EXIT

Diesel injection system - naturally-aspirated engines 07

Job No.

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07.1-001 Survey - injection pumps

Engine	Injection pump Bosch designation	Part no.	Bosch combination number	Test values MB sheet Edition
Standard basic version from start of production				
602.91	PES 5 M 55 C 320 RS 153	602 070 05 01[1])	0 400 075 982[1])	2.5 e 1st edition
Standard - as of 02/89				
602.91	PES 5 M 55 C 320 RS 170	602 070 32 01[2])	0 400 075 953[2])	2.5 w 5 09/88
		602 070 33 01[2])	0 **400 075 952**[2])	**2.5 w 4** 09/88
		602 070 34 01[1])[2])	0 400 075 951[1])[2])	2.5 w 3 09/88

[1]) ELR - Electronic idle speed control
[2]) ADA - Atmospheric pressure-dependent full-load stop

Production breakpoint: January 1989

Model	Engine	Engine end no. Manual transmission	Engine end no. Automatic transmission
201.126	602.911	**073017**	**014820**

Transfer pump Bosch designation FP'KG **24** M 150 is identical on all engines.

Note

An accurate check and adjustment of the injection pump is only possible on an injection pump calibrating test stand.

07.1-002 Survey - injectors

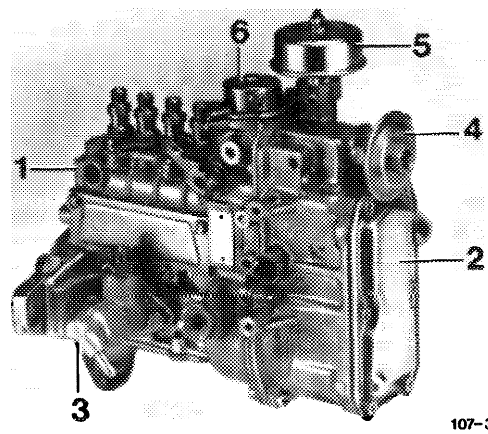
Engine		602.91
Injection nozzle	Bosch designation	DN 0 SD 265
	MB part no.	001 017 49 12
Injector holder	Bosch designation	KCA 30 S 44 KCA 27 S 55 [1])
	Combination MB part no.	002 017 26 21 002 017 34 21 [1])
Injection pressure or opening pressure in bar [2])	with new injectors	115 – 125
	with used injectors at least	100

[1]) With inclined injection.

[2]) The difference of the injection pressure among Injectors within the same engine may not be more than 5 bar gauge pressure.

07.1-003 Explanation of injection pump type plate

For example **PES 5 M 55 C 320 RS158/1**



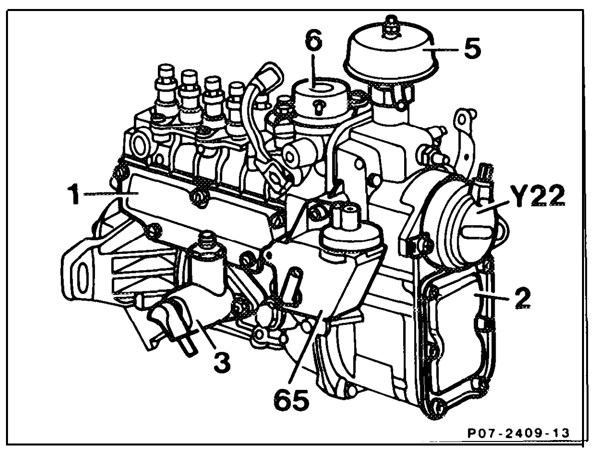
P	Pump
E	Self-driven
S	Front flange attachment
5	Number of cylinders
M	Pump size
55	Element diameter in 1/10 mm
C	Character of revision
320	Assembly number
R	Direction of rotation
S158/1	Special version

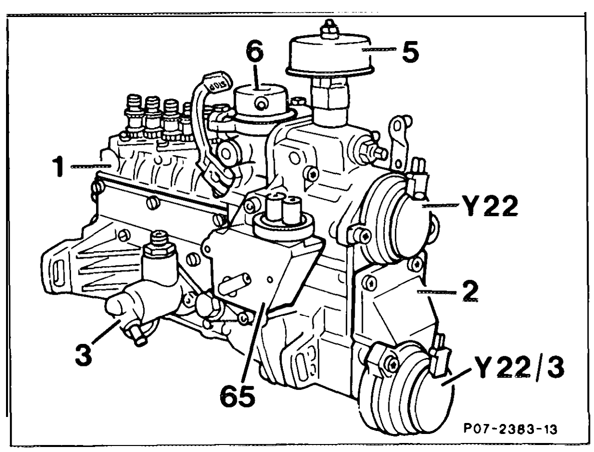
RSF- governor

R	Governor
S	Coil spring
F	Drive control

Arrangement of components

1 Injection pump
Ib Type plate
2 Governor
3 Fuel pump
4 Vacuum unit idle speed Increase
5 ADA unit
6 Stop unit
65 Vacuum control valve
Y22 Electromagnetic actuator ELR





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07.1-010 Function - injection system

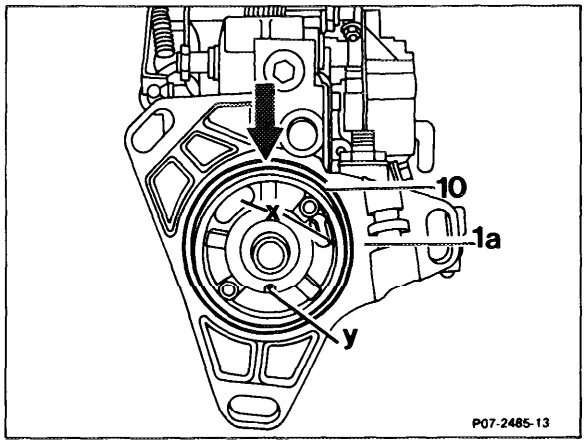
A. Lubrication of injectionpump

The injection pump is connected to the engine oil circuit by way of an oil hole (arrow).

Ttie oil returns to the crankcase by way of the circular groove (x) between bearing and housing.

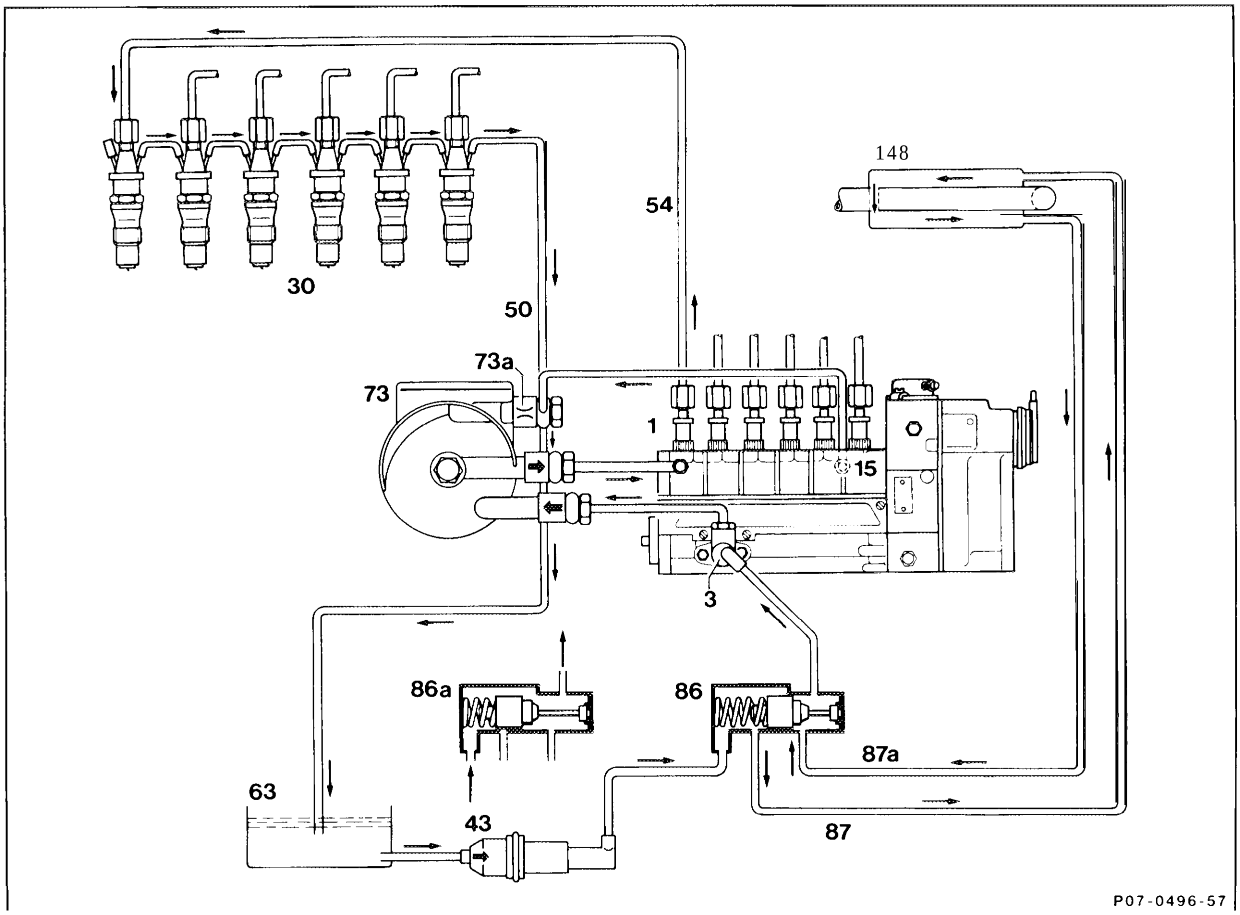
The O-ring (10) on the flange (la) seals.

The hole (y) serves to reduce the load exerted by the oil on the radial sealing ring.



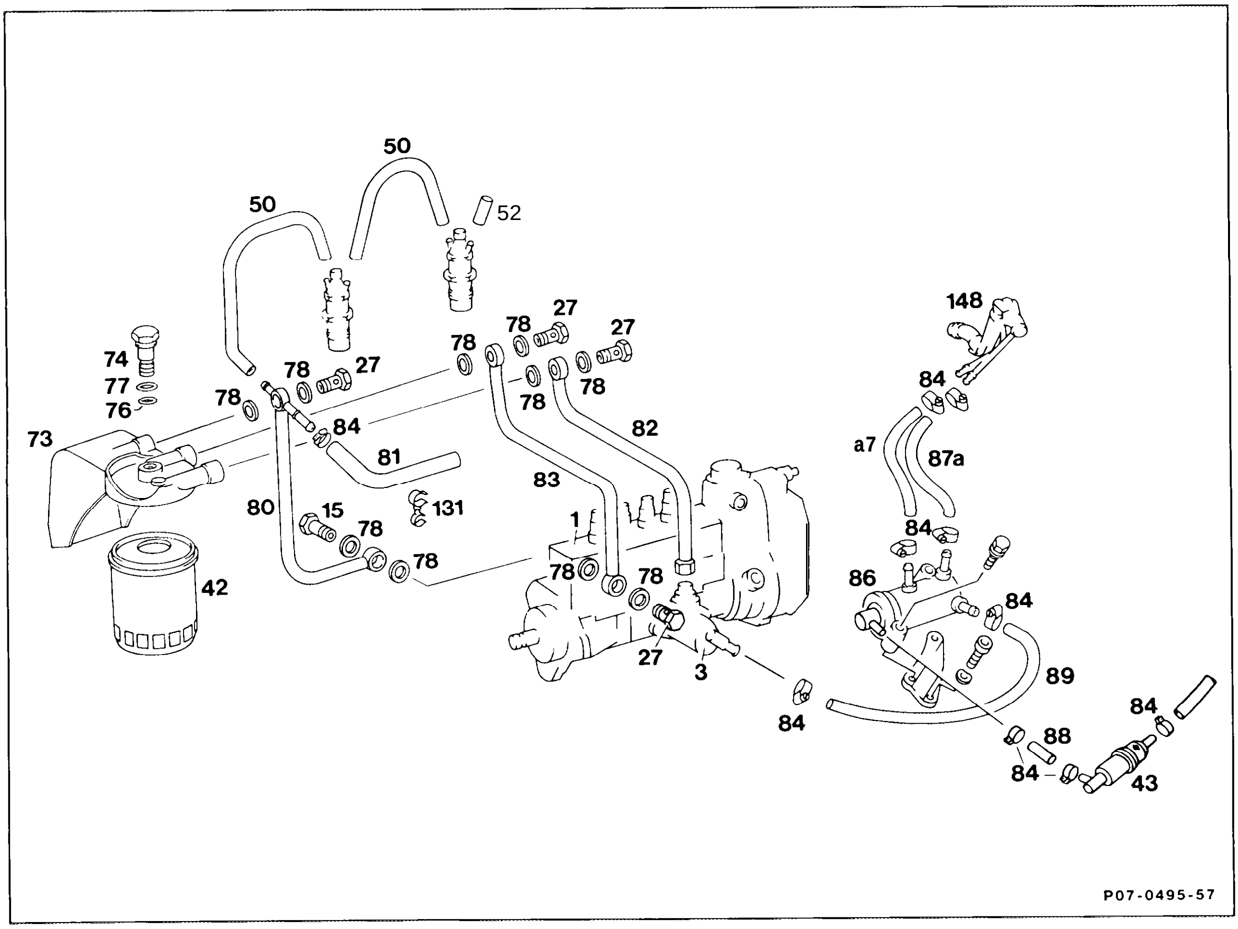
B. Fuel circuit

a) Fuel circuit diagram



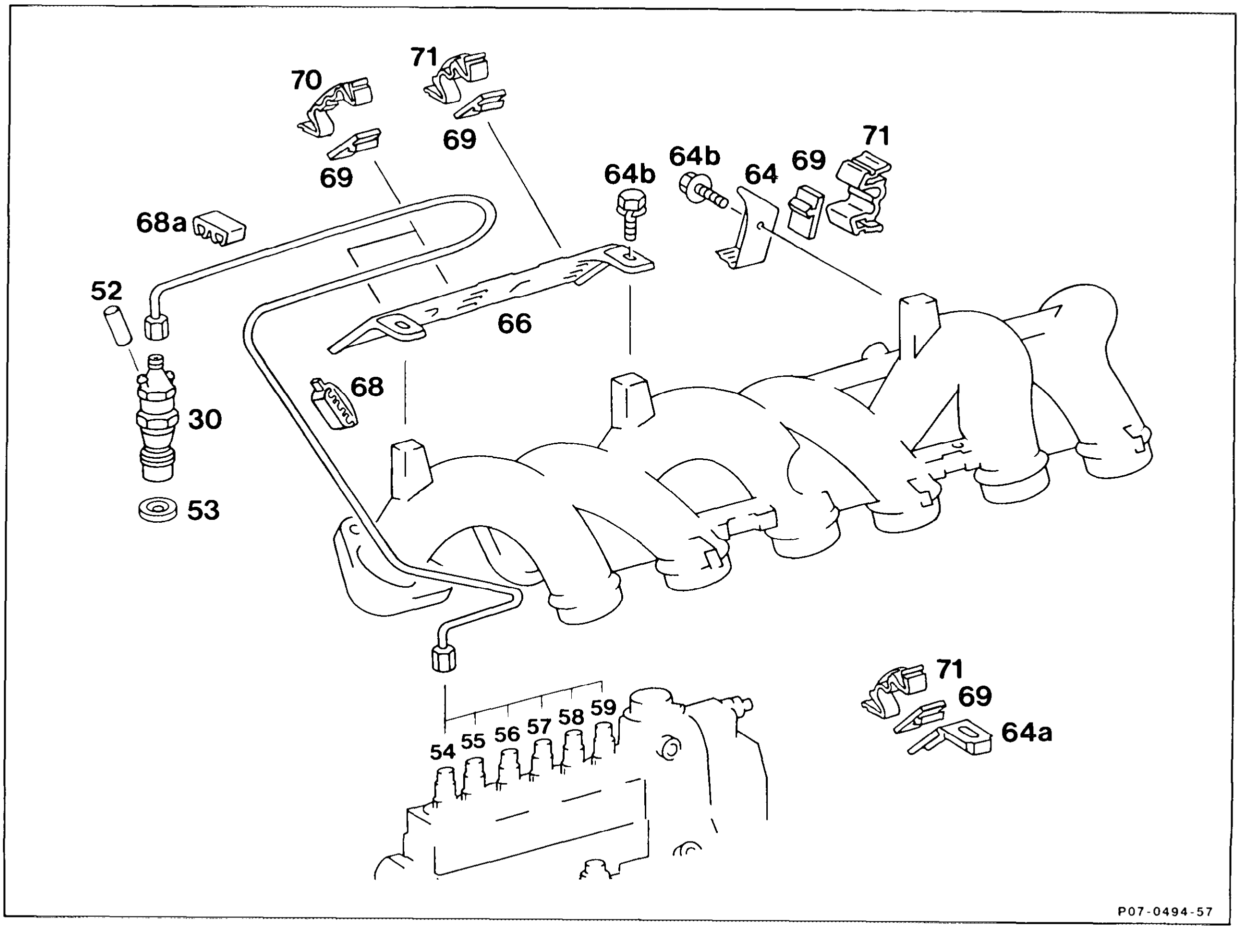
	Injection pump	73a	Choke orifice in fuel filter upper par-t 0.8 mm diameter
3	Fuel pump	86	Fuel thermostat open, position up to + 8 °C, fuel is preheated
15	Overflow valve with choke dia. 1.5 mm	86a	Fuel thermostat closed, as of + 25 °C, fuel is no longer preheated
30	Injection nozzles	87	Supply line - cold fuel
43	Fuel prefilter	87a	Return line - preheated fuel
50	Leak-off fuel hose	148	Heater supply pipe with fuel heat exchanger
54	Injection line cylinder 1		
63	Fuel tank		
73	Fuel filter upper part		

b) Low-pressure side



	Injection pump	79	Banjo fitting
3	Fuel pump	80	Return line
15	Over-flow valve with choke dia. 1.5 mm	81	Hose return
27	Hollow screw	82	Supply fuel filter
42	Fuel filter	83	Supply injection pump
43	Fuel prefilter	84	Hose clamp
50	Leak-off fuel hose	86	Fuel thermostat
51	Hose clamp	87	Supply line fuel heat exchanger
52	Screw plug	87a	Return line fuel heat exchanger
73	Fuel filter upper part	88	Supply fuel thermostat
74	Hollow screw fuel filter	89	Suction line fuel pump
76	O-ring	131	Fuel holder
77	Seal fuel filter	148	Heater supply pipe with fuel heat exchanger
78	Sealing ring		

c) High-pressure side



	Injection pump	64	Holder, cylinder 4, nozzle side
30	Injection nozzle complete	64a	Holder, cylinder 4, pump side
52	Screw plug	64b	Screw
53	Nozzle plate	66	Holder, lines
54	Injection line 1	68	Plastrc clip
55	Injection line 2	68a	Plastic clip
56	Injection line 3	69	Rubber backing
57	Injection line 4	70	Plastrc holder for 3 lines
58	Injection line 5	71	Plastic holder for 2 lines
59	Inlectron line 6		

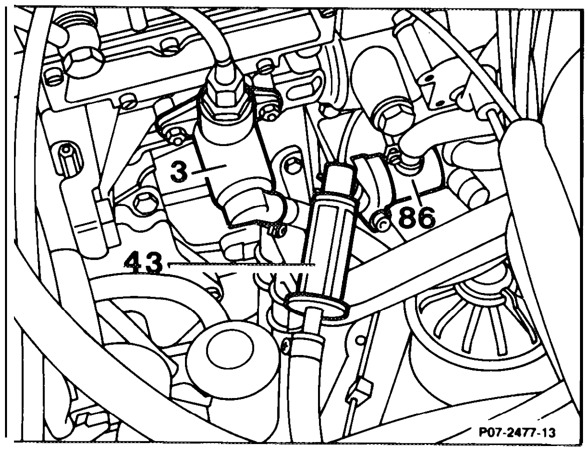
Note

Injection line cylinders 2 - 6 not shown in the figure.

Injection line cylinders 5 - 6 holders as of cylinder 4.

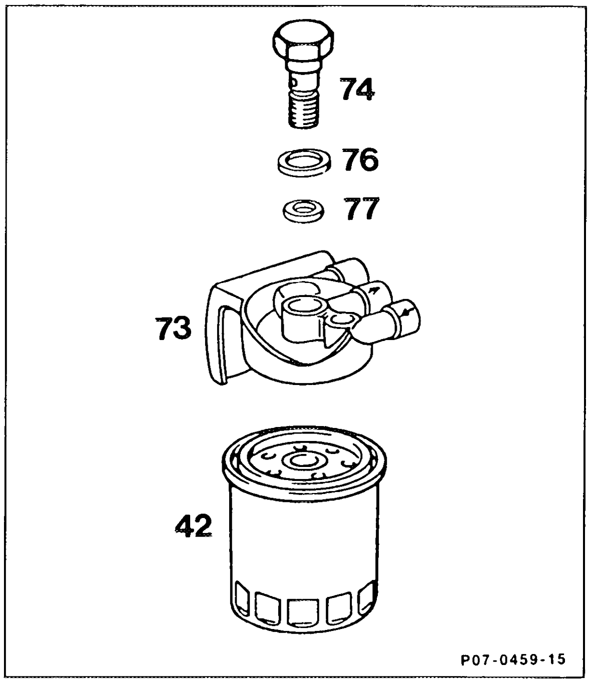
C. Fuel prefilter (43)

Installed in the suction line ahead of the fuel pump (3). The filter housing is made of transparent plastic material.
The mesh size is 0.6 mm (600 µm).



D. Fuel filter (42)

Installed in the delivery line between fuel pump and injection pump.
The paper filter element is integrated in a metal housing. The paper element has a mean pore size of 0.006-0.01 mm (6-10 µm).

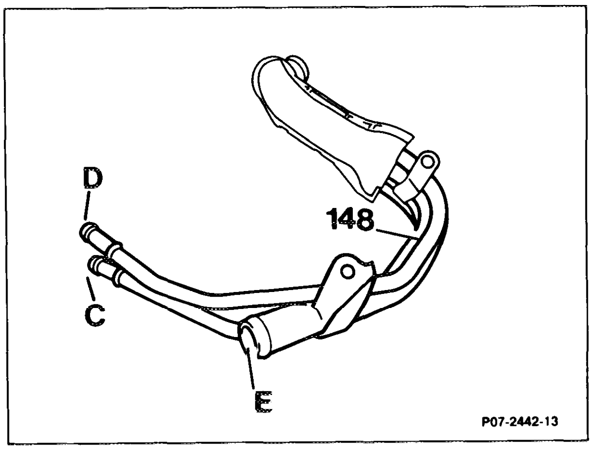


42	Filter
73	Fuel filter upper part
74	Screw
76	O-ring
77	Sealing ring (aluminum)

Note
Owing to the greater delivery capacity of the fuel pump and the chokes in the filter upper part and on the injection pump the fuel system is bled automatically during starting.

E. Fuel preheating (148)

A heat exchanger (148) for preheating the fuel is installed in the supply line of the heating system.



Heat exchanger

C Supply
D Return
E Heater supply
148 Heat exchanger

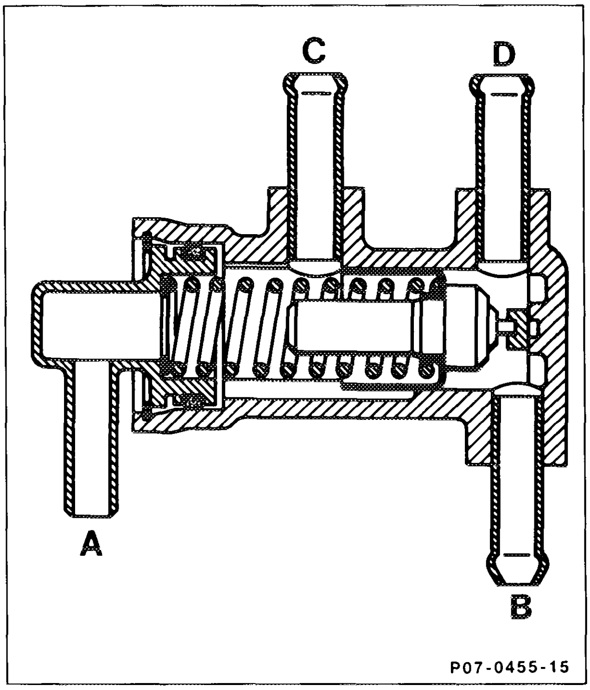
Function

Full preheating up to + 8 °C fuel temperature; the required fuel is drawn via the heat exchanger by the fuel pump.

From + 8 °C to + 25 °C mixed operation; the required fuel flows partially via the heat exchanger.

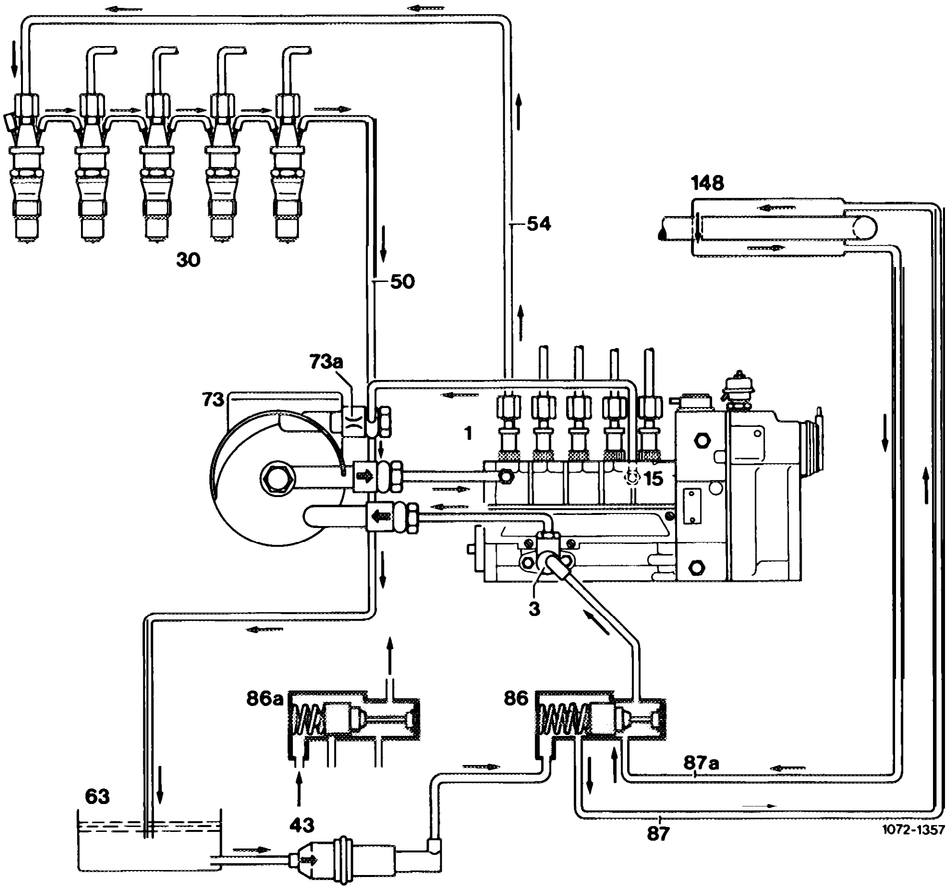
Above + 25 °C the heat exchanger is by-passed by the thermostat action: the fuel pump draws the fuel directly.

The fuel preheating allows trouble-free operation with winter diesel fuel usually up to approx. -25 °C outside temperature.



Fuel thermostat

A Supply from fuel tank
B Suction line to fuel pump
C Supply to heat exchanger
D Return from heat exchanger



Function diagram fuel preheating

1	Injection pump	54	Injection line cylinder 1
3	Fuel pump	63	Fuel tank
15	Overflow valve with choke 1.5 mm dia.	73	Fuel filter upper part
30	Nozzle holder combination	73a	Choke orifice in fuel filter upper part
42	Fuel filter	86	Fuel thermostat up to + 8 °C
42a	Choke orifice in fuel filter upper part 0.8 mm diameter	86a	Fuel thermostat above + 25 °C
		87	Supply line (cold fuel)
43	Fuel prefilter	87a	Return line (preheated fuel)
50	Fuel bleed hose	148	Fuel heat exchanger

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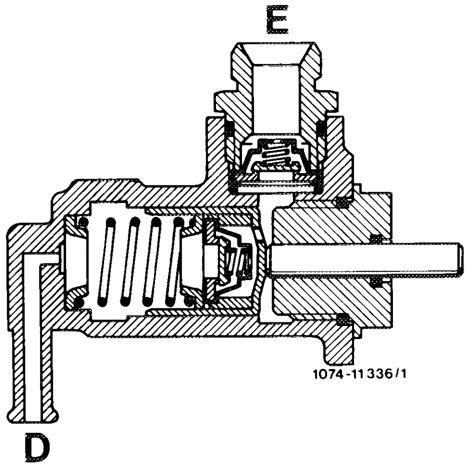
F. Fuel pump

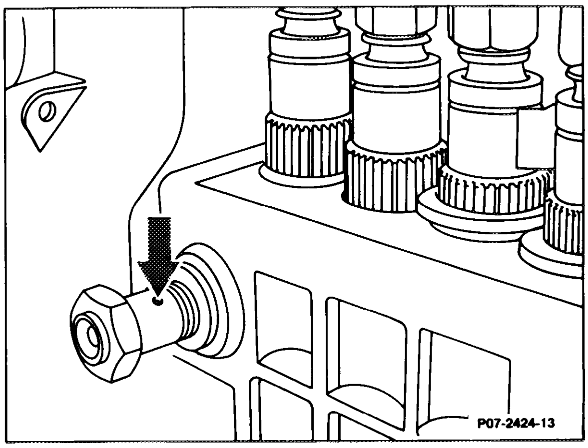
The increased delivery capacity of the fuel pump ensures that the fuel system is bled automatically. The manual priming pump is no longer required.



Rate of delivery $> 150\ cm^3/30$ s, with starter speed > 150/min, in fuel return.

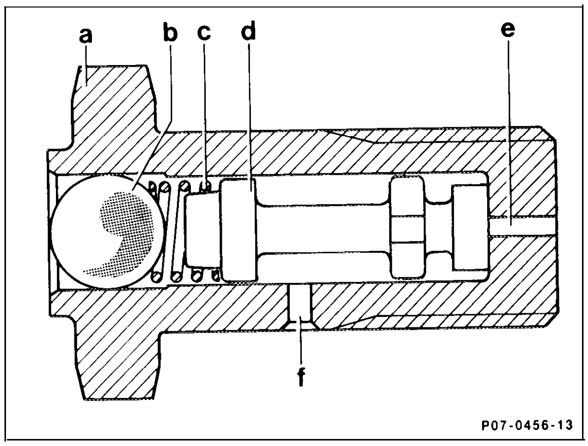
E Suction side
D Delivery side

A choke in the overflow valve on the injection pump is required for bleeding the injection pump



Overflow valve with choke dia. 1.5 mm (arrow).

The overflow valve prevents unfiltered fuel from reaching the injection pump via the return line if the supply is clogged (e.g. filter).

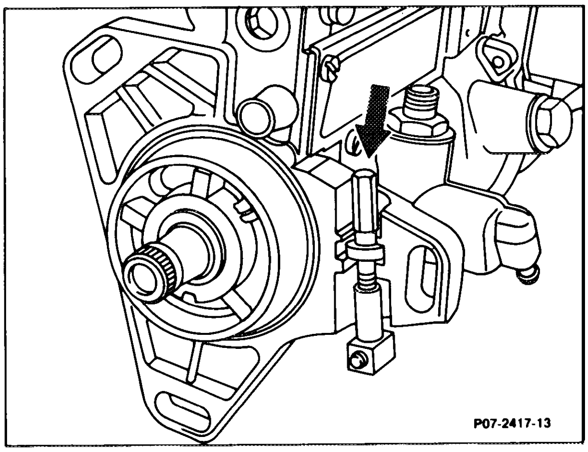


Choke with overflow valve

a Housing
b Ball
c Spring
d Plunger
e Supply
f Choke orifice dia. 1.5 mm

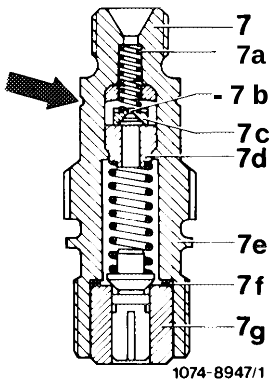
G. Start of delivery adjusting device

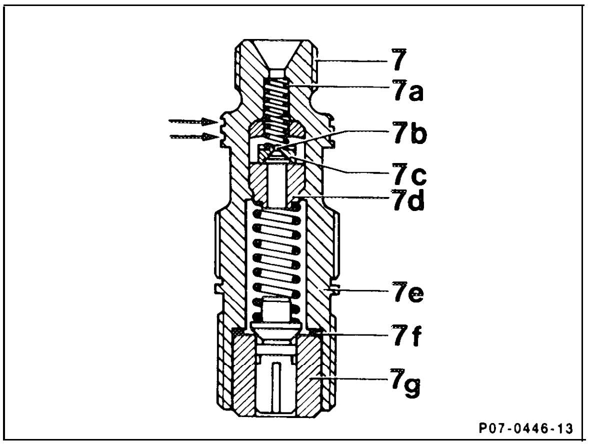
An adjusting device (arrow) is provided on the injection pump flange in order to allow adjustment of start of delivery with the engine running.



