

B 1 Engine Test, Adjustment

Listing of Test Steps

1	Test equipment	connect/disconnect.
2	CFI control module on-off ratio test (Ignition: ON)	perform.
3	CFI control module on-off ratio test (Engine: closed throttle)	perform (wait until readout display oscillates).
4	Diagnsotic trouble code read-out of CFI control module (Ignition: ON) ...	perform.
5	Engine systems (MAS) control module (N16) diagnostic trouble code read-out (Ignition: ON)	perform.
6	Ignition control module diagnostic trouble code read-out (at engine rpm) .	perform.
7	Air filter	remove and install.
8.0	Linkage rods	check throttle valve for free movement and condition. Lubricate bearings, slotted lever and ball sockets.
8.1	Closed throttle (idle) contact	check, adjust.
8.2	Wide open throttle contact	check using accelerator pedal, adjust.
9	Control pressure cable	check, adjust.
10	Cruise control (without ASR)	check, adjust.
11	Engine coolant level	check, correct.
12	Engine oil level	check, observe condition of oil.
13	Voltage at ignition coils	check (see Test and Adjustment Data, Section A).
14	Ignition timing and vacuum advance	check (see Test and Adjustment Data, Section A).

15	Oscilloscope patterns	evaluate (see section C).
16	Engine oil temperature	approximately 80 °C.
17	Intake system	check for leakage.
18	Closed throttle (idle) speed	check.
19	Lambda control system	test.
20	Closed throttle under load	check.

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Connection Diagram – Test Equipment Engine 104 CFI



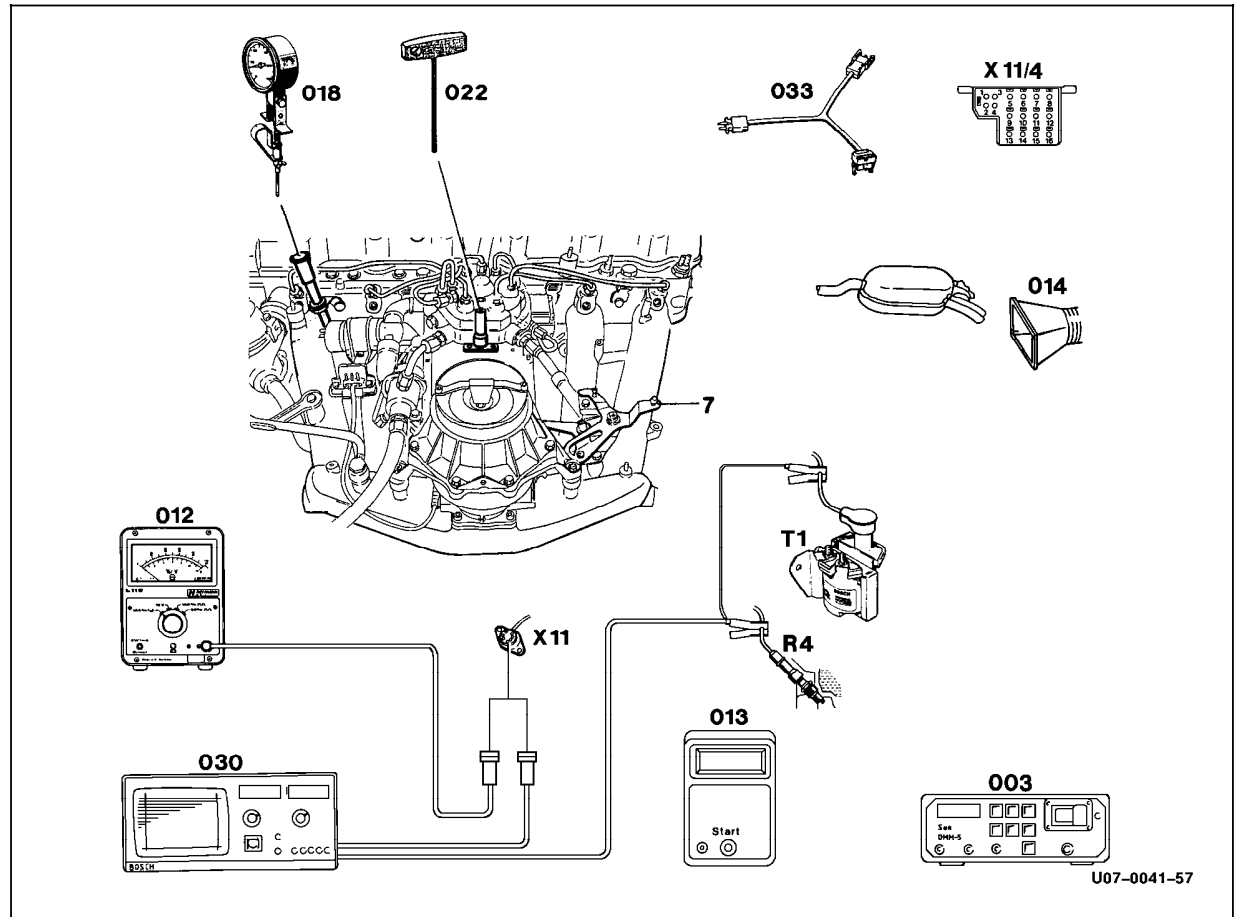
Set engine tester to 6 cylinder position

Figure 1

- R4 Spark plugs (cylinder 1)
- T1 Ignition coil
- X11 Diagnostic connector (9-pole)
- X11/4 Diagnostic connector (16-pole)
- 7 Throttle linkage
- 003 Multimeter
- 012 On-off ratio tester
- 013 Impulse counter scan tool
- 014 Exhaust vent hose
- 018 Oil thermometer
- 022 Hex. socket wrench ¹⁾
- 030 Engine analyzer with oscilloscope
- 033 Test cable

¹⁾ Required only for mixture adjustment when replacing fuel mixture adjustment tower.

Note: Depending on test equipment available, it may be necessary to alternately connect the engine analyzer and on-off ratio tester to diagnostic connector(X11).



