

B 1 Engine Test, Adjustment



With starting or warm up complaints do not condition engine to operating conditions but proceed according to complaint.

Listing of Test Steps

- | | | |
|-----|--|---|
| 1 | Test equipment | connect/disconnect according to Connection Diagram. |
| 2 | Base module DTC readout ⇒ Ignition: ON | perform. |
| 3 | LH-SFI control module DTC readout ⇒ Ignition: ON | perform. |
| 4 | DI control module DTC readout ⇒ Ignition: ON | perform. |
| 5.0 | EA/CC/ISC control module DTC readout ⇒ Ignition: ON | perform. |
| 5.1 | CC/ISC control module DTC readout ⇒ Ignition: ON | perform. |
| 6 | Air filter | remove and install. |
| 7.0 | Throttle control linkage | check throttle valve for free movement and condition. Lubricate all bearings, gate levers and ball sockets. |
| 7.1 | WOT contact | check, adjust. |
| 7.2 | CTP contact | check using accelerator pedal, adjust. |
| 8 | Control pressure cable of AT | check, adjust. |
| 9 | Fuel pressure | check. (Engine must be at closed throttle to test) |
| 10 | Engine coolant level | check, correct. |

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11	Engine oil level	check, observe condition of oil.
12	Ignition system, primary, secondary ⇒ Engine: at Idle	check (see Test and Adjustment Data, Section A).
13	Ignition timing and vacuum advance ⇒ Engine: at Idle	check (see Test and Adjustment Data, Section A).
14	Oscilloscope pattern brief acceleration to 3000 rpm ⇒ Engine: at Idle ..	evaluate (see Test and Adjustment Data section C).
15	Engine oil temperature	approximately 80 °C.
16	CTP RPM	check.
17	On-off ratio control system	check(readout oscillates).
18	Not applicable for U.S. version vehicles	—
19	CTP speed under load	check in TR “D” (service and parking brake applied) and with all accessories turned on.

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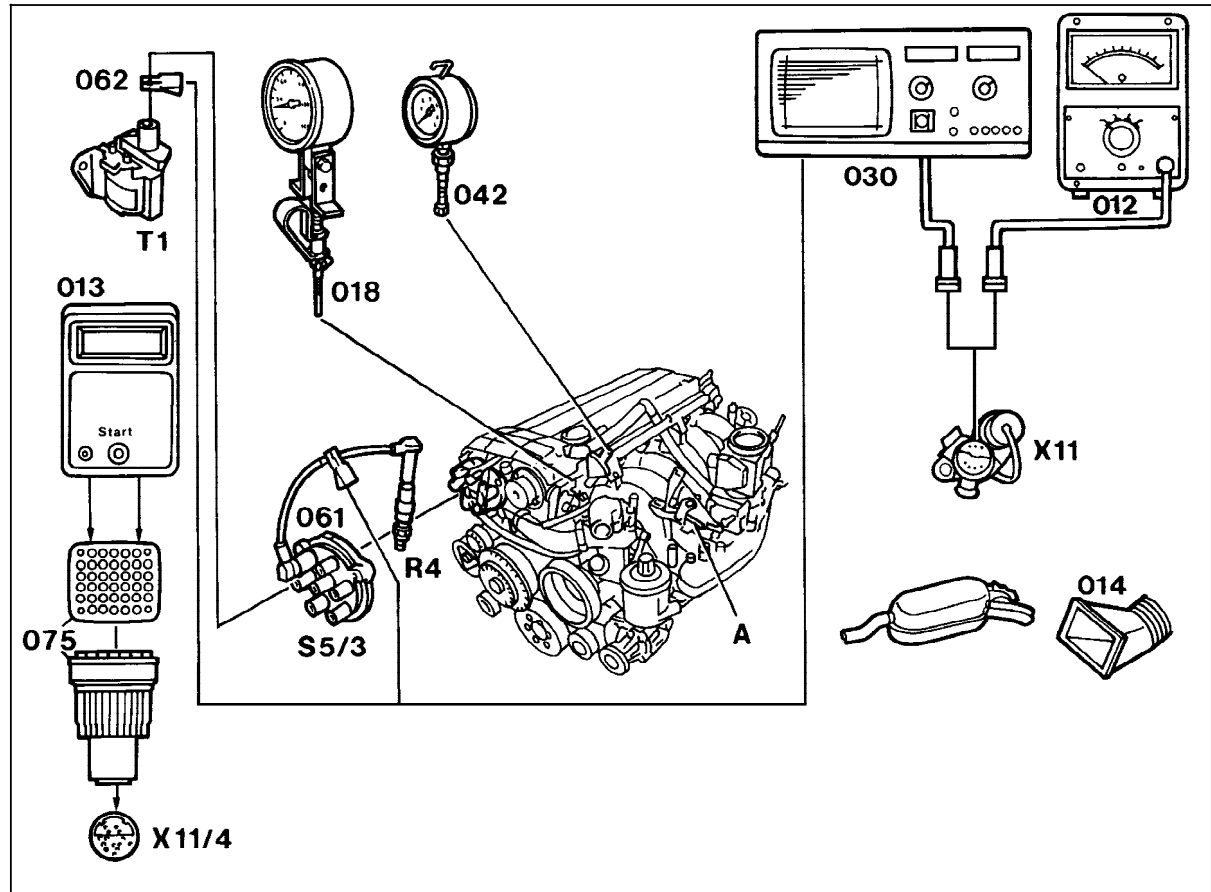
**Connection Diagram – Test Equipment
Engine 104 LH-SFI**



Set engine analyzer to 6 cylinder position

Figure 1

- A Throttle linkage
- R4 Spark plug (cylinder 1)
- S5/3 High-voltage distributor
- T1 Ignition coil
- X11 Diagnostic socket (9-pole)
- X11/4 Data link connector, (DTC readout, 38-pole)
- 012 On-off ratio tester
- 013 Impulse counter scan tool
- 014 Exhaust vent hose
- 018 Oil thermometer
- 030 Engine analyzer with oscilloscope
- 042 Pressure gauge
- 061 Trigger clamp (on cylinder 1)
- 062 Kilovolt clamp (on ignition coil)
- 075 Impulse counter scan tool adapter