H. Relief chokes in delivery valve holder

In order to reduce the hydrocarbon content in the exhaust gas, relief chokes (7b) are installed in the delivery valve holders (7) of the injection pump. The delivery valve holders with relief choke are identified externally by one or two circular grooves (arrows). The relief choke (7b) is a plate valve (7c) with a choke orifice opening in the direction of the injector. The choke orifice for all engines is 0.45 mm diameter.
The valve seat (7d) is riveted into the delivery valve holder.

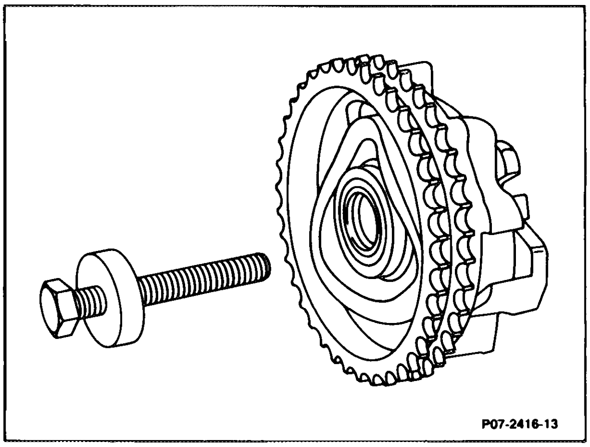


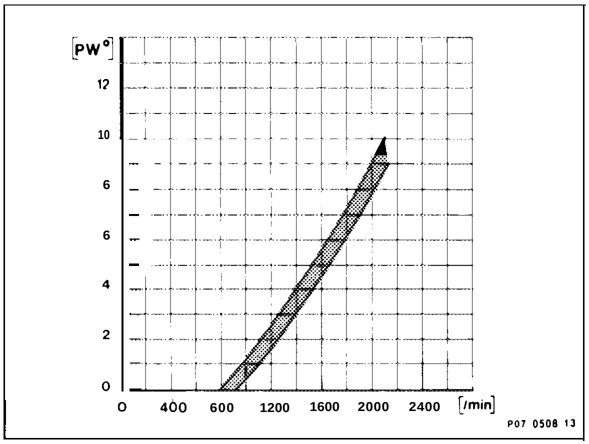


7 Delivery valve holder connection
7a Spring
7b Relief choke
7c Plate valve
7d Valve seat
7e Delivery valve holder
7f Seal
7g Delivery valve

I. Injection thing device

The timing device is mounted on the injection pump shaft and secured with a left-hand threaded center bolt.





Timing device advance curve

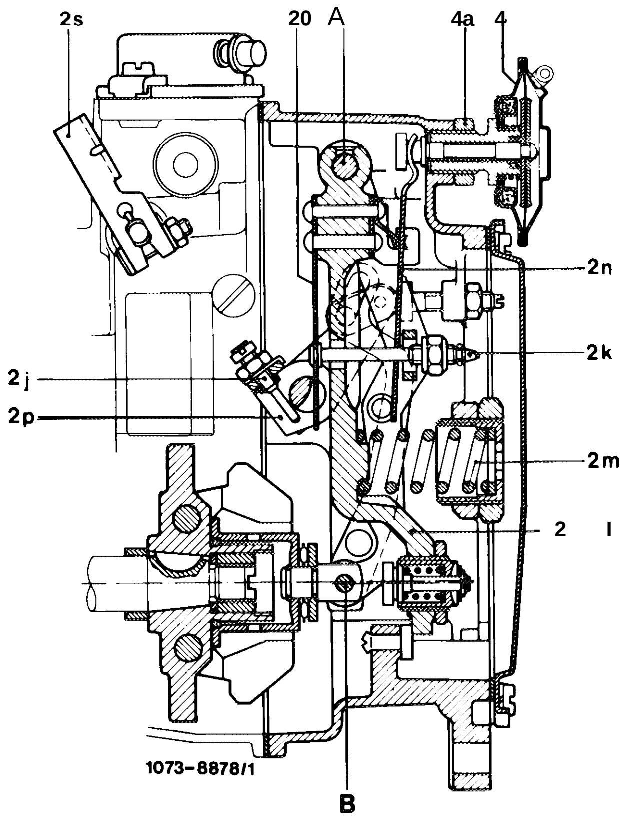
n = 1/min injection pump
PW° = Advance angle injection pump

J. RSF governor, construction and mode of operation

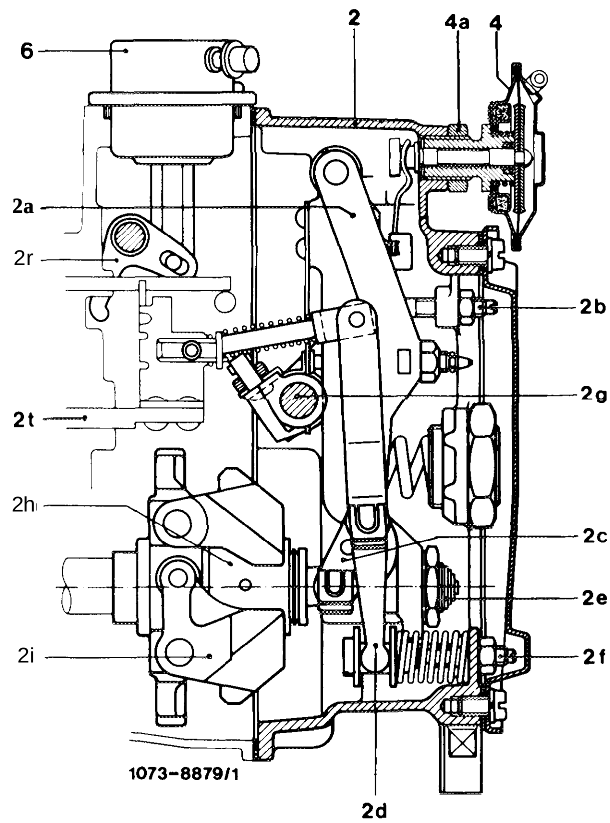
The governor is an idle speed/maximum speed governor whose control spring (2m) is dimensioned and adjusted such that, with the exception of torque control (see “Speed regulation during starting and full-load operation”), it does not regulate in the part load range.

In the part load and full-load ranges the control rod (2t) of the injection pump is only actuated by the accelerator pedal which is connected with the adjusting lever (2g) of the governor by way of the control linkage.

The vacuum unit (4) serves to preload the idle speed spring (2n) and adjust the idle speed.

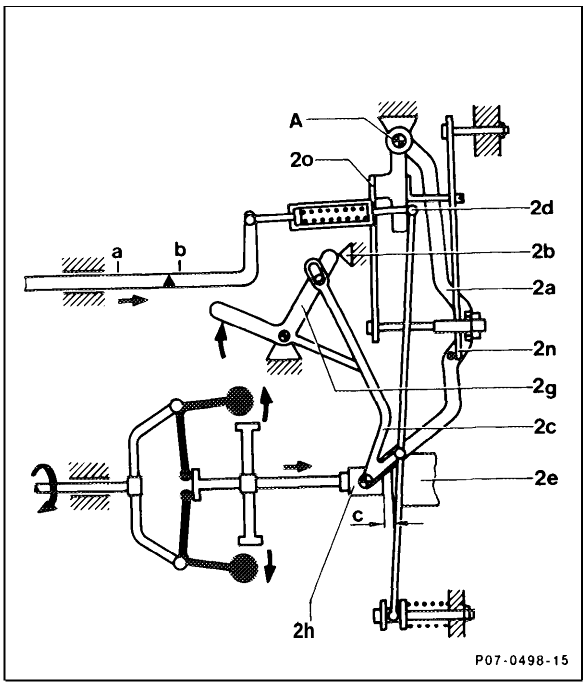


2 Governor
2a Guide lever
2b Stop screw for idle speed volume
2c Reverse-transfer lever
2d Fulcrum lever
2e Spring capsule (torque control)
2f Full-load adjusting screw
2g Control lever
2h Sliding sleeve
2i Flyweights (pump governor assembly)
2j Idle speed auxiliary spring shut-off
2k Adjusting screw for idle speed auxiliary spring (tickler)
2l Tension lever
2m Governor spring
2n Idle speed spring
2o Idle speed auxiliary spring (tickler)
2p Control lever
2r Stop lever
2s Emergency stop lever
2t Control rod
4 Vacuum unit idle speed increase
4a Idle speed adjusting nut
6 Vacuum unit (stop)



a) Idle speed regulation

The adjusting lever (2g) contacts the idle speed stop screw (2b). With increasing speed the sliding sleeve (2h) passes through the idle speed stage. The guide lever (2a) pivots around the fulcrum "A" in this way acting against the idle speed spring (2n).



a Start
b stop
c Idle speed stage

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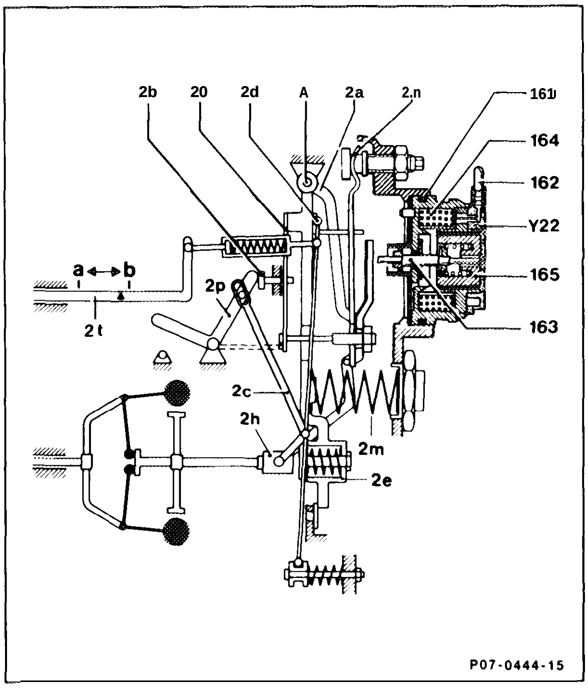
At **a** certain engine speed (approx. 600/min) the guide lever **(2a)** contacts the adjusting nut of the idle speed auxiliary spring (20). The movement of the sliding sleeve (2h) is transferred to the injection pump control rod in the same direction via the reverse-transfer lever (2c) and the control lever (2d). After passing through the idle speed stage the sliding sleeve (2h) contacts the spring capsule (2e).

If the engine speed continues to rise (e.g. while coasting), the spring capsule (2e) and then the governor spring (2m) are overcome at a certain speed. The control rod is then moved into “stop position” (deceleration shut-off).

b) Speed regulation with electromagnetic actuator

The stroke rod (163) contacts the guide lever (2a). The electromagnetic actuator (Y22) is supplied with a timed DC voltage in the frequency range of approx. 50 Hz from the control unit (electronic idle speed control).

If the engine speed drops (e.g. when engaging the driving position or power steering at the end limit), the electromagnetic actuator is given a higher voltage. As a result the stroke rod (163) will push against the guide lever (2a) and the control rod (2t) moves in the direction “a” **more volume.**



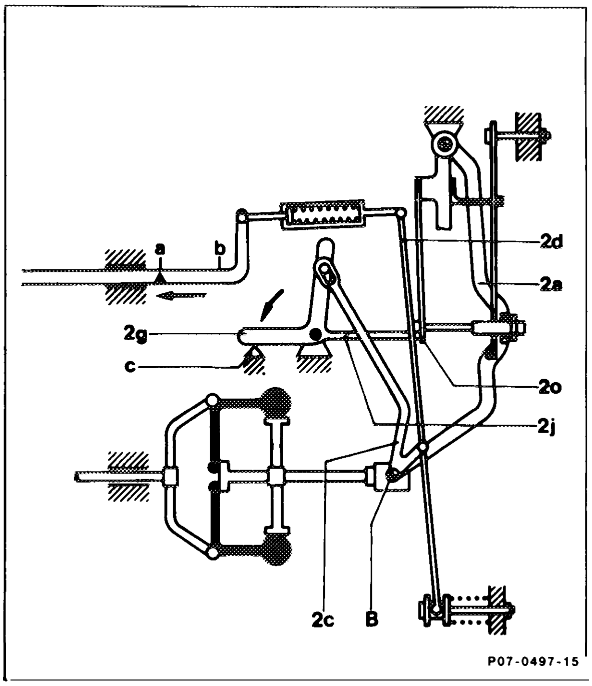
161 Sealing ring
162 Electrical connection
163 Stroke rod
164 Magnetic coil
165 Magnetic core

As soon as the engine speed rises, the voltage is reduced and the control rod (2t) moves in the direction "b" less **volume.**

c) Start position

If, with the engine stationary, the control lever (2g) contacts the full-load stop (c), the reverse-transfer lever (2c) pivots around the fulcrum "B", taking with it the fulcrum lever (2d) in the direction of start.

With the control lever (2g "full throttle") in full-load position the idle speed auxiliary spring (20, tickler) is pushed off the guide lever by the idle speed auxiliary spring shut-off (2j). This allows faster speed regulation from the starting position of the governor.



a Start
b Stop

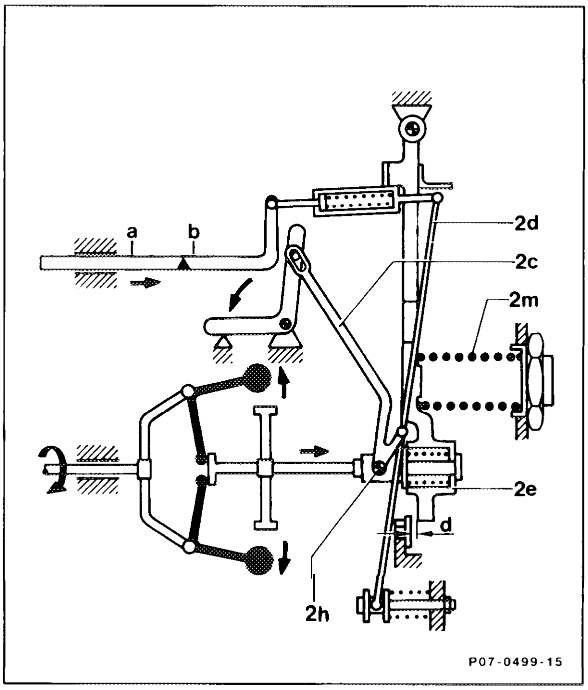
d) Maximum speed regulation/torque control

After passing through the idle speed stage (c) (see figure regulation at idle speed) the sliding sleeve (2h) contacts the spring capsule (2e). In this way the control rod of the injection pump is brought into full-load position via the reverse-transfer lever (2c) and the fulcrum lever (2d).

When a certain speed has been reached, the spring capsule (2e) is pushed on by a specified distance (d) (torque control).

If the speed of the engine rises again, the force of the flyweights is sufficient to overcome the control spring (2m) (maximum speed regulation).

The start of the speed regulation is dependent on the preload of the governor spring (2m).



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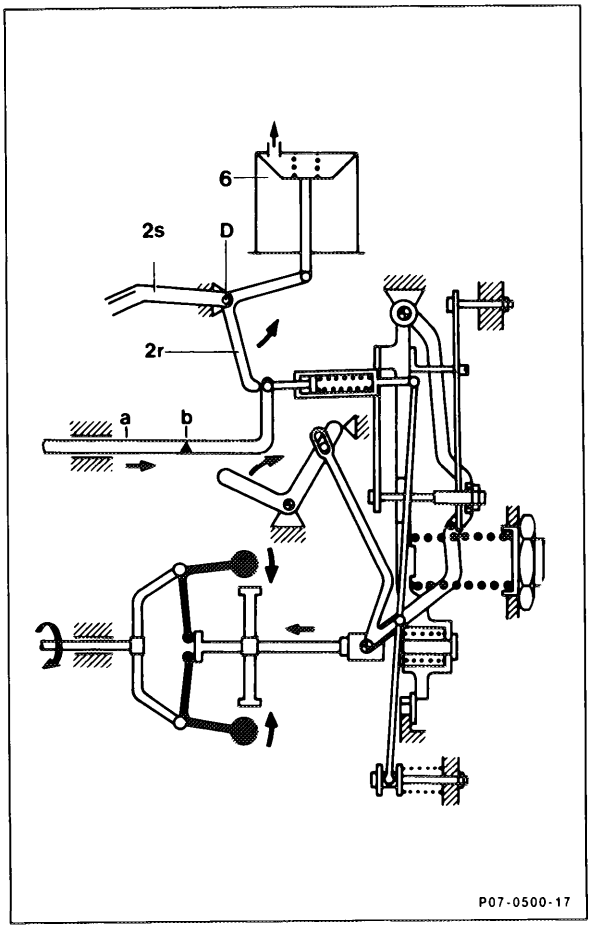
e) Shut off

The vacuum unit (6) is connected to vacuum from the vacuum pump via the glow starter switch of the vehicle. As a result, the diaphragm of the vacuum unit is pulled against the compression spring.

The vacuum unit (6) is connected with a stop lever (2r). This lever pivots around the fulcrum "D" pulling the control rod of the injection pump into the “stop position”. The bypass spring of the fulcrum lever is overcome in this process. Via the emergency stop lever (2s) the control rod can likewise be pulled into “stop position” on the outside of the governor.



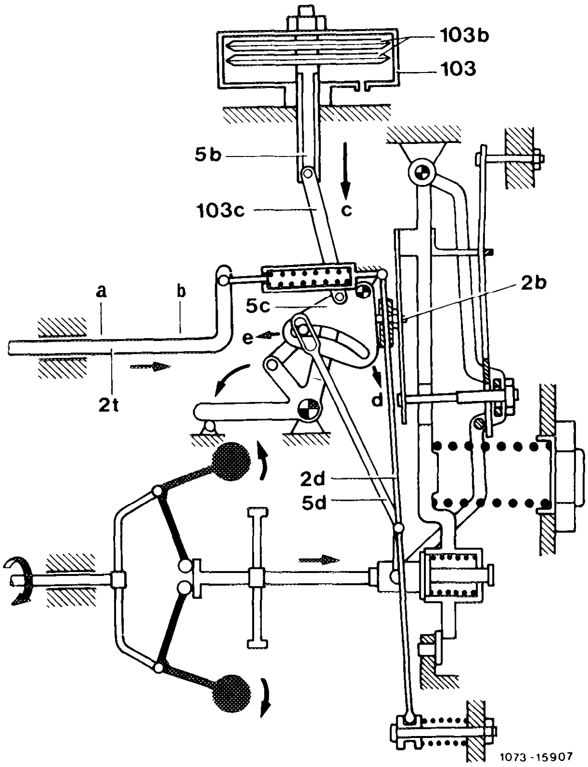
a Star-t
b Stop

K. Atmospheric pressure-dependent full-load stop (ADA)

The atmospheric pressure-dependent full-load stop serves to correct the low air density at higher altitudes.

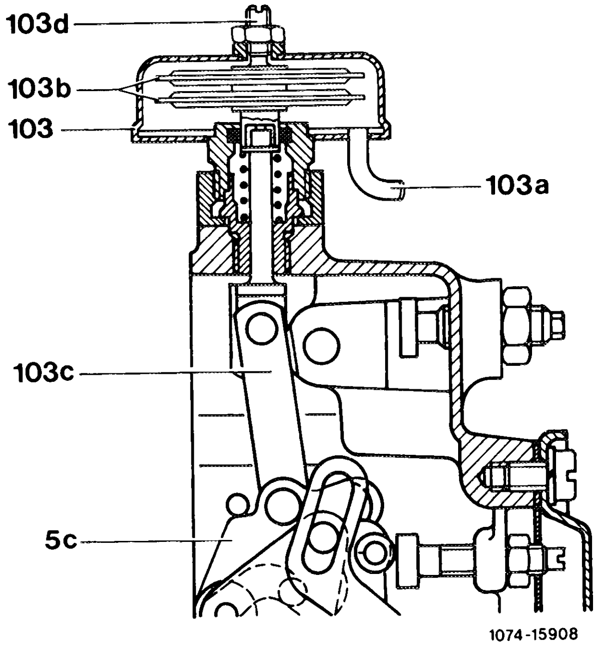
Mode of operation with a **reduction of pressure** with Increasing altitude. With diminishing pressure the aneroid boxes (103b) expand, pushing the ADA correction linkage (103c) in direction (c). The ADA guide pin (5b) continues to push the ADA correction linkage (103c) in the direction of (c), pivoting the ADA template (5c) in the direction of (d).
With the ADA template the toggle lever (5c) and the reverse-transfer lever (5d) pivot in the directions of (e) and (d). The reverse-transfer lever now pulls the control rod (2t) in stop direction (b) via the fulcrum lever (2d).
In this way the pressure drop causes a reduction of the full-load volume.

A **pressure rise** results in the process taking place in reverse order.



The atmospheric pressure-dependent full-load stop consists of aneroid boxes vertically installed in a housing, and which have been adjusted to a certain barometric level by means of an adjusting screw and counteracting spring-loaded threaded pin. Within the operating range of the aneroid boxes an expansion takes place with decreasing air pressure. The spring- loaded threaded pin on the lower side of the aneroid boxes and the connected levers transmit the changes in altitude to the control rod of the injection pump.

If the aneroid boxes expand, the control rod is pulled in the direction of "stop" and the delivery volume is reduced; if the altitude decreases, the control rod is moved into the direction of "additional volume", resulting in an increase of the delivery volume.



5c Template
103 Pressure box
103a Connection for atmospheric connection line (for registering atmospheric pressure)
103b Aneroid boxes
103c Correction linkage
103d Adjusting screw (adjusted by manufacturer)

L. Governor impulse method (RIV)

In order to be able to register the relationship of the injection pump relative to the engine two signals are required:

- TDC impulse from the crankshaft
- Governor impulse from the injection pump

Both impulses are supplied by pulse generators. In order to obtain a measuring signal the sensor pins must be moved past the pulse generators with a minimum speed (idle speed). A measuring instrument measures the time interval of the two impulses, converting the result into an angular value which is then indicated.
Checking, adjusting start of delivery
(see 07.1-I 11/112/116/117).

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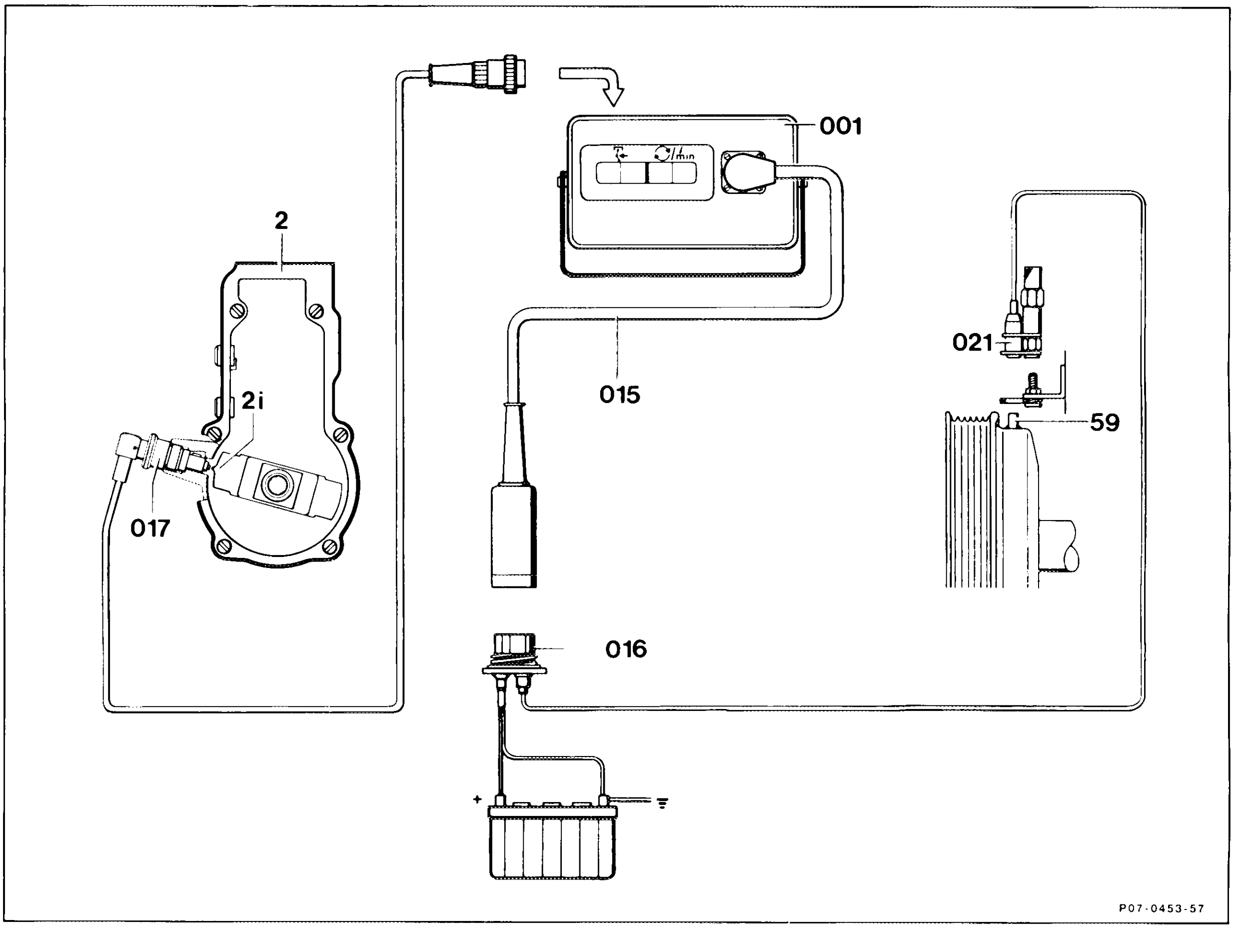


001	Digital tester
015	Test cable
016	Socket
017	RIV generator (governor impulse)
021	TDC pulse generator
059	Sensor pin
2	Governor
2i	Flyweight with sensor pin

M. Electronic idle speed control (ELR)

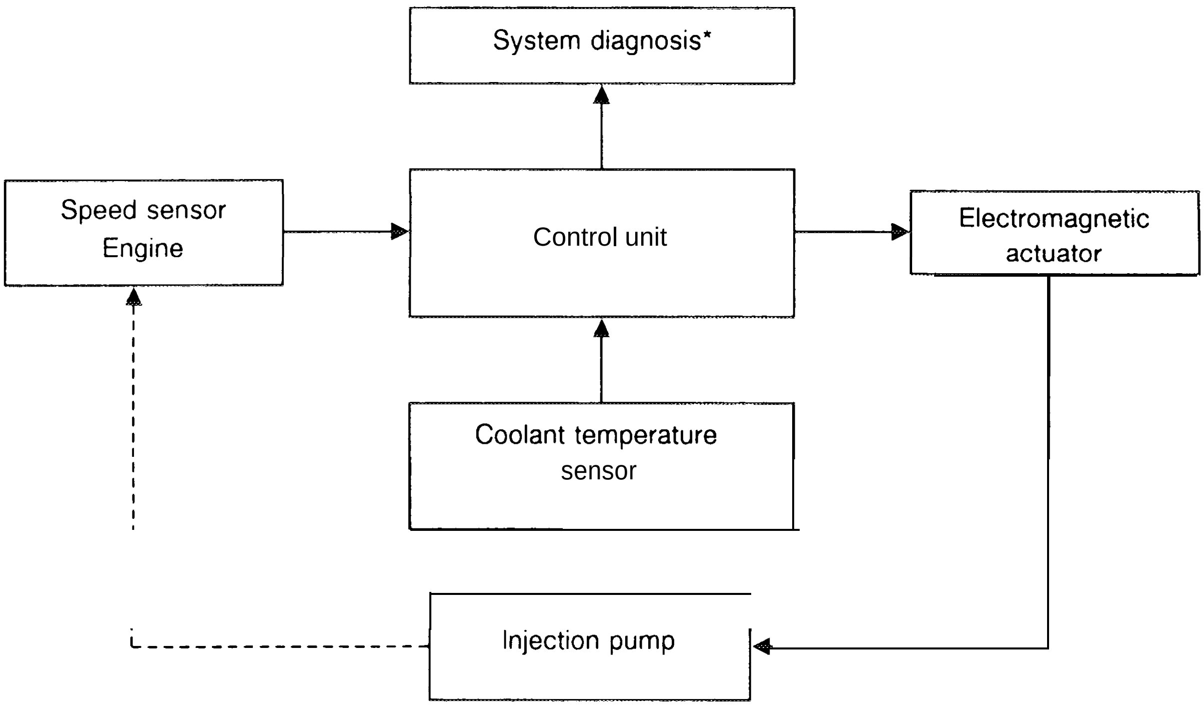
In addition to the mechanical governor an electronic idle speed governor is installed in engine 602 with air conditioner and automatic transmission.

The speed sensor (L 3) registers the engine speed (144 impulses/revolution) passing it on to the control unit (N8 or N8/1) in form of an AC voltage.

The control unit processes the speed signal and compares set value with actual value. The idle speed is kept constant by the electromagnetic actuator (Y22) independent of the load on the engine.

initiated by the temperature sensor (B 11/1), with coolant temperatures < 60 °C the idle speed set value is increased according to a predetermined characteristic.

Block diagram idle speed control



System diagnosis (as of approx. June 1988)*
With the self-testing program integrated in the control unit it is possible to test the ELR system.

A signal can be called up by way of the test coupling (X92) giving specific information on faults of a component.
However, only permanent faults can be indicated. Faults of a temporary nature cannot be registered and indicated by the control unit.

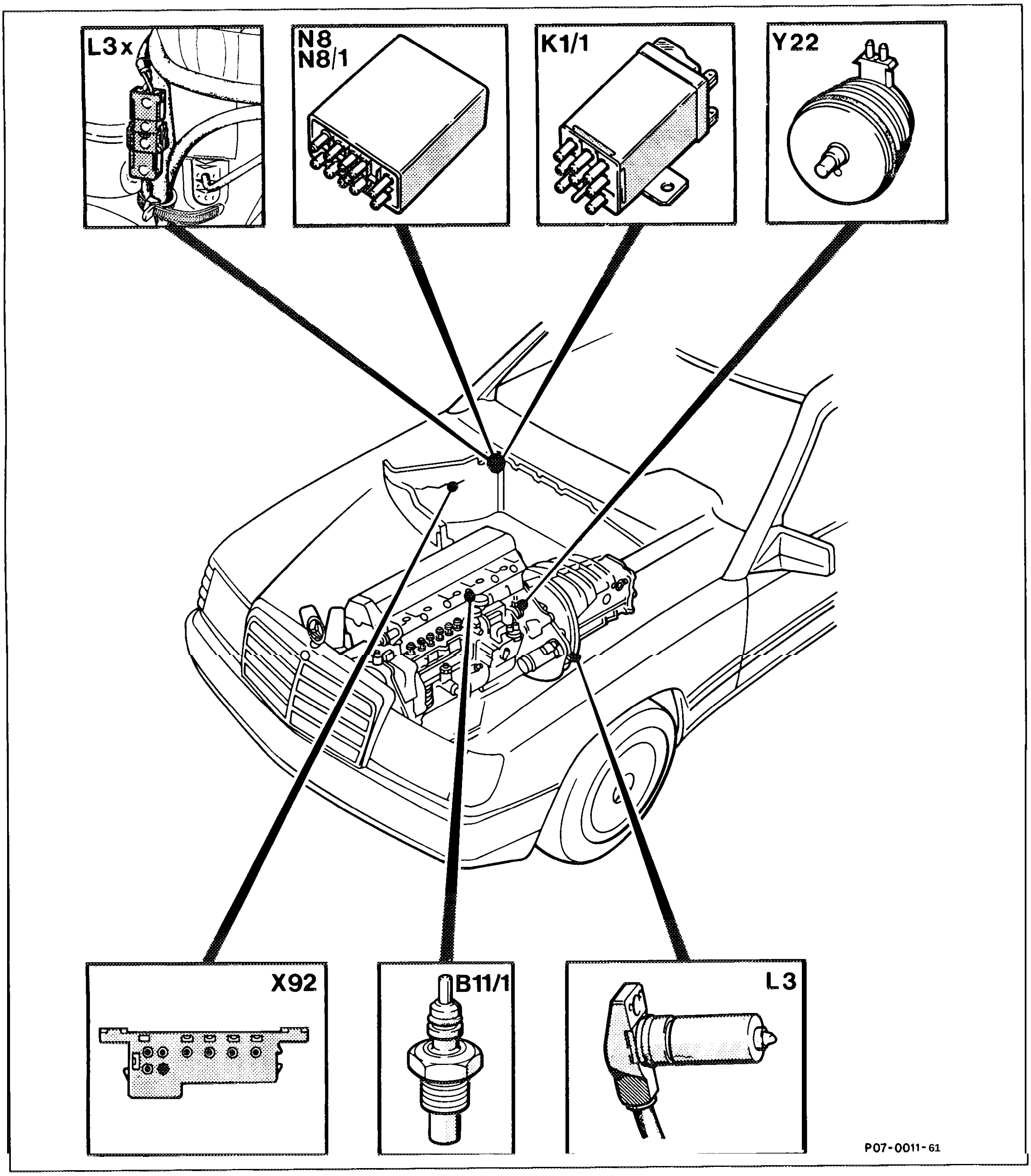
The number of signals shows which component is faulty, or whether components in the control circuit are defective.

