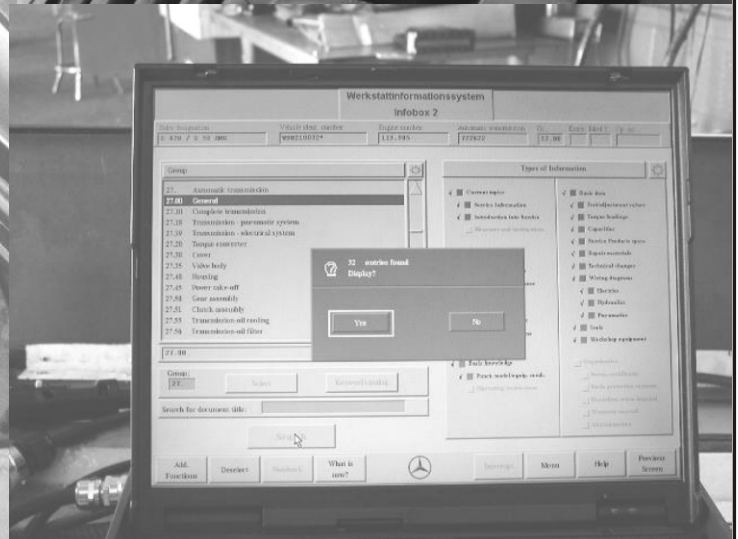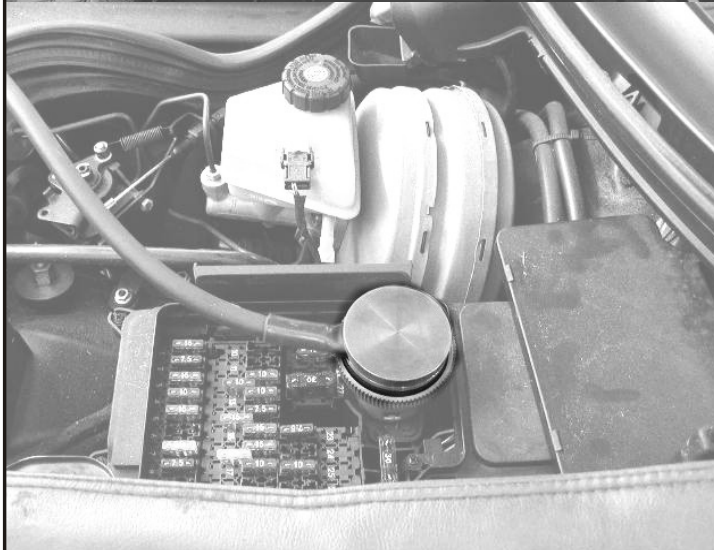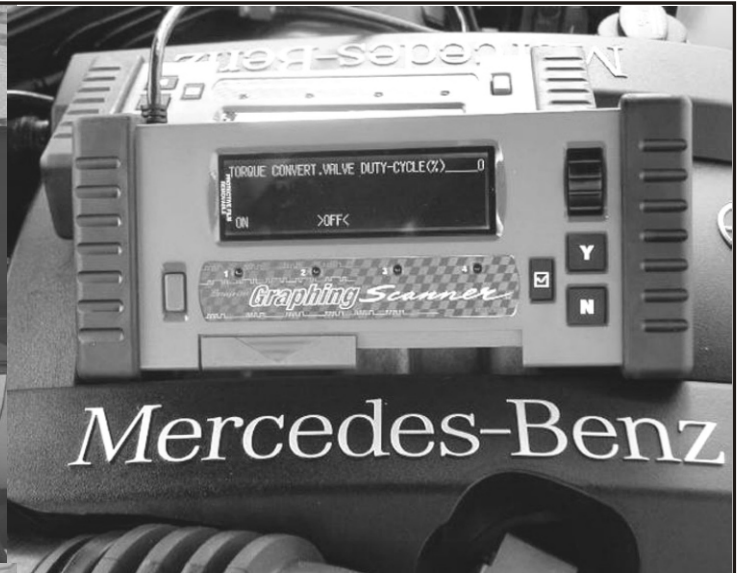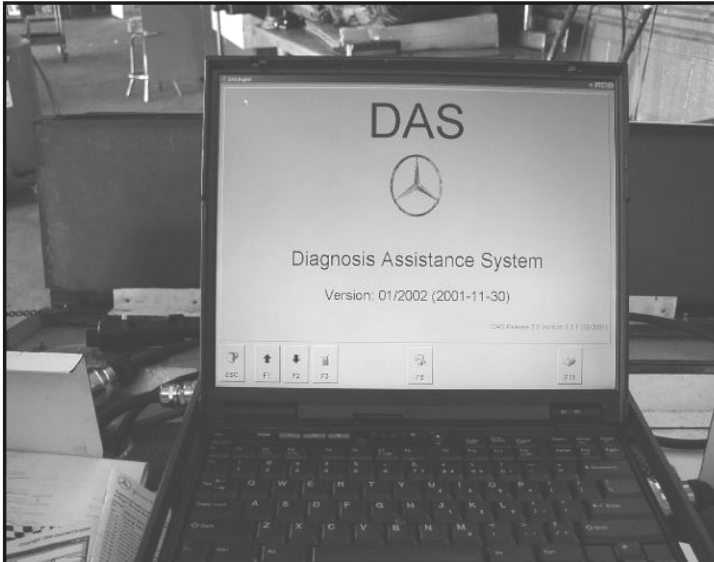# Scanner Information