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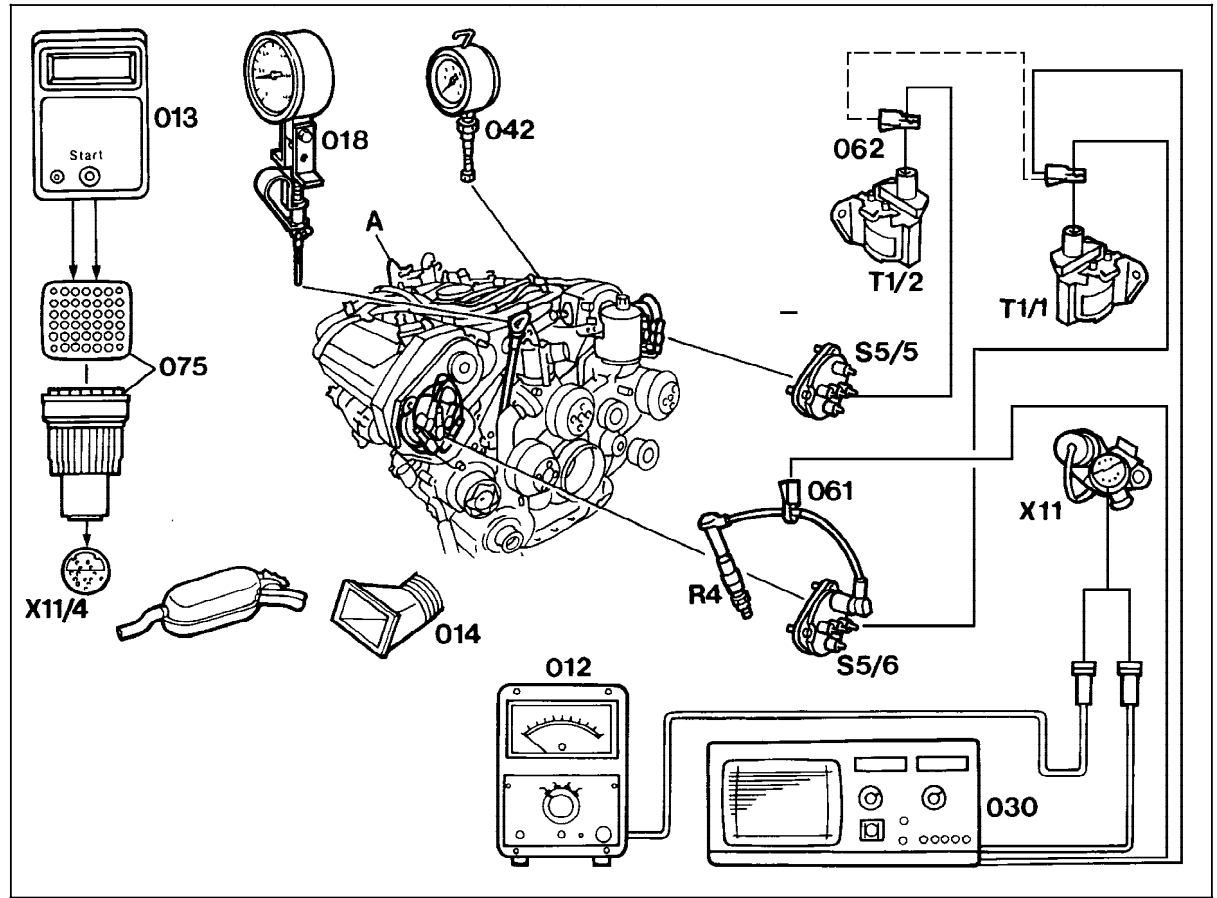
**Connection Diagram – Test Equipment
Engine 119 LH-SFI with Diagnostic
Socket (X11)**



Set engine analyzer to 4 cylinder position.
Without the diagnostic adaptor tool only one
ignition circuit can be checked at a time.

Figure 2

- A Throttle linkage
- R4 Spark plug (cylinder 1)
- S5/5 Left high-voltage distributor
- S5/6 Right high-voltage distributor
- T1/1 Ignition coil 1 (right cylinder bank)
- T1/2 Ignition coil 2 (left cylinder bank)
- X11 Diagnostic socket (9-pole)
- X11/4 Data link connector, (DTC readout, 38-pole)
- 012 On-off ratio tester
- 013 Impulse counter scan tool
- 014 Exhaust vent hose
- 018 Oil thermometer
- 030 Engine analyzer with oscilloscope
- 042 Pressure gauge
- 061 Trigger clamp (on cylinder 1)
- 062 Kilovolt clamp (on ignition coil, T1/1 or T1/2)
- 075 Impulse counter scan tool adaptor



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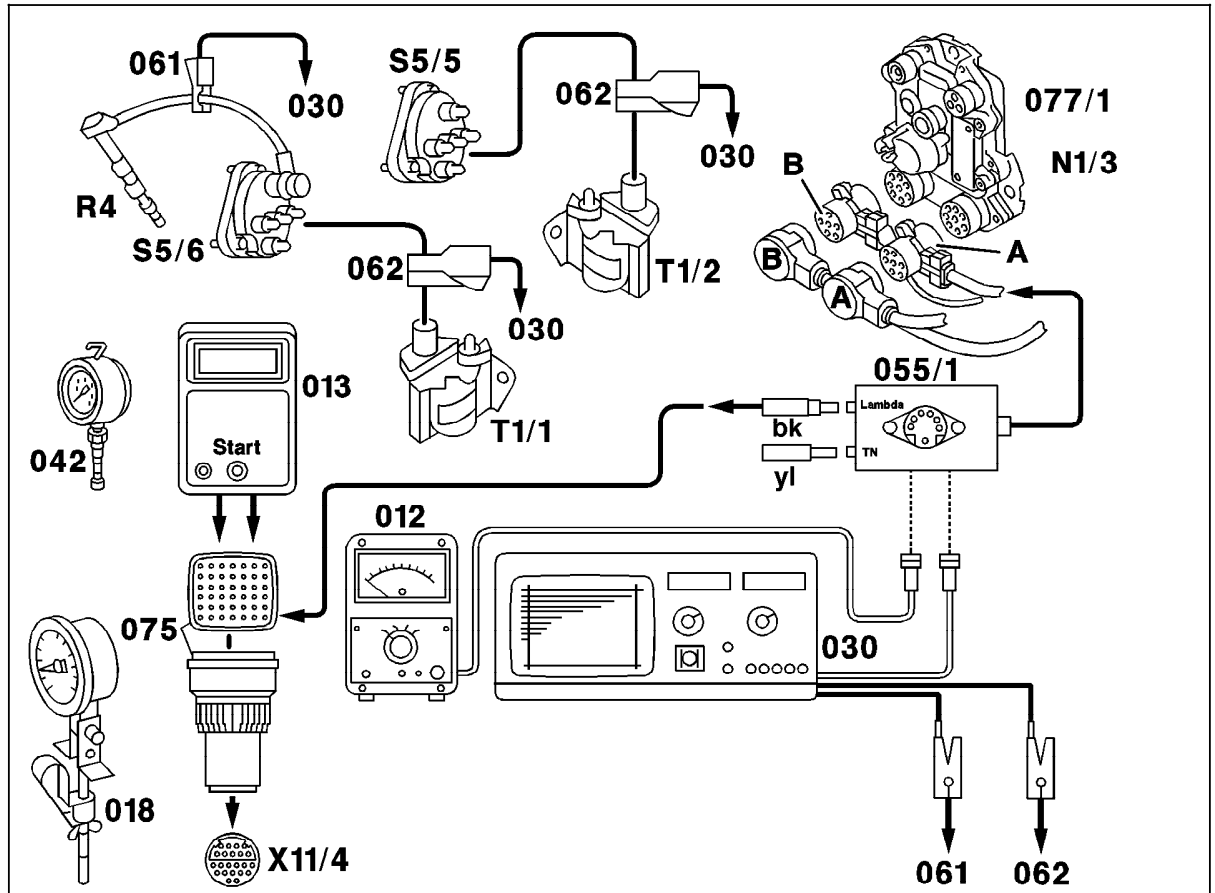
**Connection Diagram – Test Equipment
Engine 119 LH-SFI without Diagnostic
Socket (X11)**



Set engine analyzer to 4 cylinder position. Without the diagnostic adaptor tool only one ignition circuit can be checked at a time.