Impulse display	Component/Control circuit
1	All functions “in order”
2	Speed signal “fault”
3	Coolant temperature “fault”
6	Control circuit ELR “fault”

EXIT

Arrangement of components

Electrical components

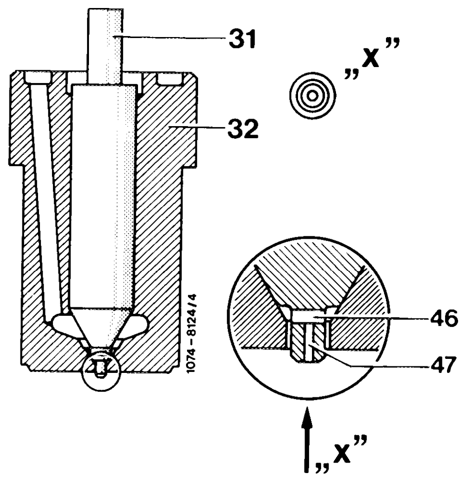


B11/1	Coolant temperature sensor	N8 or N8/1	Control unit ELR
K1/1	Overvoltage protection relay	x92	Test coupling
L3	Speed sensor	Y22	ELR electromagnetic actuator
L3x	Connector speed sensor starter ring gear		

N. **Injection** Nozzles

b) Hole-type pintle nozzle

Bosch designation DN 0 SD 240/
This nozzle is distinguished from the pintle nozzle by transverse and longitudinal bores (46 and 47) in the throttling pintle.



31 Nozzle needle
32 Nozzle body
46 Transverse bore
47 Longitudinal bore

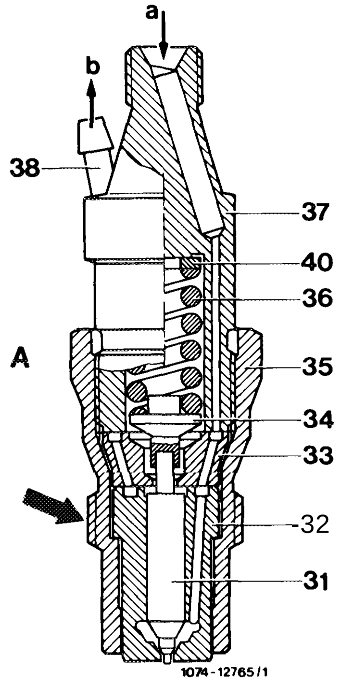
Q. Nozzle holder

Bosch designation
KCA 30 S 44 (without edge-type filter)
(vertical injection)
KCA 30 S 46 (with edge-type filter)
(vertical injection)
KCA 27 S 55
(inclined injection)

EXIT

The compression spring (36) in the holding body (37) presses on the nozzle needle (31) via thrust pin (34). The preload of the compression spring (36) and the shim (40) determine the opening pressure of the injection nozzle. The injection pressure can be adjusted by means of different shim thickness dimensions. Fuel flows to the nozzle seat via the respective supply bore (a) in the holding body (37), intermediate washer (33) and injection nozzle. During the injection process the injection pressure lifts the nozzle needle and the fuel flows through the circular groove on the throttling pintle into the prechamber.

After the injection pressure has dropped, the compression spring (36) forces the nozzle needle (31) back onto its seat; the injection process is completed.



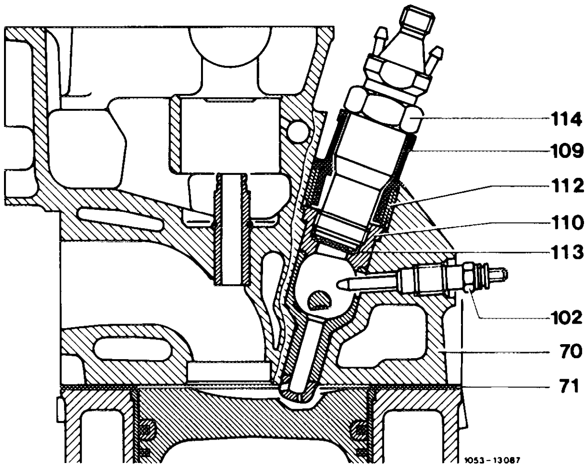
Nozzle holder for vertical injection

EXIT

5° inclined injection

Engine 602 model years 1987 and 1988

The nozzle holder combination is screwed into the upper prechamber with an inclination of 5° with reference to the prechamber longitudinal axis. The inclined injection results in an even more intensive mixing of air with fuel.



70	Cylinder head
71	Cylinder head gasket
109	Sealing sleeve
110	Prechamber
112	Threaded ring
113	Sealing plate
114	Nozzle holder

5°/180° inclined injection

Production breakpoint: Standard version January 1989

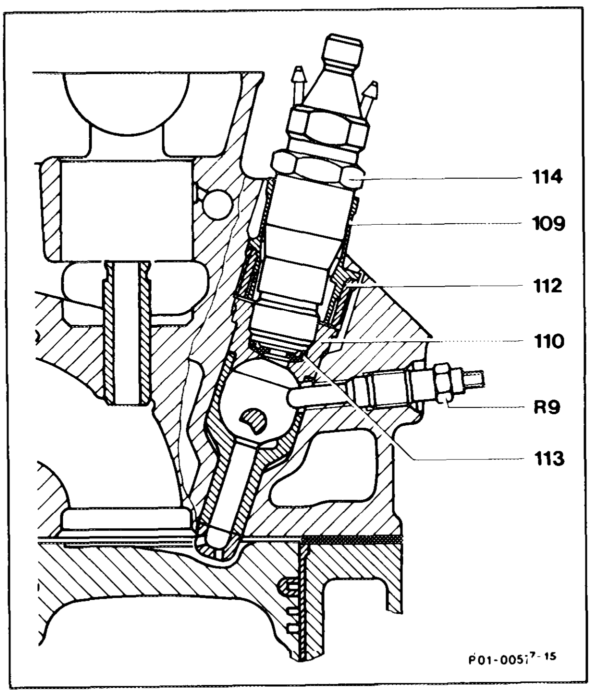
Model	Engine	Engine end no. Manual transmission	Engine end no. Automatic transmission
201.126	602.911		014820

EXIT

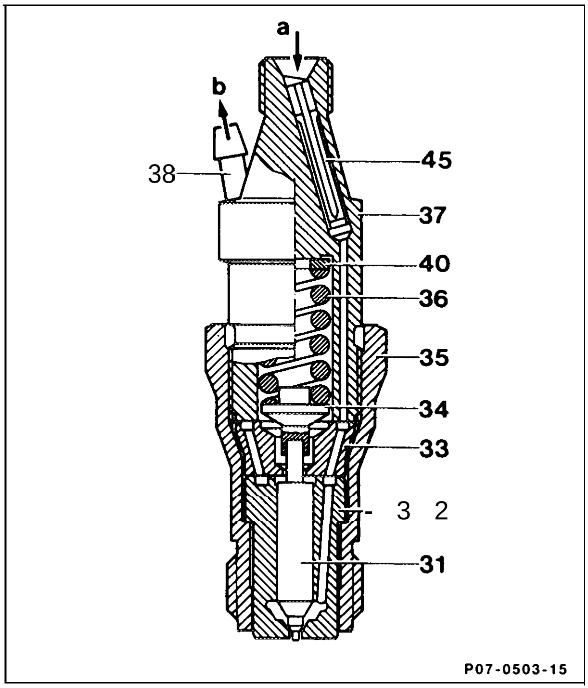
Engine 602 and Code 830 as of model year 1989
The nozzle holder combination inclined by 5° is twisted by 180° and installed into the upper prechamber.

This has the following advantages:

- Improved cold starting
- Improved mixing of air and fuel due to shortened glow plug (23 mm previously 27 mm) in connection with recess and spherical indentation in the ball pin.
- Particle reduction and improvement in the emission of hydrocarbons and carbon monoxide.



R9 Glow plug
109 Sealing sleeve
110 Prechamber
112 Threaded ring
113 Nozzle plate
114 Nozzle holder combination



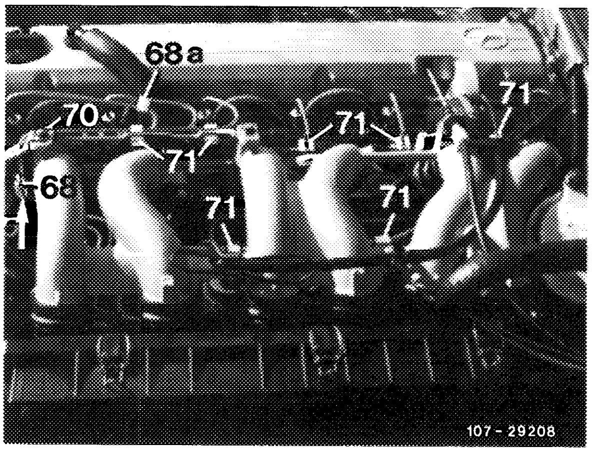
31 Nozzle needle
32 Nozzle body
33 Intermediate washer
34 Thrust pin
35 Nozzle mounting nut
36 Compression spring
37 Holding body
38 Fuel bleed connection
40 Shim
45 Supply bore
a Fuel supply
b Leak-off fuel (return)

Nozzle holder for inclined injection

O. Injection lines

The injection lines are so designed that the injection pump can be pivoted with the engine running.

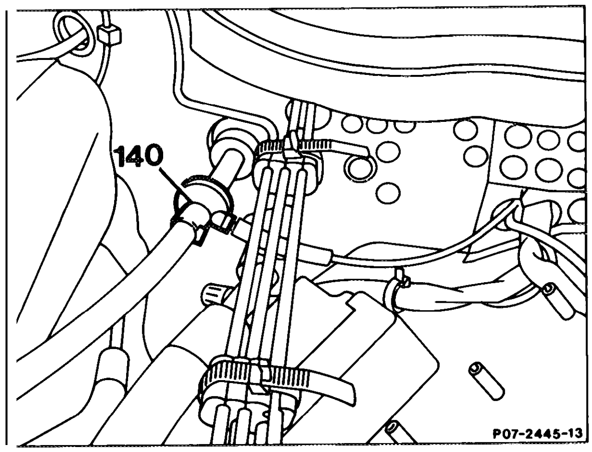
Note
Due to vibration the plastic clips 68 and 68a must be mounted as closely as possible to the radius of the injection lines (arrows). The plastic clips (71) must be fully engaged.



EXIT

P. Vacuum shut-off with vehicle key (glow starter switch)

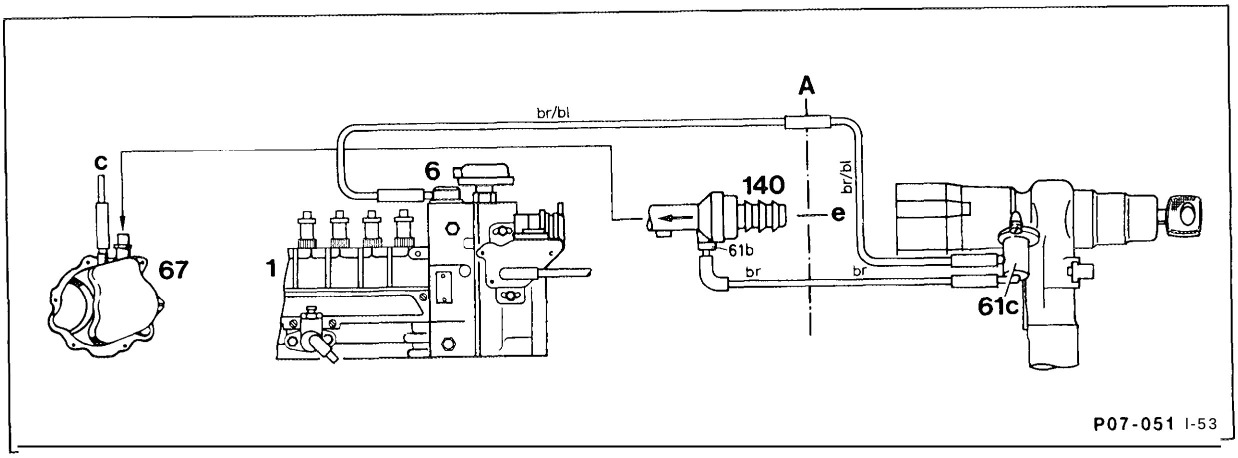
The vacuum for the key shut-off has been supplied by the check valve (140) of the main vacuum line since July 1987.



Production breakpoint: July 1987

Model	Engine	Vehicle identification end no.	
		A	F
201.126	602.911	384857	383987

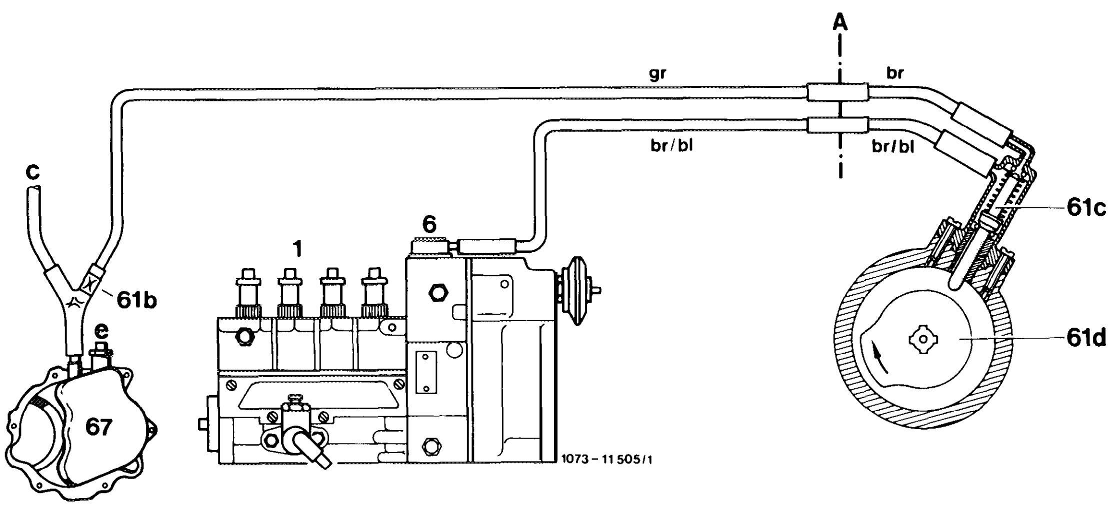
EXIT



Vacuum line routing

1	Injection pump	A	Partition panel
6	Vacuum unit (stop)	c	Remaining users
61c	Valve glow starter switch	e	To brake booster
67	Vacuum pump		
140	Check valve/main vacuum line		

Key shut-off version prior to July 1987

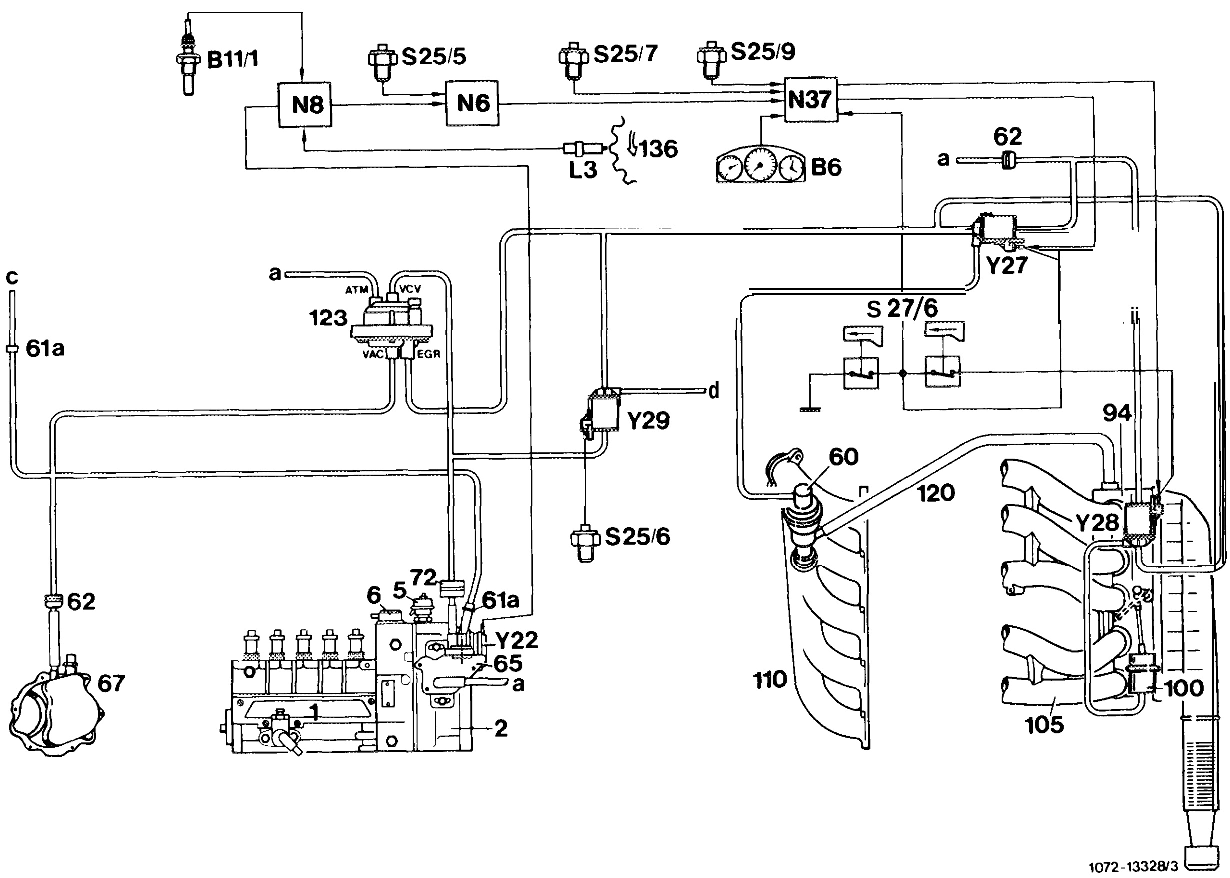


Function diagram

1	Injection pump	A	Partition panel
6	Vacuum unit (stop)	c	Remaining users
61b	Choke 0.5 mm orifice diameter	e	To brake booster
61c	Valve glow starter switch	bl	blue
61d	Cam glow starter switch (valve open)	br	brown
67	Vacuum pump		

07.1-015 **Function exhaust gas recirculation**

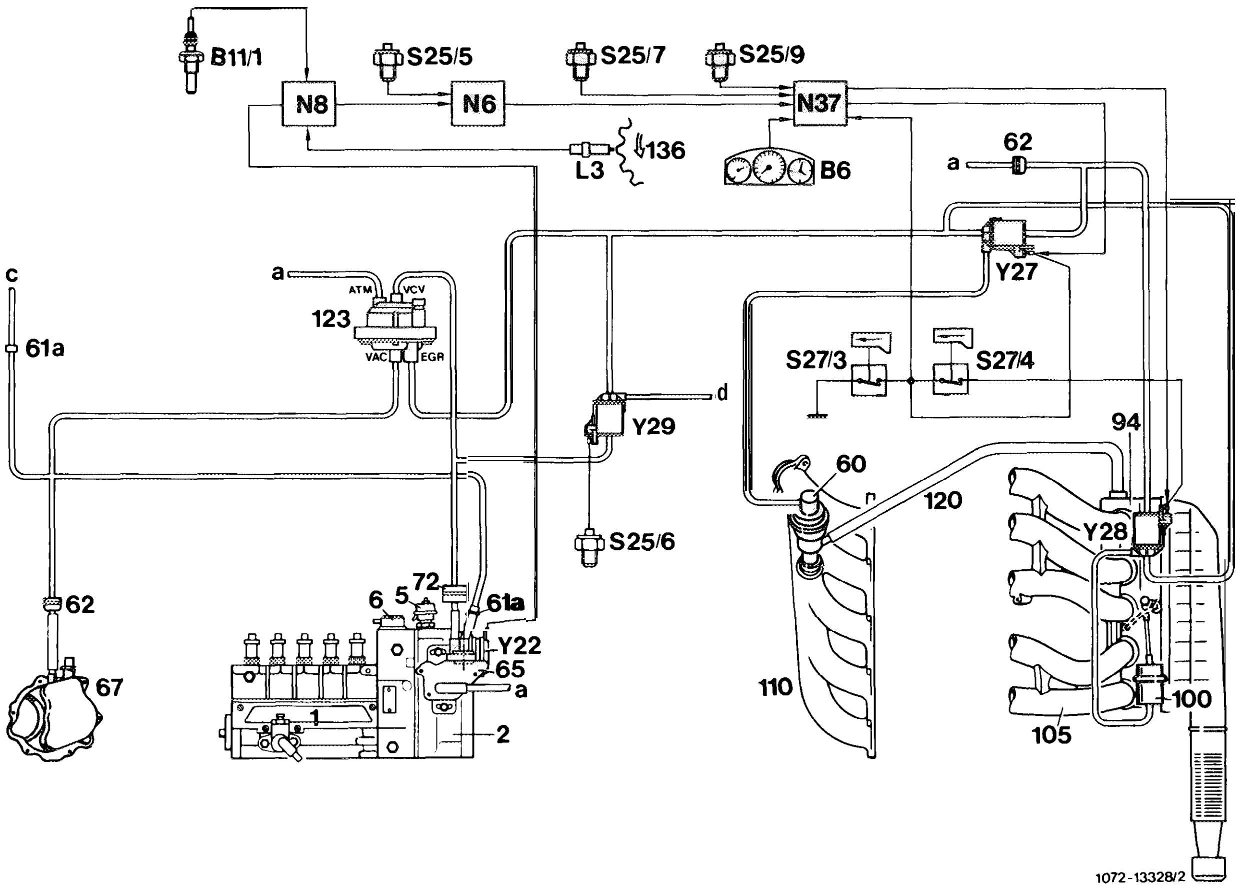
Model 201.126 is equipped with an electronically-controlled exhaust gas recirculation system as of model year 1986.



Engine 602 in model 201
as of model year 1986 1 st version
Function diagram exhaust gas recirculation

	Injection pump
2	Governor
5	ADA unit
6	Vacuum unit (stop)
61a	Choke, blue
61b	Choke, orange
62	Filter
65	Vacuum control valve
67	Vacuum pump
72	Damper
94	Air guide housing
100	Vacuum unit/vacuum control flap
105	Intake pipe
110	Exhaust manifold
120	Exhaust gas recirculation line
136	Starter ring gear

B6	Hall-effect speed sensor
B11/1	Coolant temperature sensor
L3	Speed sensor starter ring gear
N6	Compressor shut-off control unit
N8	Idle speed control unit
N37	Control unit exhaust gas recirculation
S25/5	Temperature switch 1051115 °C
S25/6	Temperature switch 50 °C
S25/7	Temperature switch 25 °C EGR
S25/9	Temperature switch 97 °C EGR
527'6	Microswitch compressor shut-off/EGR
Y22	Electromagnetic actuator ELR
Y27	Switchover valve EGR
Y28	Switchover valve vacuum control flap
Y29	Switchover valve (automatic transmission)

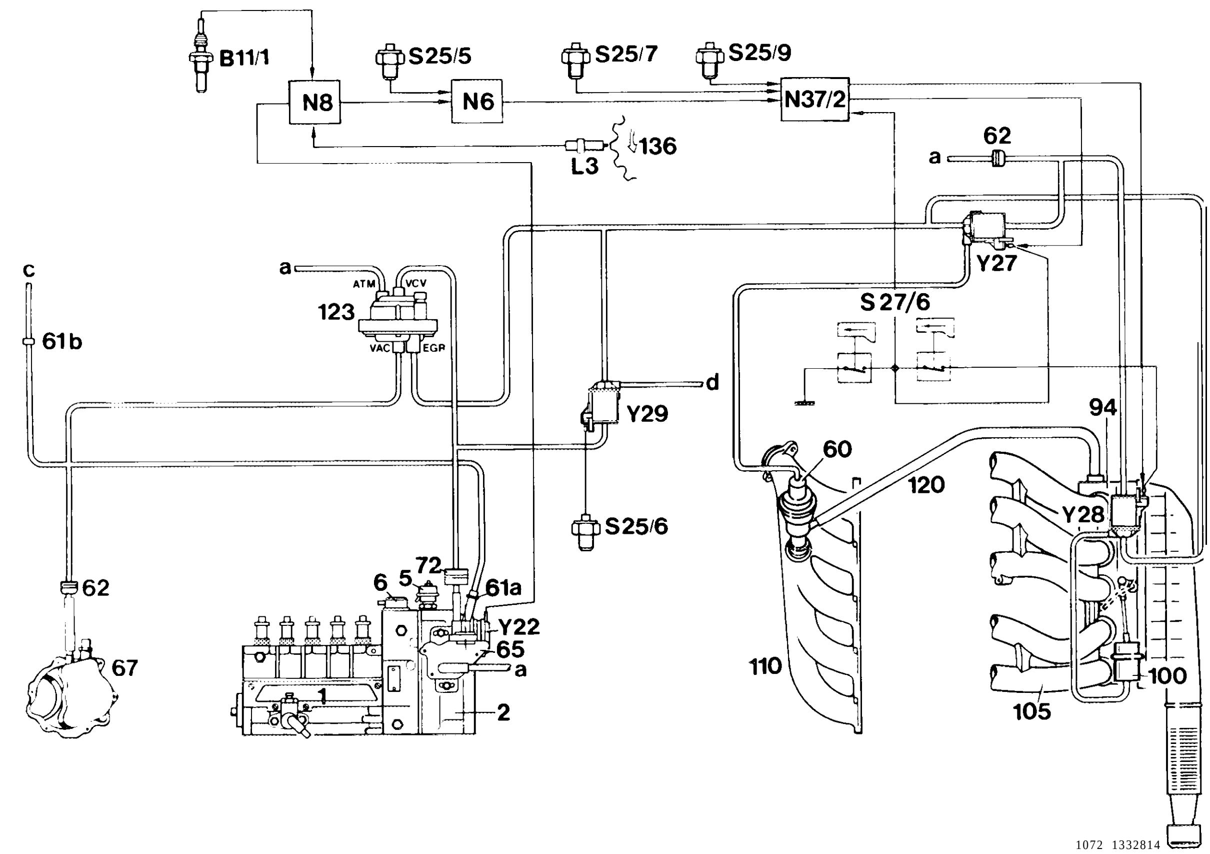


Engine 602 in model 201
as of model year 1986 2nd version
Function diagram exhaust gas recirculation

	Injection pump
2	Governor
5	ADA unit
6	Vacuum unit (stop)
61a	Choke, blue
61b	Choke, orange
62	Filter
65	Vacuum control valve
67	Vacuum pump
72	Damper
94	Air guide housrng
100	Vacuum unit/vacuum control flap
105	Intake pipe
110	Exhaust manifold
120	Exhaust gas recirculation line
136	Starter ring gear

B6	Hall-effect speed sensor
B11/1	Coolant temperature sensor
L3	Speed sensor starter ring gear
N6	Compressor shut-off control unit
N8	Idle speed control unit
N37	Control unit exhaust gas recirculation
S25/5	Temperature switch 105/115 °C
S25/6	Temperature switch 50 °C
S25/7	Temperature switch 25 °C EGR
S25/9	Temperature switch 97 °C EGR
S27/6	Microswitch compressor shut-off/
Y22	Electromagnetic actuator ELR
Y27	Swrtchover valve EGR
Y28	Swrtchover valve vacuum control flap
Y29	Swrtchover valve (automatic transmission)

EXIT



Engine 602 in model 201

model year 1989

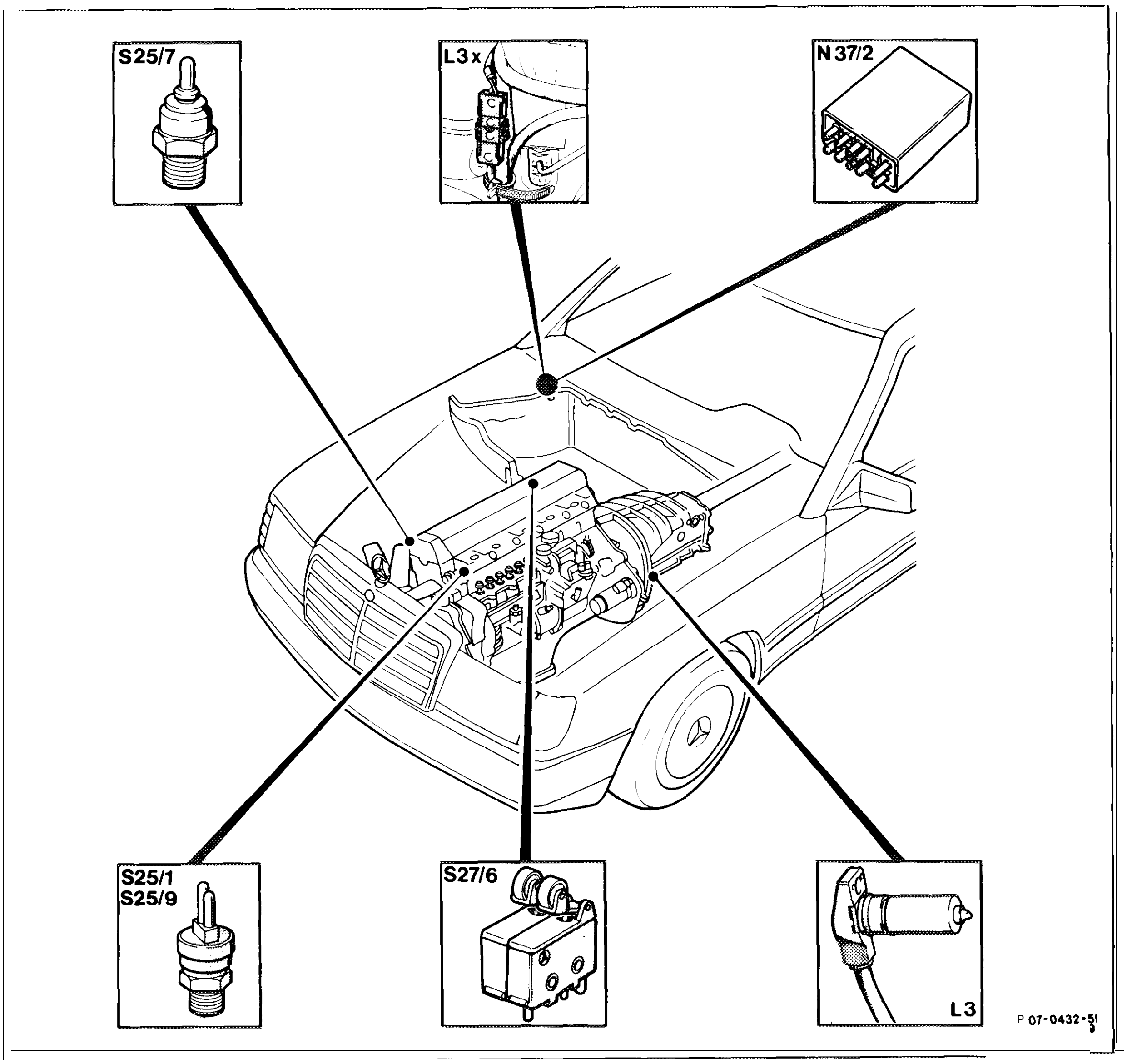
Function diagram exhaust gas recirculation

1	Injection pump
2	Governor
5	ADA unit
6	Vacuum unit (stop)
60	Exhaust gas recirculatron valve
61a	Choke, blue
61b	Choke
62	Filter
65	Vacuum control valve
67	Vacuum pump
72	Damper
94	Air guide housing
100	Vacuum unit/vacuum control flap
105	Intake pipe
110	Exhaust manifold
120	Exhaust gas recirculation line
123	Vacuum amplifier
136	Starter ring gear

B1 I/I	Coolant temperature sensor
B11/7	Climate temperature sensor
L3	Speed sensor starter ring gear
N6	Compressor shut-off control unit
N8	Idle speed control unit
N37/2	Control unit exhaust gas recirculation
S25/5	Temperature switch 1 05/1 15 °C
S25/6	Temperature switch 50 °C
S25/7	Temperature switch 25 °C EGR
S25/9	Temperature switch 97 °C EGR
S27/6	Microswitch compressor shut-off/
Y22	Electromagnetic actuator ELR
Y27	Swrtchover valve EGR
Y28	Swrtchover valve vacuum control flap
Y29	Switchover valve (automatrc transmission)
a	Ventilation to vehicle interior
c	Remaining users
d	Vacuum unit automatrc transmission
	Vacuum connections on vacuum amplifier
VAC	- Vacuum from vacuum pump
V C V	- To vacuum control valve
ATM	- Ventilation to vehicle Interior
EGR	- Exhaust gas recirculation to exhaust gas recirculation valve