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Understanding Mercedes Adaptation Shift Strategy

Getting familiar:

For those who are familiar with Daimler/Chrysler's 41TE and 42LE transmissions know that the controller operating these transmissions adapts each of their shifts utilizing a Clutch Volume Index (CVI) strategy. Chrysler's definition of CVI goes something like this: A Clutch Volume Index or learned clutch volume represents the volume of fluid that is required to stroke a clutch piston to the point where clutch pack clearance is obtained, without stroking the accumulator or picking up any torque load on the clutch. For simplicity sake, it basically indicates the amount of time it takes to make a shift. Chrysler monitors the following shifts to aquire learned clutch fill times: The 1-2, 2-3, 4-3, 4-2, 3-1 and 2-1. By these observances, the controller can tailor solenoid operation adapting for each shift compensating for possible increased clutch clearance. Mercedes adaptation principal operates in a similar manner in that it monitors shift time (the time it takes to change from one gear ratio to another) and lengthens or shortens the shift as needed so as to provide a consistent comfortable shift feel. However, the system Mercedes utilizes is far more sophisticated as compared to Daimler/Chrysler (consistent with Mercedes) as the speed of its communication system is much faster. Mercedes utilizes a CAN BUS system whereby information can travel at a rate of approximately 1 million bites per second.

The Communication System:

In the general computer world there are many types of networks. In your office there is a "Local Area Network," or "LAN." The Internet is a very large "WAN" or "Wide Area Network." In the Mercedes they use a "CAN" or "Controller Area Network."

The hardware, or communications link, in these networks are all very different, but the way the actual information is packaged, sent, and received is very similar. Information is assembled into a packet. The electronic address of the unit(s) where the packet is going is added to the front of the packet, and the packet is sent on a common communications link along with packets to and from other units. All of the units (or modules in the case of a CAN) "hear"all of the packets all of the time. They just don't "listen" unless it has their address as the destination.

The actual communications link in a CAN is a single twisted pair. This is two pieces of wire which are twisted together (no electrical contact). The type of wire, type of insulation, and the number of twists per inch are all critical. These factors change electrical characteristics such as EMI/RFI susceptibility and electrical impedance. The signals across a CAN operate at a very high frequency allowing a large amount of information to be transmitted. Twisted pair network busses are normally terminated (either at both ends or at each module) with a specific resistance. Although necessary for other reasons, this terminating resistance may be used to detect and troubleshoot faults on the wire.

WELCOME TO MERCEDES ADAPTATION PROGRAM

The following data has been compiled from information provided by Mercedes to be used in supervised training by qualified MB technicians. Procedures and values may change without notice. The information provided here is in conjunction with Mercedes dedicated diagnostic equipment known as the "Star Diagnosis." This is a PC connected to the vehicle through a piece of hardware called the Multiplexer. The Computer runs a program called the DAS (Diagnosis Assistance System) and the WIS (Werkstattinformationssytem / Workstation Information System) which also includes the HHT (Hand Held Scanner) software. Although this information is tailored for Mercedes equipment, Generic Scan Tools such as the Snap-On MT2500 scanner has come forth with their Mercedes Primary Cartridge. This Cartridge will allow the technician to view Adaptation. Therefore, the following pages will prove to be useful preparatory information for the serious transmission diagnostician.