Figure 3

- N1/3 DI control module
- R4 Spark plug
- S5/5 Left high-voltage distributor
- S5/6 Right high-voltage distributor
- T1/1 Ignition coil 1 (right cylinder bank)
- T1/2 Ignition coil 2 (left cylinder bank)
- X11/4 Data link connector (DTC readout)
- 012 On-off ratio tester
- 013 Impulse counter scan tool
- 018 Oil thermometer
- 030 Engine analyzer with oscilloscope
- 042 Pressure gauge
- 055/1 On-off ratio signal adaptor (900 589 01 15 00)
- 061 Trigger clamp (on cylinder 1)
- 062 Kilovolt clamp (on ignition coil)
- 075 Impulse counter scan tool adaptor
- 077/1 TN signal, on-off ratio signal connector (see connector A, B in wiring diagram)



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Connection Diagram –Test Equipment

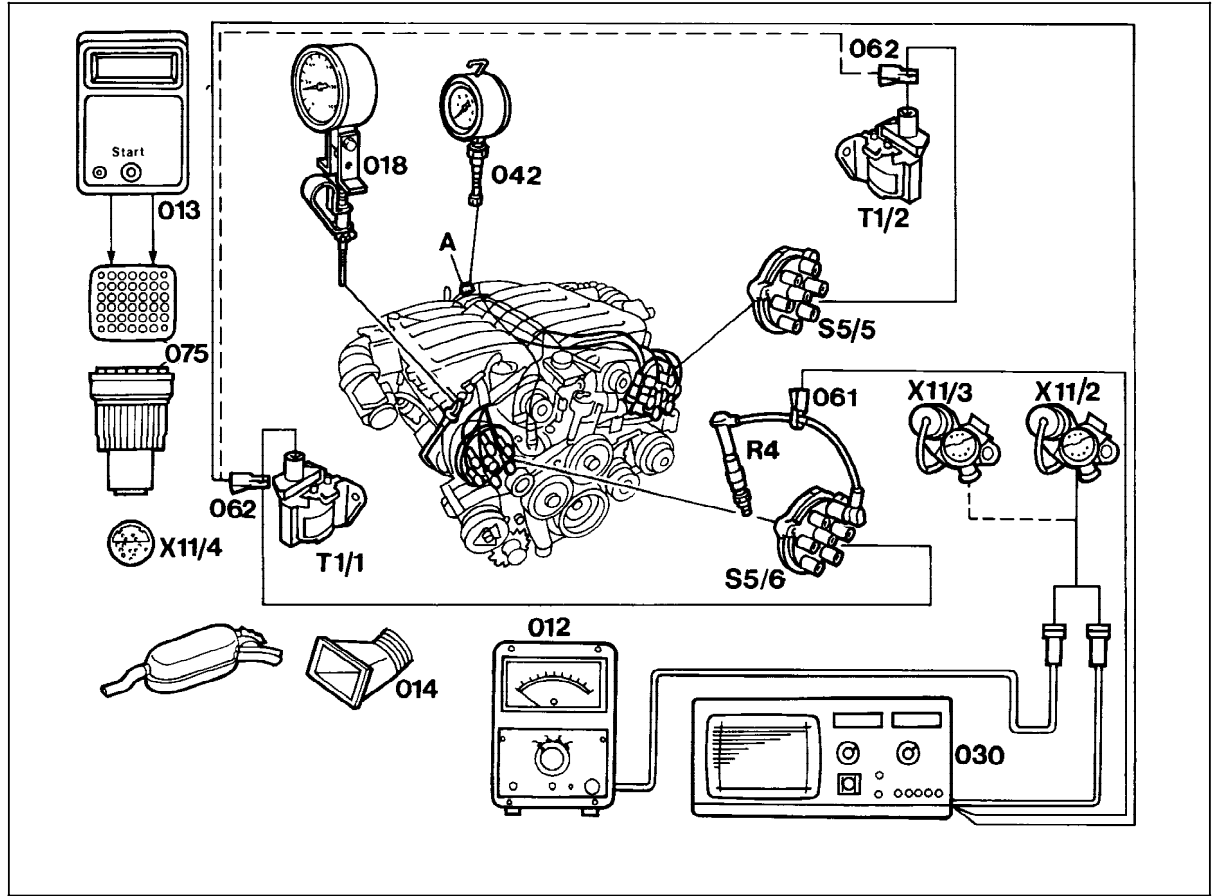
Engine 120 LH-SFI with Diagnostic Socket (X11)
 Connection diagram without diagnostic socket (X11) see engine 119.



Set engine analyzer to 6 cylinder position. Without the diagnostic adaptor tool only one ignition circuit can be checked at a time.

Figure 4

- A Throttle linkage
- R4 Spark plug (cylinder 1)
- S5/5 Left high-voltage distributor
- S5/6 Right high-voltage distributor
- T1/1 Ignition coil 1 (right cylinder bank)
- T1/2 Ignition coil 2 (left cylinder bank)
- X11/2 Left diagnostic socket (9-pole)
- X11/3 Right diagnostic socket (9-pole)
- X11/4 Data link connector, (DTC readout, 38-pole)
- 012 On-off ratio tester
- 013 Impulse counter scan tool
- 014 Exhaust vent hose
- 018 Oil thermometer
- 030 Engine analyzer with oscilloscope
- 042 Pressure gauge
- 061 Trigger clamp (on cylinder 1)
- 062 Kilovolt clamp (on ignition coil, T1/1 or T1/2)
- 075 Impulse counter scan tool adapter



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B Test and Adjustment Jobs

Engine 104, 119, 120 LH-SFI

B 1 Engine Test, Adjustment

Connection Diagram – Impulse Counter Scan Tool and On/off Ratio Tester with Diagnostic socket (X11)

Yellow wire from Impulse counter scan tool to LH-SFI control module

Engine 104, 119 Socket 4
 Engine 120 Socket 4, cylinder 1 – 6
 Socket 5, cylinder 7 – 12

