed. Care must be taken to identify these vehicles/systems before any repair procedures are performed. Failure to follow OEM guidelines when servicing interrelated systems could result in an unsafe condition.

**CAUTION:** Do not use ride height altering or load compensating components, such as variable rate springs or coil over shocks on vehicles with height sensing or load sensing proportioning- valve equipped braking systems, unless these components are supplied as original equipment.

### ACTIVE HANDLING

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

### ACTIVE SUSPENSION CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	B	Require repair or replacement



Condition	Code	Procedure
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## ACTIVE VARIABLE RATIO STEERING

**NOTE:** Besides electronically providing variable steering ratios, the computer is linked with the Vehicle Stability Control system to aid in directional stability. As the vehicle travels down the highway, road surfaces and wind gusts can affect the vehicle's directional stability. The vehicle may wander or dart to one side, (as many who have met a tractor-trailer unit on a windy day have experienced). Sensors on the vehicle detect this sudden, unintentional movement and the computer will stabilize the vehicle by moving the Active Steering electric motor and steering gear, all without the driver turning the steering wheel.

**NOTE:** Additionally, if the driver experiences a skid or slide because of poor road conditions, the Active Steering will react to information from the yaw rate and steering angle sensors to modify the steering angle of the front wheels and stabilize the vehicle. This occurs much faster than the driver can react. If the Active Steering correction is not adequate to control the skid or slide, then the Stability Control system is also activated.

Condition	Code	Procedure
Improper Operation	Â	Â
<b>NOTE:</b> Refer to manufacturers' service information.		

## ACTIVE YAW CONTROL

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

### **ADAPTIVE CRUISE CONTROL**

**NOTE:** Similar to conventional cruise control. It maintains the vehicle's pre-set speed. However, beyond conventional cruise control, this system automatically adjusts speed to maintain proper distance between vehicles in the same lane. This is achieved through use of a radar or laser headway sensor, a digital signal processor and a longitudinal controller. If the lead vehicle slows down, or another object is detected, the system sends a signal to the engine and/or braking system to decelerate. Then, when the lane is clear, the system will re-accelerate the vehicle back to the set speed. Some OEM's require that the radar or laser headway sensor be calibrated to the thrustline of the vehicle.

### **ADVANCE TRAC**

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

### **AIR BAGS**

<b>Condition</b>	<b>Code</b>	<b>Procedure</b>
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Collar cracked	A	Require replacement
End cap cracked	A	Require replacement

Condition	Code	Procedure
Inner fabric of bag damaged	A	Require replacement
Leaking	A	Require repair or replacement
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	Suggest replacement
Piston cracked	A	Require replacement

## AIR RIDE CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### **AIR RIDE SUSPENSION TORSION SPRINGS (COUNTER BALANCING)**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Broken	A	Require replacement
Missing	C	Require replacement

### **AIR RIDE SUSPENSION**

**NOTE:** Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.

### **AIR RIDE TUBES**

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connected incorrectly	A	Require repair
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Safety clip missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

## AIR SHOCKS AND AIR STRUTS

**NOTE:** This section covers the air spring portion of the air shock or strut. For damping portion of shock or strut conditions and procedures, refer to the Shock Absorbers, Strut Cartridges, and Strut Assemblies section.

Condition	Code	Procedure
Inner fabric of air bag damaged	A	Require replacement
Leaking	A	Require repair or replacement
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	Suggest replacement

## AIR SPRING VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blocked	A	Require repair or replacement
Connector bent	A	Require repair or replacement
Connector broken	A	Require replacement
Connector loose	A	Require repair or replacement
Inoperative	A	Require repair or replacement
Leaking	B	Require repair or replacement
Restricted	A	Require repair or replacement

## AIR SPRINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Collar cracked	A	Require replacement
End cap cracked	A	Require replacement
Inner fabric of bag damaged	A	Require replacement
Leaking	A	Require repair or replacement
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	Suggest replacement
Piston cracked	A	Require replacement

## AIR SUSPENSION CONTROL VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Leaking	B	Require repair or replacement
Output incorrect	B	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### **AIR SUSPENSION DRIERS**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Contaminated, affecting performance	A	Require replacement
Desiccant bag deteriorated	A	Require replacement
<b>NOTE:</b> <b>Inspect system to determine effects of desiccant bag deterioration.</b>		
Leaking	B	Require replacement
Restricted	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement



Condition	Code	Procedure
Tubing connection leaking	A	Require repair or replacement

## AXLE ACCELERATION SENSOR

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure		
Dust boot torn	A	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.		
Housing cracked	B	Require replacement
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## BALL JOINTS

**NOTE:** Before requiring or suggesting ball joint replacement, the approved OEM procedure must be used to measure ball joint wear. The measurement(s) obtained, along with the vehicle manufacturer's specifications, must be noted on the inspection report. Some states require that these measurements also appear on the invoice. The term ""perceptible movement,"" defined as any visible movement in any direction, has been the industry standard for determining the need for replacement of follower (non-load carrying) ball joints. Some vehicle manufacturers are now publishing specifications for follower ball joints that were previously diagnosed by the ""perceptible movement"" standard. Before requiring or suggesting any parts be replaced based on ""perceptible movement,"" consult your repair manual to determine if OEM specifications exist. You are not required to replace ball joints in axle sets. However, when replacing a ball joint due to wear exceeding manufacturer's specification, you may suggest replacement of the other ball joint if its measurement shows it is close to the end of its useful life, for preventive maintenance.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Further inspection required

**NOTE:**  
If greaseable, grease ball joint. If problem persists or joint is non-greaseable, require replacement.

Grease boot cracked	2	Suggest replacement
<b>NOTE:</b> Cracked grease boot will allow contaminants to enter the ball joint and will accelerate wear.		
Grease boot missing	C	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> Lack of grease boot will allow contaminants to enter the ball joint and will accelerate wear.		
Grease boot torn	A	Require replacement
<b>NOTE:</b> Torn grease boot will allow contaminants to enter the ball joint and will accelerate wear.		
Grease fitting broken	A	Require replacement of grease fitting
<b>NOTE:</b> Some vehicles come from the factory with broken fittings. No service is suggested or required on these vehicles.		
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Greaseable ball joint will not take grease	2	Suggest replacement of grease fitting
<b>NOTE:</b> If the greaseable ball joint still will not take grease after replacing the grease fitting, suggest replacement of ball joint.		
Nut on ball joint loose	A	Require repair or replacement
<b>NOTE:</b> Check for bent stud or damaged taper hole.		
Pre-load adjustment incorrect	B	Require repair or replacement
Seized	A	Require replacement
Stud bent	B	Require replacement
<b>NOTE:</b> Check for damaged taper hole.		
Stud broken	A	Require replacement
<b>NOTE:</b> Check for damaged taper hole.		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<b>NOTE:</b> Check for damaged taper hole.		
Wear exceeds manufacturer's specifications	B	Require replacement

## BODY ACCELERATION SENSOR

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure</b>		
Dust boot torn	A	Require replacement of boot
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</b>		
Housing cracked	B	Require replacement
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</b>		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## BUSHINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Deteriorated, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>If condition is caused by oil-soaking, further inspection is required to determine source of oil.</b>		
Distorted, affecting performance	A	Require repair or replacement
Leaking (fluid-filled type)	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.</b>		
Oil-soaked, affecting performance	A	Require replacement
<b>NOTE:</b> <b>Further inspection required to determine source of oil.</b>		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement
Seized	A	Require replacement
Shifted (out of position)	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required

### CENTER LINKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Binding	A	Further inspection required
<b>NOTE:</b> <b>If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.</b>		
Grease boot cracked	2	Require replacement of boot

Condition	Code	Procedure
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of center link (reason code 2). Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.</p>		
Grease boot missing	C	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of center link (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear</p>		
Grease boot torn	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of center link (reason code 2). Torn grease boot will allow contaminants to enter the joint and will accelerate wear .</p>		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement
<p><b>NOTE:</b> If seal is not available as a separate component, suggest replacement of center link (reason code 2). Lack of grease seal will allow contaminants to enter the joint and will accelerate wear.</p>		
Grease seal torn	A	Require replacement
<p><b>NOTE:</b> If seal is not available as a separate component, suggest replacement of center link (reason code 2). Torn grease seal will allow contaminants to enter the joint and will accelerate wear.</p>		
Greaseable center link will not take grease	2	Suggest replacement of grease fitting
<p><b>NOTE:</b> If greaseable center link still will not take grease after replacing the grease fitting, suggest replacement of center link.</p>		
Looseness (perceptible horizontal movement)	1	Suggest replacement
<p><b>NOTE:</b> If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Looseness that is excessive	B	Require replacement
<p><b>NOTE:</b> Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.</p>		



Condition	Code	Procedure
<b>CAUTION:</b> Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Seized	A	Require replacement
Stud bent	B	Require replacement
<b>NOTE:</b> Check for damaged taper hole.		
Stud broken	A	Require replacement
<b>NOTE:</b> Check for damaged taper hole.		
Stud loose in taper hole	A	Require repair or replacement
<b>NOTE:</b> Check for damaged taper hole.		
Taper hole elongated	A	Require replacement
<b>NOTE:</b> Check for damaged stud.		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<b>NOTE:</b> Check for damaged taper hole.		
Wear exceeds manufacturer's specifications	B	Require replacement

## COMPRESSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector bent	A	Require repair or replacement
Connector broken	A	Require replacement
Connector loose	A	Require repair or replacement
Does not build pressure	A	Require replacement
Excessive run time	B	Require replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Noisy (abnormal)	2	Suggest replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## CONTINUOUS DAMPING CONTROL

**NOTE:** A semi-active suspension system which continuously adjusts damping levels according to road conditions and vehicle dynamics, (such as speed, turning and cornering, as well as driver inputs). An ECU processes driver inputs and data from sensors. The sensors include accelerometers mounted on the vehicle body and suspension position sensors, which feed steering wheel angle, vehicle speed, brake pressure and other chassis control data to the ECU. The ECU processes sensor data and sends signals which adjust the damping level of each shock.