B. Components and function

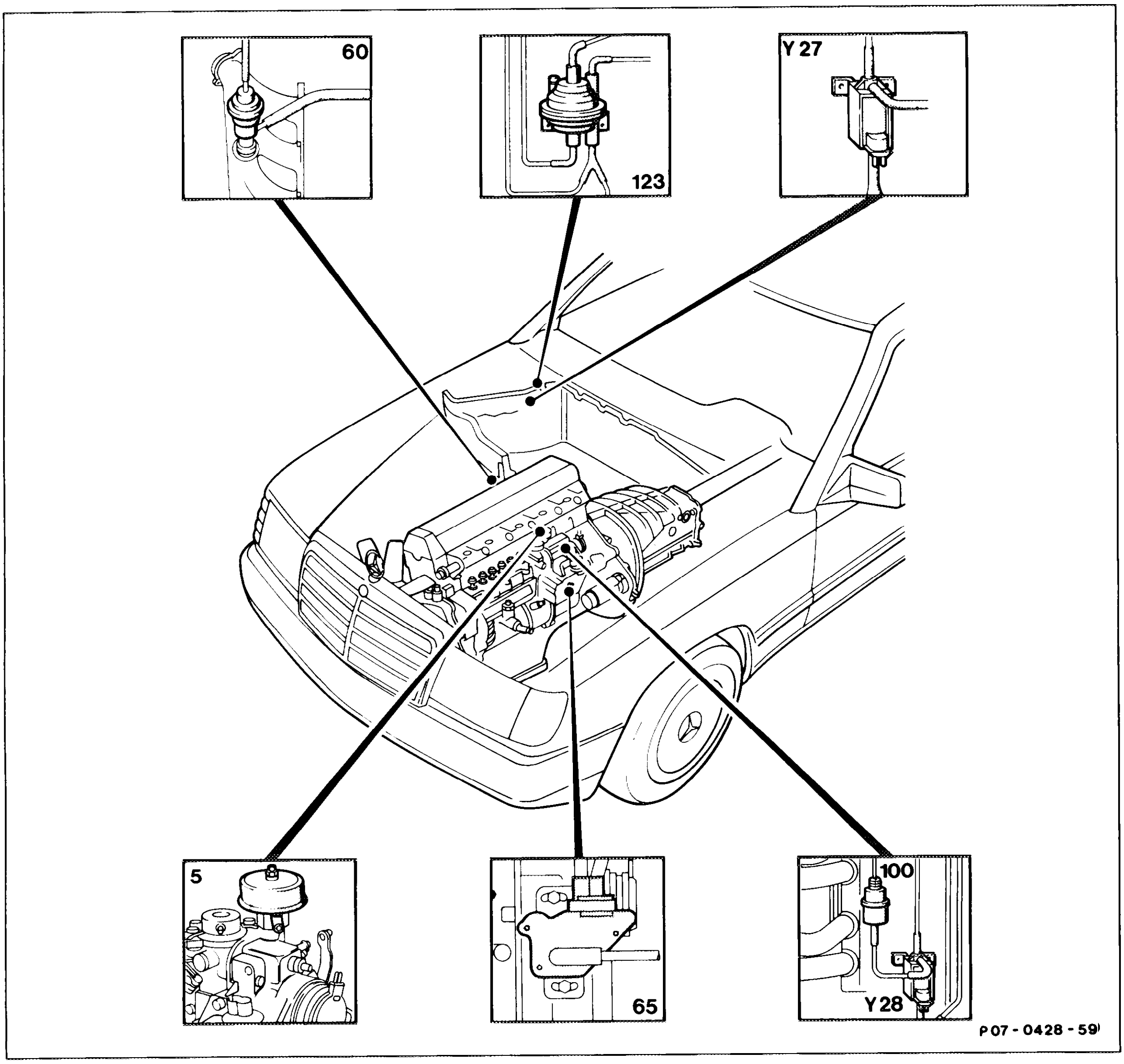
Electrical components



L3	Starter ring gear speed sensor	S25/1	Temperature switch 100 °C
L3x	Connector starter ring gear speed sensor	S25/7	Temperature switch 25 °C
N37/2	Control unit exhaust gas recirculation	S25/9	Temperature switch 97 °C
		S27/6	Microswitch compressor shut-off/EGR

EXIT

Pneumatic components



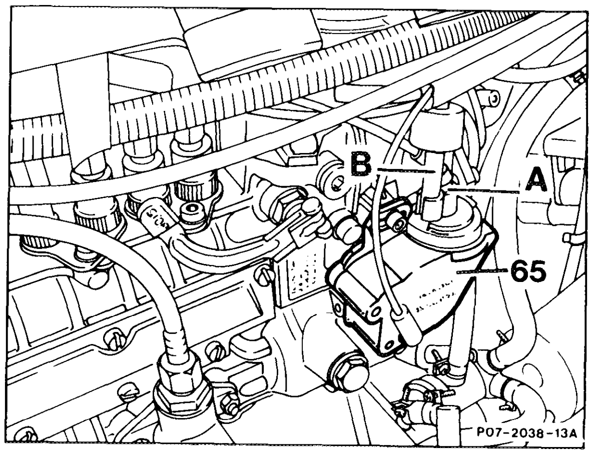
5	**ADA unit**	**100**	**Vacuum** unit vacuum control flap
60	EGR valve	123	Vacuum amplifier
65	Vacuum control valve	Y27	Switchover valve exhaust gas recirculation
		Y28	Switchover valve vacuum control flap

EXIT

C. Overall function

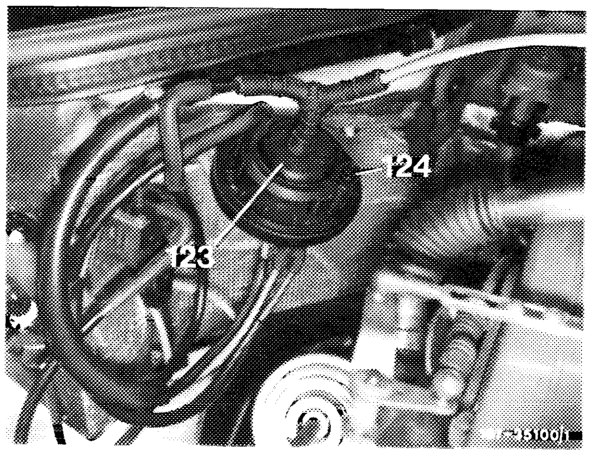
Vacuum control valve (65)
The vacuum control valve is attached to the injectton pump and connected to the control lever by means of a driver. Using available vacuum supply (central connection) it modulates decreasing pressure with increasing load.according to a.characteristic map.

The vacuum control valves have a different characteristic depending on the engine and transmission design. They are identified by differently colored sealing caps and must not be interchanged (see 07. I-I 70).



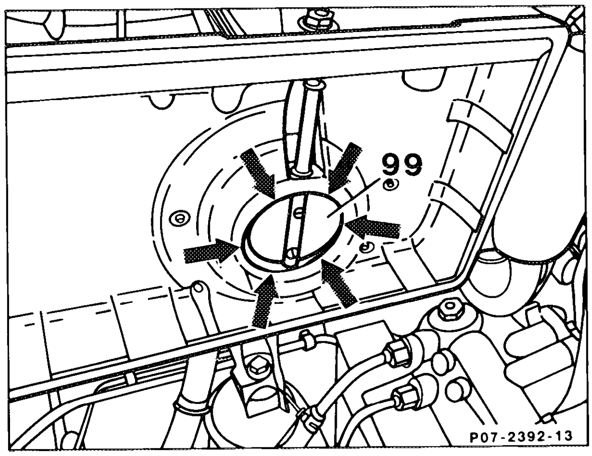
65 Vacuum control valve
A Control line
B Suction line

Vacuum amplifier (123)
(only with automatic transmission)
Attached to the unit wall.
The pressure modulated by the vacuum control valve is converted in the vacuum amplifier (123) for use in the exhaust gas recirculation system. By way of the switchover valves (Y27 and Y28) the exhaust gas recirculation valve and the vacuum control flap are activated.



Air guide housing with vacuum control flap (99)

A pneumatically actuated vacuum control flap (99) is provided in the air guide housing in order to increase the vacuum in the intake pipe.
During engine operation with exhaust gas recirculation the vacuum control flap closes off the fresh air duct.



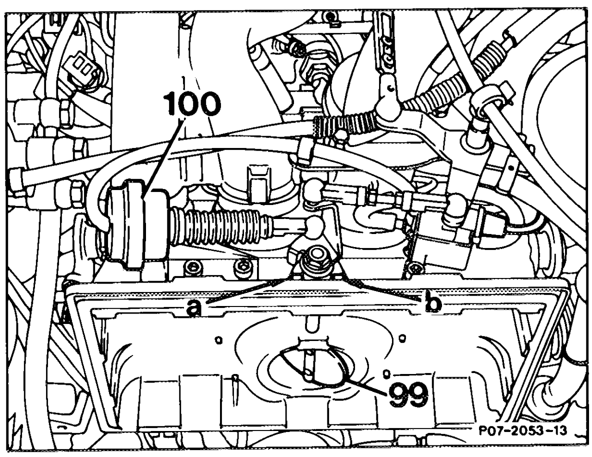
A minimum opening (arrow) between the vacuum control flap (99) and the air guide housing is maintained in a closed condition.

Note
The linkage on the vacuum unit for the vacuum control flap (99) may not be actuated manually.

Mechanical pressure control flap (99) with pneumatic control group, temperature-dependent > 40 °C

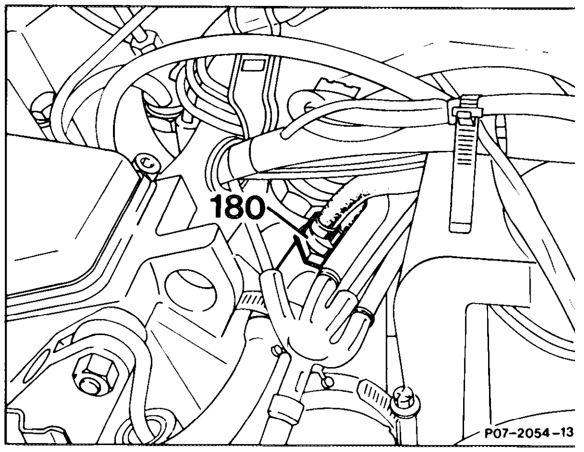
The exhaust gas recirculation is optimised by a mechanical actuation of the pressure control flap (99), thus improving the degree of the exhaust gas recirculation rate.

The pressure control flap (99) is always approximately 35° open in its initial setting (at idle speed).

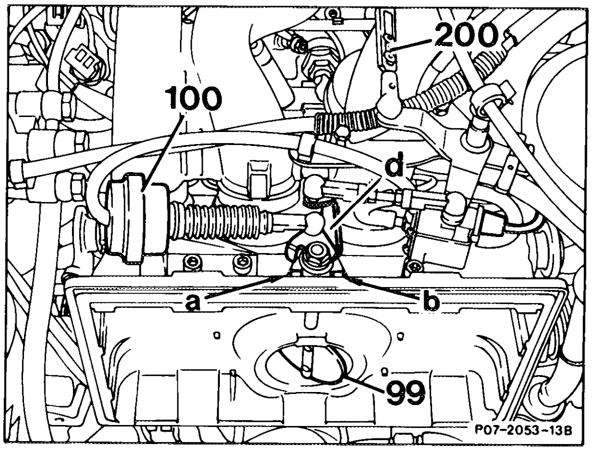


EXIT

When the coolant temperatures are > 40 °C between 1000 ± 50/min and 2500 ± 50/min the pressure control flap is pneumatically closed via the thermovalve (180) and is opened again mechanically via the accelerator depending on the load condition.
The pressure control flap is open at full throttle.

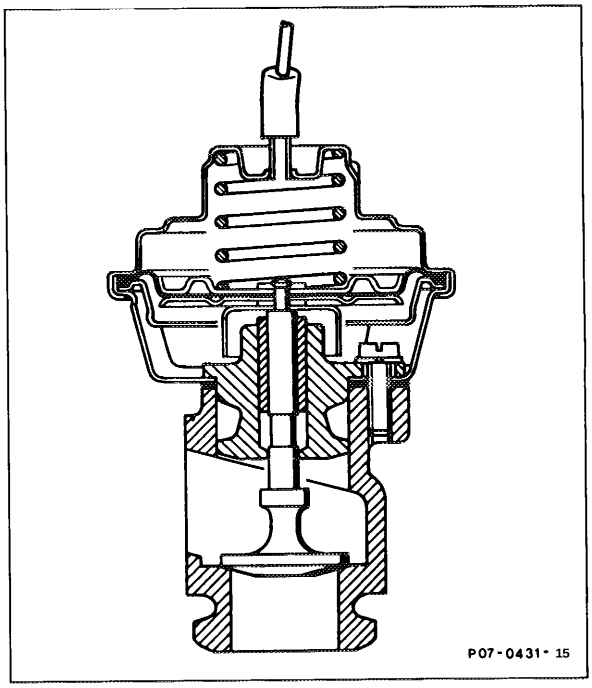


It became necessary to introduce a connecting rod (200) at the vacuum unit for the pressure control flap (due to the mechanical actuation of the pressure control valve (99)).

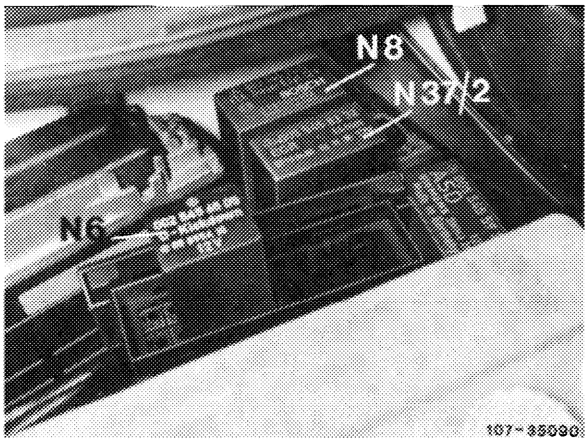


EXIT

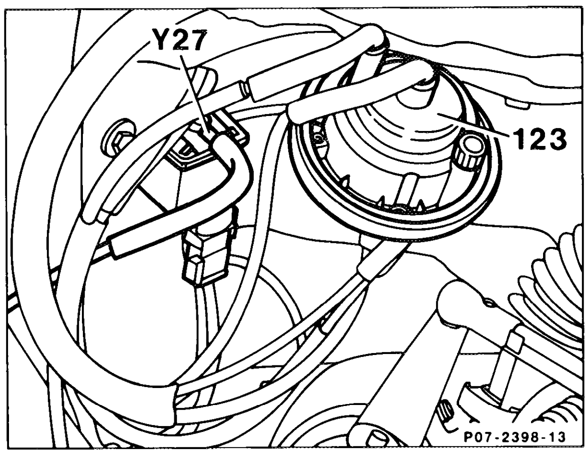
Exhaust gas recirculation valve
The exhaust gas recirculation valve is screwed into the side of the cylinder head. It is connected with the exhaust and the intake manifolds by way of the exhaust gas recirculation line.
The exhaust gas recirculation valve is activated by the modulated vacuum from the vacuum control valve and opens depending on the load condition.



Control unit (N37 and N37/2)
This is installed behind the battery. Battery voltage is available on the control unit EGR (N37 or N37/2) after the ignition has been switched on. Minimum working voltage approx. 11 V.

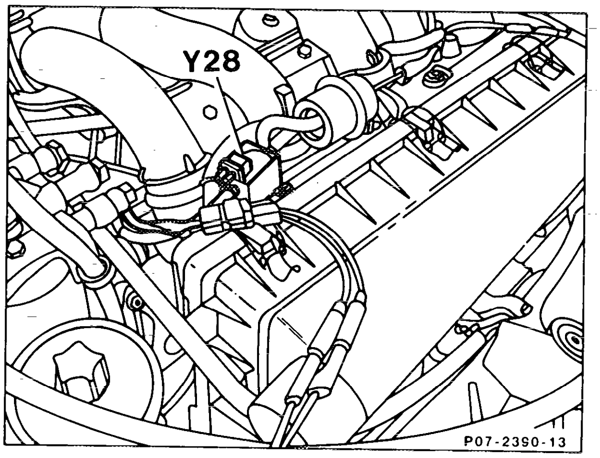


Electrical switchover valve (Y27)
This admits vacuum for the exhaust gas recirculation in certain operating conditions. The activation is by way of the control unit EGR (N37 or N37/2) as a function of coolant temperature and engine speed as well as speed and load-dependent on the microswitch (only with manual 5-speed transmission).



Electrical switchover valve (Y28)

This admits the vacuum for the vacuum control flap under certain operating conditions. The activation is by way of the-control unit EGR (N37 or N37/2) as a function of coolant temperature and engine speed as well as dependent on speed and load via the microswitch (S27 4).



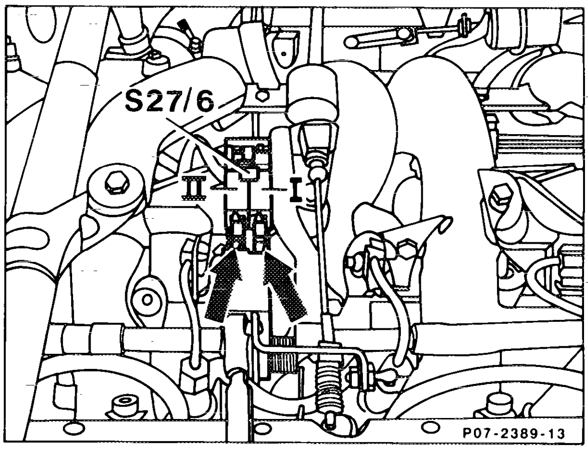
Microswitch (S27/6)

Microswitch I

Switches off the exhaust gas recirculation and the AC compressor before full load (A/C compressor only if climate comfort control is operative).

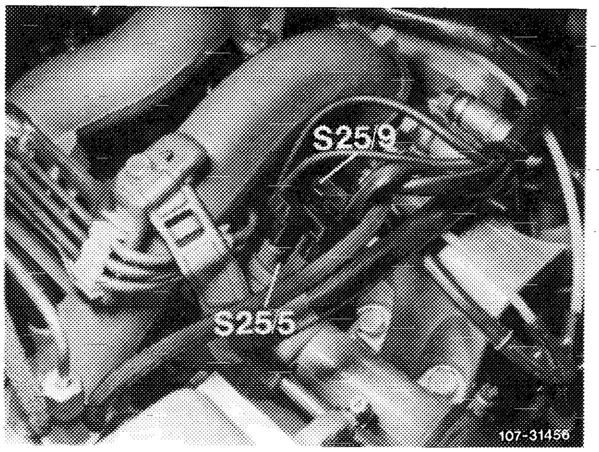
Microswitch II

Switches off the vacuum control flap before reaching full load.



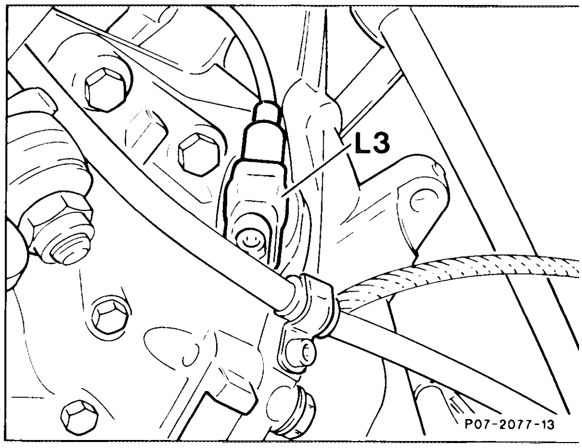
Coolant temperature switch 97° and ioo °C (S25/1, S25/4, S25/9)

For thermal protection of the engine the temperature switch switches off the exhaust gas recirculation via the control unit EGR (N37 or N37/2) from a coolant temperature of approx 100 °C.

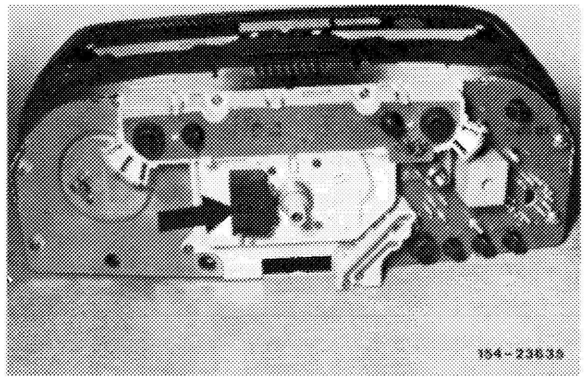


EXIT

Starter ring gear speed sensor (L3)
This is attached to the flange of the transmission. The speed sensor (L3) consists of a magnetic core and a coil. It registers the engine speed, passing it on to the control unit EGR (N37 or. N37 2) in form of an AC voltage.



#all-effect speed sensor (B6)
(only with manual transmission)
The vehicle speed is taken off the speedometer by the Hall-effect speed sensor (arrow). At a speed above 87 km/h the exhaust gas recirculation is switched off by the control unit.



D. Overall function

Exhaust gas recirculation
Exhaust gas recirculation is effective if the following requirements have been met:

- **Engine speed**
  between 1200 ± 50/min and 2950 ± 50/min for model years 1986 through 1988.
  between 1000 ± 50/min and 2950 ± 50/min for model year 1989.

- **Coolant temperature** between 25 °C and 97 °C engine 602.

- **Speed** below 85 km h approx. 56 mph, (M.Y. 1986-8), approx. 53 mph (M.Y. 1989) only manual 5-speed transmission.

- **Accelerator pedal not in full load position** as the EGR valve is closed via the microswitch just before full throttle position.

- **Vacuum control flap** between 1000 ± 50/min and 2500 ± 50/min closed.

The control unit EGR (N37 or N37 2) registers the following input signals

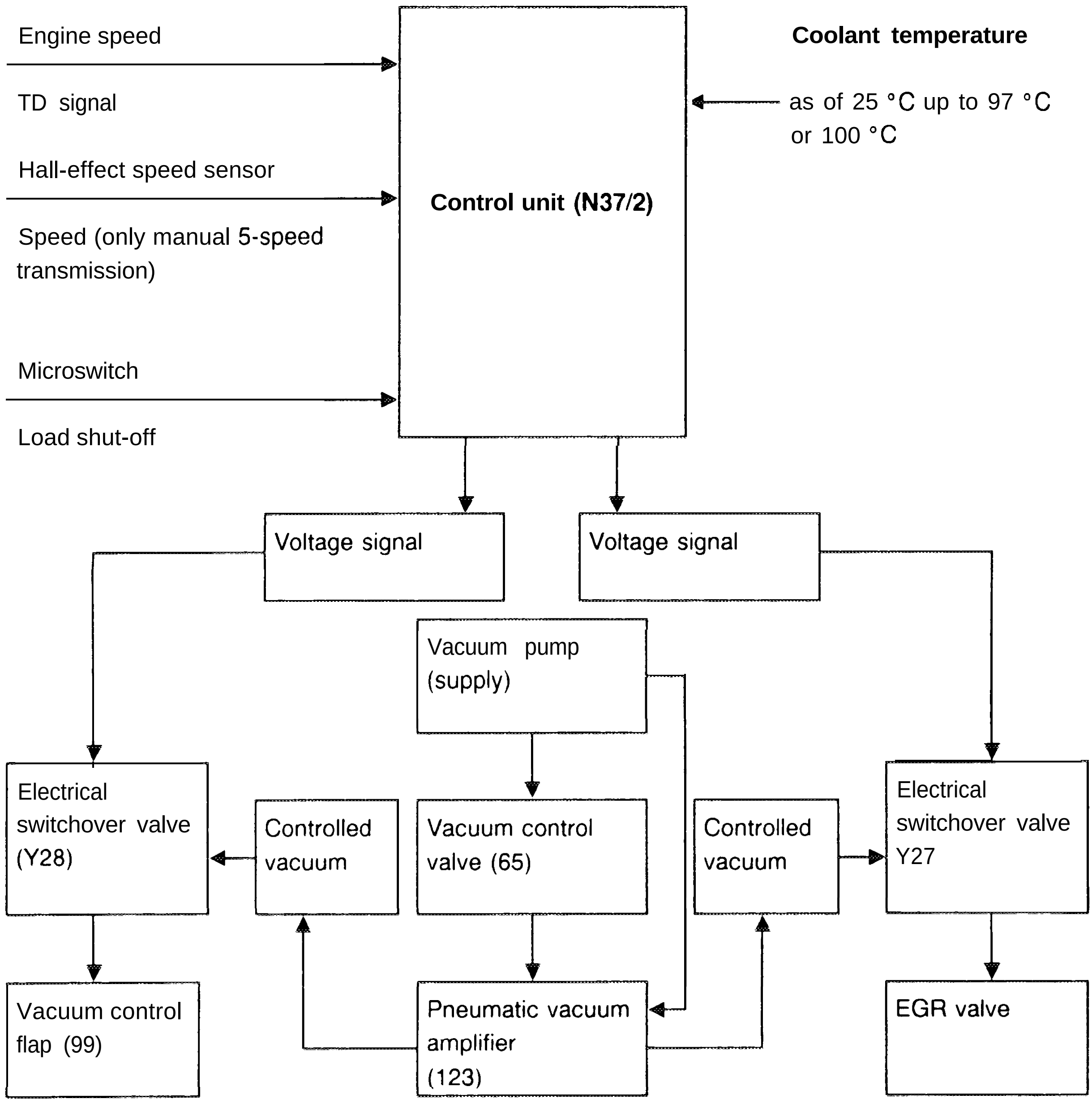
- Engine speed
- Speed (only manual 5-speed transmission)
- Temperature
- Load (accelerator pedal position)

It sends a voltage signal to the switchover valves (Y27) and (Y28). Supply vacuum is available on the vacuum control valve (65) and the vacuum amplifier (123). The vacuum control valve (65) passes a modulated vacuum on to the vacuum amplifier (123). The transducer regulates the vacuum from the vacuum control valve according to the load condition. This controlled vacuum is then used to activate the EGR valve and the vacuum control flap. The vacuum control flap is closed from 1000 ± 50/min to 2500 ± 50 min which increases the exhaust gas recirculating rate.

Note
The vacuum amplifier is not installed in vehicles with manual transmission. The exhaust gas recirculation valve and the vacuum control flap are activated directly by the vacuum control valve.

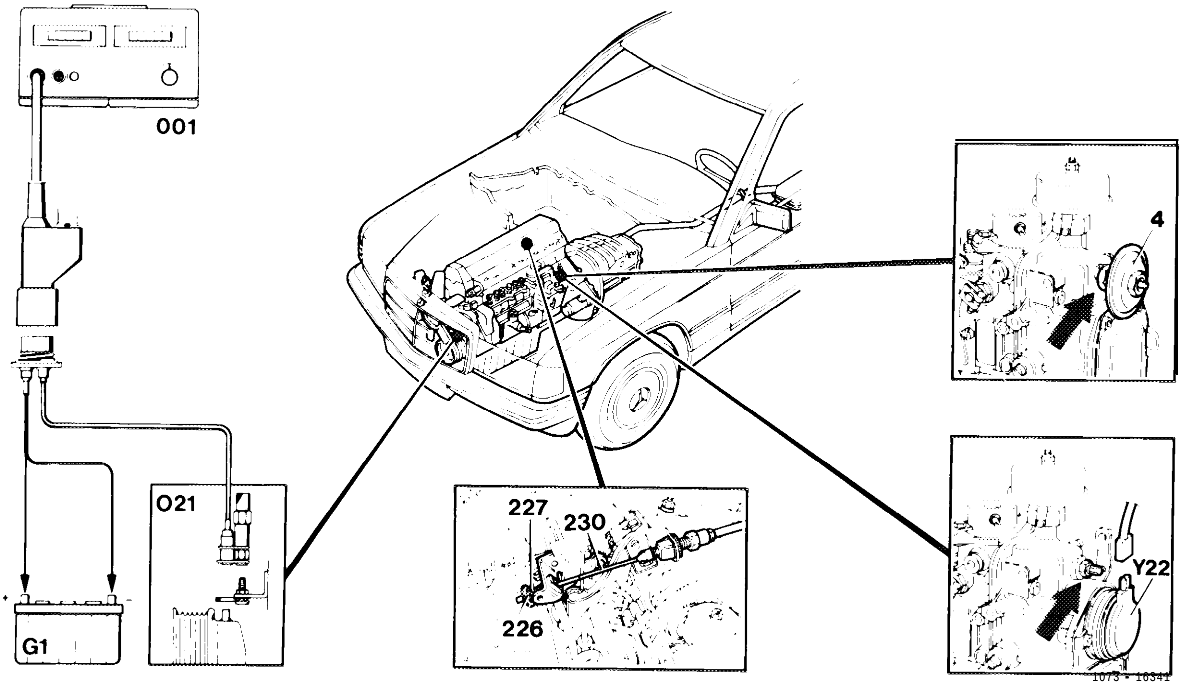
From model year 1990 mechanical pressure control flap (99) with pneumatic control unit, temperature dependent via thermovalve > 40 °C.

Block diagram exhaust gas recirculation



EXIT

07.1-100 Testing, adjusting idle speed

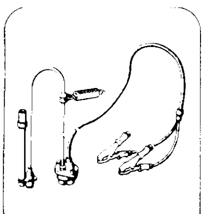


Digital tester (001) and pulse generator (021) . . .	connect, disconnect..
Control	check for easy operation.
Idle speed stop on Bowden cable	check, spring retainer (226) must contact the compression spring (227) without preload.
Bring engine to	60-80 °C coolant temperature.
Double coupling of electromagnetic actuator (Y22)	pull off, refit.
Idle speed	check, adjust.
Smooth engine operation	check by switching on all additional units.

Test and adjusting values

Engine	Idle speed 1/min Electronic idle speed control (ELR)	
	with control	without control Plug on electromagnetic actuator pulled off
602	680 ± 20	620 ± 40

Special tools



603 589 00 21 00
07

Commercially available tools

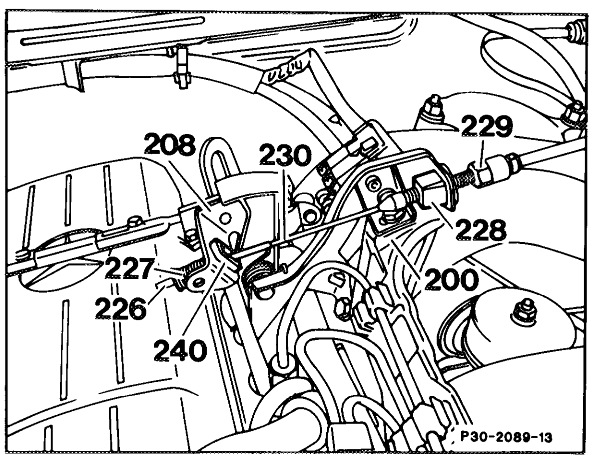
Digital tester	e.g. Bosch, MOT 002.01 Sun, DIT 9000

Adjusting

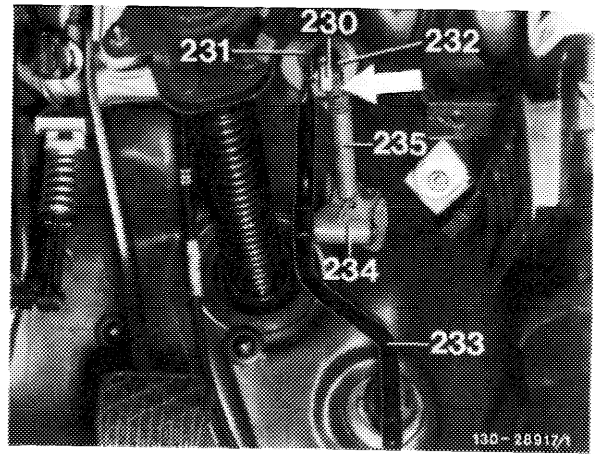
1 Connect digital tester (001) and pulse generator (020).

2 Check control for easy operation and condition.

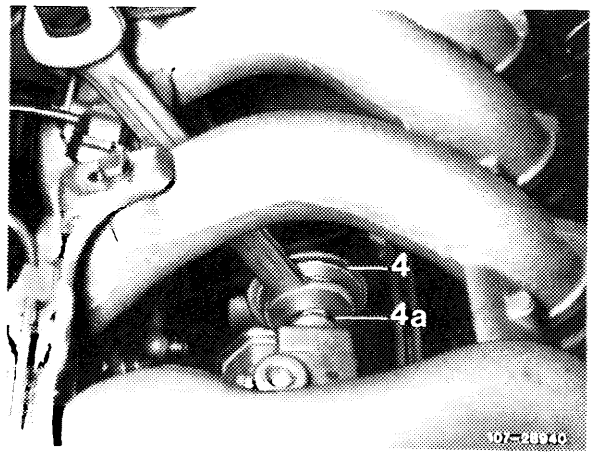
Check idle speed stop; in idle speed position the spring retainer (226) of the Bowden cable (230) must contact the compressron spring (227) without preload.



Adjust adjusting nut (232) of Bowden cable (230) from the vehicle inside if required.