Yellow wire from Impulse counter scan tool to DI control module

Engine 104, 119 Socket 17
 Engine 120 Socket 17, cylinder 1 – 6
 Socket 18, cylinder 7 – 12

Yellow wire from Impulse counter scan tool to Base module

Engine 104, 119, 120 Socket 8

Impulse Counter Scan Tool voltage supply

Engine 104, 119, 120 Socket 1, circuit 31 ground (brown wire)
 Socket 3, circuit 30 plus (red wire)

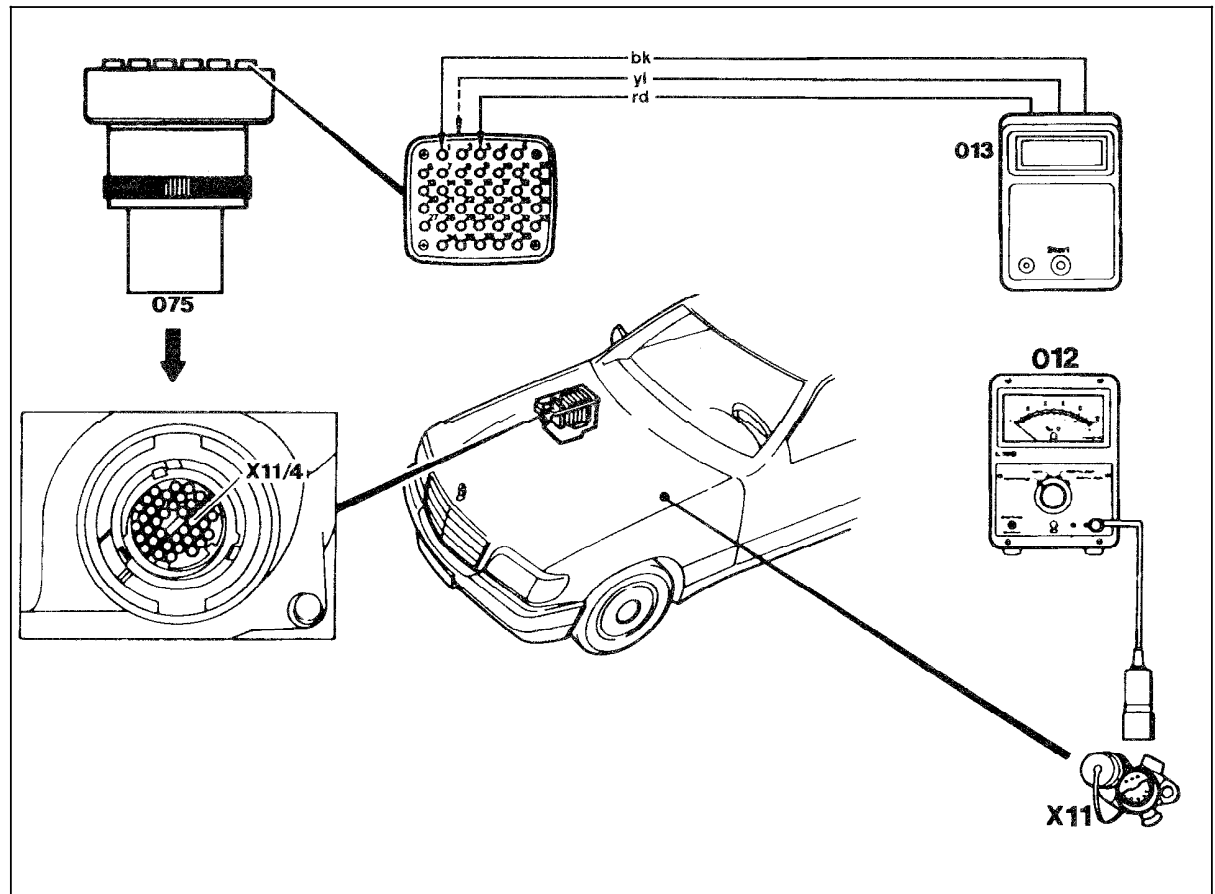


Figure 5

- 012 On-off ratio tester
- 013 Impulse counter scan tool
- 075 Impulse counter scan tool adapter
- X11 Diagnostic socket (9-pole)
- X11/4 Data link connector(DTC readout, 38-pole)

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Connection Diagram – Impulse Counter Scan Tool and On/off Ratio Tester without Diagnostic socket (X11)

a) Impulse Counter Scan Tool

Yellow wire from Impulse counter scan tool to LH-SFI control module

- Engine 104, 119 Socket 4
- Engine 120 Socket 4, cylinder 1 – 6
- Socket 5, cylinder 7 – 12

Yellow wire from Impulse counter scan tool to DI control module

- Engine 104, 119 Socket 17
- Engine 120 Socket 17, cylinder 1 – 6
- Socket 18, cylinder 7 – 12

Yellow wire from Impulse counter scan tool to Base module

- Engine 104, 119, 120 Socket 8

Impulse Counter Scan Tool voltage supply

- Engine 104, 119, 120 Socket 1, circuit 31 ground (brown wire)
- Socket 3, circuit 30 plus (red wire)

b) On-off Ratio Tester

Black wire from 055/1 to X11/4

- Engine 119 Socket 14
- Engine 120 Socket 14, cylinder 1 – 6
- Socket 15, cylinder 7 – 12