## CONTROL ARM SHAFTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Shaft bushing surface undersized (worn)	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## CONTROL ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware

Condition	Code	Procedure
Ball joint hole oversized (loose interference or press fit)	B	Further inspection required
<b>NOTE:</b> If oversized ball joint is available, require replacement orb all joint. If oversized ball joint is not available, require replacement of control arm.		
Bent, affecting performance	B	Require replacement
Bushing hole oversized	B	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Holes distorted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.		
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
<b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

### DISTANCE REGULATION CONTROL MODULE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
<b>NOTE:</b> <b>Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</b>		
Dust boot missing	C	Require replacement of boot
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure</b>		
Dust boot split	A	Require replacement of boot

Condition	Code	Procedure
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</p>		
Dust boot torn	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</p>		
Housing cracked	B	Require replacement
Inoperative	A	Require repair or replacement
<p><b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</p>		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Malfunctioning	A	Require replacement
<p><b>NOTE:</b> includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.</p>		
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Terminal burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## DISTANCE REGULATION SENSOR

**NOTE:** OEM may require this sensor be calibrated to the vehicle thrustline.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure</b>		
Dust boot torn	A	Require replacement of boot
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</b>		
Housing cracked	B	Require replacement
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</b>		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement



Condition	Code	Procedure
Wire lead shorted	A	Require repair or replacement

## DRAG LINKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Binding	A	Further inspection required
<p><b>NOTE:</b> If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.</p>		
Grease boot cracked	2	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of drag link (reason code 2). Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.</p>		
Grease boot missing	C	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of drag link (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.</p>		
Grease boot torn	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of drag link (reason code 2). Torn grease boot will allow contaminants to enter the joint and will accelerate wear.</p>		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement
<p><b>NOTE:</b> If seal is not available as a separate component, suggest replacement of drag link (reason code 2). Lack of grease seal will allow contaminants to enter the joint and will accelerate wear.</p>		
Grease seal torn	A	Require replacement
<p><b>NOTE:</b> If seal is not available as a separate component, suggest replacement of drag link (reason code 2). Torn grease seal will allow contaminants to enter the joint and will accelerate wear.</p>		
Greaseable drag link will not take grease	2	Suggest replacement of grease fitting

Condition	Code	Procedure
<p><b>NOTE:</b> If greaseable center link still will not take grease after replacing the grease fitting, suggest replacement of drag link.</p>		
Looseness (perceptible horizontal movement)	1	Suggest replacement
<p><b>NOTE:</b> If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Looseness that is excessive	B	Require replacement
<p><b>NOTE:</b> Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.</p>		
<p><b>CAUTION:</b> Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Seized	A	Require replacement
Stud bent	B	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Stud broken	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Stud loose in taper hole	A	Require repair or replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Taper hole elongated	A	Require replacement
<p><b>NOTE:</b> Check for damaged stud.</p>		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Wear exceeds manufacturer's specifications	B	Require replacement

## DYNAMIC STABILITY CONTROL

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

Condition	Code	Procedure
<p><b>NOTE:</b> On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.</p>		
<p><b>NOTE:</b> When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.</p>		

## DYNAMIC STABILITY TRACTION CONTROL

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

## ELECTRONIC RIDE CONTROL SHOCKS AND STRUTS

**NOTE:** This section covers the electronic damping control portion of the electronic shock or strut. For damping portion of shock or strut conditions and procedures, refer to the Shock Absorbers, Strut Cartridges, and Strut Assemblies section.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector bent	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector loose	A	Require repair or replacement
Electronic valve control inoperative	A	Require replacement
<p><b>NOTE:</b> It is acceptable to replace with a non-electronically controlled unit, where available.</p>		
Terminal bent	A	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal corroded	A	Require repair or replacement
Terminal loose	A	Require repair or replacement

## ELECTRONIC STABILITY CONTROL

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

## ELECTRONIC SUSPENSION SYSTEM

**NOTE:** (Typical) A semi-active suspension system which continuously adjusts damping levels according to road conditions and vehicle dynamics, (such as speed, turning and cornering, as well as driver inputs). An ECU processes driver inputs and data from sensors. The sensors include accelerometers mounted on the vehicle body and suspension position sensors, which feed steering wheel angle, vehicle speed, brake pressure and other chassis control data to the ECU. The ECU processes sensor data and sends signals which adjust the damping level of each shock.

## FLEX COUPLERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Flex coupler binding	A	Require repair or replacement of coupler
Flex coupler loose	A	Require repair or replacement of coupler
Flex coupler missing parts	A	Require repair or replacement of coupler
Flex coupler soft/ spongy	A	Require replacement of coupler
Flex coupler tom	A	Require replacement of coupler
Steering coupler shield cracked	2	Suggest replacement
Steering coupler shield missing	C	Require replacement
Steering coupler shield torn	2	Suggest replacement
U-joint binding	A	Require repair or replacement of joint
U-joint loose	A	Require repair or replacement of joint

## GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary.		

## HEIGHT SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Connector missing	C	Require replacement
Dust boot missing	C	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure		
Dust boot split	A	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.		
Dust boot torn	A	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.		
Housing cracked	B	Require replacement
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## HYDRAULIC HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

## HYDRAULIC POWER STEERING PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector missing	C	Require replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## HYDRAULIC SUSPENSION HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

## HYDRAULIC SUSPENSION PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Fluid at or beyond service interval	3	Suggest fluid change
Fluid contaminated	B	Require flushing and refilling of the system
<p><b>NOTE:</b>  <b>Determine and correct source of contamination. OEM specifications must be followed for fluid type.</b></p>		
Fluid contaminated	B	Require flushing and refilling of the system
<p><b>NOTE:</b>  <b>Determine and correct source of contamination. OEM specifications must be followed for fluid type.</b></p>		
Fluid level incorrect	B	Require adjustment of fluid level
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## IDLER ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Further inspection required

Condition	Code	Procedure
<p><b>NOTE:</b> If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.</p>		
Grease boot cracked	B	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of idler arm (reason code 2). Cracked grease boot will allow contaminants to enter joint and will accelerate wear.</p>		
Grease boot missing	C	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of idler arm (reason code 2). Lack of grease boot will allow contaminants to enter joint and will accelerate wear.</p>		
Grease boot torn	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of idler arm (reason code 2). Torn grease boot will allow contaminants to enter joint and will accelerate wear.</p>		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement of seal
<p><b>NOTE:</b> If seal is not available as a separate component, suggest replacement of idler arm (reason code 2). Missing grease seal will allow contaminants to enter joint and will accelerate wear.</p>		
Grease seal torn	A	Require replacement of seal
<p><b>NOTE:</b> If seal is not available as a separate component, suggest replacement of idler arm (reason code 2). Torn grease seal will allow contaminants to enter joint and will accelerate wear.</p>		
Greaseable joint will not take grease	2	Suggest replacement of grease fitting
<p><b>NOTE:</b> If greaseable joint will not take grease after replacing the grease fitting, suggest replacement of idler arm.</p>		
Looseness at frame bracket end	B	Require repair or replacement
<p><b>NOTE:</b> If manufacturer's procedures and specifications exist, use those procedures and specifications; otherwise, use an approved inspection method such as the dry park check.</p>		
<p><b>NOTE:</b> Looseness is defined as movement that creates excessive toe change.</p>		
Looseness at link end (perceptible horizontal movement)	1	Suggest replacement

Condition	Code	Procedure
<p><b>NOTE:</b> If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Looseness at link end that is excessive	B	Require replacement
<p><b>NOTE:</b> Excessive looseness is defined as significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.</p>		
<p><b>CAUTION:</b> Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Mounted out of position (center link not parallel)	B	Require repositioning
Nut on stud loose	A	Require repair or replacement
<p><b>NOTE:</b> Check for bent stud or damaged taper hole.</p>		
Seized	A	Require replacement
Stud bent	B	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Stud broken	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Taper hole elongated	A	Require replacement
<p><b>NOTE:</b> Check for damaged stud.</p>		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Wear exceeds manufacturer's specifications	B	Require replacement

### INTERMEDIATE SHAFT U-JOINTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Flex coupler binding	A	Require repair or replacement of coupler
Flex coupler loose	A	Require repair or replacement of coupler
Flex coupler missing parts	A	Require repair or replacement of coupler
Flex coupler soft/ spongy	A	Require replacement of coupler
Flex coupler tom	A	Require replacement of coupler
Steering coupler shield cracked	2	Suggest replacement
Steering coupler shield missing	C	Require replacement
Steering coupler shield torn	2	Suggest replacement
U-joint binding	A	Require repair or replacement of joint
U-joint loose	A	Require repair or replacement of joint

## KING PINS

**NOTE:** You are not required to replace king pins in axle sets. However, when replacing a king pin due to wear exceeding manufacturer's specifications, you may suggest replacement of the other king pin on the axle if its measurement shows it is close to the end of its useful life.

Condition	Code	Procedure
Bearing balls pitted	A	Require replacement
Bearing balls worn	A	Require replacement
Bearing races pitted	A	Require replacement
Bearing races worn	A	Require replacement
Bearing rollers pitted	A	Require replacement
Bearing rollers worn	A	Require replacement
Bearing seal bent	2	Suggest replacement of seal or bearing
Bearing seal missing	C	Require replacement of seal if available separately or bearing and seal together
Bearing seal torn	A	Require replacement of seal if available separately or bearing and seal together
Binding	A	Require repair or replacement of affected parts
End caps missing	C	Require replacement of missing part, if available; otherwise, replace king pin
End play exceeds specifications	B	Require repair
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting will not seal	A	Require replacement of grease fitting
Locating pins missing	C	Require replacement of missing part, if available; otherwise, replace king pin
Looseness exceeds manufacturer's specifications	B	Require replacement of worn parts
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Will not take grease	2	Suggest replacement of grease fitting

Condition	Code	Procedure
<p><b>NOTE:</b> If king pin will not take grease after replacement of grease fitting, suggest replacement of king pin.</p>		

## MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
<p><b>NOTE:</b> Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</p>		
Inoperative	A	Require repair or replacement
<p><b>NOTE:</b> Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</p>		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
<p><b>NOTE:</b> Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.</p>		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement



Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## PITMAN ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Binding	A	Further inspection required
<p><b>NOTE:</b>  <b>If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.</b></p>		
Grease boot cracked	2	Require replacement of boot
<p><b>NOTE:</b>  <b>If boot is not available as a separate component, suggest replacement of pitman arm (reason code 2). Cracked grease boot will allow contaminants to enter joint and will accelerate wear.</b></p>		
Grease boot missing	C	Require replacement of boot
<p><b>NOTE:</b>  <b>If boot is not available as a separate component, suggest replacement of pitman arm (reason code 2). Lack of grease boot will allow contaminants to enter joint and will accelerate wear.</b></p>		
Grease boot torn	A	Require replacement of boot
<p><b>NOTE:</b>  <b>If boot is not available as a separate component, suggest replacement of pitman arm (reason code 2). Torn grease boot will allow contaminants to enter joint and will accelerate wear.</b></p>		
Grease fitting broken	A	Require replacement grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement of seal
<p><b>NOTE:</b>  <b>If seal is not available as a separate component, suggest replacement of pitman arm (reason code 2). Lack of grease seal will allow contaminants to enter joint and will accelerate wear.</b></p>		
Grease seal torn	A	Require replacement of seal

Condition	Code	Procedure
<p><b>NOTE:</b> If seal is not available as a separate component, suggest replacement of pitman arm (reason code 2). Tom grease seal will allow contaminants to enter joint and will accelerate wear.</p>		
Looseness (perceptible horizontal movement)	1	Suggest replacement
<p><b>NOTE:</b> If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Looseness that is excessive	B	Require replacement
<p><b>NOTE:</b> Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.</p>		
<p><b>CAUTION:</b> Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Nut on stud loose	A	Require repair or replacement
<p><b>NOTE:</b> Check for bent stud or damaged taper hole.</p>		
Seized	A	Require replacement
Splines damaged	A	Require repair or replacement
Splines stripped (splines missing)	A	Require replacement
Stud bent	B	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Stud broken	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Stud loose in taper hole	A	Require repair or replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Taper hole elongated	A	Require replacement
<p><b>NOTE:</b> Check for damaged stud.</p>		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
<b>NOTE:</b> <b>Determine cause of incorrect alignment and require repair.</b>		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> <b>Determine cause of noise and suggest repair.</b>		
Plies separated	A	Require replacement
Serpentine belt routed incorrectly	B	Require repair
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

## POWER STEERING COOLERS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connection leaking	A	Require repair or replacement
Contaminated	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required
Internal restrictions	B	Require repair or replacement
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Â	No service suggested or required

## POWER STEERING FLUID

Condition	Code	Procedure
50,000 miles or greater on OE fluid (in absence of published manufacturer interval)	5	Suggest Replacement
<b>NOTE:</b> <b>One time only fluid exchange</b>		
Additive Depletion	A	Require replacement of fluid
Fluid at or beyond service interval	3	Suggest fluid replacement

Condition	Code	Procedure
Fluid contaminated (i.e. fluid other than power steering fluid present)	B	Require flushing and refilling of the system
<b>NOTE:</b> Determine and correct source of contamination. OEM specifications must be followed for fluid type.		
Fluid discolored	À	No Service Suggested or Required
<b>NOTE:</b> Further testing necessary to determine condition of fluid.		
Fluid level incorrect	B	Require adjustment of fluid level
Fluid type incorrect	B	Require flushing and refilling with correct fluid
Oxidized	A	Require replacement of fluid

## POWER STEERING HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

## POWER STEERING LINES (STEEL)

**NOTE:** When replacing steel power steering lines, be sure to use a replacement product that meets or exceeds OEM specifications.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Corroded, affecting structural integrity	A	Require replacement

Condition	Code	Procedure
Fitting incorrect (for example, compression fitting)	B	Require replacement
Flare type incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Line material incorrect (copper, etc. )	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Rust-pitted, not affecting structural integrity	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## POWER STEERING PUMPS - ELECTRIC

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Connector missing	C	Require replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement

Condition	Code	Procedure
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## POWER STEERING PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Binding	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b>		
<b>Determine cause and correct prior to replacement of part.</b>		
Connector missing	C	Require replacement
Fluid at or beyond service interval	3	Suggest fluid change
Fluid contaminated	B	Require flushing and refilling of the system
Fluid level incorrect	B	Require adjustment of fluid level
Leaking	B	Require repair or replacement
Leaking	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap



Condition	Code	Procedure
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Seized	A	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## RADAR SENSOR

**NOTE:** OEM may require this sensor be calibrated to the vehicle thrustline.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure</b>		
Dust boot torn	A	Require replacement of boot

Condition	Code	Procedure
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</p>		
Housing cracked	B	Require replacement
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</p>		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.</p>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## RADIUS ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Corroded, affecting structural integrity	a	Require replacement
Holes distorted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## RELAY RODS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Binding	A	Further inspection required
<p><b>NOTE:</b>  <b>If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.</b></p>		
Grease boot cracked	B	Require replacement of boot
<p><b>NOTE:</b>  <b>If boot is not available as a separate component, suggest replacement of relay rod (reason code 2). Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.</b></p>		
Grease boot missing	C	Require replacement of boot
<p><b>NOTE:</b>  <b>If boot is not available as a separate component, suggest replacement of relay rod (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.</b></p>		
Grease boot torn	A	Require replacement of boot
<p><b>NOTE:</b>  <b>If boot is not available as a separate component, suggest replacement of center link (reason code 2). Torn grease boot will allow contaminants to enter the joint and will accelerate wear.</b></p>		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement of seal
<p><b>NOTE:</b>  <b>If seal is not available as a separate component, suggest replacement of relay rod (reason code 2). Lack of grease seal will allow contaminants to enter the joint and will accelerate wear.</b></p>		
Grease seal torn	A	Require replacement of seal
<p><b>NOTE:</b>  <b>If seal is not available as a separate component, suggest replacement of relay rod (reason code 2). Torn grease seal will allow contaminants to enter the joint and will accelerate wear.</b></p>		
Greaseable relay rod will not take grease	2	Suggest replacement of grease fitting
<p><b>NOTE:</b>  <b>If greaseable relay rod still will not take grease after replacing the grease fitting, suggest replacement of relay rod.</b></p>		
Looseness (perceptible horizontal movement)	1	Suggest replacement

Condition	Code	Procedure
<p><b>NOTE:</b> If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Looseness that is excessive	B	Require replacement
<p><b>NOTE:</b> Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.</p>		
<p><b>CAUTION:</b> Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Seized	A	Require replacement
Stud bent	B	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Stud broken	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Stud loose in taper hole	A	Require repair or replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Taper hole elongated	A	Require replacement
<p><b>NOTE:</b> Check for damaged stud.</p>		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Wear exceeds manufacturer's specifications	B	Require replacement

## RELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware

Condition	Code	Procedure
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement
Inoperative	A	Require replacement
<b>NOTE:</b> Inoperative includes intermittent operation.		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

## SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent operation or out of specification.		
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required
<b>NOTE:</b> Follow OEM recommended adjustment procedures. Repair or replace if out of specification.		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES

**NOTE:** You are not required to replace shocks or struts in axle sets. However, when replacing a shock or strut due to the conditions that follow, you may suggest replacement of the other shock or strut on the same axle for one or more of the following: improved performance or preventive maintenance; part is close to the end of its useful life; to extend tire life; to balance ride and handling; or to improve stopping distance. When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications. Under no circumstances should a technician bend struts or strut housings. A vehicle's load-carrying and handling abilities are limited by its suspension, tires, brakes, and driveline. Installing coil over shocks or any other load assist device does not increase the vehicle's load capacity. See the vehicle owner's manual for more details. If vehicle is equipped with OEM coil over shocks, apply the conditions for coil springs from the Springs: Coil, Leaf, and Torsion Bar section of the Steering and Suspension guidelines. If the vehicle is equipped with add-on coil over shocks, you may suggest replacement with standard shocks for a spring-related condition.

Condition	Code	Procedure
50,000 miles or greater on OEM Shocks or Struts	1	Suggest Replacement
<b>NOTE:</b> Applies only to OEM hydraulic fluid and/or gas charged shocks and struts, NOT electronically controlled units.		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require replacement
Body dented	A	Further inspection required
<b>NOTE:</b> Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.		



Condition	Code	Procedure
Body punctured	A	Require replacement
Brake hose bracket bent	B	Require repair or replacement
Brake hose bracket missing	C	Require replacement
Brake hose bracket threads damaged	A	Require repair or replacement
Brake hose bracket threads stripped (threads missing)	C	Require replacement
Compression bumper missing	C	Require replacement of compression bumper
Compression bumper split	1	Suggest replacement of compression bumper
Damping (none)	A	Require replacement
Dust boot (bellows) missing	C	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which causes piston rod seal wear.</p>		
Dust boot (bellows) split	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust boot (bellows) torn	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust shield broken	2	Suggest replacement
<p><b>NOTE:</b> This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust shield missing	2	Suggest replacement
<p><b>NOTE:</b> This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Gland nut (strut housing cap) is not removable using appropriate tool	A	Require replacement of nut and/or housing
<p><b>NOTE:</b> Only required if replacing cartridge.</p>		
Gland nut (strut housing cap) threads damaged	A	Require repair or replacement of nut
Housing dented	A	Further inspection required
<p><b>NOTE:</b> Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.</p>		
Housing punctured	A	Require replacement

Condition	Code	Procedure
Jounce bumper missing	C	Require replacement of jounce bumper
Jounce bumper split	1	Suggest replacement of jounce bumper
Leaking oil, enough for fluid to be running down the body	A	Require replacement
<p><b>NOTE:</b>  <b>If the strut cartridge has been replaced previously, the oil on the strut housing may be filler oil. The technician must identify the source of the oil.</b></p>		
Noisy	2	Further inspection required
<p><b>NOTE:</b>  <b>If noise is isolated to shock or strut, suggest replacement.</b></p>		
Piston rod bent	A	Require replacement
Piston rod broken	A	Require replacement
Piston rod has surface defect	2	Suggest replacement
Piston rod threads damaged	A	Require repair or replacement
Piston rod threads stripped (threads missing)	A	Require replacement
Seized	A	Require replacement
Shock missing	C	Require replacement
Strut housing bent	A	Require replacement
Strut housing cap (gland nut) is not removable using appropriate tool	A	Require replacement of nut and/or housing
<p><b>NOTE:</b>  <b>Only required if replacing cartridge.</b></p>		
Strut housing cap (gland nut) threads damaged	A	Require repair or replacement of nut
Strut housing cap (gland nut) threads stripped (threads missing)	A	Require replacement of nut
Strut housing severely corroded, affecting structural integrity	A	Require replacement
Strut housing threads damaged	A	Require repair or replacement
Strut housing threads stripped (threads missing)	A	Require replacement
Tire cupping	A	Further inspection required
<p><b>NOTE:</b>  <b>Although shocks or struts may have contributed to tire cupping, an inspection is needed of the entire suspension system. If the shock or strut is found to be contributing to the tire cupping, require replacement.</b></p>		

## SPINDLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	B	Require replacement

Condition	Code	Procedure
Broken	A	Require replacement
Pinch bolt bent	B	Require replacement
Pinch bolt incorrect	B	Require replacement with bolt that meets OEM design
Pinch bolt loose	B	Require repair
Pinch bolt missing	C	Require replacement
Pinch bolt tabs deformed (gap closer together than allowed by OEM specification, typically minimum .032" gap before clamping)	B	Require replacement
<b>NOTE:</b> <b>Steering knuckle deformation can cause pinch bolt breakage.</b>		
Race seat area undersized	B	Require replacement
Scored	A	Require repair or replacement
Taper hole elongated	A	Require replacement
<b>NOTE:</b> <b>Check for damaged stud.</b>		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## SPRINGS, COIL, LEAF AND TORSION BARS

**NOTE:** When springs are replaced, it is suggested, but not required, that both springs on an axle be replaced to maintain equal height from side to side and to provide a balanced ride and proper handling. When variable rate springs are installed in place of conventional coil springs, they must be installed in axle sets to ensure proper handling, uniform ride, and proper chassis height. Erroneous height measurements may result from: improper tire inflation, non-standard tire or wheel size, and heavy load in vehicle or trunk.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Broken (all springs except secondary leave(s) on multi-leaf springs)	A	Require replacement
Coil clash	Â	Further inspection required
<b>NOTE:</b> <b>Require ride height check and inspection of strike out Jounce) bumper. If vehicle is within manufacturer's height specifications, no service is suggested or required.</b>		
Coil spring insulator deteriorated	2	Suggest replacement of insulator
Coil spring insulator missing	C	Require replacement of insulator
Coil spring insulator split	2	Suggest replacement of insulator

Condition	Code	Procedure
Coil spring plastic coating deteriorated - rust present	A	Refer to manufacturer's service requirements
<b>NOTE:</b> Some manufacturers require replacement under these conditions.		
Composite spring damaged	À	Further inspection required
<b>NOTE:</b> Check vehicle ride height. If ride height is OK, no service is suggested or required.		
Cracked (all springs except composite leaf and secondary leave(s) on multileaf springs)	A	Require replacement
Installed incorrectly	B	Require repair
Leaf spring insulators missing	C	Require replacement of insulators
Secondary leaf on multi-leaf spring broken	1	Suggest repair or replacement
Secondary leaf on multi-leaf spring cracked	1	Suggest repair or replacement
Torsion bar adjuster bent	A	Require repair or replacement of adjuster
<b>NOTE:</b> Only required if ride height needs to be adjusted.		
Torsion bar adjuster seized	A	Require repair or replacement of adjuster
<b>NOTE:</b> Only required if ride height needs to be adjusted.		
Torsion bar adjuster threads damaged	A	Require repair or replacement of part with damaged threads
<b>NOTE:</b> Only required if ride height needs to be adjusted.		
Torsion bar adjuster threads stripped (threads missing)	A	Require replacement of part with stripped threads
Vehicle suspension height not within OEM specifications	A	Require adjustment or replacement

## STABILITRAC

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

## STABILITY MANAGEMENT SYSTEM

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

### STEERING ANGLE SENSOR

**NOTE:** OEM may require this sensor be calibrated to the vehicle thrustline. Sensor must be reset when replacing / servicing steering rack assembly.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
<b>NOTE:</b> Determine cause and correct prior to replacement of part.		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure		
Dust boot torn	A	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.		
Housing cracked	B	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.</b>		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## STEERING ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	B	Require replacement
Broken	A	Require replacement
Pinch bolt bent	B	Require replacement
Pinch bolt incorrect	B	Require replacement with bolt that meets OEM design
Pinch bolt loose	B	Require repair
Pinch bolt missing	C	Require replacement
Pinch bolt tabs deformed (gap closer together than allowed by OEM specification, typically minimum .032" gap before clamping)	B	Require replacement
<b>NOTE:</b> <b>Steering knuckle deformation can cause pinch bolt breakage.</b>		
Race seat area undersized	B	Require replacement
Scored	A	Require repair or replacement
Taper hole elongated	A	Require replacement



Condition	Code	Procedure
<b>NOTE:</b> <b>Check for damaged stud.</b>		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## STEERING COUPLERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Flex coupler binding	A	Require repair or replacement of coupler
Flex coupler loose	A	Require repair or replacement of coupler
Flex coupler missing parts	A	Require repair or replacement of coupler
Flex coupler soft/ spongy	A	Require replacement of coupler
Flex coupler tom	A	Require replacement of coupler
Steering coupler shield cracked	2	Suggest replacement
Steering coupler shield missing	C	Require replacement
Steering coupler shield torn	2	Suggest replacement
U-joint binding	A	Require repair or replacement of joint
U-joint loose	A	Require repair or replacement of joint

## STEERING DAMPERS

**NOTE:** The following procedures are only required if the vehicle was originally equipped from the factory with a steering damper. If the steering damper is an add-on unit, then the unit may be removed (and not replaced), based on customer's informed decision.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require replacement
Damper body dented	A	Further inspection required

Condition	Code	Procedure
<p><b>NOTE:</b> Require replacement of units where dents restrict damper piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube dampers.</p>		
Damper body punctured	A	Require replacement
Damping (none)	A	Require replacement
Dust boot (bellows) missing	C	Require replacement of boot
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of steering damper (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust boot (bellows) split	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of steering damper (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust shield broken	2	Suggest replacement
<p><b>NOTE:</b> This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Dust shield missing	2	Suggest replacement
<p><b>NOTE:</b> This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</p>		
Leaking oil, enough for fluid to be running down the body	A	Require replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Noise	2	Further inspection required
<p><b>NOTE:</b> If noise is isolated to damper, suggest replacement.</p>		
Piston rod bent	A	Require replacement
Piston rod broken	A	Require replacement
Piston rod has surface defect	2	Suggest replacement
Piston rod threads damaged	A	Require repair or replacement
Piston rod threads stripped (threads missing), affecting performance	A	Require replacement
<p><b>NOTE:</b> Only required if condition affects structural integrity or if unit needs to be serviced.</p>		
Seized	A	Require replacement

### STEERING GEARS (EXCEPT RACK AND PINION)

Condition	Code	Procedure

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
<b>NOTE:</b> <b>Determine cause and correct prior to replacement of part.</b>		
Fluid contaminated	B	Require flushing and refilling of the system
<b>NOTE:</b> <b>Determine and correct source of contamination. OEM specifications must be followed for fluid type.</b>		
Gasket leaking	A	Require repair or replacement of gasket
Housing leaking	A	Require replacement
Hydraulic fittings leaking	A	Require repair or replacement of fittings
Inadequate power assist	A	Further inspection required
<b>NOTE:</b> <b>If steering gear is source of inadequate assist, require repair or replacement.</b>		
Lash exceeds manufacturer's specifications	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.</b>		
Seal leaking	A	Require repair or replacement of seal and / or mating part
Splines damaged	A	Require repair or replacement of splines
Splines stripped	A	Require replacement of splines
Steering coupler shield cracked	2	Suggest replacement
Steering coupler shield missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement of part with damaged threads
Threads stripped (threads missing)	A	Require replacement of part with stripped threads
Unequal power assist	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## STEERING GEARS, RACK AND PINION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Balance tube blocked	A	Require repair or replacement of balance tube
Balance tube missing	C	Require replacement of balance tube
Balance tube restricted	A	Require repair or replacement of balance tube
Bellows boot clamp missing	C	Require replacement of clamp
Bellows boot cracked (not through)	2	Suggest replacement of bellows boot
Bellows boot missing	C	Require replacement of bellows boot
Bellows boot not sealing	A	Require repair or replacement of bellows boot
Bellows boot torn	A	Require replacement of bellows boot
Bellows boot twisted (from toe adjustment)	B	Require repair
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement

### **NOTE:**

**Determine cause and correct prior to replacement of part.**

Connector missing	C	Require replacement
Fitting leaking	A	Require repair or replacement
Fitting missing	A	Require replacement of fitting
Fitting threads damaged	A	Require repair or replacement of part with damaged threads
Fitting threads stripped (threads missing)	A	Require replacement of part with stripped threads
Fluid contaminated	B	Require flushing and refilling of the system

### **NOTE:**

**Determine and correct source of contamination. OEM specifications must be followed for fluid type.**

Gasket leaking	A	Require repair or replacement
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Condition	Code	Procedure
Housing cracked, affecting structural integrity	B	Require replacement
Housing leaking	A	Require replacement
Inadequate power assist	A	Further inspection required
<b>NOTE:</b> <b>If steering gear is source of inadequate assist, require repair or replacement.</b>		
Lash exceeds manufacturer's specifications	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.</b>		
Seal leaking	A	Require repair or replacement
Splines damaged	A	Require repair or replacement
Splines stripped (splines missing)	A	Require replacement
Steel line blocked	A	Require repair or replacement of line
Steel line leaking	A	Require repair or replacement of line
Steel line missing	C	Require replacement of line
Steel line restricted	A	Require repair or replacement of line
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement of part with damaged threads
Threads stripped (threads missing)	A	Require replacement of part with stripped threads
Unequal power assist	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## STEERING KNUCKLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	B	Require replacement
Broken	A	Require replacement
Pinch bolt bent	B	Require replacement

Condition	Code	Procedure
Pinch bolt incorrect	B	Require replacement with bolt that meets OEM design
Pinch bolt loose	B	Require repair
Pinch bolt missing	C	Require replacement
Pinch bolt tabs deformed (gap closer together than allowed by OEM specification, typically minimum .032" gap before clamping)	B	Require replacement
<b>NOTE:</b> <b>Steering knuckle deformation can cause pinch bolt breakage.</b>		
Race seat area undersized	B	Require replacement
Scored	A	Require repair or replacement
Taper hole elongated	A	Require replacement
<b>NOTE:</b> <b>Check for damaged stud.</b>		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### **STRIKE OUT BUMPERS**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Missing	C	Require replacement
Split	A	Suggest replacement

### **STRUT BEARING PLATE ASSEMBLIES**

**NOTE:** When the following guidelines indicate replacement of bearing, only the bearing should be replaced if it is available separately; otherwise, replace the bearing plate assembly.