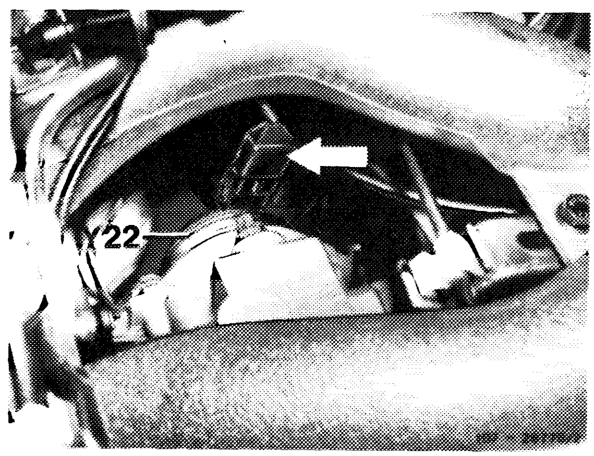


3 Run engine up to 60-80 °C coolant temperature.



Engine 602 with electronic idle speed control

4 Pull double coupling off electromagnetic actuator.

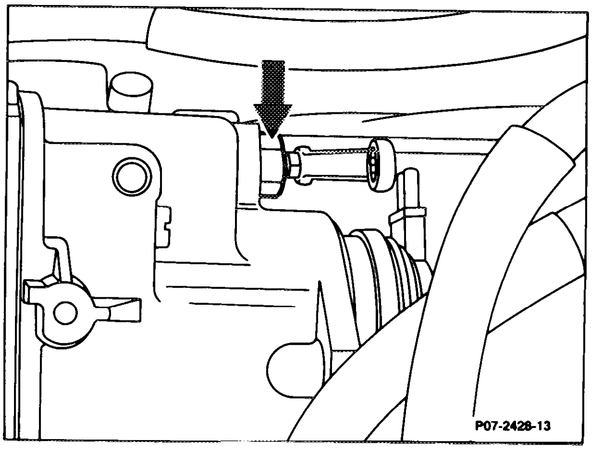


5 Loosen lock nut (arrow) and adjust idle speed

left = higher speed

right = lower speed

Test values see table Test and adjusting values

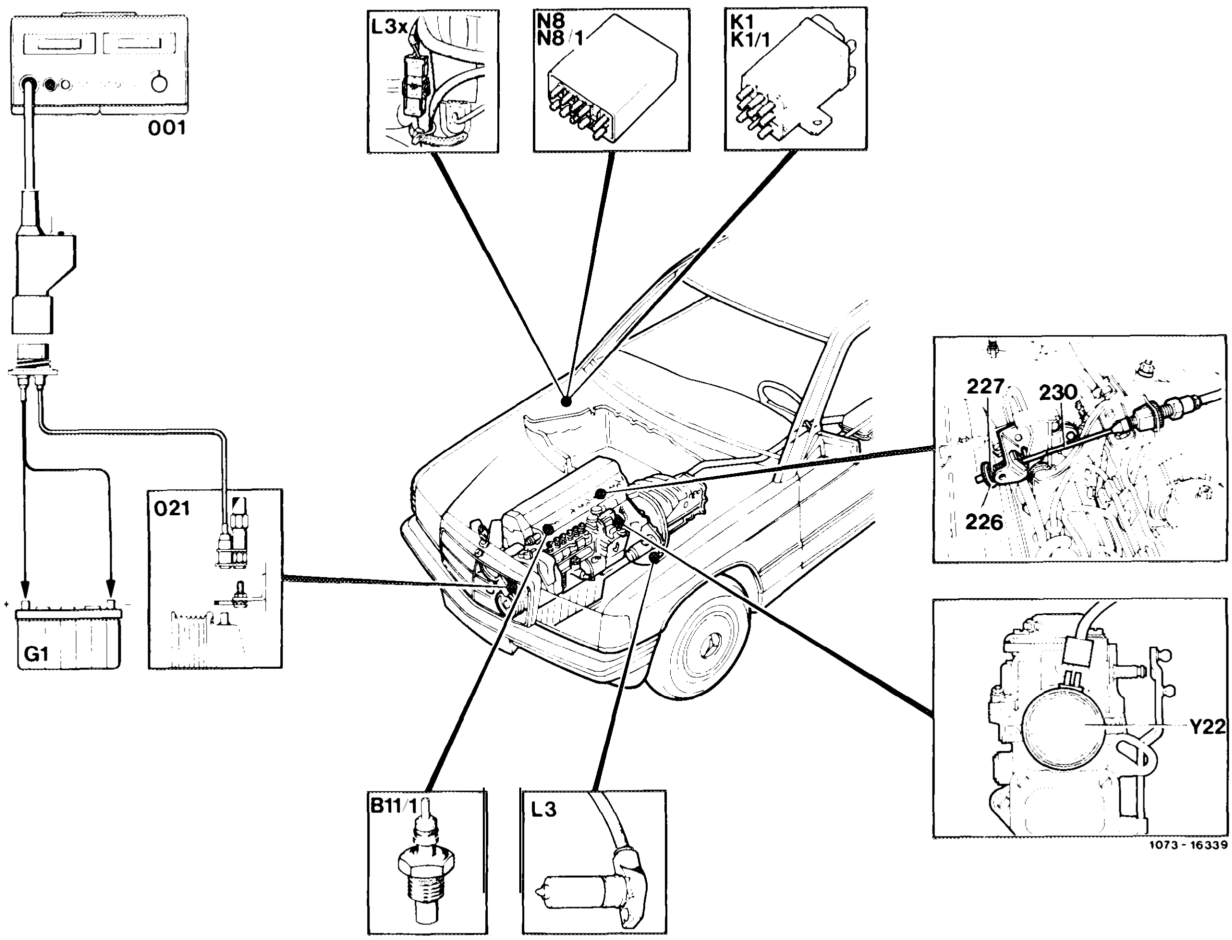


6 Switch on all additional equipment and ensure engine operates smoothly.

07.1-103 Checking electronic idle speed control

Engines without test coupling (X92)

(Engines with test coupling (X92) see 07.14 05 Checking ELR).



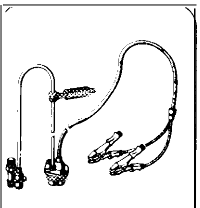
Digital tester (001) and pulse generator (021) . . .	connect, disconnect.
Control	check for easy operation.
Idle speed stop on Bowden cable (230)	check, the spring retainer (226) must contact the compression spring (227) without preload.
Overvoltage protection (K1 or K1/1) and fuse . . .	check, measure voltage between jacks 9 and 11 of the control unit coupling, set value approx. 12 V.
Engine	run to 60-80 °C coolant temperature.
Pull double coupling off electromagnetic actuator (Y22) and refit (at least for 3 s)	engine speed increases briefly.

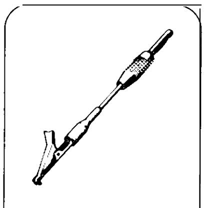
Adjusting basic idle speed on injection pump	pull plug of electromagnetic actuator (Y22).
Speed sensor (L3) on coupling (L3x)	check, resistance 0.4-2.5 kΩ, engine at idle speed voltage > 4 V AC.
Coolant temperature sensor (B11/1)	check, set value +20 °C 2.2 - 2.8 kΩ.
Electrical activation of the electromagnetic actuator (Y22)	check, engine idling, set value approx. 12 V.

Test and adjusting values

Engine	Idle speed 1/min Electronic idle speed control (ELR)	
	with control	without control Plug pulled off electrom. actuator
602.911	680 ± 20	620 ± 40

Special tools


601 589 04 21 00
07


102 589 05 63 00
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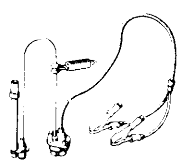
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07

Commercially available tools

Multimeter	e.g. Sun, DMM-5
Digital tester	e.g. Bosch, MOT 002.01 Sun, DIT 9000

Note
Electrical wiring diagrams see
job no. 07.1-400.

Testing jobs

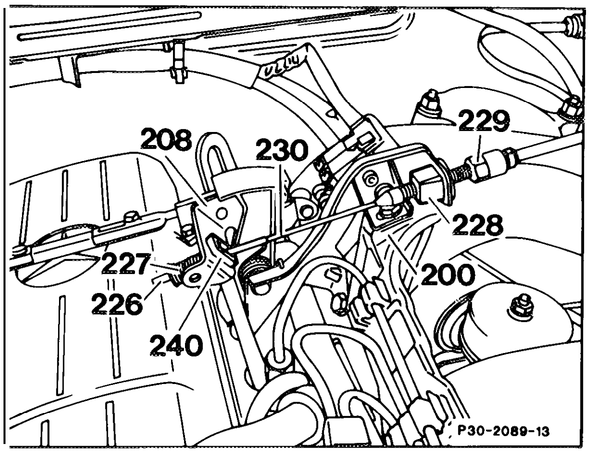
Connect digital tester (001) and pulse generator (021).

Check control for easy operation and condition.

Check idle speed stop on Bowden cable (230).

The spring retainer (226) of the Bowden cable (230) in idle speed position must contact the compression spring (227) without preload.

Run engine to 60-80 °C coolant temperature.



Checking overvoltage protection (K1 or K1/1)

Switch on ignition, pull off control unit (N8 or N8/1) and check voltage between the jacks (9 and 11).

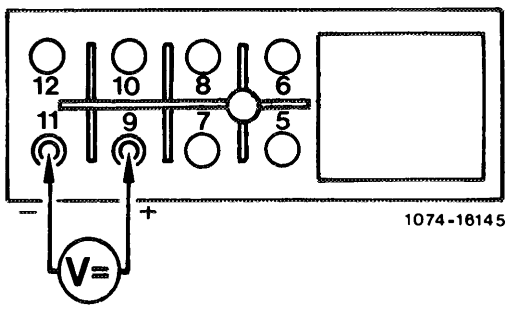
Display: approx. = 12 V

Yes	No

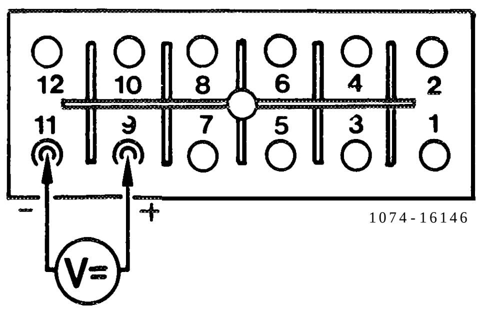
(No →) Check fuse on overvoltage protection. Check activation according to electrical wiring diagram.

End of test

N8



N8/1



Function check

Engine idling. Pull double coupling (arrow) off ELR electromagnetic actuator (Y22) for at least 3 sec. and refit. Engine speed increases briefly.

Yes	No

No →

Briefly apply battery voltage (approx. 12 V) to ELR electromagnetic actuator (Y22). Idle speed increases.

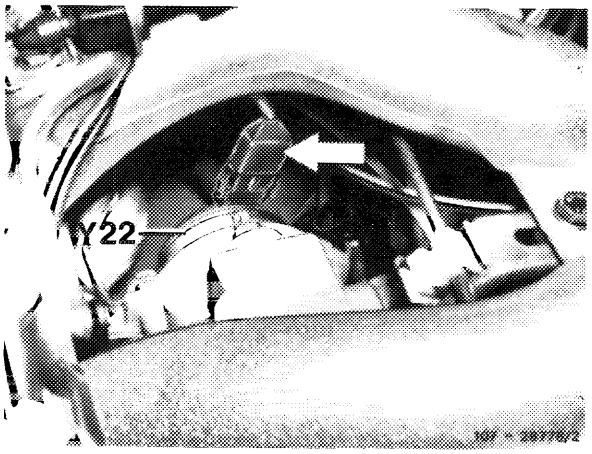
Caution!

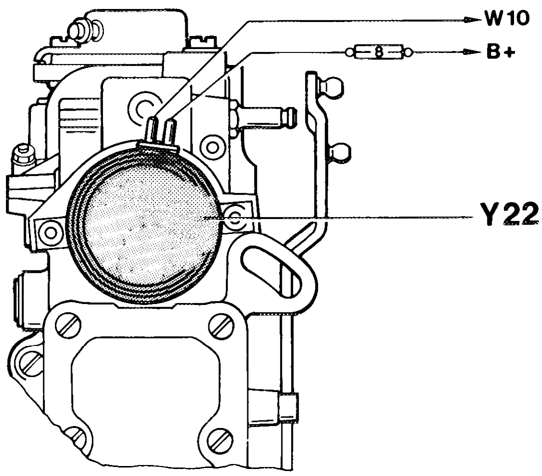
If battery voltage is applied for longer than 3 sec. the ELR electromagnetic actuator will be damaged.

Yes	No

Yes → Check individual parts.

No → Replace electromagnetic actuator (Y22).





EXIT

Engine idling. Pull double coupling of electromagnetic actuator (Y22).
Check idle speed.

Set values:

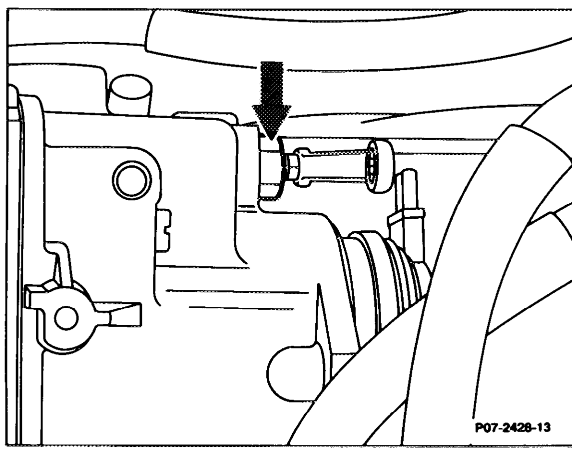
Engine	Idle speed/min
602.911	620 ± 40

Yes	No

Yes → End of test

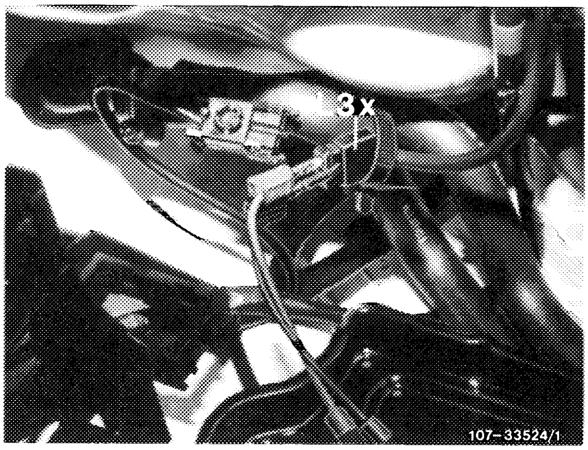
No → Adjust idle speed by loosening lock nut (arrow).

left = higher
right = lower



End of test

Checking speed sensor (L3)

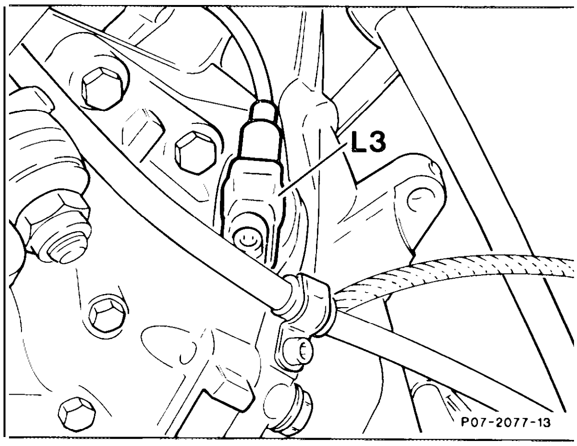


Engine switched off. Remove plug connector (L3x). Connect multimeter and press key „Ω". Check resistance.

Display: 0.4-2.5 kΩ

Yes | No

No → Replace starter ring gear speed sensor (L3).



Multimeter connectron as above, press key "V~". Run engine at idle speed.

Display: > 4 V AC
Voltage rises with speed.

Yes | **No**

No → Inspect starter ring gear speed sensor for accumulation of dirt or metal chips, clean if required.

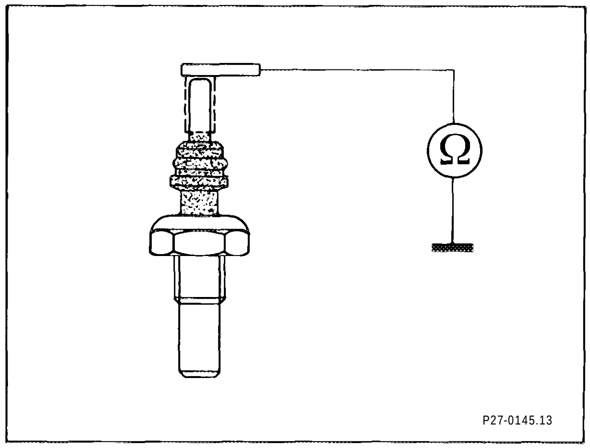
End of test

EXIT

Checking coolant temperature sensor (B1 l/l)

Engine off. Remove plug from temperature sensor and measure resistance against ground.
Set values see diagram.
Measure resistance at two temperature measuring points.

Example:
+ 20 °C = 2.2-2.8 kΩ
+ 80 °C = 290-370 Ω

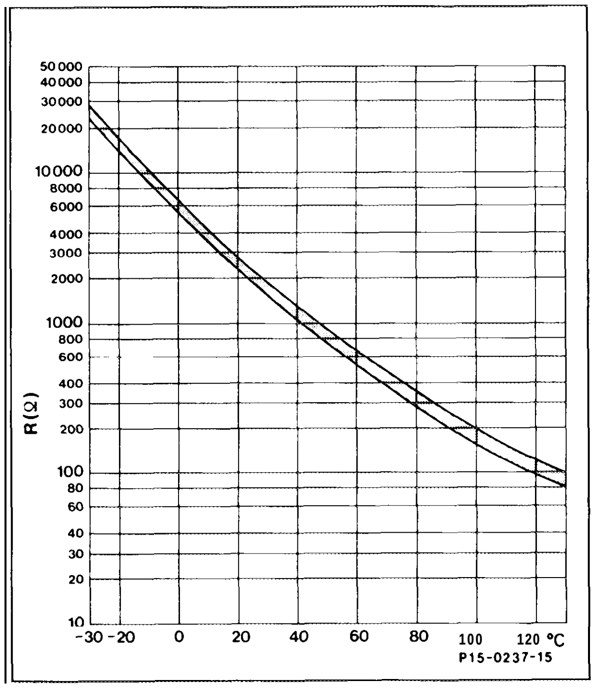


Yes	No

No → Replace codant temperature sensor.

→ End of test

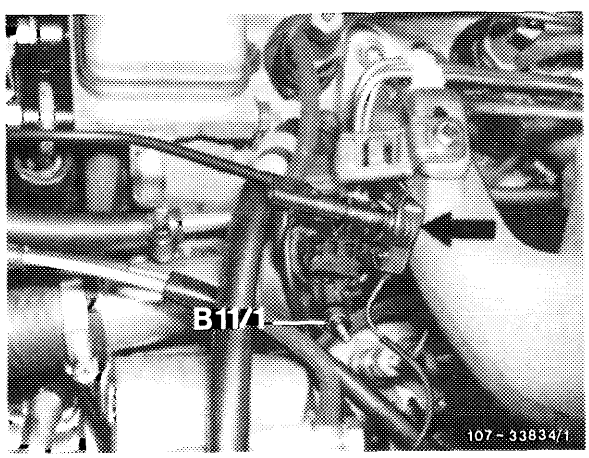
Yes → Measure voltage on l-pole coupling (arrow) "Ignition" on.



Display: approx. 5 V

Yes	No

No → Eliminate line interruption. Replace control unit (N8 or N8/1).



End of test

EXIT

Checking electrical activation of electromagnetic actuator

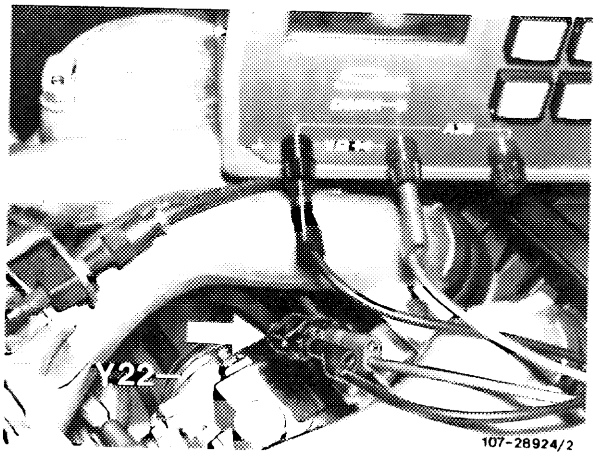
Engine idling. Remove double coupling (arrow) from electromagnetic actuator (Y22) and measure voltage with multimeter in key "V =".

Display: approx. = **12** V

Yes	No

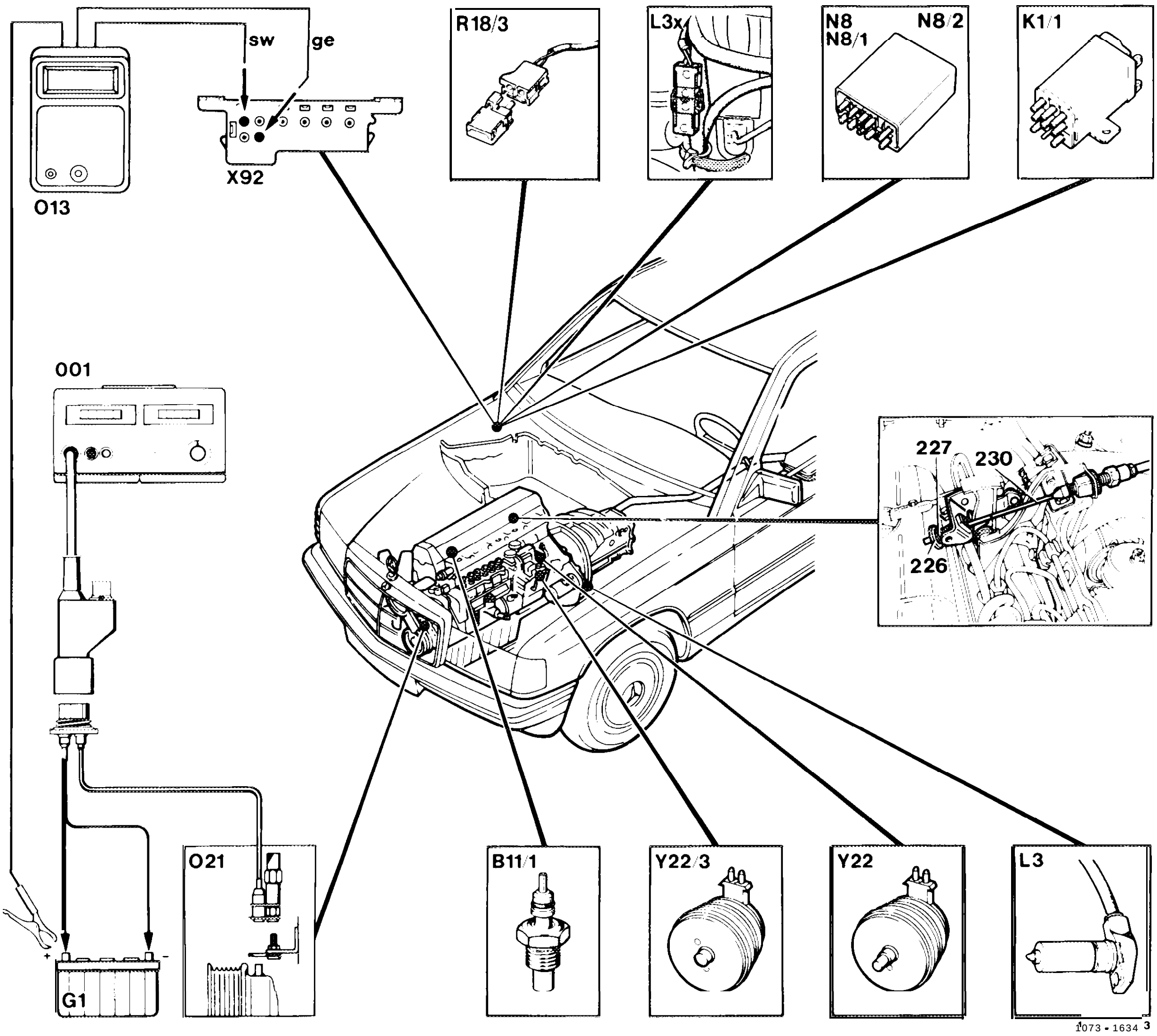
Check activation according to electrical wiring diagram, replace control unit (N8 or N8/1) if required.

End of test



EXIT

07.1405 Checking electronic idle speed control (ELR)



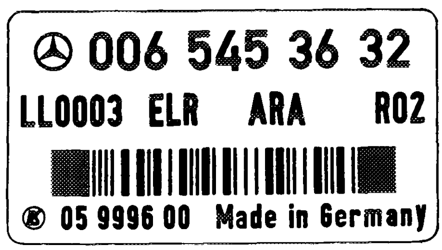
Digital tester (001) and pulse generator (021) . . .	connect, disconnect.
Impulse counter (013) to battery (G1) and test coupling (X92)	connect.
Control for easy operation	check
Idle speed stop on Bowden cable (230)	check, the spring retainer (226) must contact the compression spring (227) without preload.
Overvoltage protection fuse	check.

Engine	run at coolant temperature to 60-80 °C.
Engine	run at idle speed.
Starting key of impulse counter (013)	actuate 2 to 4 seconds.
Display	read and note down.
Starting key	again actuate, if no new display appears no further fault is in the system.

Impulse display	Component/Control circuit
1	All functions "in order"
2	Speed signal "Fault"
3	Coolant temperature "Fault"
6	Control circuit ELR "Fault"

Only short-circuit faults are identified by control units with "RO1".
Control units with "RO2" are also able to identify interruption.
Production breakpoint: Control unit with "RO2" May 1988.

P07-0531-13



P07-0532-1:

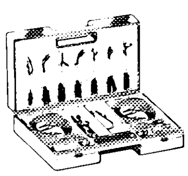
Impulse display "2"	
Speed sensor (L3) on coupling (L3x)	check, speed signal voltage > 2.8 V AC Resistance 0.4-2.5 kΩ Engine at idle speed voltage > 4 V AC.
Impulse display "3"	
Coolant temperature sensor (B1 1 / 1)	check, set value at + 20 °C 2.2-2.8 kΩ.

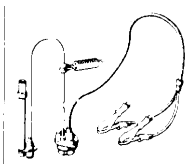
Impulse display "6" Pull double coupling off ELR electromagnetic actuator (Y22) and refit (at least 3 s)	Engine speed rises briefly.
Idle speed without control, plug on electromagnetic actuator pulled off check, adjust if required.	Set values see table.
If fitted, pull off individual adjustment plug (R18/3), glow starter switch in position "2"	check voltage. Set value: approx. 5 V.

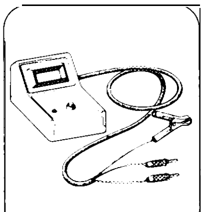
Test and adjusting values

Engine	Idle speed 1/min Electronic idle speed control (ELR)	
	with control	without control Plug pulled off electrom. actuator
602	680 ± 20	620 ± 40

Special tools

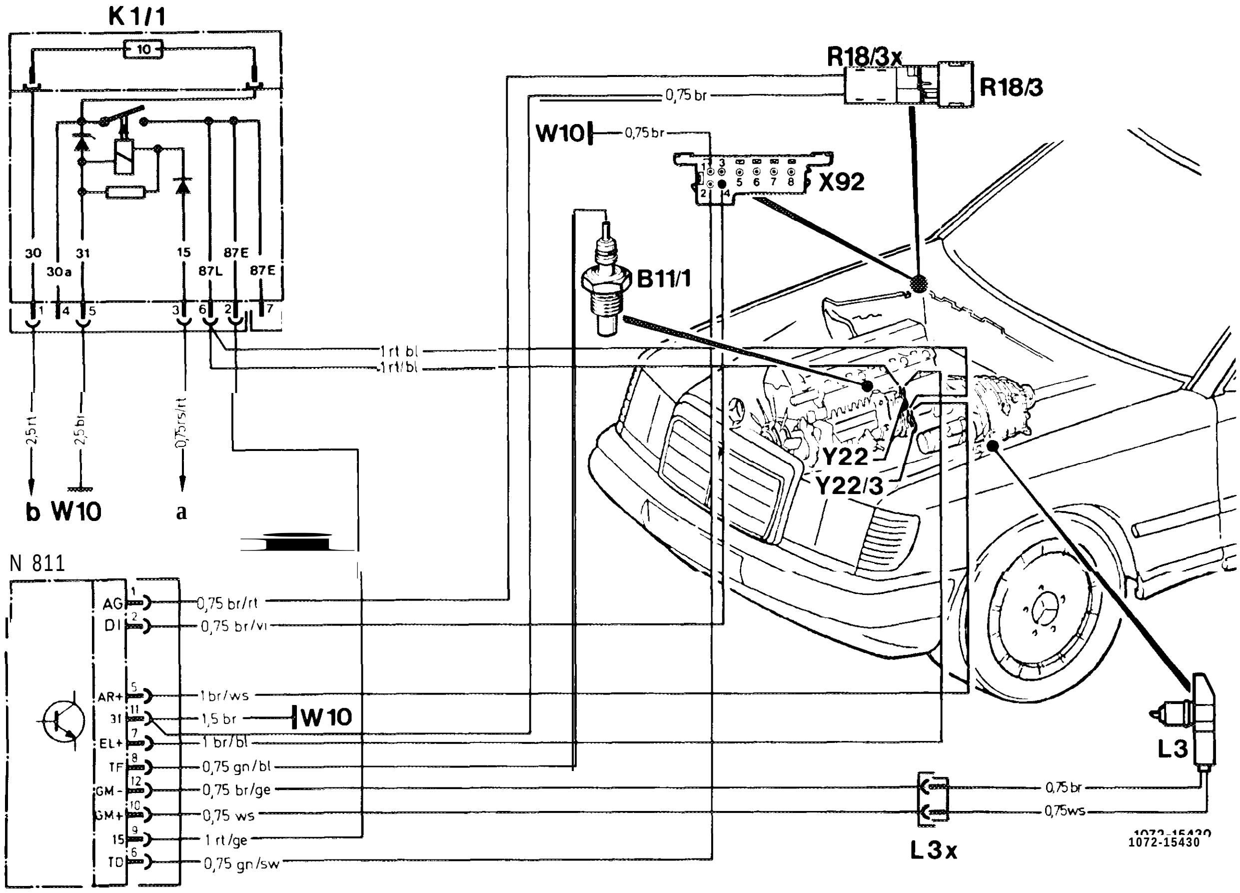

201 589 00 99 00
15 54


603 589 07 00 21 00


124 589 19 21 00
07 83

Commercially available tools

Multimeter	e.g. Sun, DMM-5
Digital tester	e.g. Bosch, MOT 002.02 Sun, DIT 9000

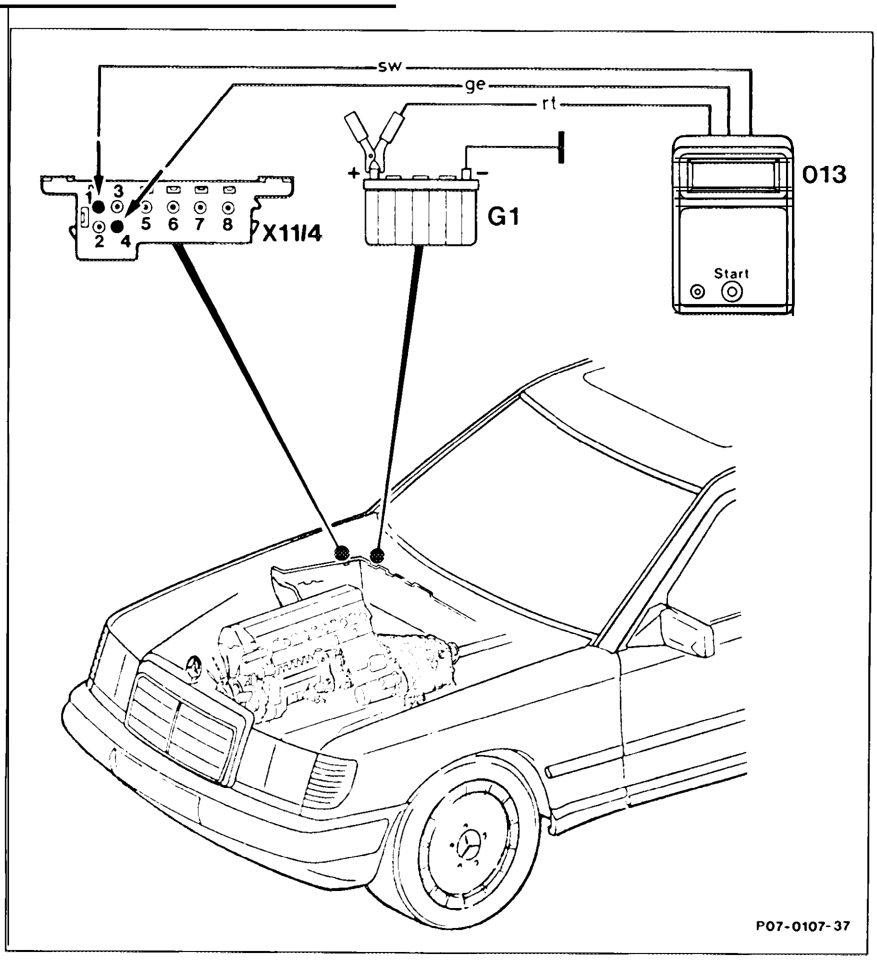


Function diagram idle speed control

B11/1	Temperature sensor (ELR)
K1/1	Overvoltage protection relay
L3	Starter ring gear speed sensor
L3x	Connector, starter ring gear speed sensor
N8/1	Control unit (ELR) ELR only with 6 cylinders
R 1 8/3	Individual adjustment plug (as required)
R18/3x	Connector, individual adjustment plug
W10	Ground, battery, spring dome
x92	Test coupling
x22	Electromagnetic actuator ELR (only 603)
Y22/3	Electromagnetic actuator ARA (non-U.S.)
a	Connector X26 jack 1 terminal 15
b	Terminal block (X7) terminal 30

EXIT

Checking



Connect digital tester (001) and pulse generator (021).