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**Connection Diagram – Test Equipment
Engine 119,120 CFI**



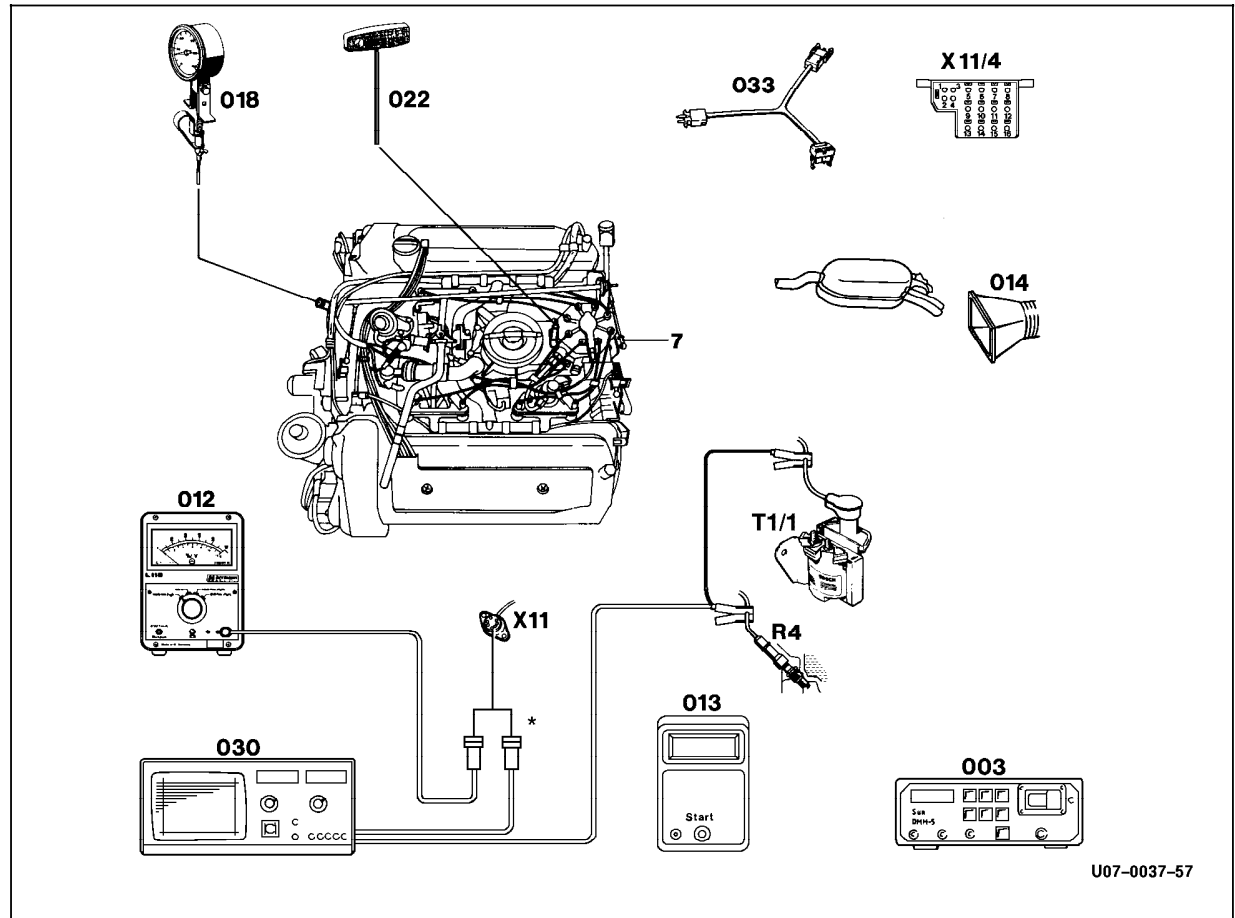
Set engine tester to 4 cylinder position. Only **one** ignition circuit can be checked at a time.

Figure 2

- R4 Spark plugs (cylinder 1)
- T1/1 Ignition coil 1
- X11 Diagnostic connector (9-pole)
- X11/4 Diagnostic connector (16-pole)
- 7 Throttle linkage
- 003 Multimeter
- 012 On-off ratio tester
- 013 Impulse counter scan tool
- 014 Exhaust vent hose
- 018 Oil thermometer
- 022 Hex. socket wrench ¹⁾
- 030 Engine analyzer with oscilloscope
- 033 Test cable

¹⁾ Required only for mixture adjustment when replacing injection system components.

Note: Depending on test equipment available, it may be necessary to alternately connect the engine analyzer and on-off ratio tester to diagnostic connector (X11).



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**Connection Diagram – Impulse Counter Scan Tool and On/off Ratio Tester
Engine 104, 119,120 CFI**

Note:

Connect red wire to X4/10.

Connect black wire to socket 1.

Connect yellow wire of impulse counter scan tool to:

Socket 3 for CFI control module

Socket 8 for Ignition control module

Socket 14 for Engine systems control module (MAS)

The red wire of the impulse counter scan tool may be optionally connected to socket 16 (circuit 15) of diagnostic onnector (X11/4) instead of terminal block.

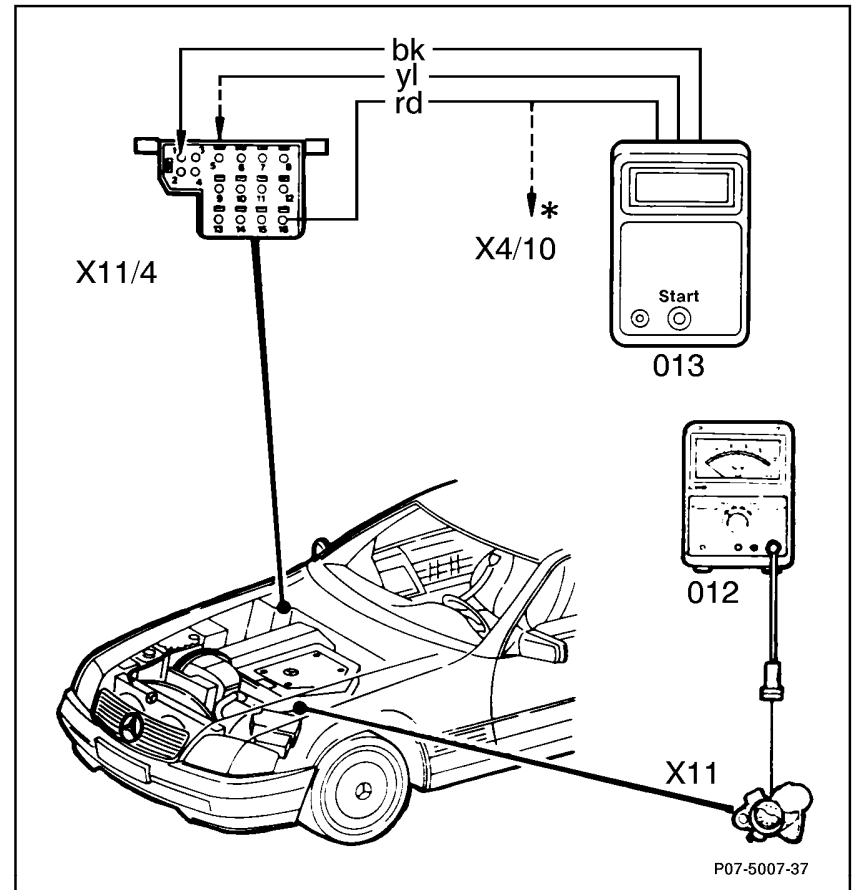


Figure 3

- 012 On/off ratio tester
- 013 Impulse counter scan tool
- X4/10 Terminal block, terminal 30/30Ü/61e87L
- X11 Diagnostic connector
- X11/4 Diagnostic connector (16-pole)