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Axial or radial movement exceeds vehicle manufacturer's specifications	B	Require replacement
Bearing binding	A	Require replacement of bearing



Condition	Code	Procedure
Bearing missing	C	Require replacement of bearing
Bearing seized	A	Require replacement of bearing
Bent, affecting performance	B	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Holes distorted	A	Require replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## STRUT RODS

Condition	Code	Procedure
Adjusting nut seized	A	Require repair or replacement of hardware
<b>NOTE:</b> Only required if an alignment is being performed and adjustment of the strut in question is required.		
Attaching (mating) hole oversized	A	Require repair or replacement of bracket or frame
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Attaching point on bracket or frame corroded, affecting structural integrity	A	Require repair of bracket or frame
Bent, affecting performance	A	Require replacement
Mating (attaching) hole oversized	A	Require repair or replacement of bracket or frame
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## SUSPENSION PUMPS (HYDRAULIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Fluid at or beyond service interval	3	Suggest fluid change
Fluid contaminated	B	Require flushing and refilling of the system

Condition	Code	Procedure
<b>NOTE:</b> <b>Determine and correct source of contamination. OEM specifications must be followed for fluid type.</b>		
Fluid level incorrect	B	Require adjustment of fluid level
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

### SWAY BAR LINKS

Condition	Code	Procedure
Attaching (mating) hole distorted	A	Require repair or replacement of bracket or control arm
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Ball and socket has looseness (perceptible vertical movement)	1	Suggest replacement
<b>NOTE:</b> <b>If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</b>		
Ball and socket has looseness that is excessive	B	Require replacement
<b>NOTE:</b> <b>Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method.</b>		
<b>CAUTION:</b> <b>Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</b>	Â	Â
Â Bent	B	Require replacement
Broken	A	Require replacement
Bushing cracked	A	Require replacement

Condition	Code	Procedure
Bushing deteriorated, affecting performance	A	Require repair or replacement
<b>NOTE:</b> If condition is caused by oil-soaking, further inspection is required to determine source of oil.		
Bushing distorted, affecting performance	A	Require repair or replacement
Bushing missing	C	Require replacement
Bushing oil-soaked, affecting performance	A	Require replacement
<b>NOTE:</b> Further inspection required to determine source of oil.		
Bushing shows surface cracking (weather-checked)	Â	No service suggested or required
Bushing split	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Grease boot cracked	2	Suggest replacement
<b>NOTE:</b> Cracked grease boot will allow contaminants to enter the joint and will accelerate wear .		
Grease boot missing	C	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sway bar link (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.		
Grease boot torn	A	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of sway bar link (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.		
Mating (attaching) hole distorted	A	Require repair or replacement of bracket or control arm
Missing	C	Require replacement
Nut on stud loose	A	Require repair
<b>NOTE:</b> Check for bent stud or damaged mating hole.		
Stud bent	B	Require replacement
<b>NOTE:</b> Check for damaged mating hole.		
Stud broken	A	Require replacement
<b>NOTE:</b> Check for damaged mating hole.		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<b>NOTE:</b> Check for damaged mating hole.		

## SWAY BAR MOUNTING BUSHINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Deteriorated, affecting performance	A	Require repair or replacement
<p><b>NOTE:</b>  <b>If condition is caused by oil-soaking, further inspection is required to determine source of oil.</b></p>		
Distorted, affecting performance	A	Require repair or replacement
Leaking (fluid-filled type)	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<p><b>NOTE:</b>  <b>If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.</b></p>		
Oil-soaked, affecting performance	A	Require replacement
<p><b>NOTE:</b>  <b>Further inspection required to determine source of oil.</b></p>		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement
Seized	A	Require replacement
Shifted (out of position)	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required

## SWAY BARS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	B	Require replacement
Broken	A	Require replacement

Condition	Code	Procedure
Sway bar corroded at point of attachment to frame bushing	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Burned, not affecting performance	1	Determine cause and correct prior to repair or replacement of part
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
<b>NOTE:</b> <b>Includes inoperative, intermittent operation, or failure to perform all functions.</b>		
Melted, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Melted, not affecting performance	2	Determine cause and correct prior to repair or replacement of part
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

## TIE ROD ENDS (INNER AND OUTER)

Condition	Code	Procedure
Adjusting sleeve bent	B	Require replacement of sleeve
Adjusting sleeve clamps out of position	B	Require repair

Condition	Code	Procedure
Adjusting sleeve corroded, affecting structural integrity	A	Require replacement of sleeve
Adjusting sleeve missing	C	Require replacement of sleeve
Adjusting sleeve seized	A	Require repair or replacement
<b>NOTE:</b> Only required if toe needs to be adjusted.		
Adjusting sleeve threads damaged	A	Require repair or replacement of sleeve
Adjusting sleeve threads stripped (threads missing)	A	Require replacement of sleeve
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	A	Require replacement
Binding	A	Further inspection required
<b>NOTE:</b> If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.		
Grease boot cracked	2	Suggest replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of tie rod end (reason code 2). Cracked grease boot will allow contaminants to enter joint and will accelerate wear.		
Grease boot missing	C	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of tie rod end (reason code 2). Lack of grease boot will allow contaminants to enter joint and will accelerate wear.		
Grease boot torn	A	Require replacement of boot
<b>NOTE:</b> If boot is not available separately, suggest replacement of tie rod end (reason code 2). Torn grease boot will allow contaminants to enter joint and will accelerate wear.		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement of seal
<b>NOTE:</b> If seal is not available separately, suggest replacement of tie rod end (reason code 2). Lack of grease seal will allow contaminants to enter joint and will accelerate wear.		
Grease seal torn	A	Require replacement of seal



Condition	Code	Procedure
<p><b>NOTE:</b> If seal is not available separately, suggest replacement of tie rod end (reason code 2), wear. Torn grease seal will allow contaminants to enter joint and will accelerate wear.</p>		
Greaseable tie rod end won't take grease	2	Suggest replacement of grease fitting
<p><b>NOTE:</b> If greaseable tie rod end will not take grease after replacing the grease fitting, suggest replacement of tie rod end.</p>		
Looseness (perceptible horizontal movement)	1	Suggest replacement
<p><b>NOTE:</b> If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Looseness exceeds manufacturer's specifications	B	Require replacement
Looseness that is excessive	B	Require replacement
<p><b>NOTE:</b> Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.</p>		
<p><b>CAUTION:</b> Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Noisy	2	Further inspection required
<p><b>NOTE:</b> If greaseable, grease joint. If problem persists or joint is non-greaseable, suggest replacement.</p>		
Nut on stud loose	A	Require repair or replacement
<p><b>NOTE:</b> Check for bent stud or damaged taper hole.</p>		
Seized	A	Require replacement
Stud bent	B	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Stud broken	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<p><b>NOTE:</b> Check for damaged taper hole.</p>		

## TIRE PRESSURE MONITORING SYSTEM

**NOTE:** A Tire Pressure Monitoring System (TPMS) is designed to detect and alert the driver should the air pressure level in one or more of the vehicle's tires, up to all four tires, fall below the manufacturer's recommended inflation pressure or another pre-set level.

**NOTE:** NHTSA does not consider installation of an aftermarket or replacement tire or rim that is not compatible with the TPMS to be a "make inoperative" situation under 49 U.S.C. 30122, provided that the entity does not disable the TPMS malfunction indicator.

## TIRE PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
<b>NOTE:</b> Inoperative includes intermittent failure.		
Loose	B	Require repair or replacement
Missing (Non-OE Wheel and/or Tire Applications)	2	Suggest replacement if appropriate sensor is available
Missing (OE Wheel and Tire Applications)	C	Replacement Required
Not Responding	Â	Further inspection required
<b>NOTE:</b> If sensor does not Wake Up, follow manufacturers recommended diagnostic procedure to determine cause		

## TIRES

**NOTE:** These guidelines do not apply to split rims. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. Consult the vehicle owner's manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association. When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle. Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule. Do not mix size or type (Run Flat, all season, performance, mud and snow) of tires on the same axle. If any flammable

emergency tire inflation product has been used on a tire, consult inflation product, manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death. In some vehicles, changing the tire diameter from factory-equipped size can affect drive ability, as well as the performance of ABS and other vehicle systems. Consult the vehicle manufacturer's specifications.