Connect impulse counter (013) to battery (Gl) and test coupling (X92).

- If the LED U-Batt appears after connecting, impulse counter and voltage supply for impulse counter are in order.

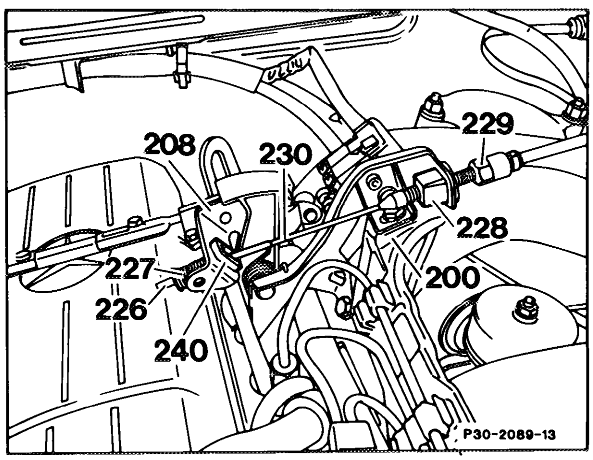
Note
LED U-Batt in the display field must light up, if not:

a) Check impulse counter fuse.

b) Check jack 1 of test coupling (X92) against battery plus (approx. 12 V).

c) Check jack 4 of test coupling (X92) against battery plus (approx. 12 V).

Check control for easy operation.



EXIT

Check idle speed stop on Bowden cable (230).

The spring retainer (226) of the Bowden cable (230) in idle speed position must contact the compression spring (227) without preload.

Check fuse on overvoltage protection. Run engine to 60-80 °C coolant temperature.

Run engine at idle speed.

Actuate starting key of impulse counter (013) for 2 to 4 seconds.

Read display of impulse counter (013) and note down.

Again press start key for 2 to 4 seconds. If no further fault is in the system, no new display will appear.

Correct noted faults according to the test program or carry out individual parts test.

Notes on impulse display
Figures from 1 to 6 appear on the impulse counter display.

Figure 1 means that no fault has been registered in the electronic system. All other figures are allocated to a certain group of faults.

The number of impulses shows if and which component is faulty, or if components in the control circuit are defective.

Impulse display	Component/Control circuit
1	All functions “in order”
2	Speed signal “Fault”
3	Coolant temperature “Fault”
6	Control circuit ELR “Fault”

Checking individual components

Check overvoltage protection (K1/1)

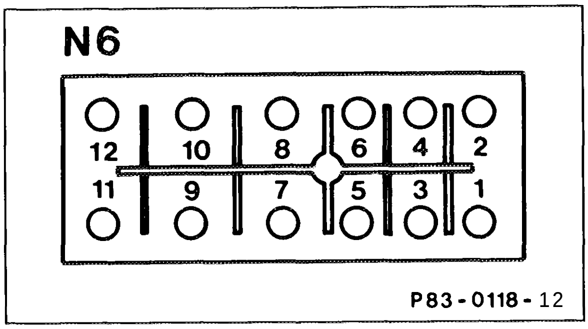
Switch on ignition, pull off control unit (N8 or N8/1) and measure voltage between the jacks (9 and 11).

Nominal voltage: approx. 12 V DC

Yes	No

No → Check fuse on overvoltage protection. Activation according to electrical wiring diagram.

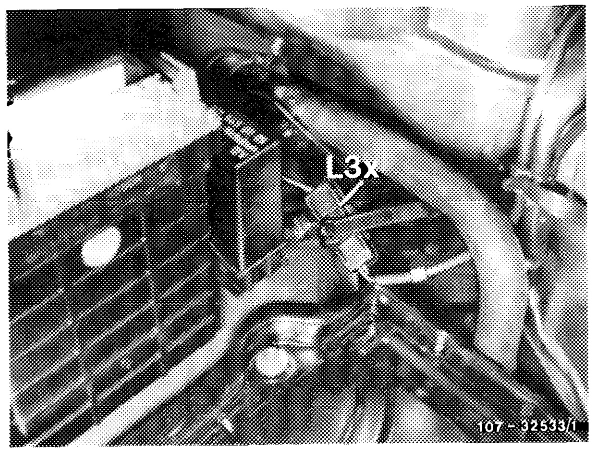
Yes / No → End of test



EXIT

Impulse display "2"

Checking speed sensor
Engine off. Pull off double coupling (L3x). Connect multimeter to pins of double coupling and press key "Ω". Measure resistance.



Display: 0.4-2.5 kΩ

Yes	No

No → Replace starter ring gear speed sensor (L3).

Multimeter connection as above, press key "V~". Run engine at idle speed.

Display: > 4 V. AC
Voltage rises with increasing speed.

Yes	No

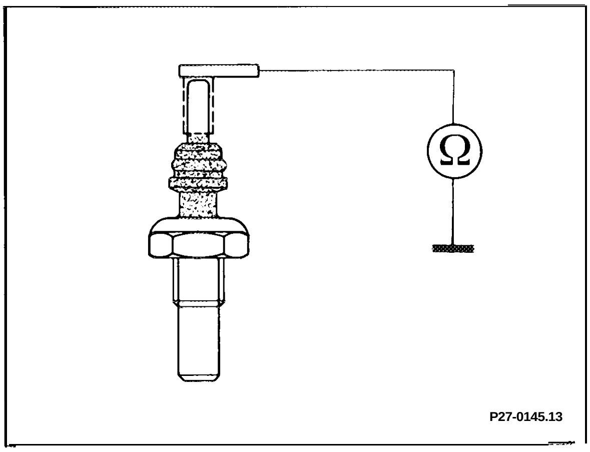
No → Inspect starter ring gear speed sensor for accumulation of dirt or metal chips, clean if required.

End of test

Impulse display "3"

Checking coolant temperature sensor (B11/1)
Engine off. Pull plug off temperature sensor and check resistance to ground. See diagram and check resistance at two.temperatures.
Example:
+ 20 °C = 2.2-2.8 kΩ
+ 80 °C = 290-370 Ω

Yes	No



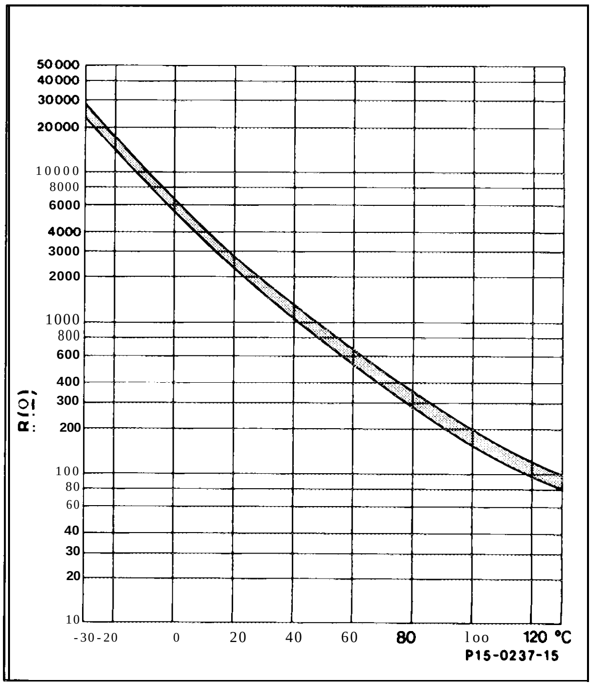
No → Replace coolant temperature sensor.

→ End of test

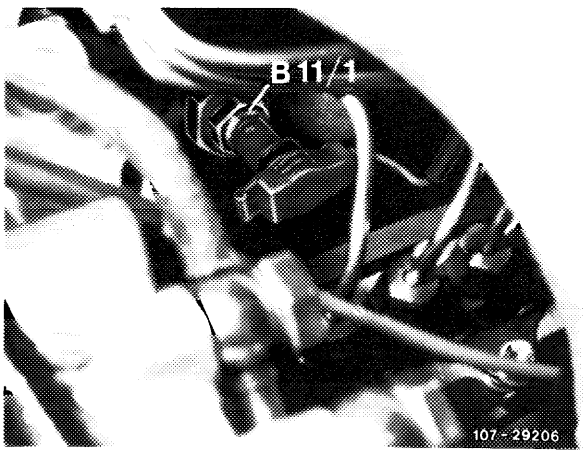
Yes → Check voltage on 1 -pole coupling "Ignition" On.

Display: approx. 5 V

Yes	No



No → Eliminate line interruption. Replace control unit (N8 or N8/1).



End of test

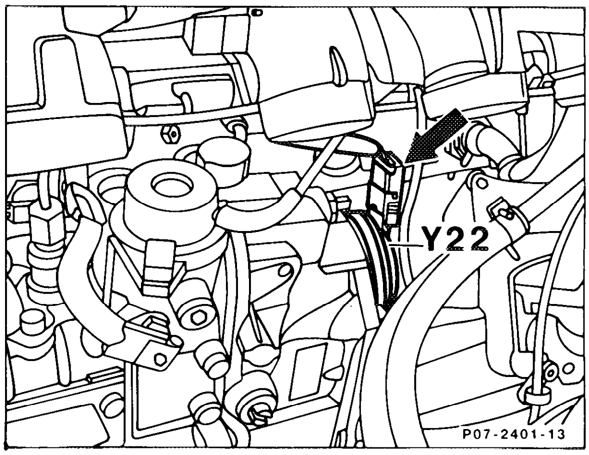
EXIT

Impulse display "6"

Engine idling. Remove double coupling (arrow) from ELR electromagnetic actuator (Y22) for at least 3 sec. and reconnect.

Upon reconnecting, the idle speed should briefly increase above normal.

Yes	No



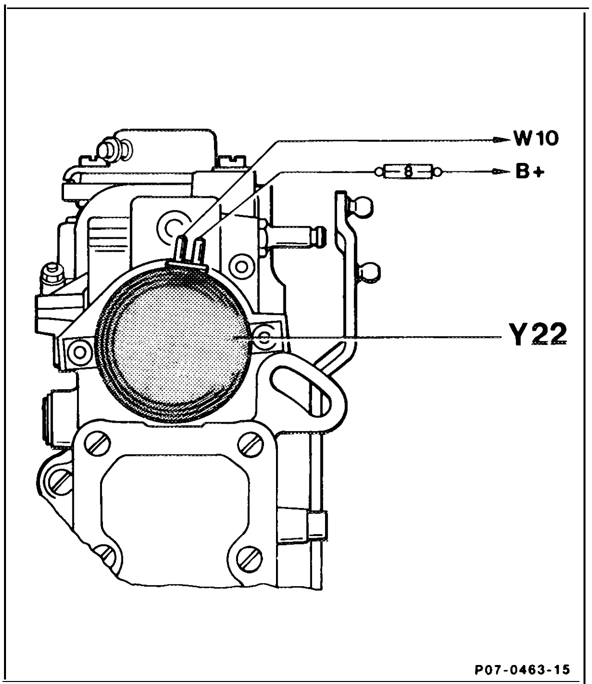
Apply battery voltage to ELR electromagnetic actuator (Y22) for a maximum of 3 sec..
Caution! If the voltage is applied for longer than 3 sec., the ELR electromagnetic actuator will be damaged.

Idle speed increases.

Yes	No

Replace electrom. actuator.

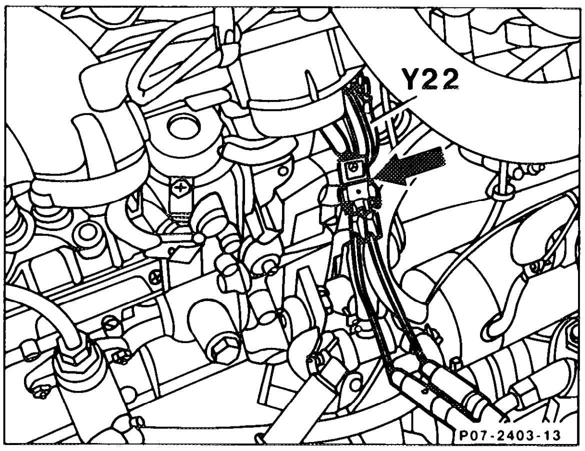
End of test



Engine idling. Remove double coupling (arrow) from electromagnetic actuator (Y22).. Connect multimeter and set to "V = ".

Display: approx. 12 V

Yes	No



Check lines according to wiring diagram. Check fuse of overvoltage protection relay K1 1.

If lines are OK, replace control unit (N8/1).

End of test

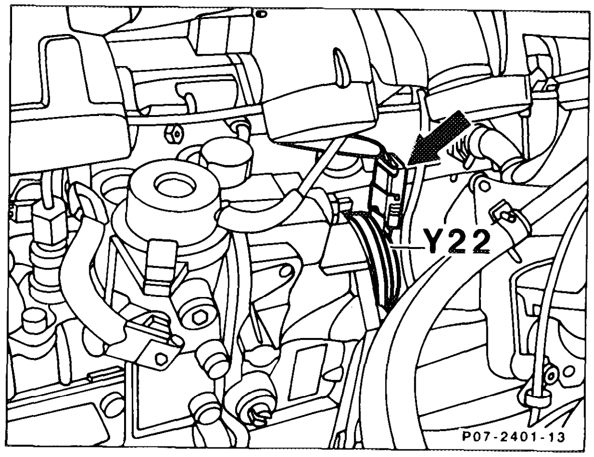
Engine idling. Remove double coupling (arrow) from ELR electromagnetic actuator (Y22).

Check idle speed.

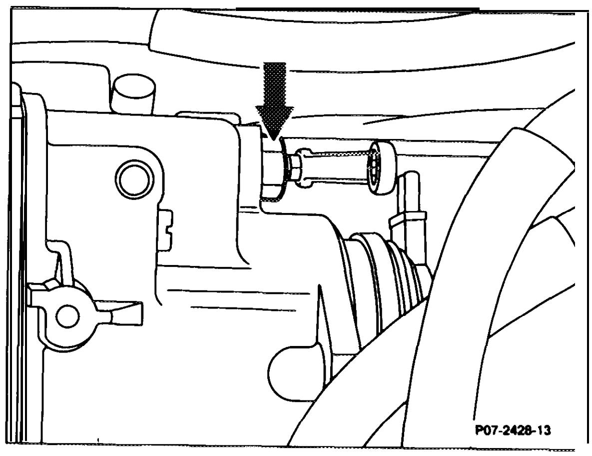
Set values:

Engine	Idle speed/min
602	620 ± 40

Yes	No



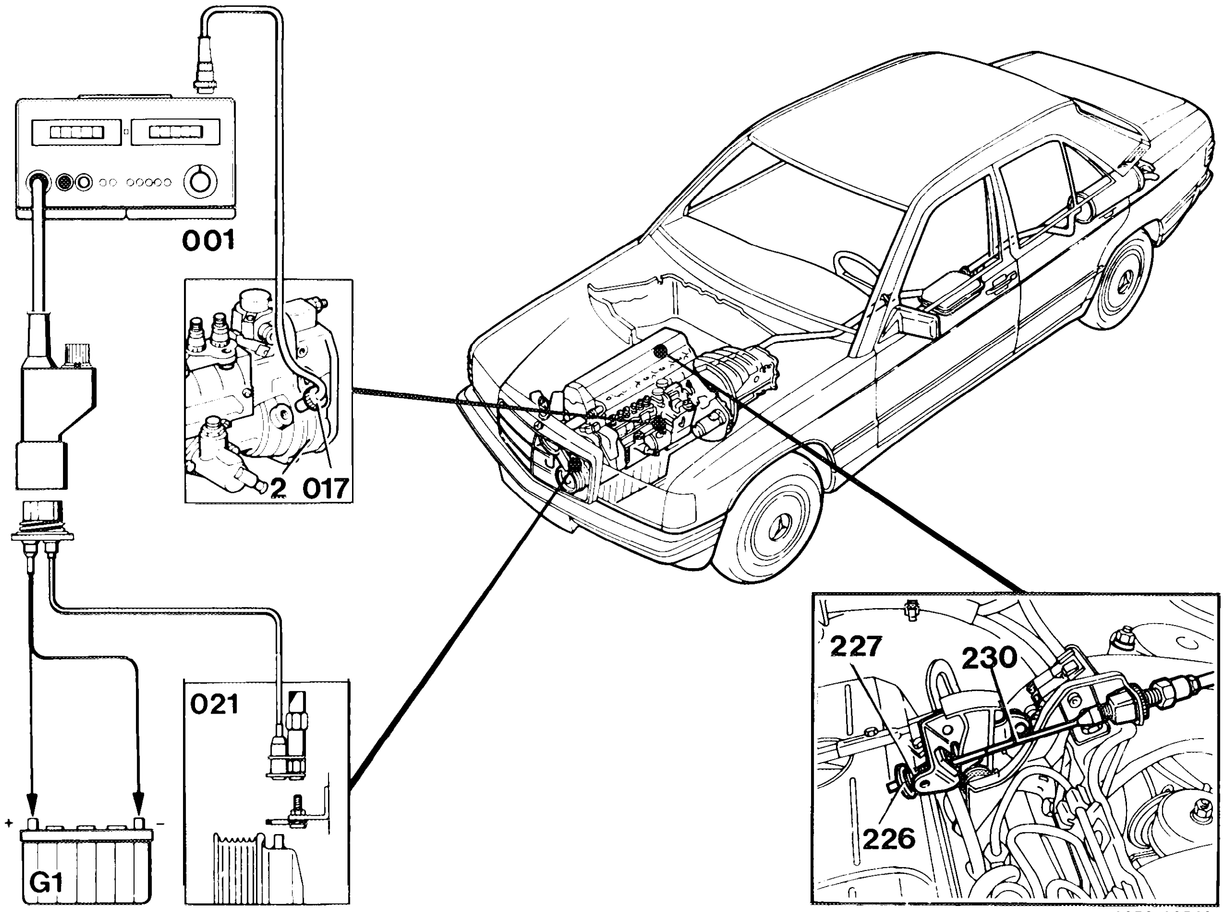
Loosen lock nut and adjust idle speed (arrow).
left = higher
right = lower



End of test

EXIT

07.1-I 10 Checking, tuning engine



Test sheet	complete.
Coolant level	check, correct.
Engine oil level	check, observe oil condition (visual inspection).
Oil level in automatic transmission	check, correct.
Air cleaner	remove, reinstall.
Testers (001, 017)	connect
Pulse generator (021)	connect.

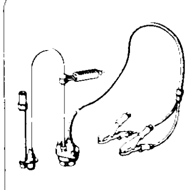
EXIT

Control linkage	check for easy operation and condition. Lubricate pivots of reverse- transfer levers, ball sockets.
Full throttle stop on Bowden cable	check, adjust if required.
Idle stop on Bowden cable	check, adjust if required
Battery voltage	check. Set value: minimum 11.5 V.
Engine	run to 60-80 °C coolant temperature.
Air conditioner or automatic climate control	switch off.
Idle speed	check, adjust if required. Pull plug off electromagnetic actuator.
Start of delivery	check.
Maximum speed	check.
Injection timing device	check. Set value: approx. + 3° to + 5° after RIV at approx. 5 1 00/min.

Test and adjusting values

Engine		602.911
Idle speed 1 /min	Electronic idle speed increase	680 ± 20
Maximum no-load speed		5150 ± 150
Start of delivery with digital tester	RI set value	-15° ± 1° ATDC

Special fools



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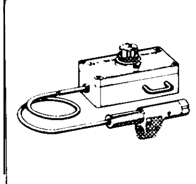
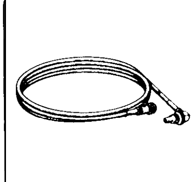


617 589 09 21 00
07



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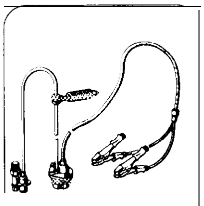
07

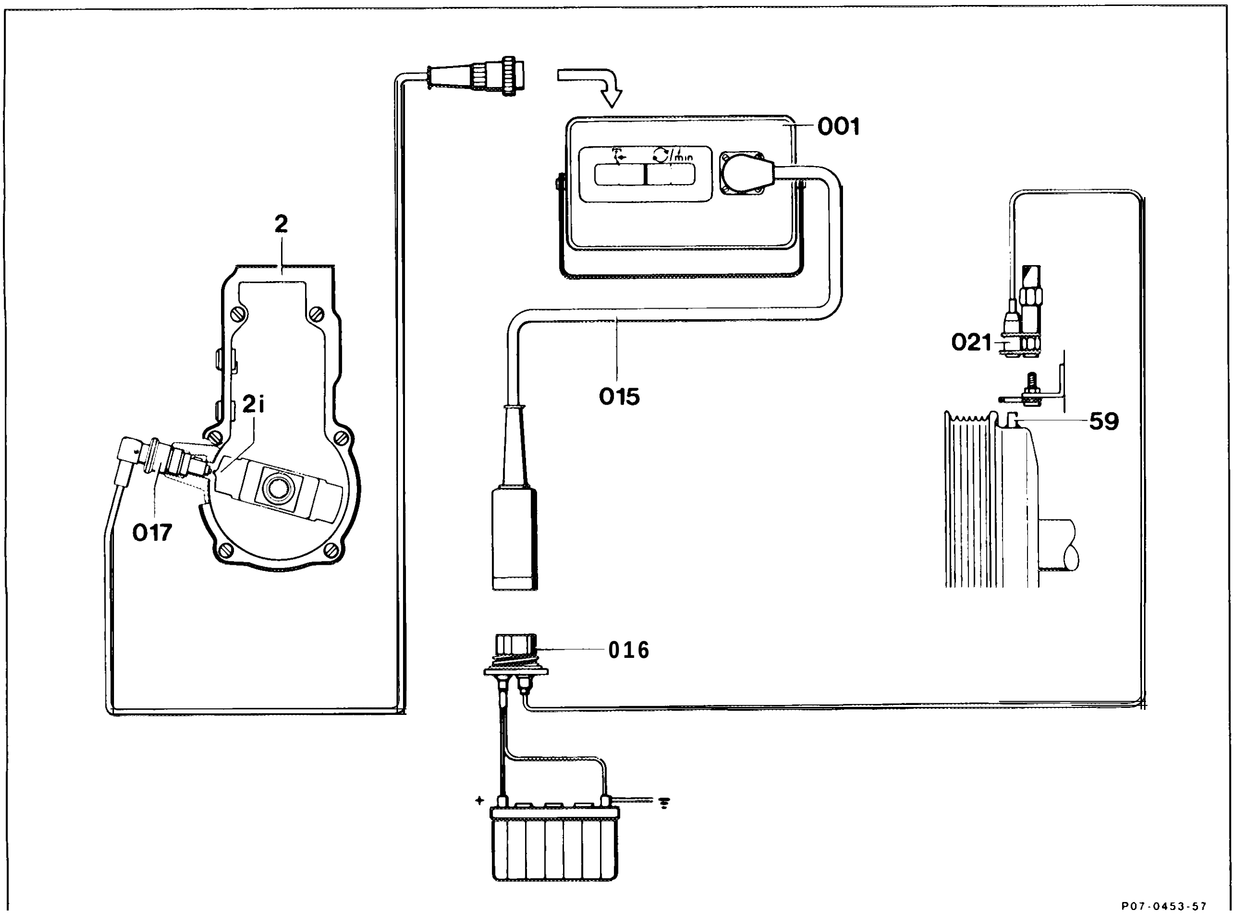


601 589 04 21 00
07

Commercially available testers

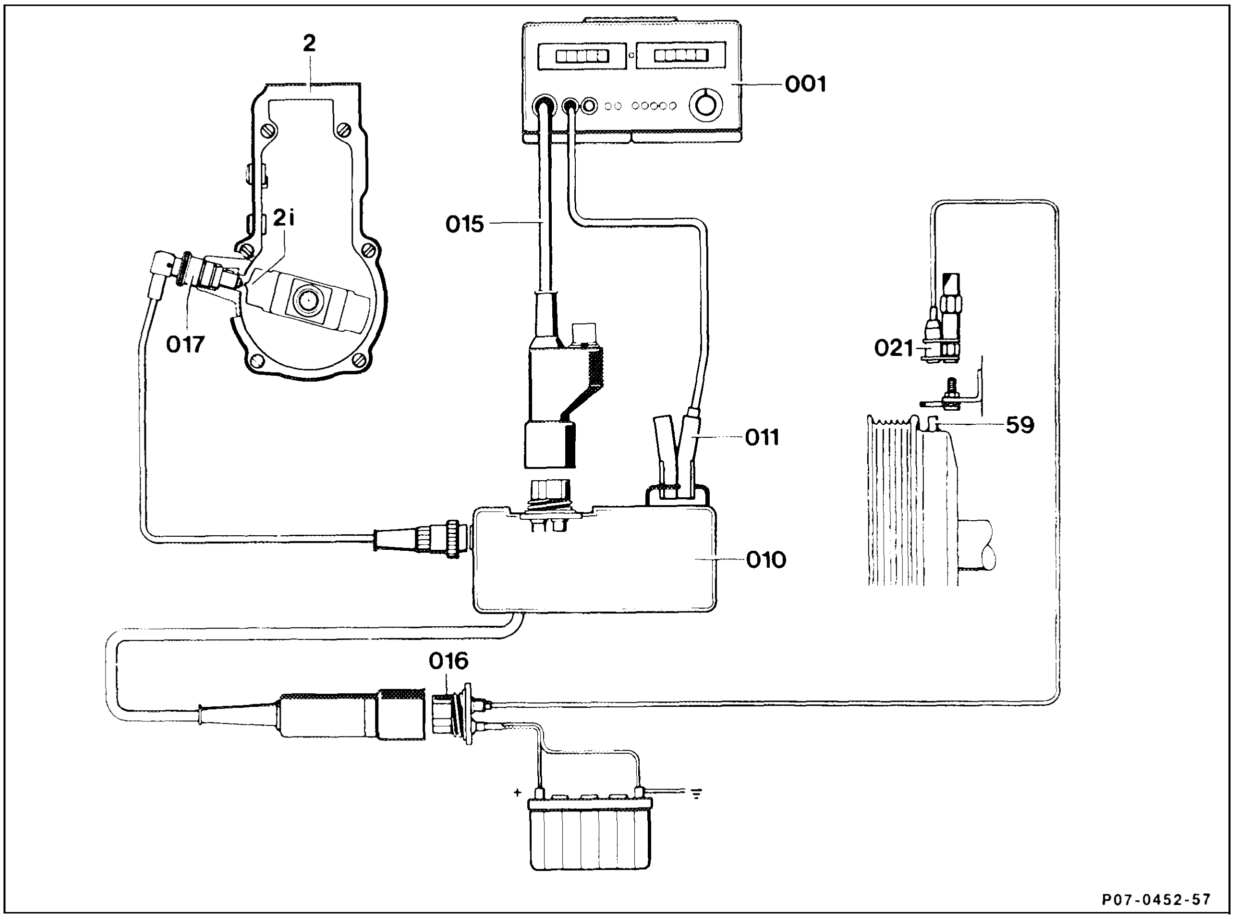
Use without adapter	
Digital testers	e.g. AVL, Diesel-Tester 873
	e.g. Bosch, ETD 019.002 or MOT 350/500/501

Use with adapter	e.g. Sun, DIT 9100
Digital testers	e.g. Bosch, MOT 001.03



Connection diagram for testers without adapter

001	Digital testers	021	TDC impulse sensor
015	Test cable with plug	59	TDC sensor pin
016	Diagnostic socket	2	Governor
017	Governor impulse sensor	2i	Governor Impulse sensor pin



Connection diagram for existing testers with adapter

001	Digital tester	017	Governor Impulse sensor
010	Adapter	021	TDC Impulse sensor
011	Alligator clamp	59	TDC sensor pin
015	Test cable with plug	2	Governor
016	Diagnostic socket	2i	Governor impulse sensor pin

Checking, tuning

1 Complete test sheet, enter measured values.

2 Check, correct coolant level.

3 Check engine oil, inspect oil condition.

4 Check oil level in automatic transmission.

5 Connect testers (001, 017) according to connection diagram.

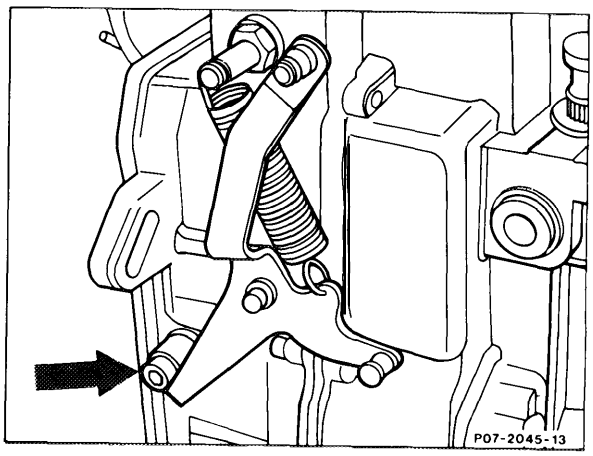
6 Connect pulse generator (021).

7 Remove, reinstall air cleaner element; check for contamination.

8 Check control for easy operation and condition and lubricate.

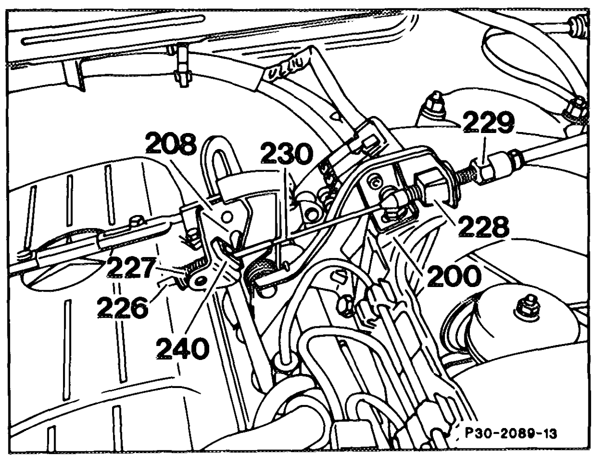
9 Check full load stop.

With engine off, fully depress accelerator pedal. The control lever must contact the full load stop (arrow).

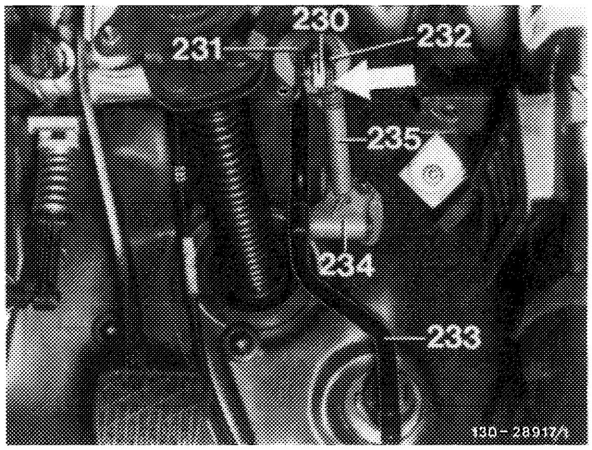


10 Check idle stop.

In idle speed position the spring retainer (226) of the Bowden cable (230) must contact the compression spring (227) without preload.



Adjust Bowden cable (230) with the adjusting nut (232) from the vehicle inside if required.



11 Check battery voltage.
Set value: at least 11.5 V.

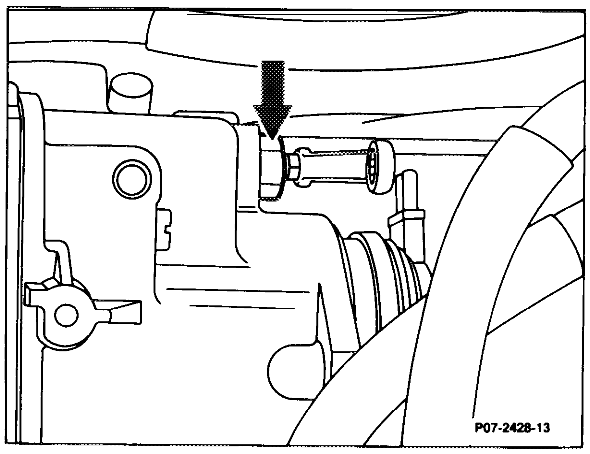
12 Run engine to a coolant temperature of 60-80 °C.