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Connection chart for test equipment without diagnostic adapter for two circuit ignition systems

Test equipment version	Cylinder no. setting on test equipment	Type of measurement	Circuit on Diagnostic connector			Trigger clamp on ignition cable	kV-Clamp on ignition cable ignition circuit
			X11 Engine 119	X11/2 Engine 120 L.	X11/3 Engine 120 R.		
SUN MEA1500-MBT	Engine 119: 4 Engine 120: 6	RPM/ dwell angle of Ignition circuit →	T1/1		T1/1		
		RPM/ dwell angle of Ignition circuit →		T1/2			
		Timing of Ignition circuit →	T1/1		T1/1	Cylinder 1	Engine 119: T1/1 Engine 120: T1/1
		Timing of Ignition circuit →	T1/2	T1/2		Engine 119: cyl. 2 ¹⁾ Engine 120: cyl. 12	Engine 119: T1/2 Engine 120: T1/2
		Oscilloscope primary/secondary → and voltage at terminal 15/1 of Ignition coil	T1/1		T1/1	Engine 119: cyl. 1 Firing order 1-4-6-7 Engine 120: cyl. 1 Firing order 1-5-3-6-2-4	Engine 119: T1/1 Firing order 1-4-6-7 Engine 120: T1/1 Firing order 1-5-3-6-2-4
		Oscilloscope primary/secondary → and voltage at terminal 15/1 of Ignition coil		T1/2		Engine 119: cyl. 5 Firing order 5-8-3-2 Engine 120: cyl. 12 Firing order 12-8-10-7-11-9	Engine 119: T1/2 Firing order 5-8-3-2 Engine 120: T1/2 Firing order 12-8-10-7-11-9

1) On engine 119 subtract 90° crankshaft from measured value.
Example: measured: 107° crankshaft, 107°-90°= 17° crankshaft timing

B 1 Engine Test, Adjustment**Notes regarding on/off ratio check using on/off ratio tester**

The operation of the Lambda control can be tested by checking the on/off ratio. In addition, any malfunctions that exist momentarily can be recognized. The tests distinguish between malfunctions that occur with the ignition **ON** or with the engine **at idle**.

The on/off ratio can be checked using the on/off ratio tester or engine analyzer. An on/off ratio of 50% indicates that all input signals are OK, but Lambda control is not functioning. A varying on/off ratio indicates that the Lambda control is functioning correctly. On/off ratios from 10% to 95% are each assigned a specific malfunction (see DTC memory, DM Engines, Volume 2, Section 2). After testing the on/off ratio, a diagnostic trouble code (DTC) readout using the impulse counter scan tool must always be performed.

Notes regarding diagnostic trouble code (DTC) readout using the Impulse counter scan tool

When diagnosing engine running complaints, or when the CHECK-ENGINE lamp is illuminated, the DTC memory should be read out and the DTC's noted before any repairs are attempted. This will ensure that the technician can differentiate between actual malfunctions and "simulated malfunctions," since testing done on a running engine will cause malfunctions to be stored that were caused by a simulation or a disconnected circuit.

When testing is completed, the DTC memory of the CFI and Ignition control modules and the Engine systems control module (MAS) must be cleared.

B 1 Engine Test, Adjustment**Notes regarding DTC readout using Impulse counter scan tool****1. Connect impulse counter scan tool according to diagram.**

The LED "U-Batt" should come on. If not, check the following:

- a) Voltage supply.
- b) Impulse counter scan tool fuse.

2. DTC memory readout

- a) Ignition: **ON**.
- b) Push start button for 2-4 seconds.
- c) Read and record DTC readout.
- d) Push start button again.
- e) Read and record DTC readout.

Repeats steps d) and e) until the first DTC readout reappears.

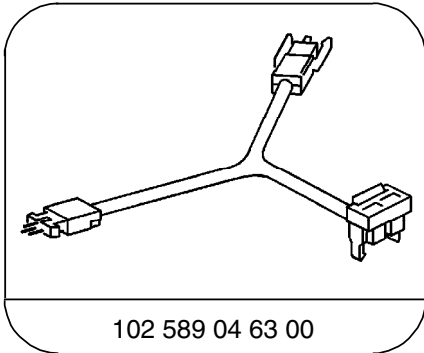
3. Clearing DTC memory

Note: The clearing process must occur within 20 seconds after the DTC readout.

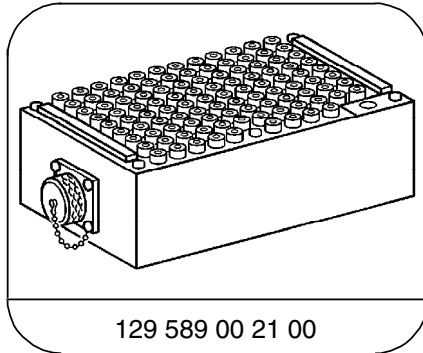
- a) Push start button 2-4 seconds (Impulse display appears).
- b) After a waiting period of 3 seconds, push the start button for 6-8 seconds which will erase the previously displayed DTC.
- c) Erase each DTC separately.