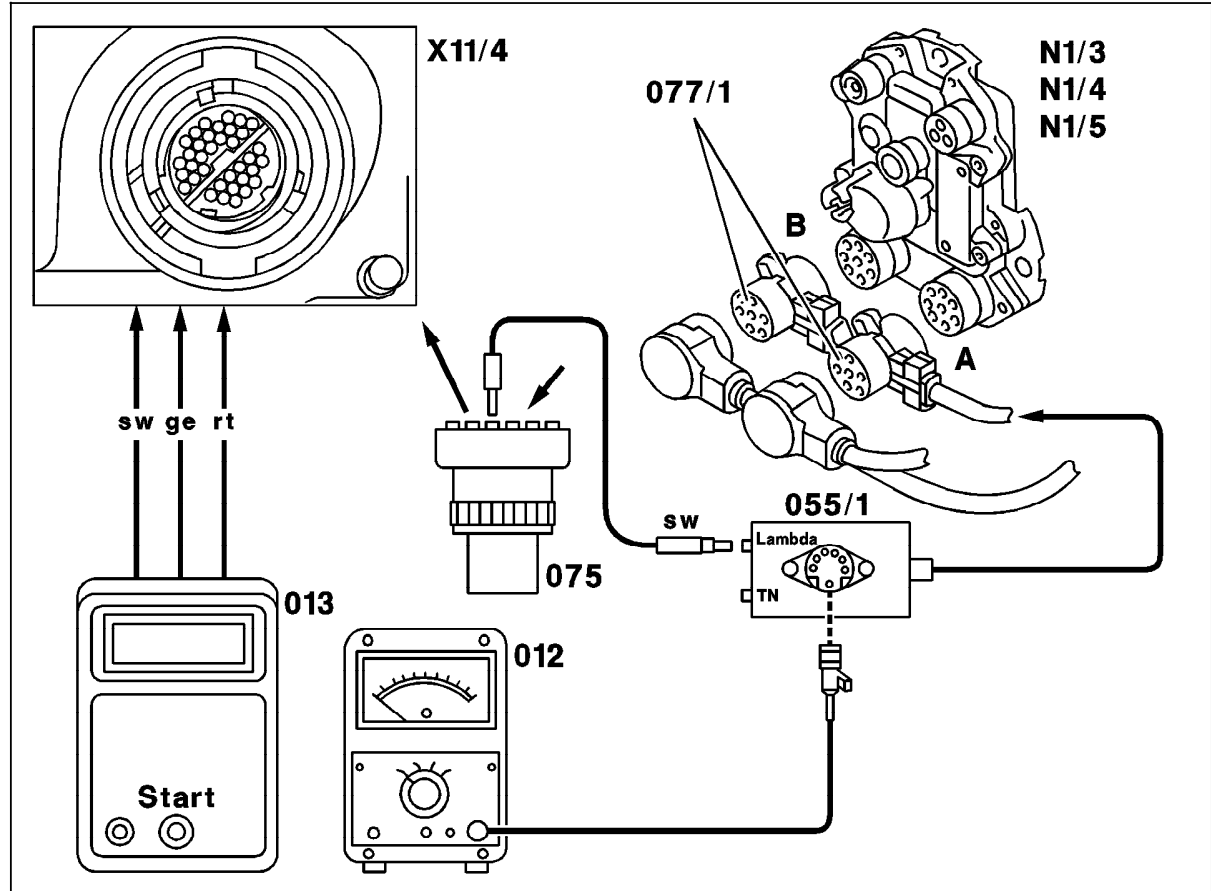


Figure 6

- 012 On-off ratio tester
- 013 Impulse counter scan tool
- 075 Impulse counter scan tool adaptor
- X11/4 Data link connector (DTC readout)
- 055/1 On-off ratio signal adaptor (900 589 01 15 00)
- 077/1 TN signal, on-off ratio signal connector (see connector A, B in wiring diagram)

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B 1 Engine Test, Adjustment

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 socket			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.		
Bear DACE (Model 40-960) Sun MEA-1500MB	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 °CKA from measured value. Example: measured: 107 °CKA, 107-90= 17 °ignition timing

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

The operation of the on-off ratio 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 on-off ratio control is not functioning. A varying on-off ratio indicates that the on-off ratio 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 LH-SFI control module, base module, DI control module and the EA/CC/ISC control module or CC/ISC control module 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.

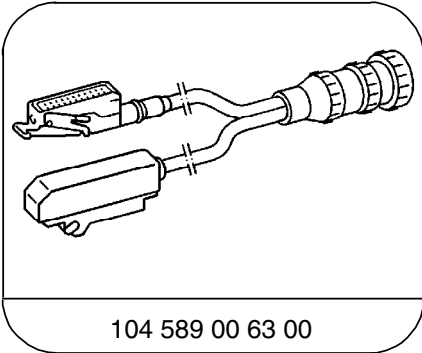
3. Clearing DTC memory

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

- a) Ignition: **ON**
- b) Push start button 2-4 seconds (Impulse display appears).
- c) After a waiting period of 3 seconds, push the start button for 6-8 seconds which will erase the previously displayed DTC.
- d) Erase each DTC separately.
- e) Turn off ignition for at least 30 seconds.

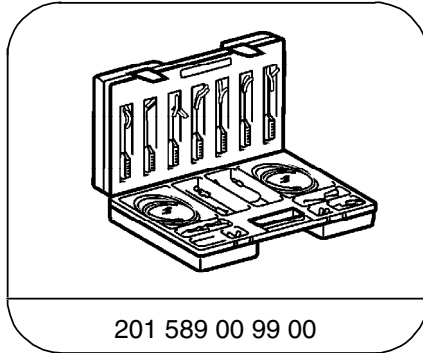
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Special Tools