Condition	Code	Procedure
Air pressure incorrect	B	Require repair
Bead broken	A	Require replacement
Bead leaking, caused by tire	A	Require repair or replacement
Bead wire/cord exposed	A	Require replacement
Cord or belt material exposed	A	Require replacement
Cord ply separations	A	Require replacement
Directional/asymmetrical tires mounted incorrectly	B	Require remounting and/or repositioning
Irregular tread wear, affecting performance	2	Suggest replacement
<b>NOTE:</b> <b>Determine and correct cause of irregular tire wear.</b>		
Load ratings less than OEM specifications	B	Require replacement
Mixed tread types (all season, performance, mud and snow) on same axle	A	Require replacement
Number of punctures exceeds manufacturer's limit	B	Require replacement
Out of balance	B	Require rebalance of tire/wheel assembly
Ply separation	A	Require replacement
Pull or lead, caused by tire	A	Require repair or replacement
Radial and bias or bias-belted ply tires on same axle	B	Require repair or replacement
Radials are on the front and not on the rear	B	Require repair or replacement
<b>NOTE:</b> <b>If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.</b>		
Run flat damage	A	Require replacement
Shoulder cut	A	Require replacement
Shoulder puncture	A	Require replacement
Shoulder with plug	A	Require replacement
Sidewall bulge	A	Require replacement
Sidewall cut	A	Require replacement
Sidewall indentation	Â	No service required or suggested
Sidewall puncture	A	Require replacement
Sidewall with plug	A	Require replacement
Speed rating designations different on same axle	2	Suggest rotation or replacement
Tire and wheel assembly has excessive run-out	B	Require repair or replacement of appropriate part
<b>NOTE:</b> <b>Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.</b>		
Tires with excessive diameter difference on an all-wheel drive vehicle or four-wheel drive vehicle	B	Require replacement

Condition	Code	Procedure
<b>NOTE:</b> <b>Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4" diameter difference.</b>		
Tires with excessive diameter difference on the same side of a dual-wheel application	B	Require replacement
<b>NOTE:</b> <b>Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4" diameter difference.</b>		
Tread area puncture larger in diameter than manufacturer's specifications	B	Require replacement
Tread missing pieces (chunking), exposing cord	A	Require replacement
Tread missing pieces (chunking), not exposing cord	1	Suggest replacement
Tread separations	A	Require replacement
Tube in tubeless tire	3	Suggest removal of tube
<b>NOTE:</b> <b>Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel . Assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and! Or wheel listed in these guidelines.</b>		
Weather-checking	Â	No service required or suggested
Worn to tread wear indicators	B	Require replacement

## TORQUE SENSOR

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## TORSION SPRINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Broken	A	Require replacement
Missing	C	Require replacement

## TRACK BAR BUSHINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Deteriorated, affecting performance	A	Require repair or replacement
<b>NOTE:</b> If condition is caused by oil-soaking, further inspection is required to determine source of oil.		
Distorted, affecting performance	A	Require repair or replacement
Leaking (fluid-filled type)	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.		
Oil-soaked, affecting performance	A	Require replacement
<b>NOTE:</b> Further inspection required to determine source of oil.		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement

Condition	Code	Procedure
Seized	A	Require replacement
Shifted (out of position)	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required

## TRACK BARS

Condition	Code	Procedure
Attaching (mating) hole distorted	A	Require repair or replacement of bracket or frame
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Grease boot cracked	2	Suggest replacement of boot
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of tie rod end (reason code 2). Cracked grease boot will allow contaminants to enter joint and will accelerate wear .</p>		
Grease boot missing	C	Require replacement of boot
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of track bar (reason code 2). Lack of grease boot will allow contaminants to enter joint and will accelerate wear.</p>		
Grease boot torn	A	Require replacement of boot
<p><b>NOTE:</b> If boot is not available separately, suggest replacement of track bar (reason code 2). Torn grease boot will allow contaminants to enter joint and will accelerate wear.</p>		
Holes distorted	A	Require replacement
Looseness (perceptible horizontal movement)	1	Suggest replacement
<p><b>NOTE:</b> If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</p>		
Looseness that is excessive	B	Require replacement
<p><b>NOTE:</b> Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.</p>		



Condition	Code	Procedure
<b>CAUTION:</b> Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.		
Mating (attaching) hole distorted	A	Require repair or replacement of bracket or frame
Nut on stud loose	A	Require repair or replacement of nut
<b>NOTE:</b> Check for bent stud or damaged mating hole.		
Seized	A	Require replacement
Stud bent	B	Require replacement
<b>NOTE:</b> Check for damaged mating hole.		
Stud broken	A	Require replacement
<b>NOTE:</b> Check for damaged mating hole.		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
<b>NOTE:</b> Check for damaged mating hole.		
Wear exceeds manufacturer's specifications	B	Require replacement

### TRAILING ARM BUSHINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Deteriorated, affecting performance	A	Require repair or replacement
<b>NOTE:</b> If condition is caused by oil-soaking, further inspection is required to determine source of oil.		
Distorted, affecting performance	A	Require repair or replacement
Leaking (fluid-filled type)	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
<b>NOTE:</b> If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.		

Condition	Code	Procedure
Oil-soaked, affecting performance	A	Require replacement
<b>NOTE:</b> <b>Further inspection required to determine source of oil.</b>		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement
Seized	A	Require replacement
Shifted (out of position)	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required

## TRAILING ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Ball joint hole oversized (loose interference or press fit)	B	Further inspection required
<b>NOTE:</b> <b>If oversized ball joint is available, require replacement of ball joint. If oversized ball joint is not available, require replacement of control arm.</b>		
Bent, affecting performance	B	Require replacement
Bushing hole oversized	B	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Holes distorted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

## VALVE STEMS

**NOTE:** Most tire manufacturers suggest replacement of non-TPMS valve stems any time a new tire is installed. For TPMS valve stems, the manufacturer may require replacement of the valve stem, o-ring seals, washers, gaskets, valve cores, compression washers and/or locking nut.

Condition	Code	Procedure
Bent	2	Suggest replacement
Broken	A	Require replacement
Cap seized	A	Require repair or replacement
Cut, but not leaking	1	Suggest replacement
Deteriorated (cracking, dry rot)	1	Suggest replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
O-Ring leaking	A	Require replacement of O-Ring

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped	A	Require replacement
Valve cap missing	C	Require replacement of cap

## VEHICLE DYNAMICS CONTROL

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

## VEHICLE SPEED SENSOR

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement

**NOTE:**

**Determine cause and correct prior to replacement of part.**

Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot

**NOTE:**

**If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**

Dust boot torn	A	Require replacement of boot
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**NOTE:**

**If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**

Condition	Code	Procedure
Housing cracked	B	Require replacement
<b>NOTE:</b> If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

## VEHICLE STABILITY ASSIST

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

## VEHICLE STABILITY/SKID CONTROL

**NOTE:** An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

**NOTE:** On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering

behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

**NOTE:** When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

## WARNING LAMPS

Condition	Code	Procedure
Bulb burned out	A	Require replacement
Warning light does not come on during bulb check	Â	Further inspection required to determine cause
Warning light flashes	Â	Further inspection required to determine cause
Warning light is intermittent	Â	Further inspection required to determine cause
Warning light stays on after initial bulb check	Â	Further inspection required to determine cause

## WHEEL ALIGNMENT

**NOTE:** Wheel alignment is defined as the measurement, analysis, and adjustment of steering and suspension angles to conform to manufacturer specifications. These angles usually include, but are not limited to: caster, camber, toe, and thrust angle. Where these angles are not adjustable and not in specification, component replacement or correction kits may be required. Errors in set-back and steering axis inclination (SAI) are often attributable to failed or damaged components and must be corrected prior to performing an alignment. Failure to replace or correct suggested parts or service may prevent a proper alignment. Before performing an alignment check, inspect and verify the following: Tire pressure and size . Vehicle loading . Ride height . Steering and suspension parts only if the inspection reveals that all the above are within published specifications, a wheel alignment check and a proper wheel alignment, if needed, may be performed. Under no circumstances should a technician bend or heat any steering or suspension component, unless specified by the vehicle manufacturer. All measurements and specifications must be noted on the inspection report.

Condition	Code	Procedure
Beyond manufacturer's service interval	3	Suggest alignment check
Dog tracking, shown to be caused by faulty alignment	2	Suggest repair
Drift, shown to be caused by faulty alignment	A	Require alignment
Lead, shown to be caused by faulty alignment	A	Require alignment
Outside manufacturer's specifications	B	Require repair
Part has been changed, affecting alignment	A	Require alignment check
Pull, shown to be caused by faulty alignment	A	Require alignment
Steering wheel off-center	2	Suggest alignment
Tire wear, shown to be caused by faulty alignment	A	Require alignment
Wander, shown to be caused by faulty alignment	A	Require alignment

## WHEEL ATTACHMENT HARDWARE

**NOTE:** For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement
<b>NOTE:</b> Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.		
Locking lug nut locking groove damaged	A	Require replacement
Loose	A	Require repair or replacement of affected component
Lug nut installed backward	B	Require repair or replacement
Lug nut mating surface distorted	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut missing	C	Require replacement
Lug nut rounded	A	Require replacement of nut
<b>NOTE:</b> Only required if removing wheel.		
Lug nut seized	A	Require replacement of nut
<b>NOTE:</b> Only required if removing wheel.		
Stud incorrect	B	Require replacement of stud
Stud missing	C	Require replacement
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped	A	Require replacement of component with stripped threads

## WHEEL BEARINGS, RACES AND SEALS

**NOTE:** When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible. If proper adjustment cannot be obtained, require replacement of bearing and race assembly
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly or other damage affecting performance.	B	Require replacement of bearing and race assembly
Seal leaking	A	Require replacement of seal and inspection of bearings
<b>NOTE:</b> Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.		
Seal missing	C	Require replacement

## WHEELS (RIMS)



**NOTE:** Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.

Condition	Code	Procedure
Bead leaking, caused by wheel	A	Require repair or replacement
<b>NOTE:</b> Do not attempt to correct a bent rim.		
Bent hub mounting surface	A	Require replacement
Bent rim, causing vibration	2	Suggest replacement
<b>NOTE:</b> Do not attempt to correct a bent rim.		
Broken	A	Require replacement
Cast wheel porous, causing a leak	A	Require repair or replacement
Clip-on balance weight is incorrect type for rim flange	2	Suggest replacement of weight
Corrosion affecting structural integrity	A	Require replacement
Corrosion build-up on wheel mounting surface	A	Require repair
Cracked	B	Require replacement
Directional/asymmetrical wheels mounted incorrectly	B	Require remounting and/or repositioning
Load capacity less than OEM specifications	B	Require replacement
Mating surface distorted	A	Require replacement
Offset mismatched on same axle	B	Require replacement
Rivets leaking	A	Require replacement
Run-out beyond OEM specs	B	Require replacement
<b>NOTE:</b> Some wire-spoke wheels may be repaired.		
Stud holes elongated	A	Require replacement
<b>NOTE:</b> Inspect wheel attaching hardware for damage.		
Welded or brazed repair	2	Suggest replacement
Welds leaking	A	Require replacement
Wheel centering (pilot) hole incorrect	B	Require replacement

## WIRING HARNESES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest repair or replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Protective shield (conduit) missing	C	Require repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
<b>NOTE:</b> <b>Determine cause and correct prior to repair or replacement of part.</b>		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

## REASON CODE EXPLANATION

Code	Reason
<b>Required</b>	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification ( Regardless Of Performance)
C	Part Is Missing
<b>Suggested/Optional</b>	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

## AUTOMOTIVE TERMINOLOGY & DEFINITIONS

## **ACTIVE SUSPENSION SYSTEM**

active suspension systems move each wheel up and down to control body motion in response to road abnormalities. The system responds to inputs from the road and the driver. With an active suspension, a vehicle can simultaneously provide the smooth ride of a soft suspension along with the superior handling associated with a firm suspension.