13 Switch off air conditioner and automatic climate control.

14 Check idle speed; read off start of delivery.
RI set value 15 ± 1 ° ATDC.

a) Engine 602 with electronic idle speed increase

Pull double coupling off electromagnetic actuator. Loosen lock nut (arrow) and adjust idle speed.

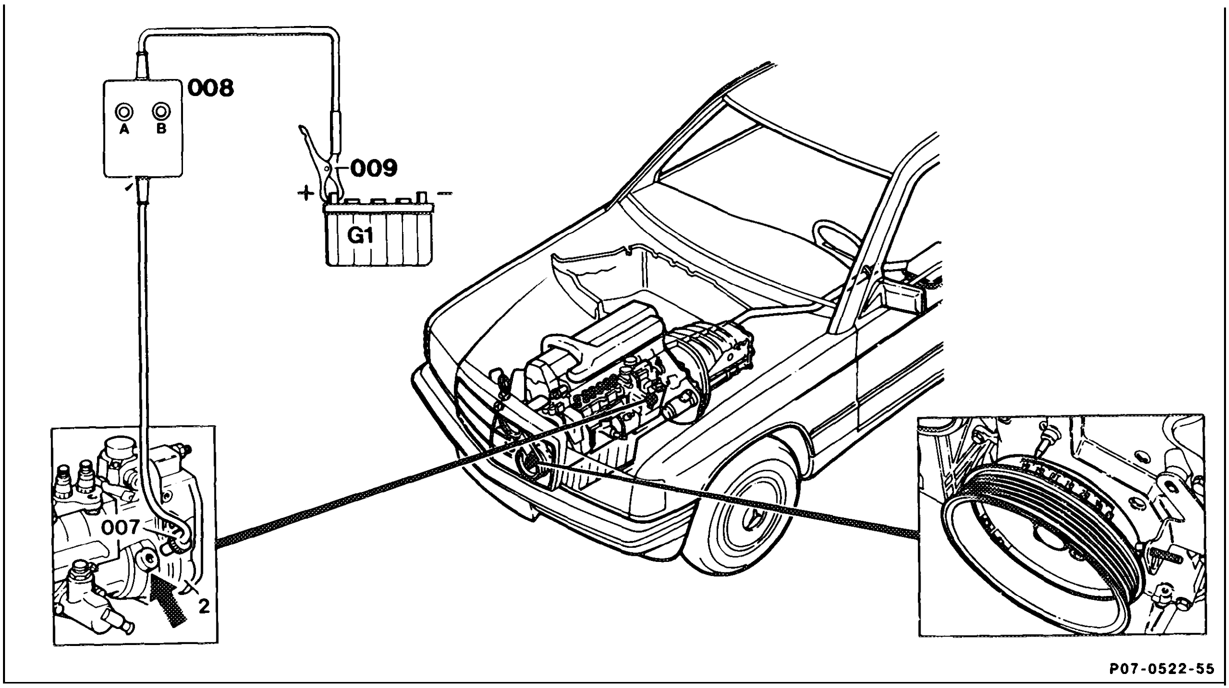


15 Check maximum no-load speed.

16 Check injection timing device without load.
Set value: 3" to 5° BTDC according to RIV at approx. 5 1 00/min.

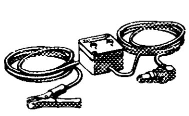
EXIT

07.1-I 11 Checking start of delivery (position sensor RIV method)

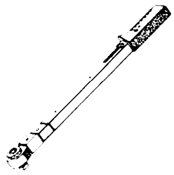


Governor housing screw plug (11)	unscrew, tightening torque 30-35 Nm.
Position sensor (007)	turn in.
Battery alligator clamp (009)	connect to battery +.
Manually turn crankshaft until	lamps A and B of the indicating instrument (008) light up simultaneously.
Read RI value (indirect start of delivery)	of the graduated scale, set value 15° ± 1 ° ATDC. Adjust start of delivery if required (07.1-I 16).

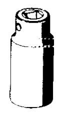
Special tools



617 589 08 21 00 07



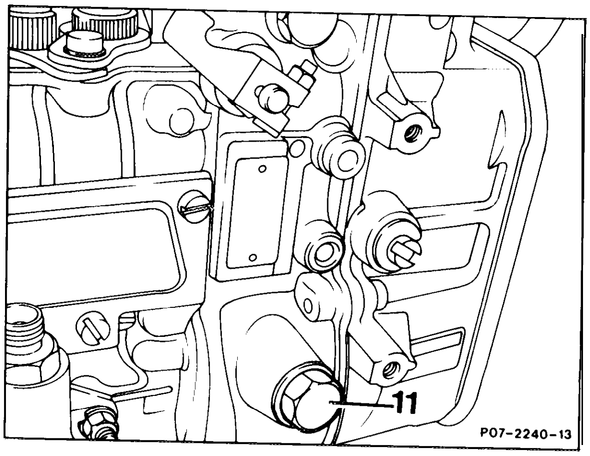
001 589 66 21 00 00



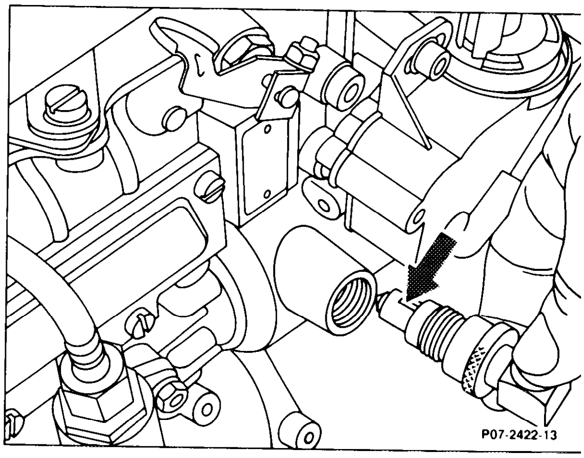
001 589 65 09 00 03 07 32

Checking

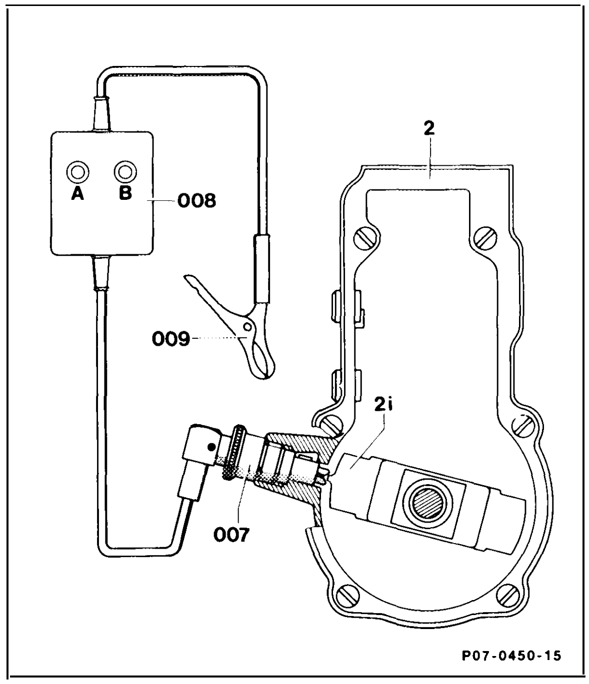
1 Remove screw plug (11).



2 Turn position sensor into the governor housing. Ensure that the guide pin of the position sensor (arrow) faces up. Tighten union nut by hand.



3 Connect position sensor according to connection diagram.

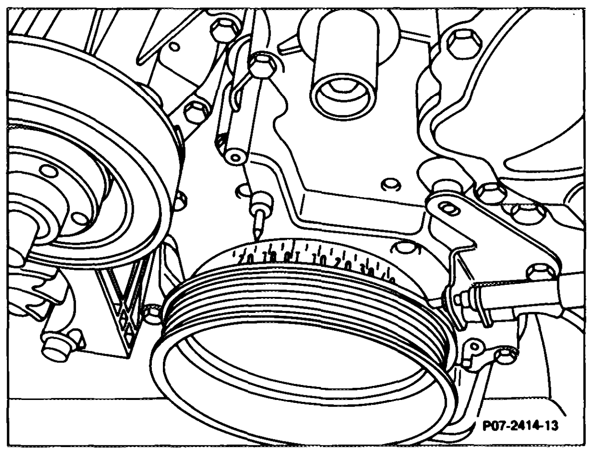


007 Position sensor
008 Indicating instrument
009 Battery alligator clamp (battery plus)
2i Flyweight (RIV sensor pin)

4 Use tool to turn crankshaft manually (only in direction of rotation) until lamp **"A"** lights up. Continue to turn until **both lamps "A + B"** light up. In this position read WI value (indirect start of delivery) off graduated scale.

RI set value: 15° ± 1° ATDC.

If only lamp "B" lights up, repeat test.



5 Remove position sensor.

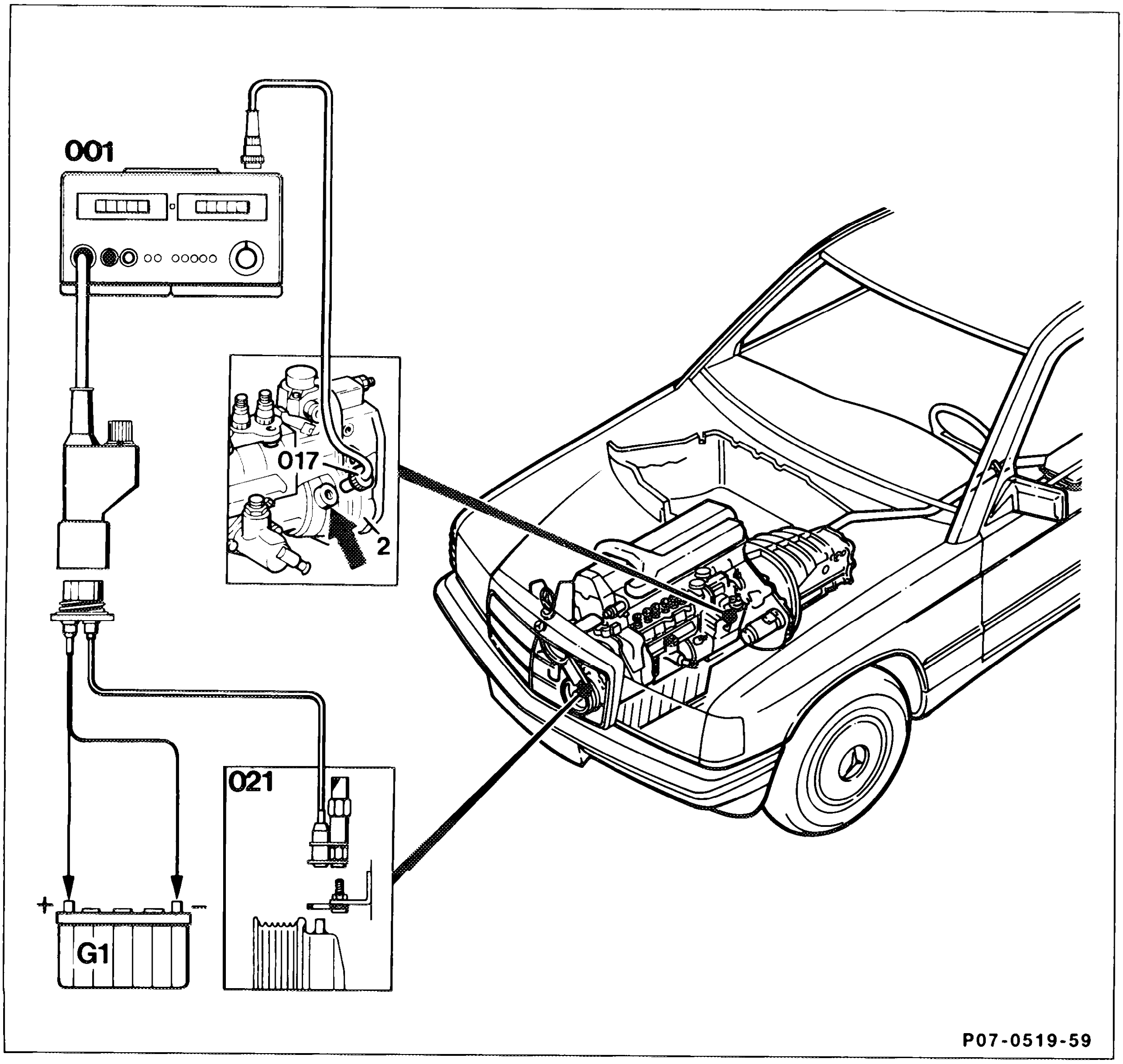
6 Turn screw plug into governor housing (tightening torque 30-35 Nm).

7 Carry out leak test with engine running.

8 Check engine oil level and correct if required.

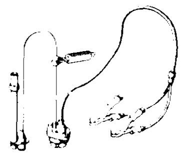
EXIT

07.1-I 12 Checking start of delivery with digital tester (RIV method)



Remove screw plug (arrow) from governor housing (2)	unscrew. Tightening torque 30-35 Nm.
Testers (001, 017, 021)	connect, disconnect.
Run engine at idle speed	read RI value off digital tester at 15° ATDC. RI set value: 15° ± 1° ATDC. Adjust start of delivery if required (07.1.116 and 117).

Special tools



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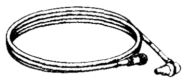
07



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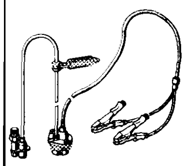
07



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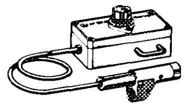
07

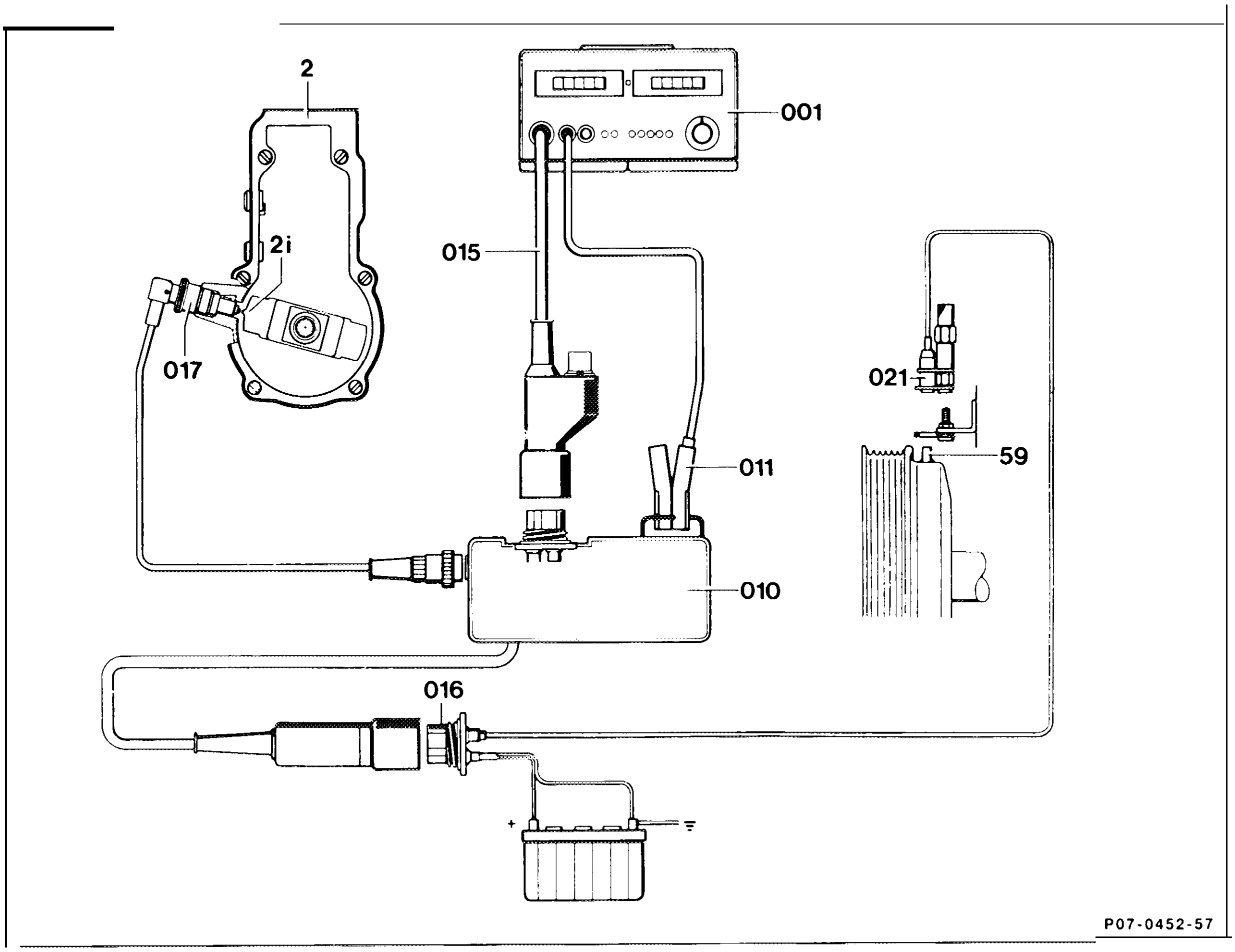


617 589 09 21 00
07

Commercially available tools

Use without adapter	
Digital testers	e.g. **AVL,** Diesel-Tester 873
	e.g. Bosch, ETD 019.002
	e.g. Sun, DIT 9100
Use with adapter	
Digital tester	e.g. Bosch, MOT 001.03

EXIT

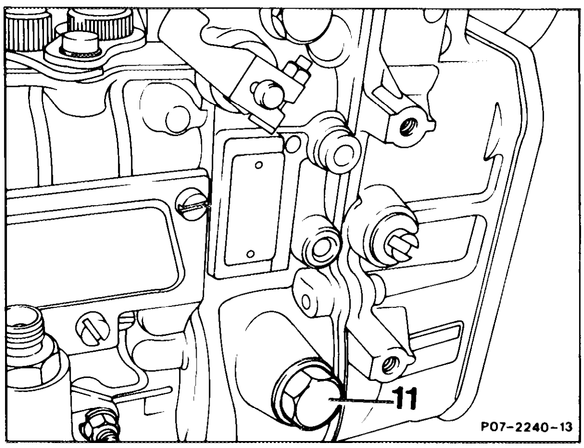


Connection diagram for existing testers with adapter

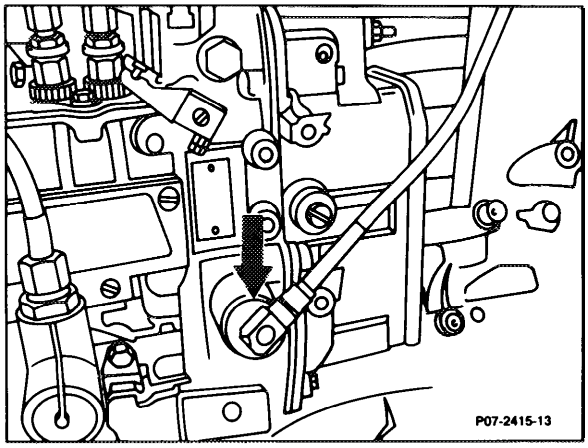
001	Digital tester	017	RIV sensor
010	Adapter	021	TDC pulse generator
011	Alligator clamp	2	Governor
015	Test cable with plug	2i	RI sensor pin
016	Diagnostic socket	59	TDC sensor pin

Checking

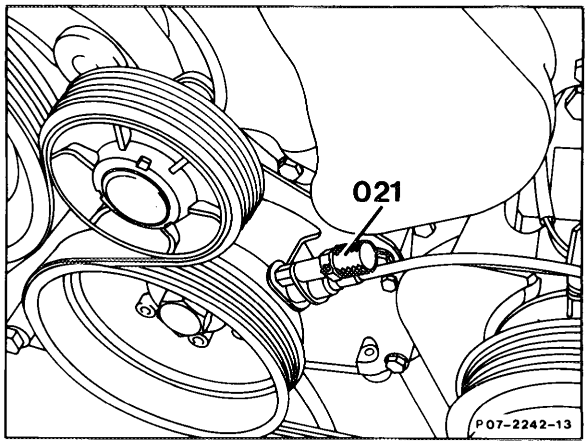
1 Remove screw plug (11) from governor housing.



2 Turn RIV sensor (017) into governor (injection pump).



3 Turn TDC pulse generator (021) into bracket (engine).



4 Connect digital tester according to connection diagram.

5 Engine idling. Read RIV value (indirect start of delivery) off digital tester at idle speed.

RI set **value: 15° ± 1 ° ATDC.**

6 Switch off engine.

7 Disconnect digital tester.

8 Install screw plug in governor (tightening torque 30-35 Nm).

9 Carry out leak test with engine running.

10 Check engine oil level and correct, if required.

EXIT

07.1413 Establishing fuel consumption by road test

1 Fill up vehicle tank in the presence of the customer with the vehicle on level ground.

2 Drive approx. 100 km (62 mi.), of this approx. 40 km (25 mi.) highway and approx. 60 km (37 mi.) back roads and city traffic.

3 After driving fill up again and calculate fuel consumption.

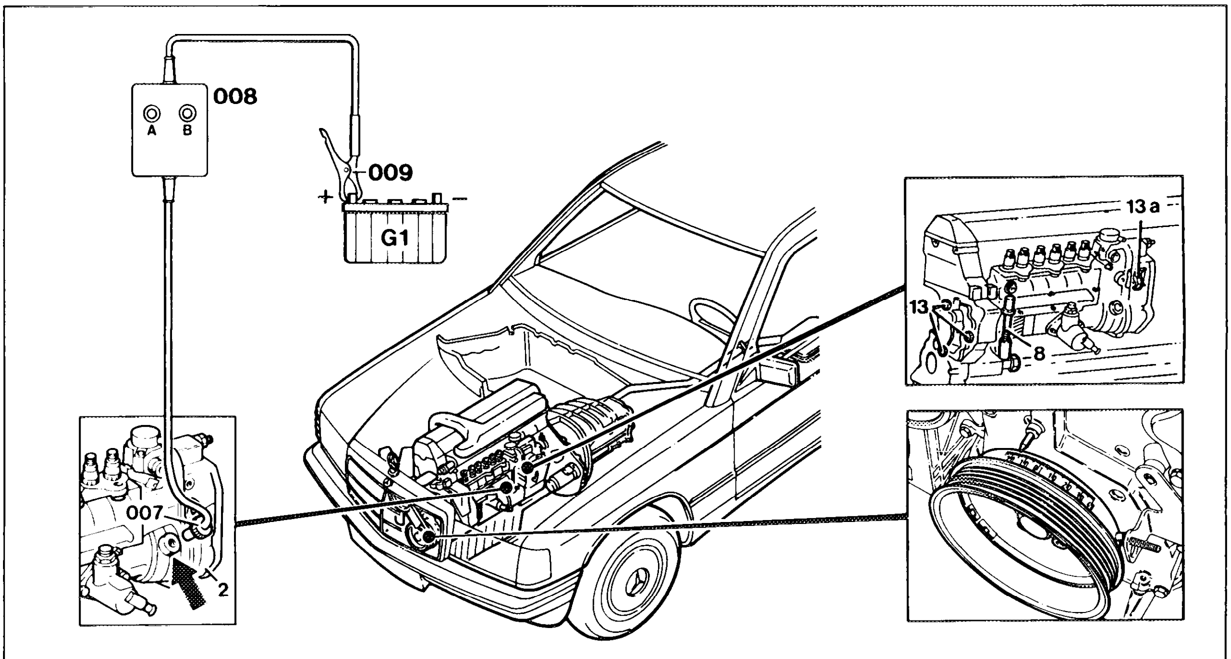
Example 1:
Fuel consumption in liters1100 km

$$= \frac{\text{Fuel quantity consumed in liters}}{\text{Kilometers driven}} \times 100$$

Example 2:
Fuel consumption in miles/gallon

$$\frac{\text{Miles driven}}{\text{Fuel quantity consumed in gallons}}$$

07.1-116 Adjusting start of delivery (position sensor RIV method)



P07-0520-55

Turn crankshaft in direction of rotation	to 15° ATDC of 1 st cylinder.
Loosen mounting screws (13 and 13a) on the injection pump flange and support bracket	tightening torque 20-25 Nm.
Indicating instrument (008) and clamp (009)	connect to B + .
Pivot injection pump by turning the adjusting screw at the adjusting device for start of delivery (8)	both lamps "A and B" must light up in the indicating instrument (008).

Direction of rotation of the adjusting screw

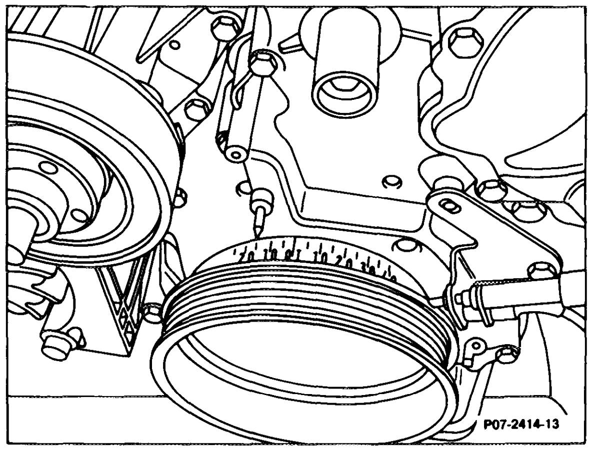
Right = start of delivery retarded	
Left = start of delivery advanced	RIV set value 15° ATDC.
Position sensor (007)	remove.
Screw plug (11)	turn in.
Control linkage	check, adjust if required (30-300).
Leak test with engine running	carry out.
Engine oil level	check, correct.

EXIT

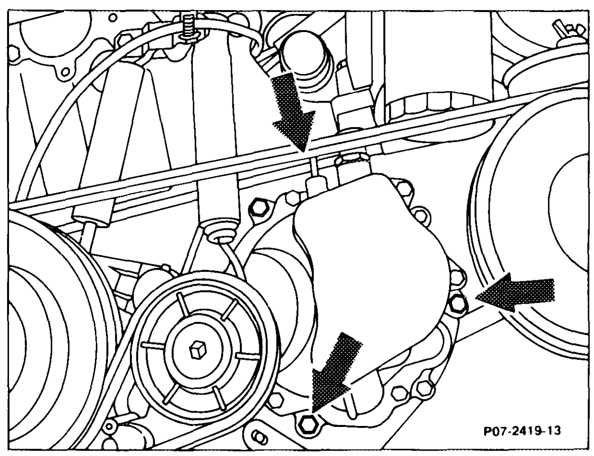
Note
Before adjustment, check start of delivery (07.1-111).

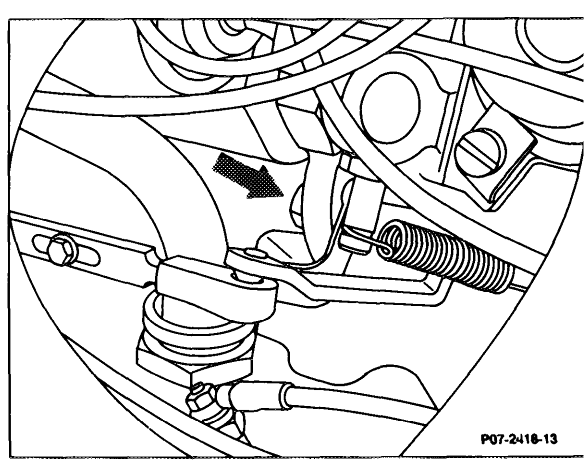
Adjusting

1 Turn crankshaft in direction of rotation to 15" ATDC of 1st cylinder.



2 Loosen mounting screws (arrows) on injection pump flange and support bracket (arrow).

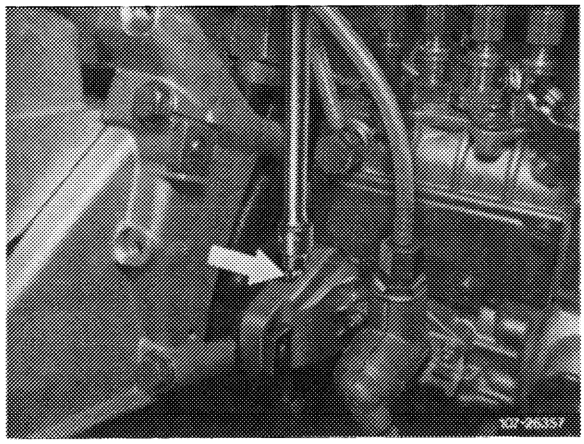




Screw on support bracket

3 Connect Indicating instrument (008) and clamp (009) to battery plus.

4 Pivot injection pump by turning the adjusting screw on the start of delivery adjusting device until both lamps light up.



Direction of rotation of the adjusting screw

Right = retarded start of delivery
Left = advanced start of delivery

RIV set value: 15° ± 1 ° ATDC

Note
If the adjusting range is inadequate, the injection pump must be repositioned. Injection pump, remove, reinstall (07.1-200).

5 Secure mounting bolts on injection pump flange and support bracket, tightening torque 20-25 Nm.

6 Remove position sensor.

7 Install screw plug, tightening torque 30-35 Nm.

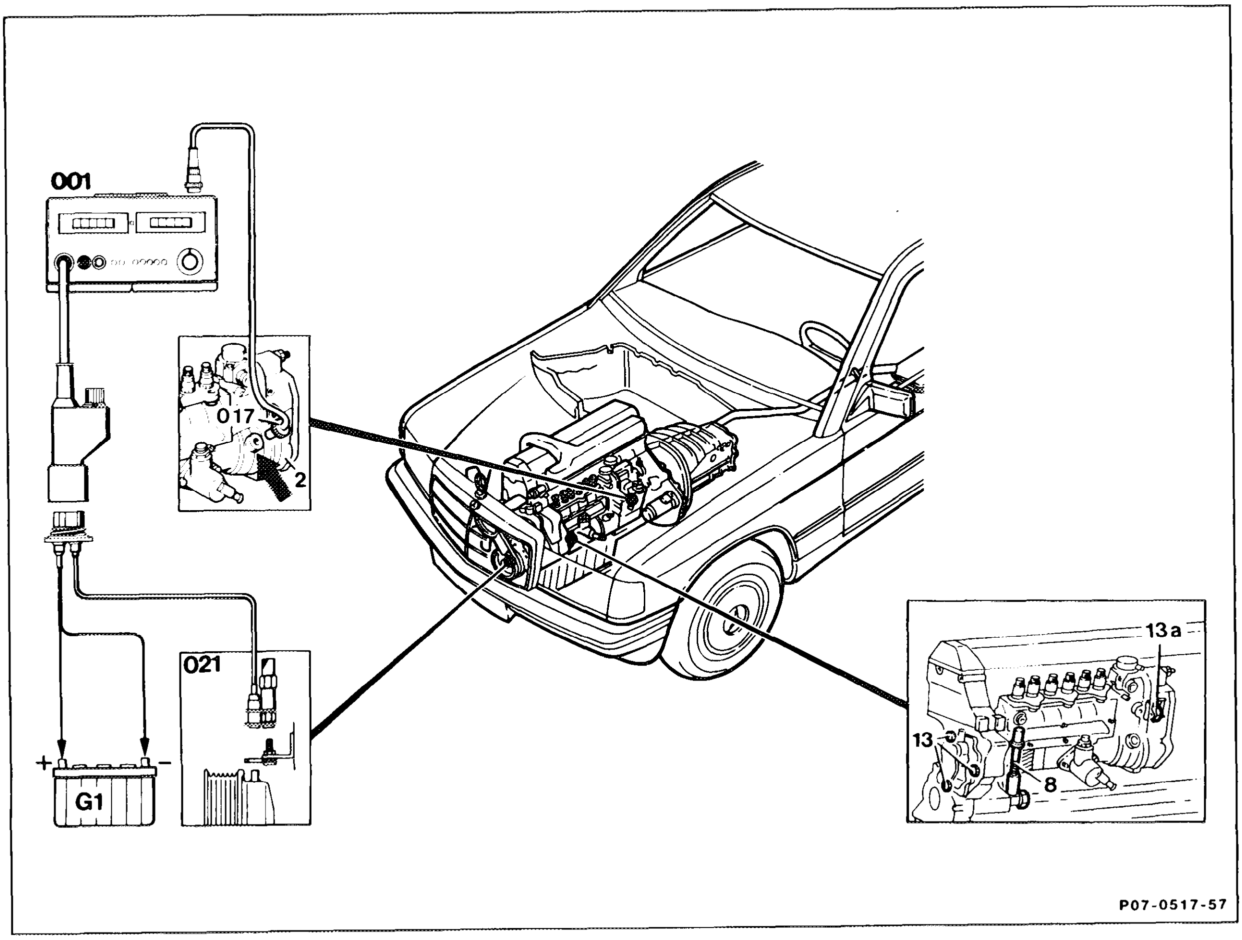
8 Check control linkage and adjust if required (30-300).