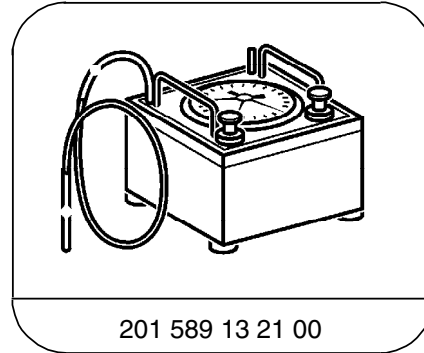
104 589 00 63 00

Test cable



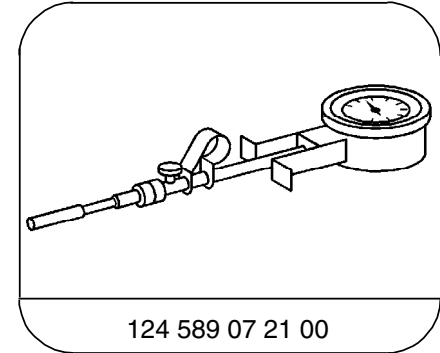
201 589 00 99 00

Electrical connecting set



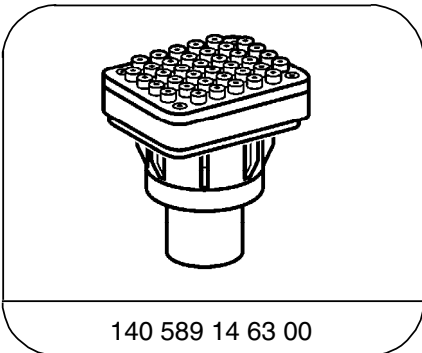
201 589 13 21 00

Tester



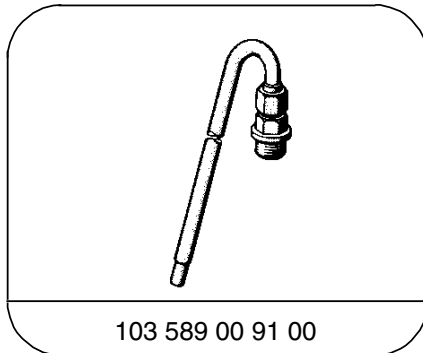
124 589 07 21 00

Remote thermometer



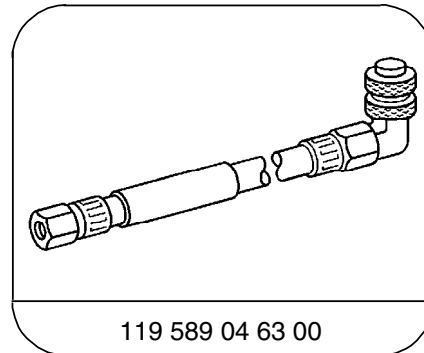
140 589 14 63 00

Adapter



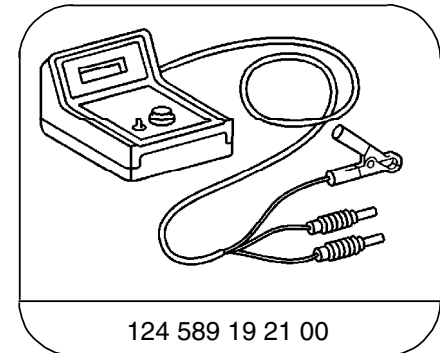
103 589 00 91 00

Measuring connection



119 589 04 63 00

Pressure hose



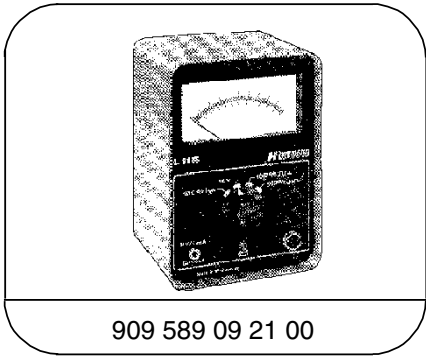
124 589 19 21 00

Pulse counter

B Test and Adjustment Jobs

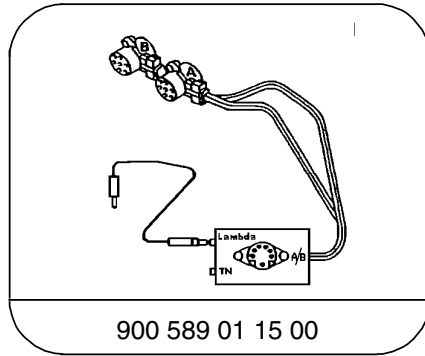
Engine 104, 119, 120 LH-SFI

B 1 Engine Test, Adjustment



909 589 09 21 00

On-off ratio tester



900 589 01 15 00

On-off ratio signal adapter

Equipment

Engine analyzer ¹⁾	Bear DACE (Model 40-960) Sun MEA-1500MB
Digital multimeter ¹⁾	Fluke models 23, 83, 85, 87

¹⁾ Available through the MBUSA Standard Equipment Program.

B 1 Engine Test, Adjustment

Note:

The on-off ratio 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 Base module DTC readout	Connect impulse counter scan tool: Yellow wire to socket 8 of data link connector (X11/4) Ignition: ON	DTC readout "I"	See DM Engines, Vol. 2 – 3.1 or 3.2
⇒ 3 LH-SFI control module DTC readout	Connect impulse counter scan tool: Yellow wire to data link connector (X11/4). Engine 104, 119 Socket 4 Engine 120 Socket 5, left LH-SFI control module (cyl. 7 – 12) Socket 4, right LH-SFI control module (cyl. 1 – 6) Ignition: ON	DTC readout "I"	See DM Engines, Vol. 2 – 3.1 or 3.2

¹⁾ Observe Preparation for Test, see 22.

B 1 Engine Test, Adjustment

Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 4 DI control module DTC readout	Connect impulse counter scan tool: yellow wire to data link connector (X11/4) Engine 104, 119 Socket 17 Engine 120 Socket 18, left DI control module (cyl. 7 – 12) Socket 17, right DI control module (cyl. 1 – 6) Ignition: ON	DTC readout "I"	See DM Engines, Vol. 2 – 5.2 or 5.3
⇒ 5.0 EA/CC/ISC control module (N4/1) DTC readout	Connect impulse counter scan tool: yellow wire to socket 7 of data link connector X11/4 Ignition: ON	DTC readout "I"	See DM Engines, Vol. 2 – 6.2 or 6.3
⇒ 5.1 CC/ISC control module (N4/3) DTC readout	Connect impulse counter scan tool: yellow wire to socket 7 of data link connector X11/4 Ignition: ON	DTC readout "I"	See DM Engines, Vol. 2 – 7.1
⇒ 5.2 Not applicable for U.S. version vehicles	–	–	–

¹⁾ Observe Preparation for Test, see 22.

B Test and Adjustment Jobs

Engine 104, 119, 120 LH-SFI

B 1 Engine Test, Adjustment

Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 6 Remove and install air cleaner	Ignition: OFF	–	–
⇒ 7 Check condition and free movement of throttle linkage and throttle valve	Ignition: OFF Actuate throttle linkage	Smooth operation, no binding should be evident.	Lubricate all bearings and ball sockets.
⇒ 7.1 Check WOT position	Ignition: OFF Accelerator pedal at WOT position (do not actuate kickdown switch).	Throttle valve lever must rest against wide open throttle stop (audible contact).	Adjust WOT stop (SMS, Job No. 30 – 1010).
⇒ 7.2 Check CTP	Ignition: OFF Accelerator pedal at CTP.	Throttle valve lever must rest against closed throttle stop (audible contact).	Adjust CTP stop on engine (SMS, Job No. 30 – 1010).
⇒ 8 Check automatic transmission control pressure cable	Ignition: OFF Accelerator pedal at CTP.	Arrows must align.	Adjust control pressure cable (SMS, Job No. 30 – 1010).

¹⁾ Observe Preparation for Test, see 22.

B 1 Engine Test, Adjustment

Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 9 Check fuel pressure	Connect/disconnect pressure gauge Engine: at Idle	3.2 to 3.6 bar	Check fuel pumps and FP relay module (DM Engines, Vol. 2 – 3.1 or 3.2).
⇒ 10 Engine coolant level	Ignition: OFF	Marking: min - max	Correct engine coolant level
⇒ 11 Engine oil level	Ignition: OFF	Marking: min - max	Correct engine oil level
⇒ 12 Check primary and secondary ignition circuits	Ignition: at Idle	See Test and Adjustment Data (Section A)	Check ignition system (DM Engines, Vol. 2 – 5.2 or 5.3)
⇒ 13 Check ignition timing with and without vacuum	Engine: at Idle Transmission range “P” Climate control system: OFF	See Test and Adjustment Data (Section A)	Check ignition system (DM Engines, Vol. 2 – 5.2 or 5.3)

¹⁾ Observe Preparation for Test, see 22.