## **ACTIVE TILT CONTROL**

active tilt control winds up the stabilizer bars in the front and rear suspension to resist body lean while cornering. Because active control is used only as needed, vehicle spring rates and stabilizer bar stiffness can be reduced, improving normal ride characteristics. In addition, this system has potential to increase low-speed, off-road traction on 4WD vehicles.

## **ACTIVE VARIABLE RATIO STEERING**

electronically provides variable steering ratios. A computer is linked with the vehicle stability control system to aid in directional stability of the vehicle. As the vehicle travels down the highway, road surfaces and wind gusts can affect the vehicle directional stability. The car may wander a little or dart to one side, as many who have met a tractor-trailer unit on a windy day have experienced. Sensors on the car detect this sudden unintentional movement and the computer will stabilize the car by moving the Active Steering electric motor and steering gear. The driver doesn't turn the steering wheel at all.

## **AIR SPRING**

a suspension device made up of a flexible bladder containing compressed air. The air spring takes the place of a conventional coil or leaf spring. Air is supplied by an on-board compressor, usually with auxiliary equipment to sense vehicle weight and modify the pressure in the air spring as needed.

## **AIR SUSPENSION**

instead of steel coil or leaf springs, some vehicles have a bellows-like unit at each corner that contains pressurized air. As a rule, air suspensions can produce a softer ride.

## **ALIGNMENT**

an adjustment to bring parts or components into a line or proper coordination.

## **ALL-WHEEL DRIVE**

the method of providing traction to any of the wheels of a vehicle, as conditions require. Depending on the system, it may be full-time or part-time.

## **ANTI-ROLL BAR**

see 'stabilizer bar'.

## **ASPECT RATIO**

the relationship between the height of a tire from bead to tread, and the tread width, usually expressed as a percentage of the tread width.

## **AUTOMATIC RIDE CONTROL**

automatic ride control adjusts vehicle shock absorber resistance (damping) in response to driver inputs such as steering and braking and for changes in road surface. During maneuvers such as hard braking or quick lane changes, the system increases suspension damping to improve dynamic stability. Damping is automatically decreased during steady driving, so that bumps and potholes are absorbed rather than being transmitted to the occupants. Some systems also allow the driver to select suspension settings: soft, normal or firm (sport).

## **AXIAL LOAD**

a type of load placed on a bearing that is parallel to the axis of the rotating shaft.

## **AXIAL PLAY**

movement of a component parallel to the axis of rotation.

## **AXIAL**

round, on or along an axis; having the same direction or being parallel to the axis of rotation.

## **AXIS**

a real or imaginary straight line on which or around which an object rotates.

## **BALANCE**

a condition of equal weight distribution within a component or among components; the act of equalizing the weight distribution, such as balancing a tire or an engine's reciprocating assembly.

## **BALL JOINT**

a suspension component that provides a pivot point, allowing the steering knuckle to move up and down as well as turn. In response to steering input. The ball fits into a socket housing that is attached to the control arm and the stud on the other end of the ball is attached to the steering knuckle. A dust cover is installed over the ball and socket assembly to keep dirt out and lubricant in.

## **BEAD**

the steel reinforced inner edge of a tire, which fits inside and seals against the wheel rim.

## **BOOT**

protective rubber cover with accordion pleats used to contain lubricants and exclude contaminating dirt, water and grime, located at each end of the rack-and- pinion assembly and FWD CV-joints.

## **BUMP STEER**

a steering problem in which a vehicle tends to the left or the right after a bump, without steering wheel input from the driver. This is usually caused by some steering misalignment or damage that permits change of toe when the suspension works up and down.

## **BUSHING**

a liner, usually removable, for a bearing; an anti-friction liner used in place of a bearing; a type of bearing that is used to support rotating shafts.

## **CAMBER**

the attitude of a wheel/tire assembly in which, when viewed from the front, the distance between the tops and bottoms of the tires are different. If the distance between the tops is greater than between the bottoms, positive camber is present. If the distance between the tops is less than between the bottoms, negative camber is present.

## **CASTER**

angle formed between the kingpin axis and a vertical axis as viewed from the side of the vehicle. Caster is considered positive when the top of the kingpin axis is behind the vertical axis, that is, tilted toward the rear of the vehicle.

## **CENTER LINK**

a steering linkage component which attaches the Pitman arm to the idler arm, tie-rod or crosslink.

## **COIL SPRING**

spring steel rod wound into a coil that supports the vehicle's weight while allowing suspension movement.

## **COLLAPSIBLE STEERING COLUMN**

a steering column that is designed to collapse, to prevent the column from heavily impacting the driver during an accident.

## **CONSTANT VELOCITY (CV) JOINT**

a flexible coupling between two shafts that allows each shaft to maintain the same speed regardless of operating angle.

## **CONTROL ARM**

a suspension component that connects the vehicle frame to the steering knuckle or axle housing and allows the up and down movement of the wheels.

## **COTTER PIN.**

a safety component made from soft steel, used to keep a nut from loosening on a bolt or stud. The cotter pin is inserted through a hole in the bolt or stud and through slots in the nut (see 'castellated nut'), then the ends of the cotter pin are spread to lock it in position.

## **CROSSMEMBER**

part of the vehicle frame structure, arranged transversely and attached to the frame rails at each side of the vehicle. Can be removable or welded in place.

## **DAMPEN**

to slow or reduce oscillations or movement.

## **DEAD AXLE**

a load-supporting axle that does not transmit power; an axle that does not rotate, but merely forms a base on which to attach the wheels.

## **DIRECTIONAL STABILITY**

the ability of a car to travel in a straight line on a flat surface with a minimum of driver control.

## **DIRECTIONAL TIRE**

tire with a tread pattern that is designed to give maximum traction by removing water from under the tread in such a way as to minimize the risk of aquaplaning. Directional tires must be installed to turn in a specific direction.

## **DOWNFORCE**

negative aerodynamic lift.

## **DRAG COEFFICIENT**

drag divided by the product of dynamic pressure and projected area. A factor representing the drag acting on a body (as an automobile or airfoil).

## **DRAG LINK**

a steering linkage component that connects the pitman arm and the steering arm.

## **DRAG**

horizontal aerodynamic retarding force on a vehicle parallel to the relative wind direction.

## **DYNAMIC BALANCING**

balancing a part while it is in motion.

## **ELECTRICALLY POWERED STEERING**

electrically powered steering uses an electric motor to drive either the power steering hydraulic pump or the steering linkage directly. The power steering function is therefore independent of engine speed, resulting in significant energy savings.

## **ELECTRONIC AIR SUSPENSION**

electronic air suspension provides the comfort of riding on air with adjustable spring rates and capability to change ride height and load-carrying ability. Under normal driving conditions, an electronic air suspension vehicle rides at the same height as a traditionally sprung vehicle. With a heavy load, ride height is increased automatically. On current vehicles, the suspension lowers the ride height by 20 mm at highway speeds for improved aerodynamics, with about 2 percent better fuel economy. Lower ride height also can improve on-center feel of steering due to the change in suspension geometry and increased caster angle.

## **ELECTRONIC LEVEL CONTROL.**

a suspension system that uses air springs to maintain vehicle ride height. Height sensors are used to signal a control unit when the vehicle is riding low or high. In response to this signal, compressed air is either sent to or vented from the air springs.

## **HALFSHAFT**

transfers power from the transaxle to the front wheels on a front-wheel drive vehicle. Also used on some vehicles with rear-wheel drive and independent rear suspension to transfer power from the differential to the rear wheels. Consists of a stub shaft that is splined into the differential side gear, another stub shaft that is splined into the wheel hub, an interconnecting shaft, and two CV-joints, which connect the interconnecting shaft to the stub shafts.

## **HARMONIC VIBRATION**

periodic motion or vibration along a straight line. The severity depends on the frequency or amplitude.

## **HEIGHT SENSOR**

a component used in an air suspension system to signal a control unit when the vehicle is riding low or high. In response to this signal, compressed air is either sent to or vented from the air springs.

## **HUB**

mounting point for the wheel on an axle or spindle; the part of the synchronizer assembly that is splined to the transmission shaft; the center part of a wheel, gear, etc., that rides on a shaft.

## **IDLER ARM**

a conventional steering system component consisting of an arm that swivels in a bushing on a shaft, which is attached to the frame. The idler arm is mounted on the right side of the vehicle and is the same length and set at the same angle as the Pitman arm. Its function is to hold the right end of the center link level with the left end, which is moved by the pitman arm, and transfer the steering motion to the right side tie-rod.

## **INCLUDED ANGLE**

the sum of the angle of camber and steering axis inclination; the sum of two intersecting angles.



## **INDEPENDENT SUSPENSION**

a suspension in which each wheel can travel up and down without directly affecting the position of the opposite wheel.

## **INTEGRAL POWER STEERING**

a power steering system in which the power cylinder and control valve are contained in one housing.

## **INTELLIGENT VEHICLE HIGHWAY SYSTEM (IVHS)**

the Intelligent Vehicle Highway System (IVHS) provides a variety of information to the vehicle and driver through cooperation of automotive electronics, communications, controls and systems engineering technologies. IVHS has two areas of interest to car and truck makers: (1)telematics and (2)active safety warning and control systems. Several features are: Telematics: Navigation systems Traffic messaging Emergency messaging and security tracking (e.g. RESCU - Remote Emergency Satellite Cellular Unit) Short range communications/ automatic toll collection Active Safety Warning and Control Systems Collision warning/avoidance - Backup and parking aids - Side vision aid - Vision enhancement - (all weather/night vision) - Adaptive cruise control - Lane departure control

## **INTERACTIVE VEHICLE DYNAMICS (IVD)**

interactive Vehicle Dynamics is designed to minimize loss of vehicle control due to loss of traction. The IVD system could be activated when a vehicle is taking a turn too quickly or when encountering an icy patch.

## **JAM NUT**

a locknut.

## **KINGPIN**

the pivot shaft for the steering knuckle on most early axles and some modern heavy-duty axles.