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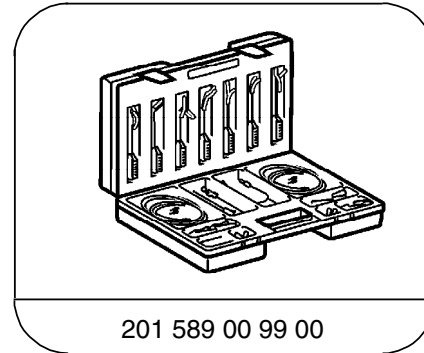
Special Tools



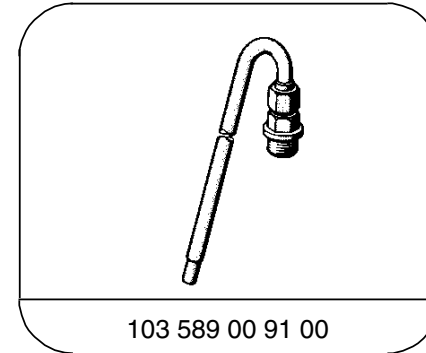
Test cable



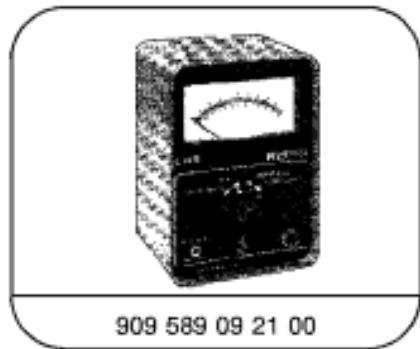
126-pin socket box



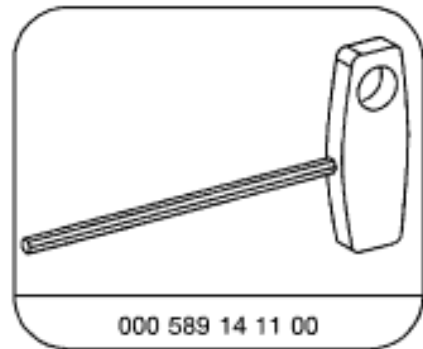
Electrical connecting set



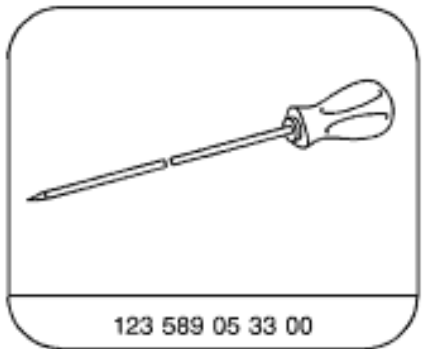
Measuring connection



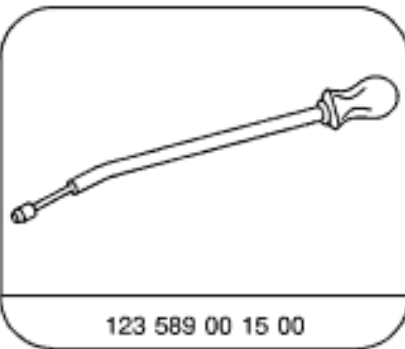
On-off ratio tester



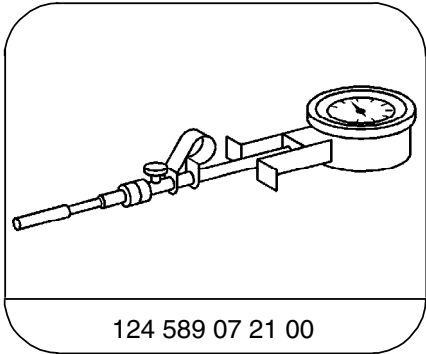
3 mm screwdriver, 3 mm



Puller

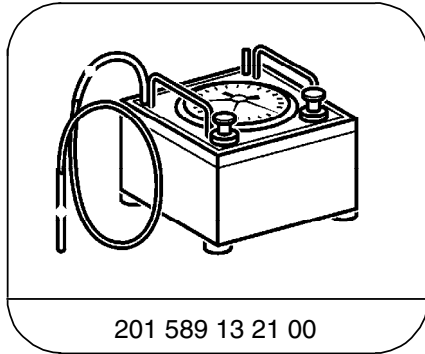


Drift punch



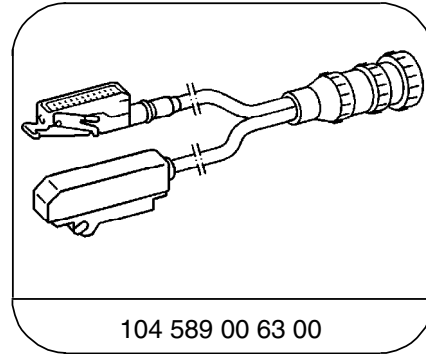
124 589 07 21 00

Remote thermometer



201 589 13 21 00

Tester



104 589 00 63 00

Test cable

B 1 Engine Test, Adjustment**Equipment**

Engine analyzer ¹⁾	Bear DACE (Model 40-960) with dual ignition adapter Sun EMT-1019/Master 3 ²⁾ Sun MCM-2110 ²⁾ Sun MEA-1500MB ²⁾
Multimeter ¹⁾	Fluke Model 23, 83, 85, 87 Sun DMM-5

¹⁾ Available through the MBUSA Standard Equipment Program.

²⁾ On engines with dual ignition system, only one cylinder bank can be measured at a time, using the present equipment.

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Note:

The Lambda control system test should not be performed on a very hot engine, for example, after a fast drive or after an output test on a dynamometer.

Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 1 Connect test equipment according to diagram	Ignition: OFF	–	–
⇒ 2 CFI control module on/off ratio readout	Ignition: ON Coolant temperature 80° C	50%	See DTC memory diagnosis (DM Engines Vol. 2, Section 2)
⇒ 3 CFI control module on/off ratio readout	Engine: closed throttle (idle) Coolant temperature 80° C	Readout oscillates	See DTC memory diagnosis (DM Engines Vol. 2, Section 2) Adjust Lambda control ⇒ 19
⇒ 4 CFI control module DTC readout	Connect impulse counter scan tool: yellow wire to socket 3 of diagnostic connector X11/4 Ignition: ON	DTC readout 1	See DTC memory diagnosis (DM Engines Vol. 2, Section 2)

¹⁾ Observe Preparation for Test, see 22.

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Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
<p>⇒ 5 Engine systems control module DTC readout</p>	<p>Connect impulse counterscan tool: yellow wire to socket 14 of diagnostic connector X11/4 Ignition: ON</p>	<p>DTC readout 1</p>	<p>See DTC memory diagnosis (DM Engines Vol. 2, Section 2)</p>
<p>⇒ 6 Ignition control module DTC readout</p>	<p>Connect impulse counter scan tool: yellow wire to socket 8 of diagnostic connector X11/4 Engine: Start</p> <p>Vacuum hose to ignition control module connected. Hold engine at 3100-3600 rpm for 8 seconds. Disconnect vacuum hose at idle, set parking brake, move selector lever from transmission range "P" to "D" and back to "P". Hold engine at more than 5000 rpm for at least 2 seconds. Reconnect vacuum hose at idle. Raise engine to approx 2300 rpm, followed by brief opening to wide open throttle position (wide open throttle contacts must close). Engine: closed throttle (idle) Readout stored DTC's from memory.</p>	<p>DTC readout 1</p>	<p>See DTC memory diagnosis (DM Engines Vol. 2, Section 2)</p>

¹⁾ Observe Preparation for Test, see 22.