Driving Style Adaptation:

The Driving Style Adaptation program in the Electronic Transmission Control Module (ETC), lives for the moment meaning that it does not retain any particular driving condition for a later date. The ETC will monitor, adapt and respond in shift feel and timing immediately from the following inputs:
1. The vehicles acceleration and deceleration activity.
2. The rate of change as well as the position of the throttle pedal.
3. Lateral acceleration (The speed in which turns are taken).
4. The frequency of gear change

The Shift Time Adaptation:

Shift Time Adaptation is the time it takes to make a shift from one gear into another. It is defined as the time it takes to disengage one clutch pack while another is being applied (i.e. Shift Overlap). Specific values are needed to make the Shift Time Adaptation and these values are written to memory enabling the ETC to adapt during the following shift occurrences:
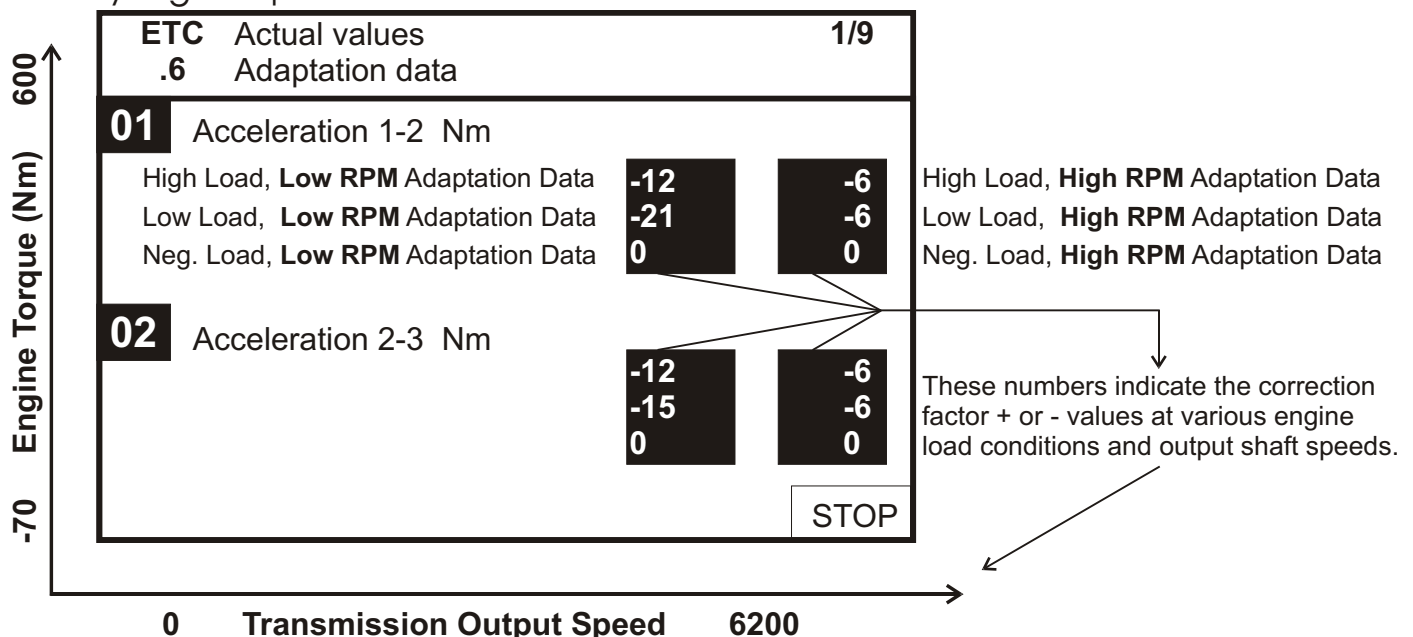1. Accelerating Up-shift adaption: Up-shifts that occur under load
2. Deceleration Up-shifts adaption: Up-shifts that occur under no load
3. Accelerating Down-shifts adaptation: Down-shifts that occur under load
4. Deceleration Down-shifts adaptation: Down-shifts that occur under no load (i.e. coast down shift)
These values are represented in Newton meters (Nm) meaning "Torque." In other words, the strength of the shift. There are no ideal numbers to achieve, however a 0 indicates that a clutch pack does not require adaptation or the clutch pack has not yet adapted. If an adaptation value is at its maximum value, and the shift is unacceptable, repair work may be required. Additional adaptation cannot be achieved when the following values are reached:
Maximum values in Nm:
8 and 12 cylinder engines have a + or - 210 Nm
6 cylinder engines have a　　　　+ or - 180 Nm
4 cylinder engines have a　　　　+ or - 150 Nm