## **KNUCKLE**

the suspension component that connects the upper and lower control arms or the strut and lower control arm. On rear wheel drive vehicles, it usually incorporates the front wheel spindle and on front wheel drive vehicles it has an opening where the halfshaft passes through. A steering arm is attached to the knuckle, where the tie-rod end is connected. Also called a steering knuckle.

## **LANE-DEPARTURE WARNING SYSTEM**

Issues a warning when the vehicle edges off course and reaches the highway lane markers. Introduced on the 2005 Infiniti FX and available on the 2006 Infiniti M45, the system developed by Iteris can detect lane dividers even in rainy weather. It delivers a noticeable sound when the vehicle starts to move into an adjacent lane, whether due to inattention, drowsiness or distraction.

## **LATERAL RUNOUT**

side-to-side movement or wobble in a wheel or tire.

## **LEAF SPRING**

a suspension spring consisting of a single flat plate made of steel or composite material or several steel plates bundled together.

## **LOW TIRE PRESSURE WARNING**

a low tire pressure warning system alerts the driver if the air pressure in a tire becomes too low. Typically, a light on the instrument panel will be illuminated to warn of the low-pressure condition.

## **MACPHERSON STRUT**

the principal device in the suspension of the same name, in which the spring, shock absorber and sometimes the steering knuckle are combined in a single unit.

## **MEMORY STEER**

a steering condition where the steering wheel and wheels want to return to a position other than center. This can be caused by tightening rubber bonded socket tie-rod ends when the steering wheel is not centered, binding in the upper strut mounts, or binding in a steering component or ball joint.

## **ON-CAR BALANCING**

the practice of spinning a wheel on the car to balance the wheel and all other rotational components together.

## **PARALLELOGRAM STEERING LINKAGE**

a type of conventional steering linkage consisting of a pitman arm, center link, idler arm and tierod assemblies to connect to the steering knuckles. The pitman arm, center link and idler arm form three sides of a parallelogram.

## **PITMAN ARM**

a steering system component mounted on the steering box shaft and transfers the gearbox motion to the steering linkage.

## **PLUNGER JOINT**

the inboard CV-joint on a halfshaft, so called because the joint moves in and out in response to the suspension's up and down movement, which causes the distance between the transaxle and the wheel to change. The movement takes place within the joint, with the tripod rollers or double offset ball bearings moving in and out on elongated grooves in the yoke or outer race.

## **PRESS FIT**

when a part is slightly larger than a hole it must be forced together with a press.

## **PULL**

a steering condition where the vehicle driver has to maintain constant pressure on the steering wheel to keep the vehicle moving straight.

## **RACK-AND-PINION STEERING**

a type of steering mechanism that replaces the pitman arm, center link and idler arm on gearbox steering. The steering column ends in a pinion gear that moves the driven rack to the left and right. The rack ends contain ball studs connected to the outer tie-rod ends and steering knuckles.

## **RADIAL LOAD**

load applied at 90 degrees to an axis of rotation.

## **RADIAL RUNOUT**

the out-of-roundness of a wheel or tire.

## **RADIAL**

branching out in all directions from a common center; perpendicular to the shaft or bearing bore.

## **RADIUS ARM**

a suspension component that is connected to a twin I-beam or solid axle at one end and to the vehicle frame through bushings at the other. The radius arm braces the I-beam or axle and keeps it at a right angle to the vehicle frame.

## **REAR WHEEL STEERING**

a system used on a some vehicles to change the toe of the rear wheels to either steepen a sharp turn or enhance cornering on a shallower, faster one.

## **RIDE HEIGHT**

the dimension between a fixed point on the vehicle and the pavement. The fixed point varies according to vehicle and manufacturer. Also called vehicle height.

## **ROLLING RESISTANCE**

retarding force, parallel to the direction of travel, caused by tire resistance along the ground.

## **RUNOUT**

wobble or deflection beyond a rotating part's normal plane of movement.

## **SAI**

see 'steering axis inclination',

## **SCRUB RADIUS**

the distance between the point at which the tire's vertical centerpoint intersects the road, and the steering axis inclination (SAI) intersects the road.

## **SHACKLE**

the attachment to the frame for one end of a leaf spring. The shackle allows the spring to change in length as the vehicle encounters uneven road surfaces.

## **SHIM**

thin sheets of material, usually metal, used as spacers to control the distance between parts.

## **SHOCK ABSORBER**

a device used to dampen the oscillation of the suspension caused by irregularities in the road surface.

## **SHORT AND LONG ARM SUSPENSION**

a suspension system in which the upper control arm is shorter than the lower control arm, allowing the wheel to deflect in a vertical direction with minimal change in camber.

## **SPINDLE**

a shaft used to attach the wheel assembly on non-drive axles.

## **SPRING**

a suspension system component that supports the vehicle and absorbs shock caused by uneven road surfaces; a device that returns to its original form after being forced out of shape.

## **SPROCKET**

a toothed wheel used to engage a chain or ribbed belt.

## **SPRUNG WEIGHT**

the weight of all the vehicle components that are supported by the springs; see 'unsprung weight'.

## **STABILIZER BAR**

a torsion-bar spring connecting the suspension on either side of the vehicle. When a vehicle rolls to the side in a turn, the suspension at the outside wheel compresses and the suspension at the inside wheel extends. The stabilizer bar that connects them twists to apply a counteracting force to hold the vehicle closer to level. Also called an anti-roll bar or sway bar.

## **STATIC BALANCE**

balance at rest; still balance; the equal distribution of weight of the wheel and tire around the axis of rotation such that the wheel assembly has no tendency to rotate by itself regardless of its position.

## **STEERING ARM**

the steering system component that links the steering knuckle to the tie-rod assembly.

## **STEERING AXIS INCLINATION**

the angle between true vertical and an imaginary line running through the rotational center of the ball joint(s).

## **STEERING COLUMN**

the housing, steering shaft, bearings and related components between the steering wheel and the steering gear.

## **STEERING GEAR**

the assembly located at the end of the steering column, which contains the gears and other components that multiply the driver turning force.

## **STEERING KNUCKLE**

the suspension component that connects the upper and lower control arms or the strut and lower control arm. On rear wheel drive vehicles, it usually incorporates the front wheel spindle and on front wheel drive vehicles it has an opening where the halfshaft passes through. A steering arm is attached to the steering knuckle, where the tie-rod end is connected.

## **STEERING LINKAGE**

all of the components that connect the steering gear to the front wheels.

## **STRUT ROD**

on vehicles where the lower control arm is attached to the frame at one pivot point, a strut rod is used to brace the control arm against the vehicle frame.

## **STUD**

a fastener that has screw threads at both ends.

## **SWAY BAR**

see 'stabilizer bar',

## **THRUST ANGLE**

the difference between the thrust line and the geometric centerline of the vehicle.

## **THRUST LINE ALIGNMENT**

aligning the front wheels to the thrust line during a wheel alignment, when rear wheel toe cannot be adjusted to specification.

## **THRUST LINE**

an imaginary line that divides the total toe angle of the rear wheels.

## **THRUST LOAD**

load placed on a part that is parallel to the center of the axis.

## **TIE-ROD END**

a ball and socket joint that connects the tie-rod to the steering knuckle arm and to the center link or steering rack.

## **TIE-ROD**

steering linkage member which connects the steering knuckle arm with the centerlink or the steering rack.

## **TIRE ROTATION**

the practice of moving a set of tires to different positions on the vehicle to equalize wear and extend the life of the tires.

## **TIRE SLIP**

see 'wheel slip'.

## **TOE**

the direction in which a wheel tends to roll, a major factor in tire wear.

## **TOE-IN**

a condition that exists if the tire's line of forward direction intersects the extended centerline of the vehicle.

## **TOE-OUT ON TURNS**

the designed angle of the steering arm on the steering knuckle, which causes the inside front wheel to turn at a sharper angle than the outside front wheel during a turn. The specification is checked using the turntables on wheel alignment machine. Toe-out on turns is not an adjustable angle, and if it is incorrect it is most likely due to a bent steering arm.

## **TOE-OUT**

a condition that exists if the tire's line of forward direction and the vehicle centerline are angled apart.

## **TRACK**

the distance between the centers of the treads of parallel wheels.

## **TRACKING**

travel of the rear wheels in a parallel path with the front wheels.

## **TWIN I-BEAM SUSPENSION**

a type of independent front suspension and used on light trucks and vans. It consists of two I-beams supported by coil springs, and the steering knuckles/spindles, which are connected by king pins or ball joints. The inner end of the axle connects to the vehicle frame through a rubber

bushing. A radius arm also connects to the frame through rubber bushings to control wheelbase and caster.

## **UNSPRUNG WEIGHT**

the components of a vehicle that rest directly on the road surface without being supported by the suspension springs.

## **VARIABLE ASSIST POWER STEERING**

a power steering system that uses valves and speed sensors to vary the amount of steering assist according to engine or road speed. At slow speeds more steering assist is delivered and steering the wheels is easier; necessary for parking, etc.. At higher speeds, steering assist is reduced and more steering effort is required to steer the car, giving the driver greater feel of the road. Also known as Speed-sensitive power steering.

## **VEHICLE HEIGHT**

see 'ride height'.

## **WHEEL ALIGNMENT**

the adjustment of suspension and steering components to optimize steering control and minimize tire wear.

## **WHEEL BALANCE**

the condition in which a wheel/tire assembly has equal weight around its center, preventing vibration at high speeds. Wheel balance can be static, such as on a bubble balancer, or dynamic, such as with a spin balancer.

## **WHEEL OFFSET**

the dimensional difference between a wheel's centerline and the plane of the axle flange mounting surface.

## **WHEEL SLIP**

a measurement (in percentage) of the friction between the tire and road surface; at zero slip the tire rotates freely, while at 100% slip the tire is locked up and is pushed along the road surface by the moving vehicle. Also called tire slip.

## **WHEEL SPEED SENSOR**

a permanent magnetic sensor that sends information to the computer in an ABS system regarding wheel speed.

## **WHEEL WEIGHTS**

small weights, usually made of lead, attached either mechanically or by adhesive to a wheel/tire assembly to correct its balance.

## **WORM GEAR**

a gear into which teeth are cut, resembling the threads of a screw.

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