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Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 7 Remove air cleaner	Ignition: OFF	–	–
⇒ 8.0 Check condition of linkage and throttle valve	Operate throttle linkage without ASR: Ignition: OFF with ASR: Ignition: ON	Smooth operation, no binding should be evident.	Lubricate all bearings and ball sockets
⇒ 8.1 Check closed throttle (idle) speed position	Ignition: OFF Accelerator pedal at closed throttle position	Throttle valve lever must rest against closed throttle stop. without ASR: Roller must contact slotted lever at closed throttle stop free of tension. with ASR: Lever (53) must contact closed throttle stop.	Adjust throttle linkage (SMS, Job No. 30-300)
⇒ 8.2 Check wide open (full) throttle position	Ignition: ON , Engine OFF Accelerator pedal at wide open throttle position (not kickdown)	without ASR: Throttle lever must stop approx. 0.5-1 mm away from the wide open throttle stop. with ASR: Throttle lever must contact wide open throttle stop.	Adjust throttle linkage (SMS, Job No. 30-300)













¹⁾ Observe Preparation for Test, see 22.

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Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 9 Check automatic transmission control pressure cable	Ignition: OFF Accelerator pedal at closed throttle position	Arrows must align (Fig. 4-7)	Adjust control pressure cable (SMS, Job No. 30-300)
⇒ 10 Check cruise control (without ASR)	Ignition: OFF Accelerator pedal at closed throttle position	Push actuator lever (Fig. 4-7) to closed throttle position, then pull approx. 1 mm away from closed throttle contact and adjust linkage rod (21) so that it can be attached free of tension.	Adjust throttle linkage (SMS, Job No. 30-300)
⇒ 11 Engine coolant level	Ignition: OFF	Marking: min - max	Correct engine coolant level
⇒ 12 Engine oil level	Ignition: OFF	Marking: min - max	Correct oil level


¹⁾ Observe Preparation for Test, see 22.

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Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾	
<p>⇒ 13 Check voltage at ignition coil</p>	<p>Ignition: ON</p>		<p>See checking ignition system, (DM Engines Vol. 2, Section 5)</p>	
	<p>Engine 104: Ignition coil T1 X11</p>	<p>2 —   5</p>		<p>11–14 V</p>
	<p>X11</p>	<p>4 —   5</p>		<p>0 V</p>
	<p>Engine 119: Ignition coil T1/1 X11</p>	<p>2 —   5</p>		<p>11–14 V</p>
	<p>X11</p>	<p>4 —   5</p>		<p>0 V</p>
	<p>Ignition coil T1/2 X11</p>	<p>4 —   5</p>		<p>11–14 V</p>
	<p>X11</p>	<p>4 —   5</p>		<p>0 V</p>

¹⁾ Observe Preparation for Test, see 22.

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Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 14 Check ignition timing and vacuum advance	Engine: Start Check ignition timing at closed throttle. Check ignition timing with and without vacuum at specified engine rpm.	See Test and adjustment data (section A)	See checking ignition system, (DM Engines Vol. 2, Section 5)
⇒ 15 Evaluate oscilloscope patterns	Engine: closed throttle (idle) Briefly accelerate to 3000 rpm	Voltage difference between cylinders should be no more than 3kV. Voltage increase with engine accelerated should be no more than 6 kV over idle value.	Evaluate with engine analyzer (section C)
⇒ 16 Warm engine oil to operating temperature	Engine rpm: approx. 3000 rpm	Engine oil temperature approx. 80 ° C	–
⇒ 17 Check intake system for leakage	Engine: closed throttle (idle) Spray connections with carburetor cleaner.  Do not use conventional fuel for leak test (dangerous fumes). Note fire risk and do not spray on red hot parts or on ignition system.	–	Repair leaks

¹⁾ Observe Preparation for Test, see 22.

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Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 18 Check closed throttle (idle) rpm	Engine: closed throttle (idle) Transmission range "P", climate control system OFF, engine oil temperature approx. 80° C	See Test and adjustment data (section A)	Check closed throttle speed control (DM Engines Vol. 2, Section 2)
⇒ 19 Adjust Lambda control system ²⁾	Transmission range "P", climate control system OFF. Disconnect purge line to throttle valve housing at purge valve and plug. Reconnect line after measurement. Engine oil temperature approx. 80° C. Engine: closed throttle (idle)	See Test and adjustment data (section A)	If the specified value cannot be obtained, check electrical components with socket box tester (DM Engines Vol. 2, Section 2)

1) Observe Preparation for Test, see 22.

2) The fuel mixture adjustment screw is secured against unauthorized adjustment by means of a steel ball in the adjustment tower. After fuel mixture adjustment at the factory, the ball is installed in the adjustment tower using a special tool and **must not be removed**.

The fuel mixture may only be corrected when replacing a fuel injection system component or when performing an engine repair. To do so, the fuel mixture adjustment tower must be replaced.

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Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 20 Check closed throttle under load	Engine: closed throttle (idle) Transmission range "D" Switch on all electrical consumers, Turn steering wheel to full lock.	Engine must continue to idle within specified range.	Check closed throttle speed control (DM Engines Vol 2, Section 2)

¹⁾ Observe Preparation for Test, see 22.

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**Accelerator Control 104 CFI
(without ASR)**