B 1 Engine Test, Adjustment

Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 14 Evaluate oscilloscope patterns	Engine: at Idle Briefly accelerate to 3000 rpm	Voltage difference between cylinders 3kV. Voltage increase with engine accelerated should be no more than 6 kV over idle value.	Check ignition system (DM Engines, Vol. 2 – 5.2 or 5.3)
⇒ 15 Warm engine oil to operating temperature	Engine rpm: Maintain at approx. 3000 rpm	Engine oil temperature approx. 80 °C	–
⇒ 16 Check closed throttle (idle) rpm	Engine: at Idle Selector lever in “P”, climate control system “OFF”.	See Test and adjustment data (section A)	Test program: Check EA/CC/ISC system (DM Engines, Vol. 3 – 6.2 or 6.3), Check CC/ISC system (DM Engines, Vol. 3 – 7.1)
⇒ 17 Check on-off ratio control system	Selector lever in “P”, Climate control system OFF. Disconnect and plug purge line (A or B) at switchover valve (Figure 1, 3 and 4). Reconnect line after measurment. Engine: at Idle	See Test and adjustment data (section A)	Check electronic components with socket box tester (DM Engines, Vol. 2 – 3.1 or 3.2)

¹⁾ Observe Preparation for Test, see 22.

B 1 Engine Test, Adjustment

Test step/Test sequence	Test condition	Nominal value	Possible cause/Remedy ¹⁾
⇒ 18 Not applicable for U.S. version vehicles	–	–	–
⇒ 19 Check CTP speed under load	Engine: at Idle TR “D” (service and parking brake applied), Switch on all electrical consumers, Turn steering wheel to full lock.	Engine must continue to idle within specified range.	Test program: Check EA/CC/ISC system (DM Engines, Vol. 3 – 6.2 or 6.3), Check CC/ISC system (DM Engines, Vol. 3 – 7.1)

¹⁾ Observe Preparation for Test, see 22.

B 1 Engine Test, Adjustment

**Accelerator Control
Engine 119 LH-SFI (without ASR)**

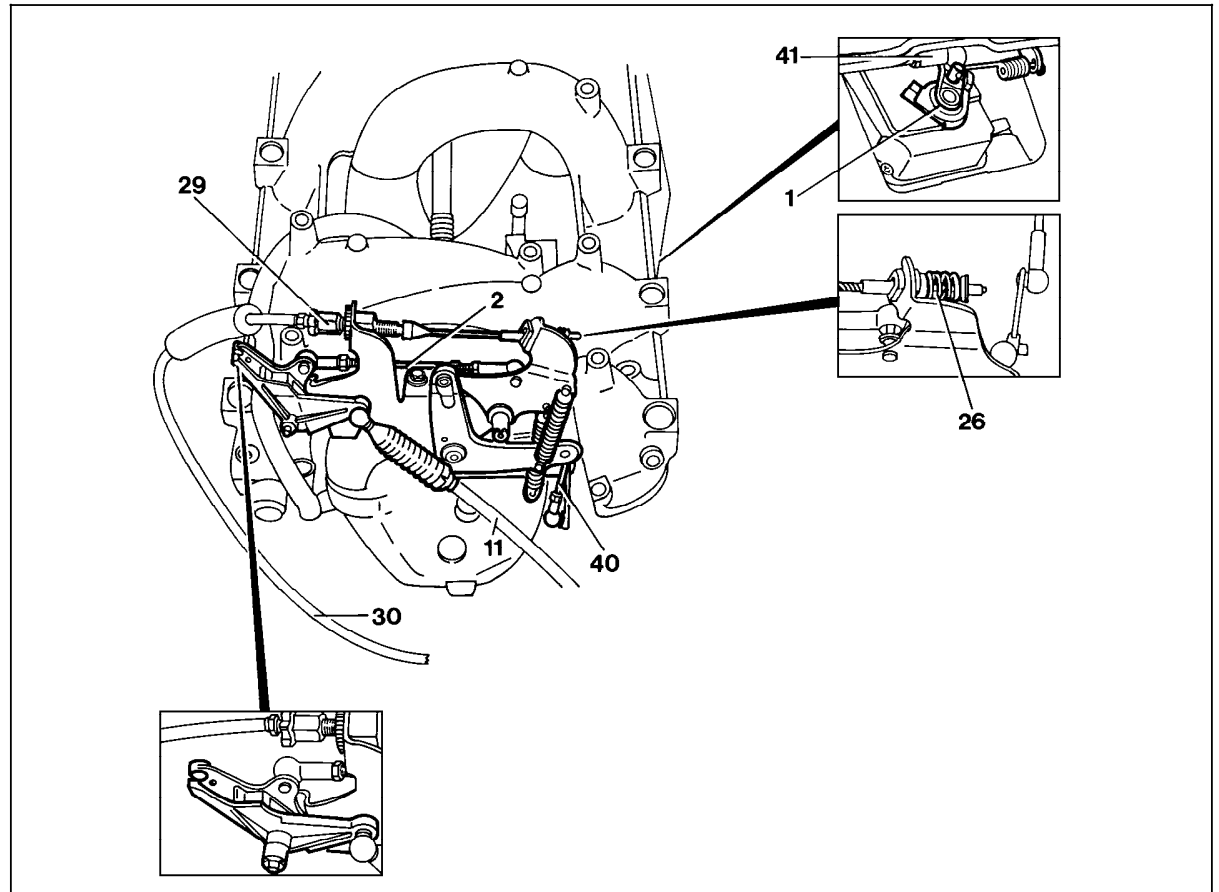


Figure 7

- 1 Bell crank
- 2 Connecting link
- 11 Control pressure cable for automatic transmission
- 26 Spring
- 29 Adjustment screw
- 30 Bowden cable
- 40 Idle travel rod
- 41 Connecting link