Analyzing Adaptation for Shift Time Data as seen on the HHT - Hand Held Scanner

ETC	Actual values	1/9
.6	Adaptation data	

01 Acceleration 1-2 Nm

High Load, **Low RPM** Adaptation Data	-12	-6	High Load, **High RPM** Adaptation Data
Low Load, **Low RPM** Adaptation Data	-21	-6	Low Load, **High RPM** Adaptation Data
Neg. Load, **Low RPM** Adaptation Data	0	0	Neg. Load, **High RPM** Adaptation Data

02 Acceleration 2-3 Nm

-12 / -6
-15 / -6
0 / 0

These numbers indicate the correction factor + or - values at various engine load conditions and output shaft speeds.

STOP

Engine Torque (Nm): 600 ... -70
Transmission Output Speed: 0 ... 6200

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The Shift Time Adaptation continued:

Viewing the 1-2 up-shift as our example in the HHT Adaptation window , the low numbers indicate that a small amount of adaptation was required to optimize the shift. It is the K1 clutch that is applied on the 1-2 up-shift. Therefore, we can conclude that the clutch clearance for the K1clutch is within specification tolerances. It also indicates that there are no excessive leaks in the circuit as well.

The following key points must be observed when performing and viewing a re-learn adaptation procedure on a 722.6. It is recommended to have a driving assistant enabling you to be free to concentrate and observe the scanner data.

1. The ideal transmission fluid temperature should be **176 to 194ºF (80 to 90ºC)** however **140 to 221ºF (60 to 105ºC)** is acceptable.
2. Turn **A/C Off** and drive the vehicle on a **level road** with **light throttle**.
3. Do not exceed maximum engine RPM during the shift process, refer to the example charts below.
4. Refer to the "Adaptation Torque Requirement" example charts below.
5. Let the **engine idle for ten minutes** after the adaptation process or you will lose the new adaptation data.
6. To assure effective adaptation, clutch packs must apply and release at least 8 times for M119 and M120 engines and a minimum of 4 times for M104, M111 and OM606 engines.

Adaptation Torque Requirement chart for Shift Time - M104, M111 and OM606				
Shift	**Torque**	**Torque**	**Torque**	**Torque**
Engine	M104.941	M111.973	M111.974	OM606.912
1-2	**14-36 Nm**	**15-36 Nm**	**15-28 Nm**	**14-27 Nm**
2-3	**20-59 Nm**	**20-59 Nm**	**20-59 Nm**	**20-55 Nm**
3-4	**20-45 Nm**	**20-45 Nm**	**20-46 Nm**	**15-54 Nm**
4-5	**0-121 Nm**	**0-121 Nm**	**0-82 Nm**	**0-81 Nm**
Max. Engine Speed =	2400 RPM	2400 RPM	2400 RPM	1800 RPM

Adaptation Torque Requirement chart for Shift Time - M119 and M120				
Shift Member	**Up-shift** Very Light Throttle	**Downshift** Idle Throttle (w/o shifter)	Permissible Engine Torque During the shift process **M119 4.2 liter**	Permissible Engine Torque During the shift process **M119 4.2 liter and M120**
K1	1-2	-	**20-40 Nm**	**20-50 Nm**
K2	2-3	-	**20-70 Nm**	**20-80 Nm**
K3	3-4	-	**0-60 Nm**	**0-140 Nm**
B1	4-5	-	**0-110 Nm**	**0-140 Nm**
B2	-	4 -3	**0 to -50 Nm**	**0 to -50 Nm**
K1	-	5-4	**0 to -50 Nm**	**0 to -50 Nm**
Max. Engine Speed =		1800 RPM		

Shift Time Adaptation continued:

The shift time is controlled by the TCM through a combination of "Fill Pressure" and "Fill Time" strategy. This type of strategy allows the controller to manage the "Shift Time" by determining the amount of pressure needed to engage the clutch as well as the time needed to fill the drum behind the piston to apply the clutch pack. In other words, the Shift Time reports to the TCM how hard or soft (how short or long) the shift was. The TCM then adjusts the shift feel by controlling how much pressure is used to apply the clutch as well as controlling the flow rate to that particular clutch drum.