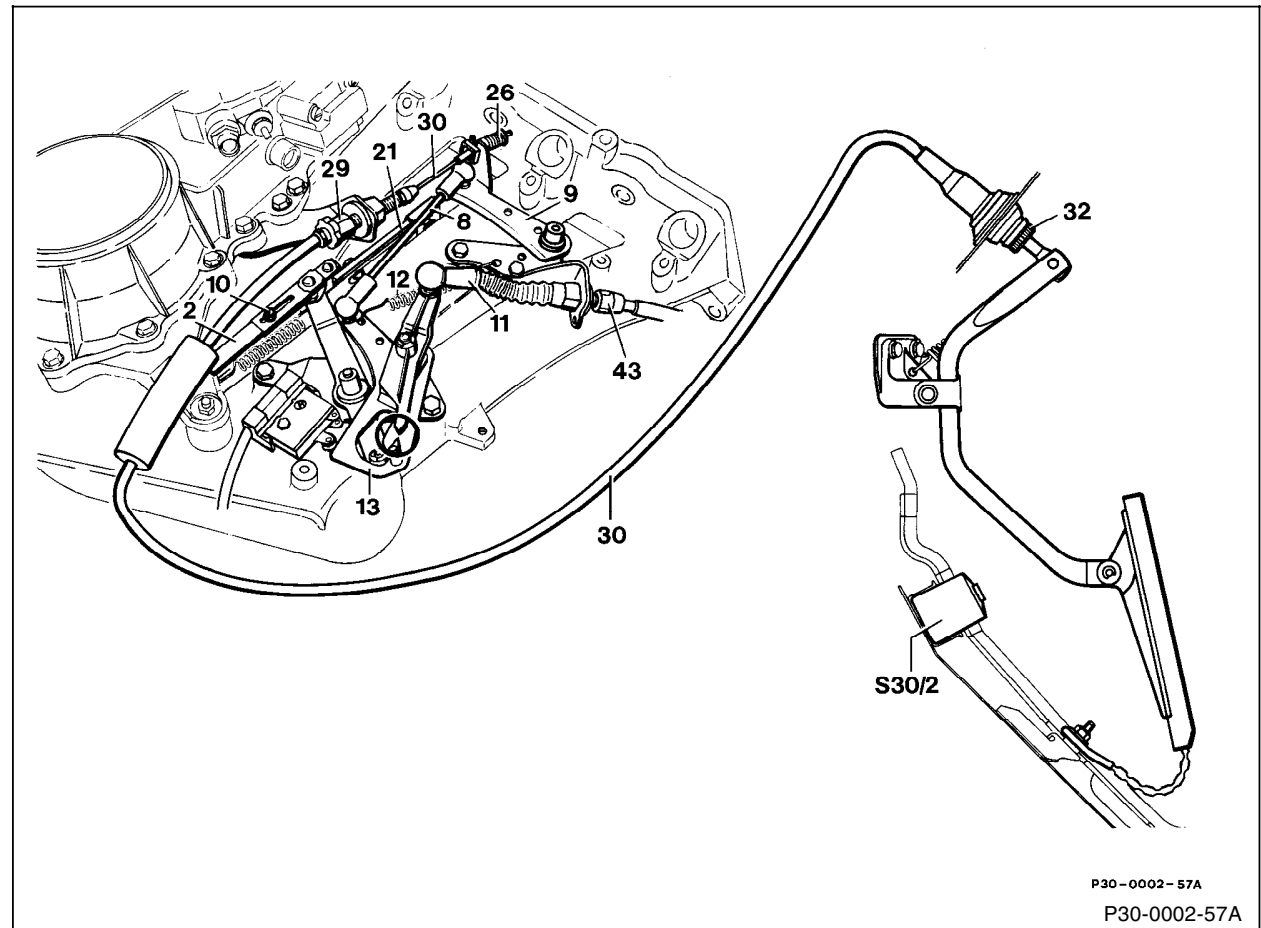
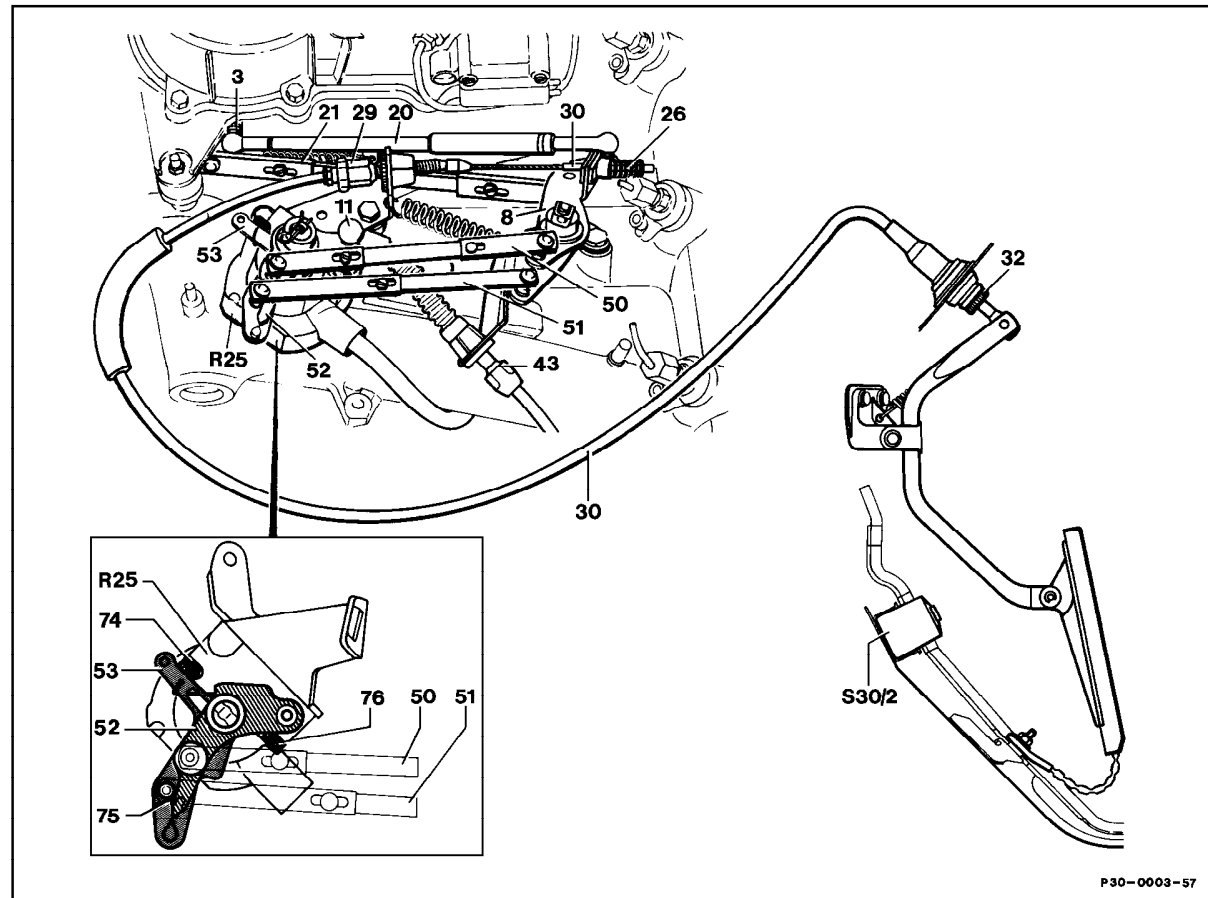