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B 1 Engine Test, Adjustment

**Accelerator Control
Engine 119 LH-SFI (with ASR)**

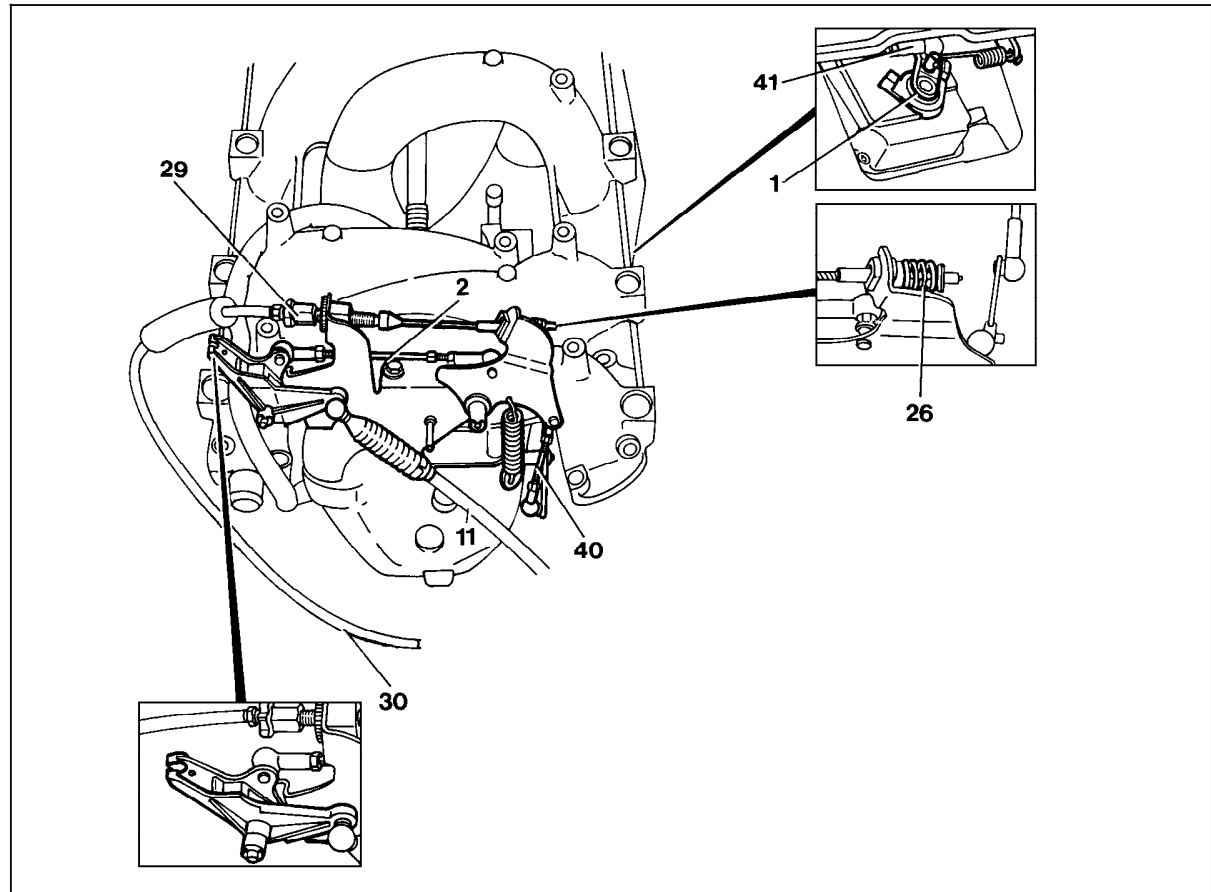


Figure 8

- 1 Bell crank
- 2 Connecting link
- 11 Control pressure cable for automatic transmission
- 26 Spring
- 29 Adjustment screw
- 30 Bowden cable
- 40 Idle travel rod
- 41 Connecting link

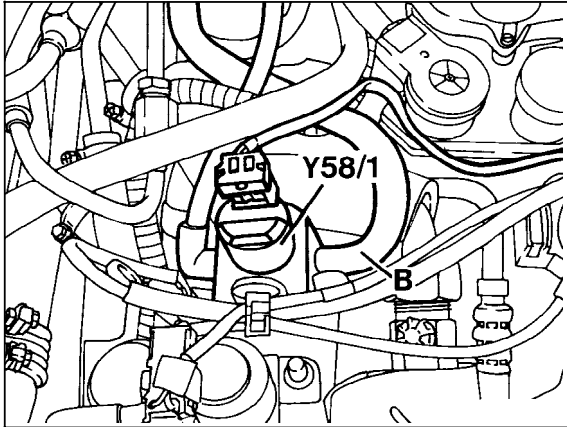
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B Test and Adjustment Jobs

Engine 104, 119, 120 LH-SFI

B 1 Engine Test, Adjustment

Component Locations

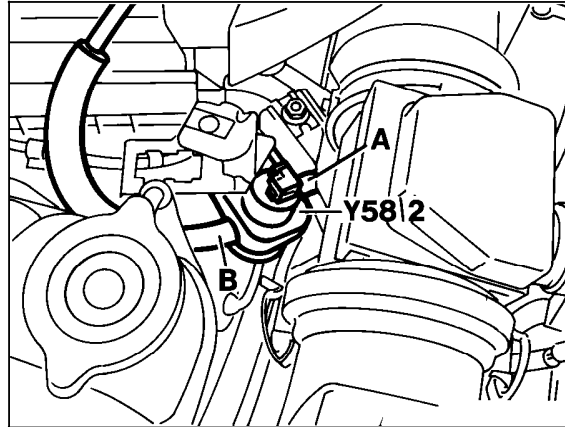


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Figure 9

Model Model 140, Engine 104, 119

- | | |
|-------|---------------------------------|
| Y58/1 | Purge control valve |
| A | Purge line to engine |
| B | Purge line to charcoal canister |

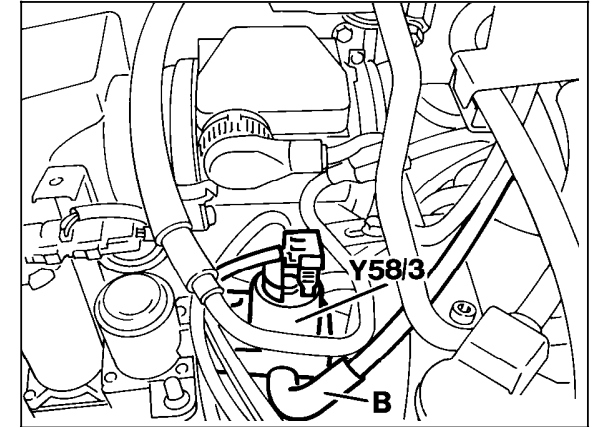


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Figure 10

Model Model 140, Engine 120

- | | |
|-------|--|
| Y58/2 | Left purge control valve (located on right side of engine) |
| A | Purge line to engine |
| B | Purge line to charcoal canister |



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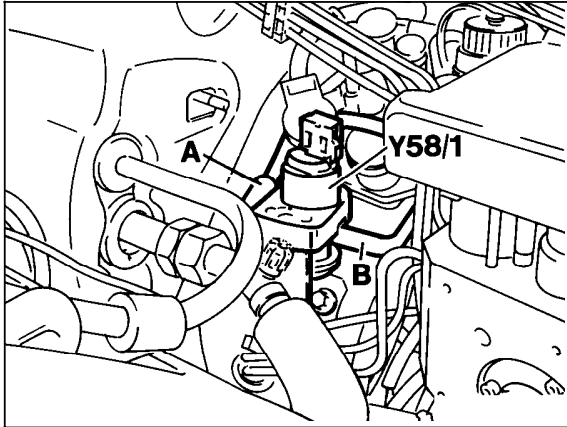
Figure 11

Model Model 140, Engine 120

- | | |
|-------|--|
| Y58/3 | Right purge control valve (located on left side of engine) |
| A | Purge line to engine |
| B | Purge line to charcoal canister |

B 1 Engine Test, Adjustment

Component Locations



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Figure 12

Model Model 124, Engine 119

- Y58/1 Purge control valve
- A Purge line to engine
- B Purge line to charcoal canister