Fill Pressure Adaptation:

Fill pressure adaptation is the ability of the ETC module to modify the pressure used to engage the clutch pack. The value of this pressure determines how firm the shift will be. If too much pressure is used the shift will be hard. Likewise, if too little is used the transmission may slip. Fill pressure adaptation values are written to memory and the ETC module can make adjustments that affect shift quality. The following is an HHT screen reporting Fill Pressure Adaptation data.

Analyzing Adaptation for Fill Pressure Data as seen on the HHT

```
ETC   Actual values
 .6   Adaptation data

17    Fill pressure 1-2
                     -400 mbar   MAX 1600
18    Fill pressure 2-3
                     -100 mbar
19    Fill time K1 in 2nd gr.
                     0 Cycle
20    Fill time K2
                     0 Cycle
21    Fill time K3
                     0 Cycle
```

MT2500 Scanner display and booklet information:

Fill pressure for specific up-shifts. This group includes the following parameters:

    FILL PRESSURE 1-2(mbar)_XXXX   (range: 0 to 1600 mbar)
    FILL PRESSURE 2-3(mbar) _XXX   (range: 0 to 800 mbar)

The ETC calculates these adaptive values based on the current draw from the solenoid shift valve. These values compensate for tolerances in the solenoid valve, the modulated shift pressure valve, and for the tension on the return spring for the respective shift member. Higher values indicate that the ETC is increasing fill pressure to create a harder shift. Lower values indicate that the ETC is decreasing fill pressure to create a softer shift. A value of 0 mbar means that either the ETC has not stored an adaptive value, or that the shift member does not require correction. A value at the parameters upper limit, along with poor shift quality, indicates the need for repair.

Fill Time Adaptation:

Fill Time Adaptation is the ability of the ETC module to modify the time it takes to fill the clutch pack. Fill time is the time it takes to fill the clutch drum behind the apply piston taking all the clearance up but not applying the clutch pack. This adaptation compensates for the condition of the clutches and steel plates and the clearance between them. The certain values (i.e. previous shift condition, etc..) needed to make these adapts are written to memory.

Analyzing Adaptation for Fill Time Data as seen on the HHT

ETC	Actual values		9/9
.6	Adaptation data		
22	Fill time B1		
		0 Cycle	
23	Fill time B2		
		0 Cycle	MAX 15
24	Fill time K1		
		0 Cycle	

MT2500 Scanner display and booklet information:

Fill time for specific clutch and brake pack shift members. This group includes the following parameters:

FILL TIME K1 IN 2ND GEAR CYCLE_XX   (range: 0 to 15 cycles)
FILL TIME K1 IN 4TH GEAR CYCLE_XX
FILL TIME K2 CYCLE_XX   FILL TIME K3 CYCLE_XX
FILL TIME B1 CYCLE_XX   FILL TIME B2 CYCLE_XX

These data parameters display adaptations to the length of time it takes to fill the clutch (K) and brake (B) shift members with ATF to remove the clearances just before application. These adaptations compensate for the condition of the clutches, the number of steel plates, and the clearance between the steel plates.

The ETC sends an amplitude-modulated current to the fill solenoids. The greater the signal amplitude, or difference between the crests and troughs of the signal, the greater the pressure. The ETC can only change signal amplitude once per 20 milliseconds (ms). This prevents overcorrection. Each cycle displayed by these data parameters equals one 20-ms period. If the Scanner reports a fill time adaptation of 3 cycles, this means that it took three periods of 20-ms each (60 ms) to alter pressure enough to accomplish the correct application of the shift member.

The maximum fill correction time is 15 cycles, or 300 ms. A value of 0 cycles indicates no fill correction was needed.

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