Figure 4

- 2 Linkage rod
- 8 Linkage rod
- 9 Control lever
- 10 Set screw
- 11 Control pressure cable for automatic transmission
- 12 Release spring
- 13 Slotted lever
- 21 Cruise control linkage rod
- 26 Spring
- 29 Adjustment nut
- 30 Bowden cable
- 32 Adjustment nut
- 43 Adjustment nut
- S30/2 Kickdown switch

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**Accelerator Control 104 CFI
(with ASR)**



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Figure 5

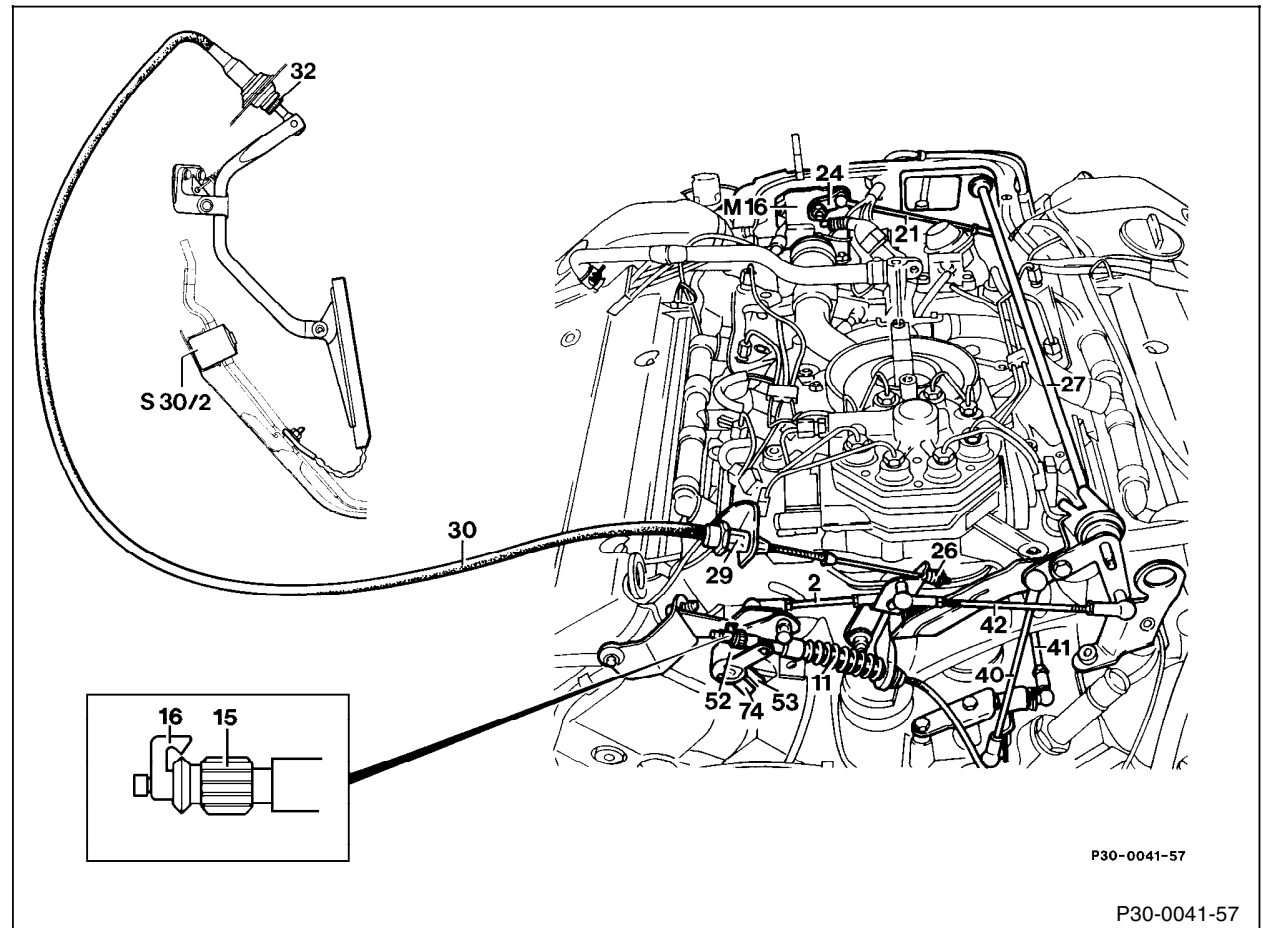
- 3 Throttle valve lever
- 8 Control lever
- 11 Control pressure cable for automatic transmission
- 20 Telescoping rod (backup rod)
- 21 Connecting rod
- 26 Spring
- 29 Adjustment nut
- 30 Bowden cable
- 32 Adjustment nut
- 43 Adjustment nut
- 50 Connecting rod
- 51 Connecting rod
- 52 Lever
- 53 Lever
- 74 Closed throttle stop of lever (53)
- 75 Closed throttle stop of lever (52)
- 76 Wide open throttle stop
- R25 Accelerator pedal position sensor
- S30/2 Kickdown switch

B 1 Engine Test, Adjustment

**Accelerator Control 119 CFI
(without ASR)**

Figure 6

- 2 Linkage rod
- 11 Control pressure cable for automatic transmission
- 15 Adjustment nut
- 16 Spacer sleeve
- 21 Cruise control linkage rod
- 24 Actuator lever
- 26 Spring
- 27 Longitudinal control shaft
- 29 Adjustment nut
- 30 Bowden cable
- 32 Adjustment nut
- 40 Linkage rod
- 41 Linkage rod
- 42 Linkage rod
- 52 Lever
- 53 Lever
- 74 Idle stop
- M16 Cruise control actuator
- S30/2 Kickdown switch

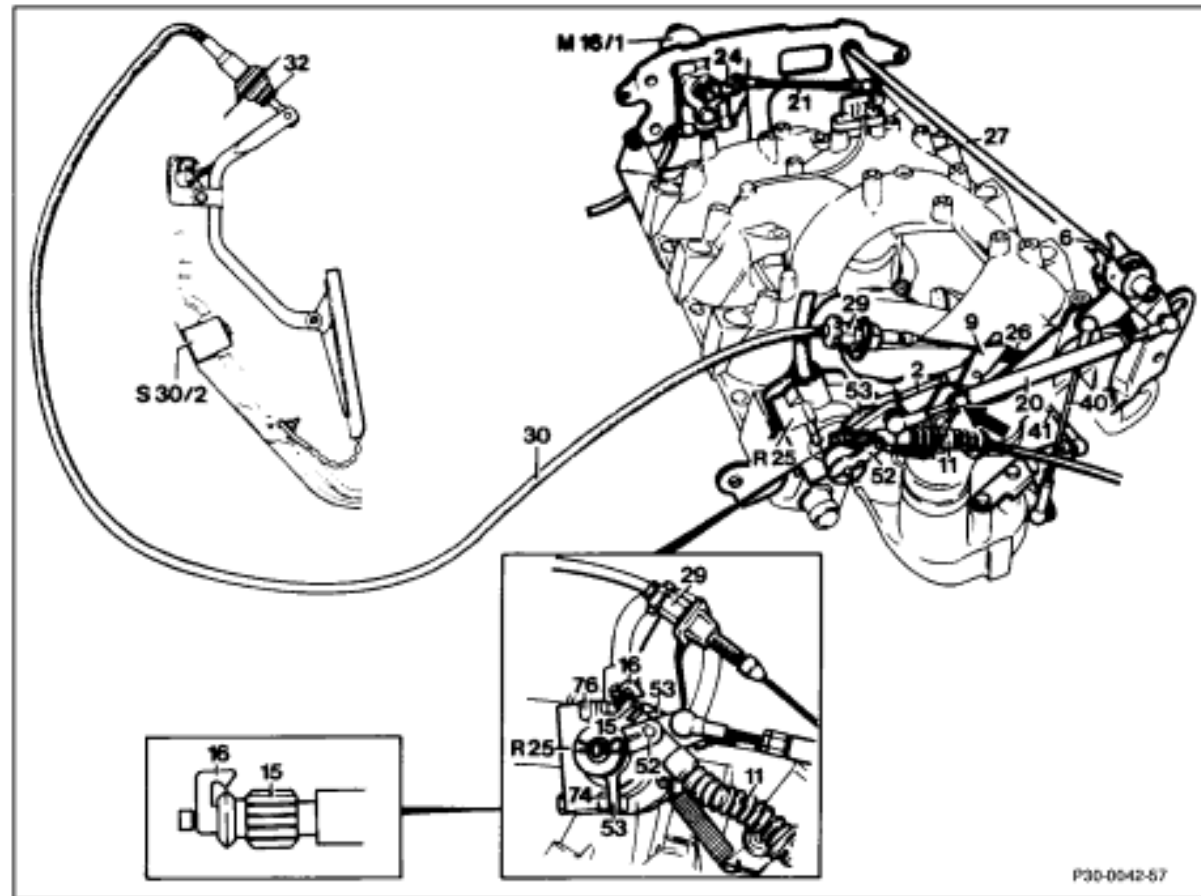


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Accelerator Control 119 CFI
(with ASR)

Figure 7

- 2 Linkage rod
- 6 Lever on longitudinal control shaft
- 9 Control lever
- 11 Control pressure cable for automatic transmission
- 15 Adjustment nut
- 16 Spacer sleeve
- 20 Telescoping rod (backup rod)
- 21 Linkage rod
- 24 Actuator lever
- 26 Spring
- 27 Longitudinal control shaft
- 29 Adjustment nut
- 30 Bowden cable
- 32 Adjustment nut
- 40 Linkage rod
- 41 Linkage rod
- 52 Lever
- 53 Lever
- 74 Closed throttle stop
- 76 Wide open throttle stop
- M16/1 Electronic accelerator actuator
- S30/2 Kickdown switch



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Component Location: Mixture Adjustment, Purge Valve, Purge Switchover Valve

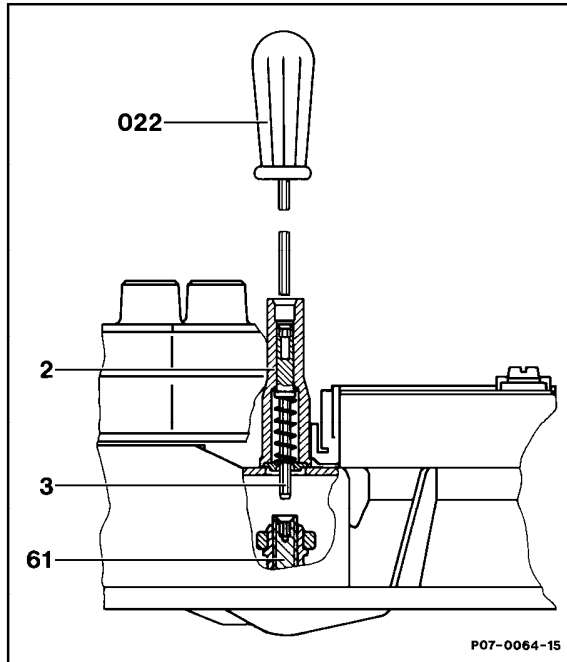


Figure 8 P07-0064-15

- 022 Hex. socket wrench
- 2 Fuel mixture adjustment tower
- 3 Hex. head
- 61 Fuel mixture adjustment screw

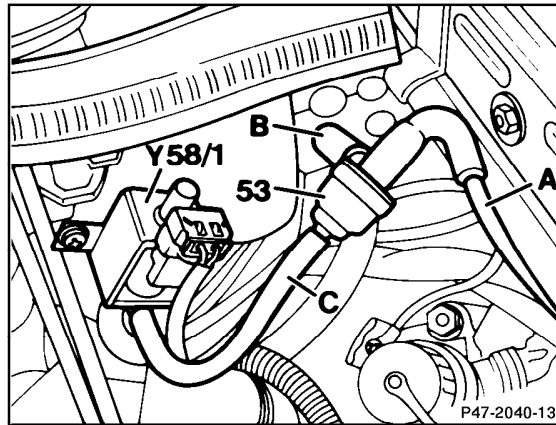


Figure 9 P47-2040-13

- 53 Purge valve
- Y58/1 Purge switchover valve

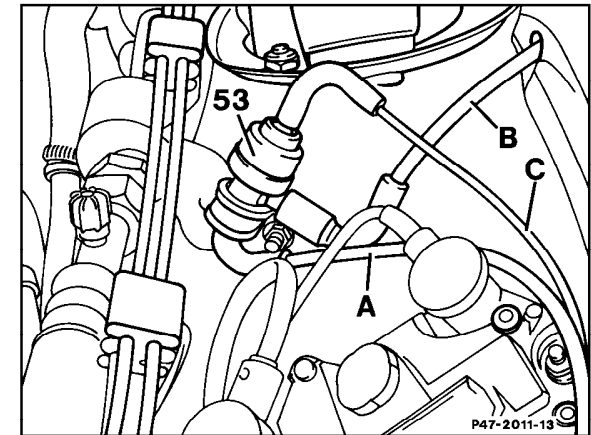


Figure 10 P47-2011-13

- 53 Purge valve