9 Carry out leak test with engine running.

10 Check engine oil level and correct if required.

EXIT

07.1-117 Adjusting start of delivery with digital tester (RIV method)



Mounting screws (13 and 13a) on injection pump flange and support bracket	loosen.
Engine	run at idle speed.
RIV value (indirect start of delivery)	adjust by turning the adjusting device (8)

Direction of rotation of the adjusting screw (8)

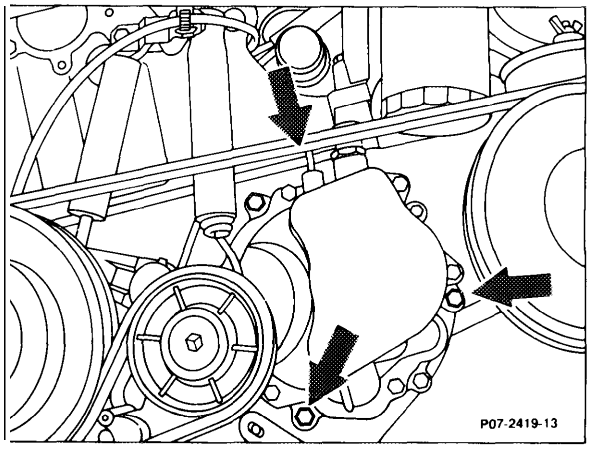
Right = start of delivery retarded	
Left = start of delivery advanced	RI set value 15° ± 1 ° ATDC.
Engine	switch off.
Mounting screws (13 and 13a) on injection pump flange and support bracket	secure tightening torque **20-25** Nm.
Testers	disconnect.
Screw plug (arrow) on governor	turn in, tightening torque 30-35 Nm.
Control linkage	check, adjust if required (30-300).
Leak test with engine running	perform.
Engine oil level	check.

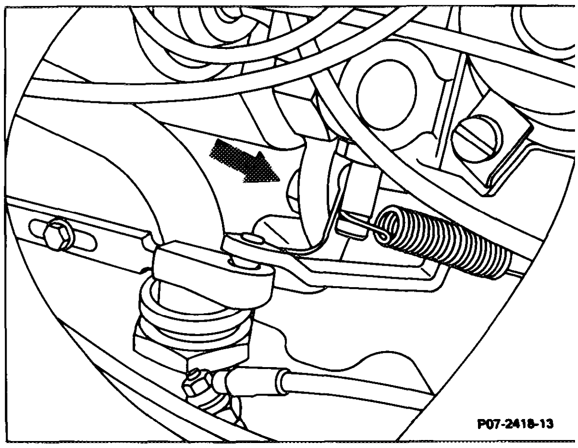
EXIT

Note
Before adjustment, check start of delivery (07.1-112).

Adjusting

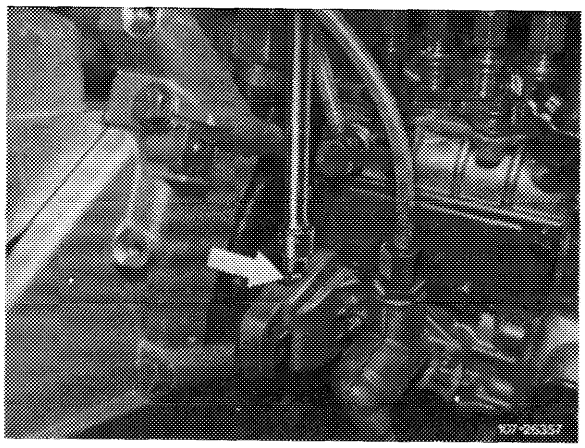
1 Loosen mounting screws (arrows) on injection pump flange and support bracket (arrow).





Screw on support bracket

2 Run engine at idle speed.



3 Adjust RIV value (indirect start of delivery) by turning the adjusting screw on the start of delivery adjusting device.

RIV set value: 15° ± 1 ° ATDC

Direction of rotation of the adjusting screw

Right = retards start of delivery
Left = advances start of delivery

EXIT

Note
If the adjusting range is inadequate, the injection pump must be repositioned. Injection pump, remove, reinstall (07.1-200).

4 Switch off engine.

5 Disconnect tester.

6 Turn screw plug into governor, tightening torque 30-35 Nm.

7 Secure mounting screws on injection pump flange and support bracket, tightening torque 20-25 Nm.

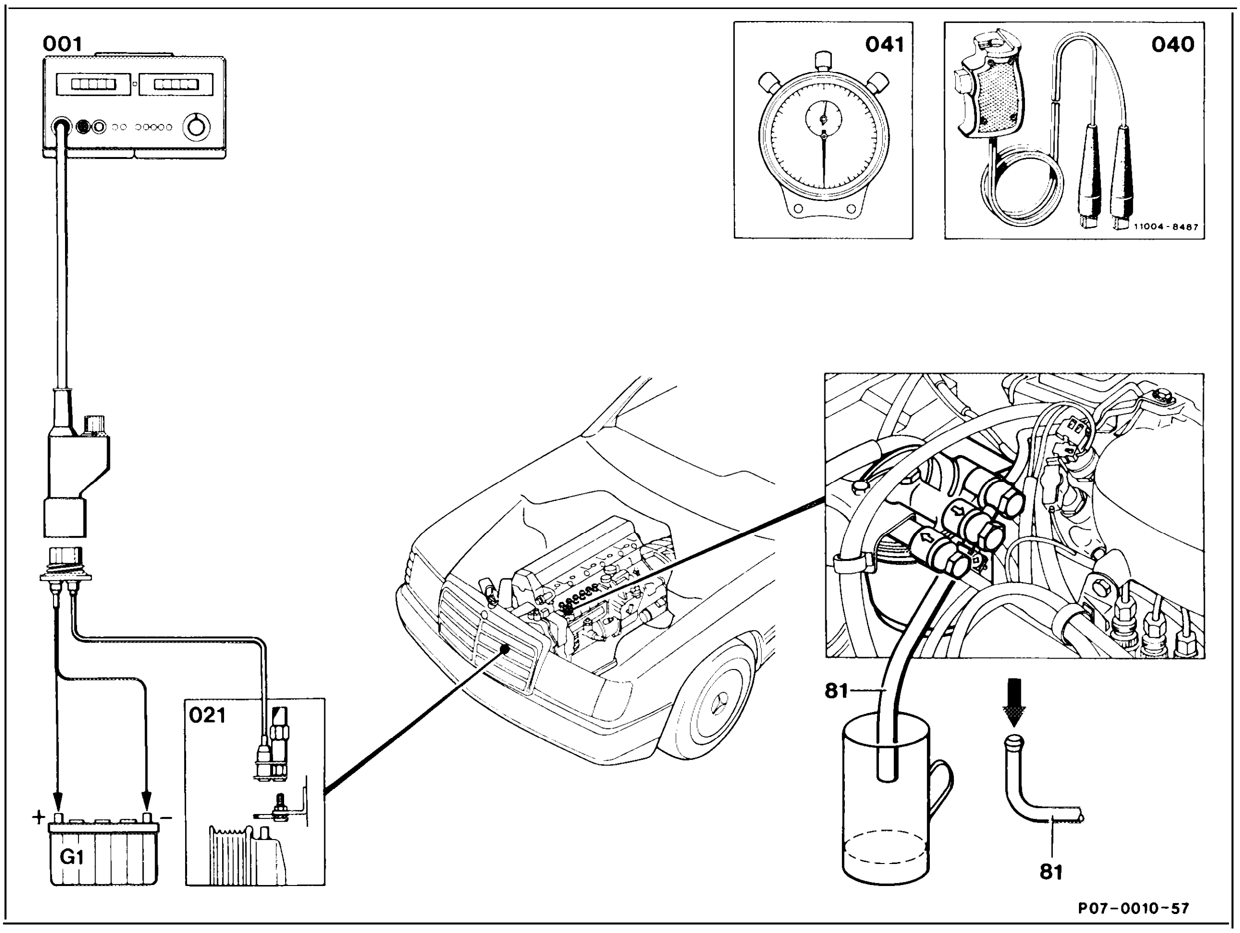
8 Check control linkage and adjust if required (30-300).

9 Perform leak test with engine running.

10 Check engine oil level and correct if required.

EXIT

0X1-145 Checking fuel pump



Testers (001, 015, 016, 021)	connect
Return line (81)	disconnect and hold in the measuring cup approx. 1 l.

Note

The return to the fuel tank must be sealed.

Key in steering lock position	turn to "0", this means the injection pump is in zero delivery position.
Connect contact handle (040) to terminal 30 and terminal 50	and start engine for 30 seconds (starting voltage min. 10 V).

Set value

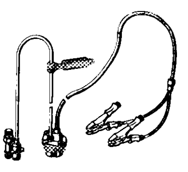
Transfer pump at least 150 cm³/30 seconds. Replace fuel filter and/or transfer pump if required. Check fuel pressure (07. l-l 46).

Use . . . . stop watch (041)

Test values

Engine	601, 602, 603
Rate of delivery at 150/min minimum	at least 150 $cm^3/30$ s
Test requirement	Glow starter switch in position "0"

Special tools



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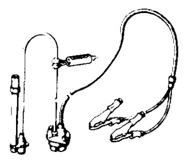
07



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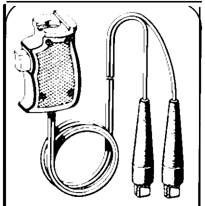
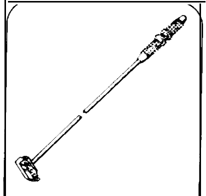
07



001 589 46 21 08



124 589 36 63 00
01

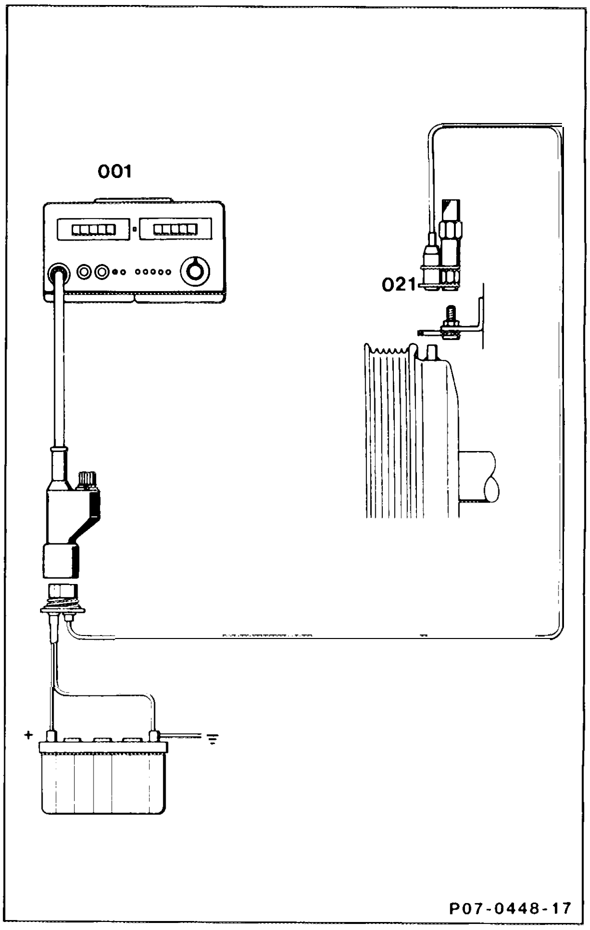
Commercially available tools

Digital tester	e.g. Bosch, MOT 001.03
Measuring glass or cup (at least 1 liter)	
Stop watch	

EXIT

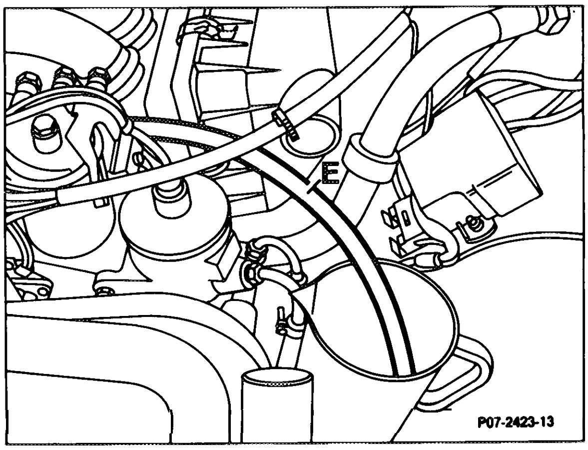
Checking

1 Connect digital tester (001) according to connection diagram.



001 Digital tester
021 TDC pulse generator

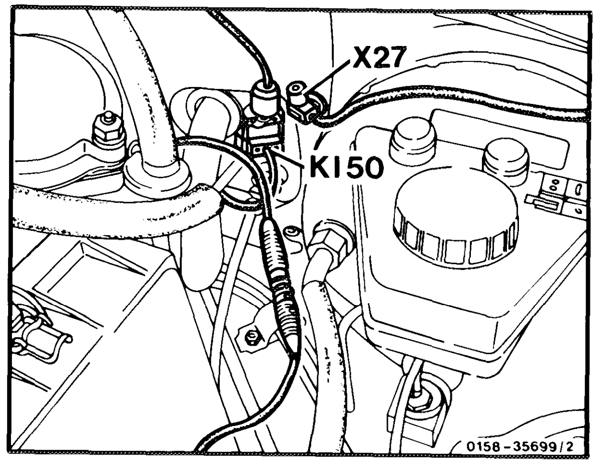
2 Disconnect return line (E) and hold into the measuring cup.



3 Turn ignition lock in position "0", the injection pump is now in “zero” delivery position.

EXIT

4 Pull off coupling (X 27) and connect adapter line to terminal 50 (KI 50).

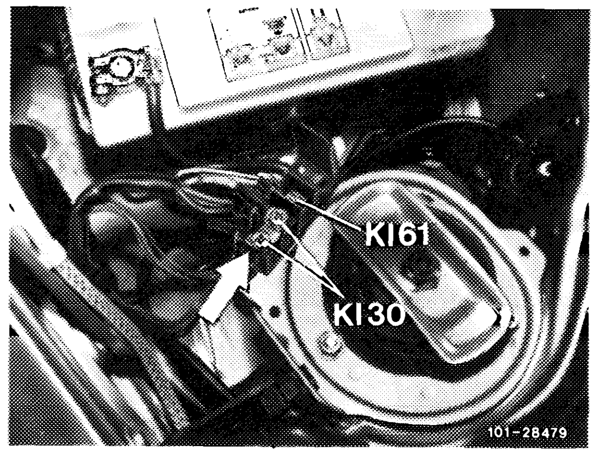


Model 201

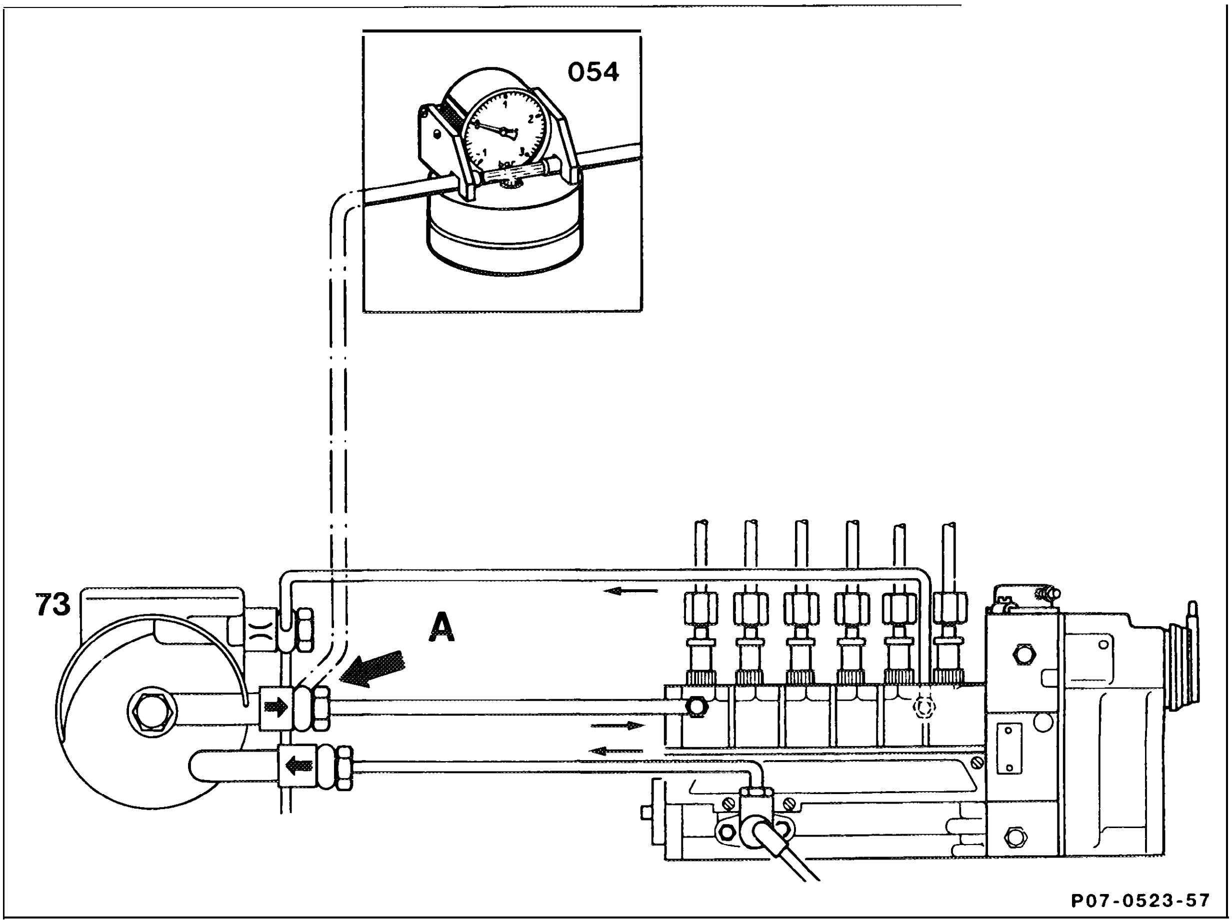
Connect contact handle to adapter line and to one of the terminals 30 (KI 30) on terminal block (arrow) and start engine for 30 seconds.
(Starting voltage at least 10 V)

Set value rate of delivery:
at least 150 cm^3 30 seconds

If the set value is not achieved, check fuel pressure (07.1- 146).



07.1-146 Checking fuel pressure (after checking delivery capacity)



Fuel line "A" from filter upper part (73) .... unscrew,
connect tester (054).

Set values:

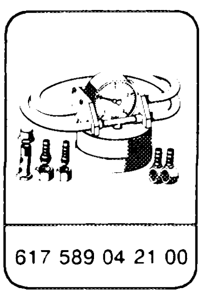
at idle speed **>** 0.3 bar

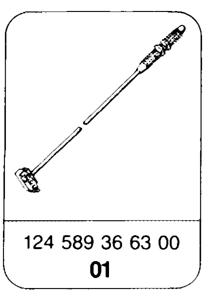
at full load **>** 0.5 bar

If the set values are not achieved:

Replace fuel filter.

Special tools

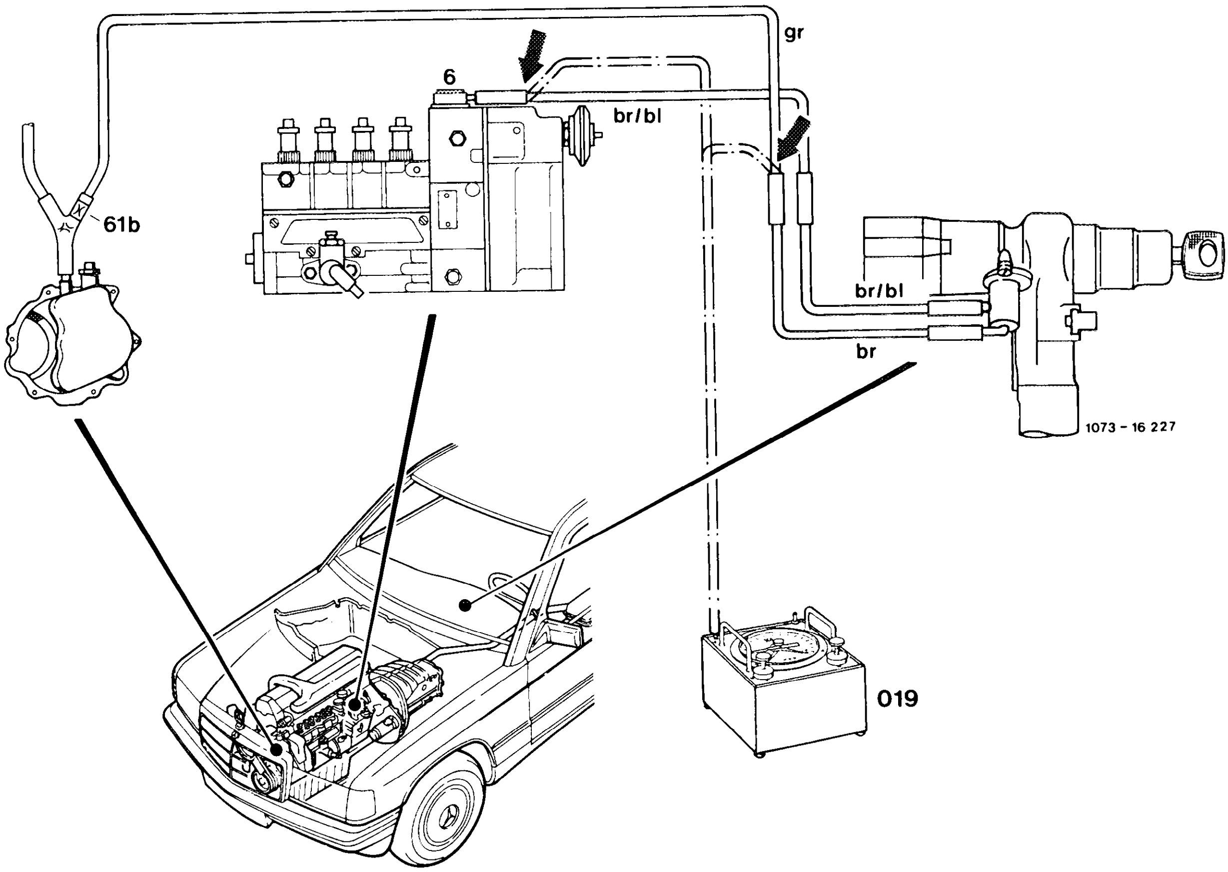




EXIT

07.1-150 Testing vacuum shut-off for leaks

1 st version



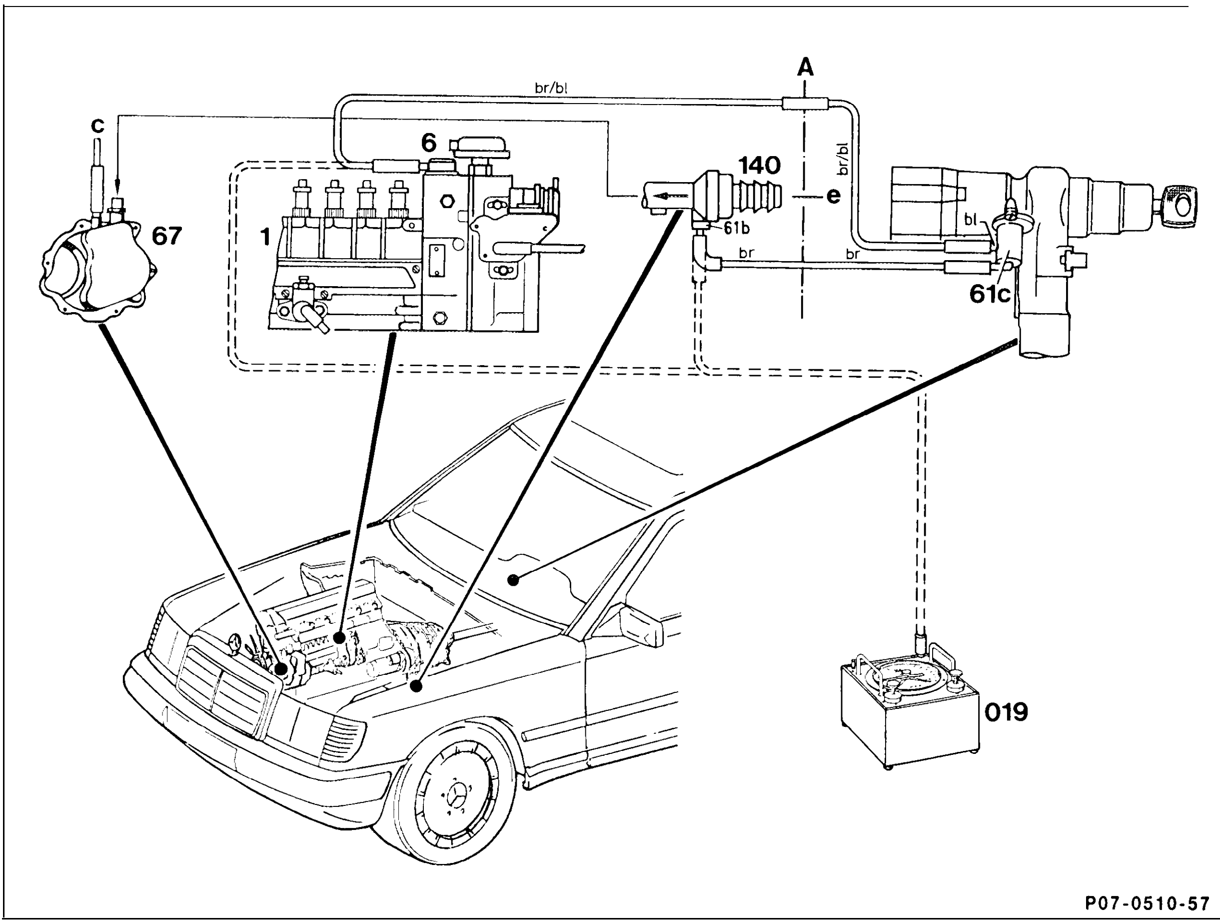
1	Injection pump	A	Partition panel
6	Vacuum unit (stop)	c	Remaining users
61b	Choke 0.5 mm orifice diameter	e	To brake booster
61c	Valve glow starter switch		
61d	Cam glow starter switch (valve open)		
67	Vacuum pump		

EXIT

Glow starter switch	turn to position “2”.
Vacuum tester (019)	connect to suction line “brown” and apply vacuum of 400 + 50 mbar (max. pressure drop 6 mbar/min). Turn glow starter switch to position "0", the stop lever goes down or in stop position.
Vacuum tester (019)	connect to vacuum unit (6) and apply vacuum of 300 + 50 mbar (max. pressure drop 5 mbar/min).

2nd version

Production breakpoint as of July 1987.



1	Injection pump	A	Partition panel
6	Vacuum unit (stop)	c	Remaining users
61c	Valve glow starter switch	e	To brake booster
67	Vacuum pump		
140	Check valve/main vacuum line		

Glow starter switch .... press to position "2".

Vacuum tester (019) .... connect to suction line "brown" and apply vacuum of 400 + 50 mbar (max. pressure drop 6 mbar min).
Turn glow starter switch to position "0", the stop lever goes down or in stop position.

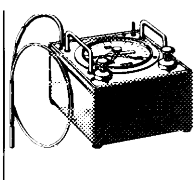
Vacuum tester (019) .... connect to vacuum unit (6) and apply vacuum of 300 + 50 mbar (max. pressure drop 5 mbar/min).

Permissible loss of vacuum mbar/min

Model	201
Entire system at 400 + 50 mbar vacuum	6[1])
Individual parts at 300 + 50 mbar vacuum	5[1])

[1]) Maximum pressure drop

Special tool



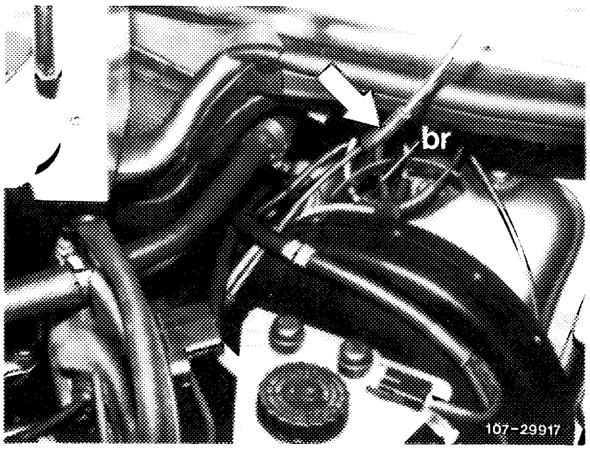
201 589 13 21 00
00 42 80

Testing

1 Turn ignition key on glow starter switch to position "2".

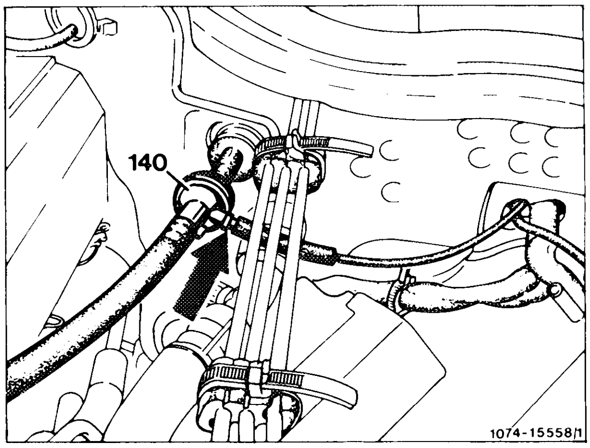
2 Pull suction line (brown) from connector (arrow).

Model 201

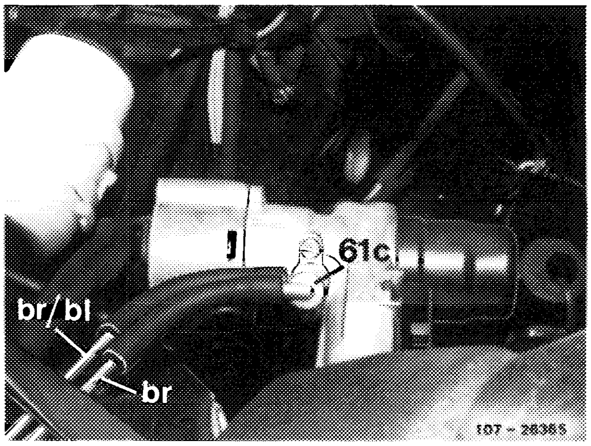


EXIT

Vacuum supply directly from check valve of main vacuum line.
Model 201 as of July 1987



3 Connect tester and apply vacuum of 400 + 50 mbar.



If the display on the pressure gauge fails to change, the valve for the glow starter switch is leaking.

If a vacuum drop of more than 6 mbar min occurs on the pressure gauge, the valve (61c) on the glow starter switch is leaking.

Caution!
Before replacing the valve for the glow starter system and the vacuum unit of the injection pump, check hose lines and connections.

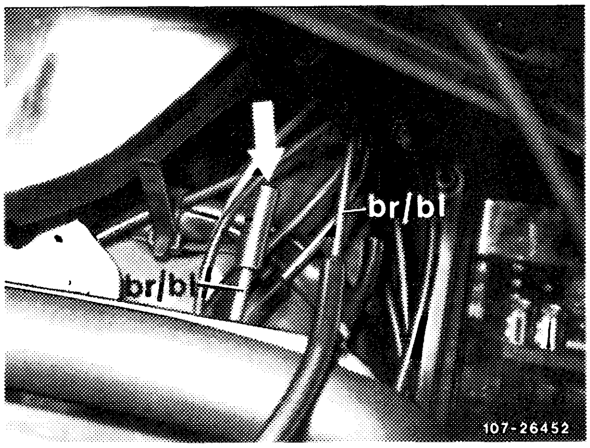
4 Replace valve on glow starter switch.

5 Turn ignition key on glow starter switch to position "0".

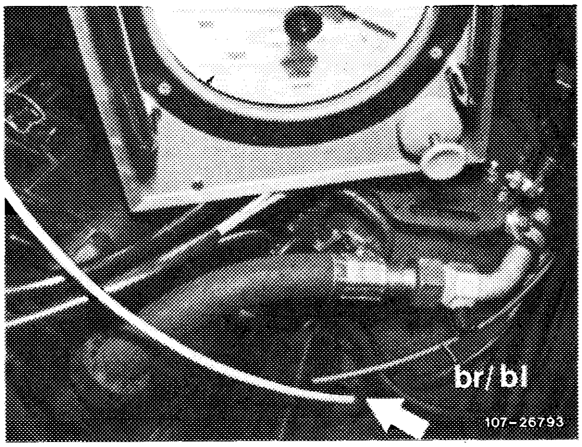
If a vacuum drop occurs on the pressure gauge, the vacuum unit or the valve may be leaking.

6 In this case, disconnect tester from suction line (brown).

7 Pull control line (brown blue) from connector (arrow).



Model 201
Standard version



Model 201
California version

8 Connect tester to connector and apply vacuum of 300 + 50 mbar.

If a vacuum drop of more than 5 mbar/min occurs on the pressure gauge, the vacuum unit of the injection pump is leaking.

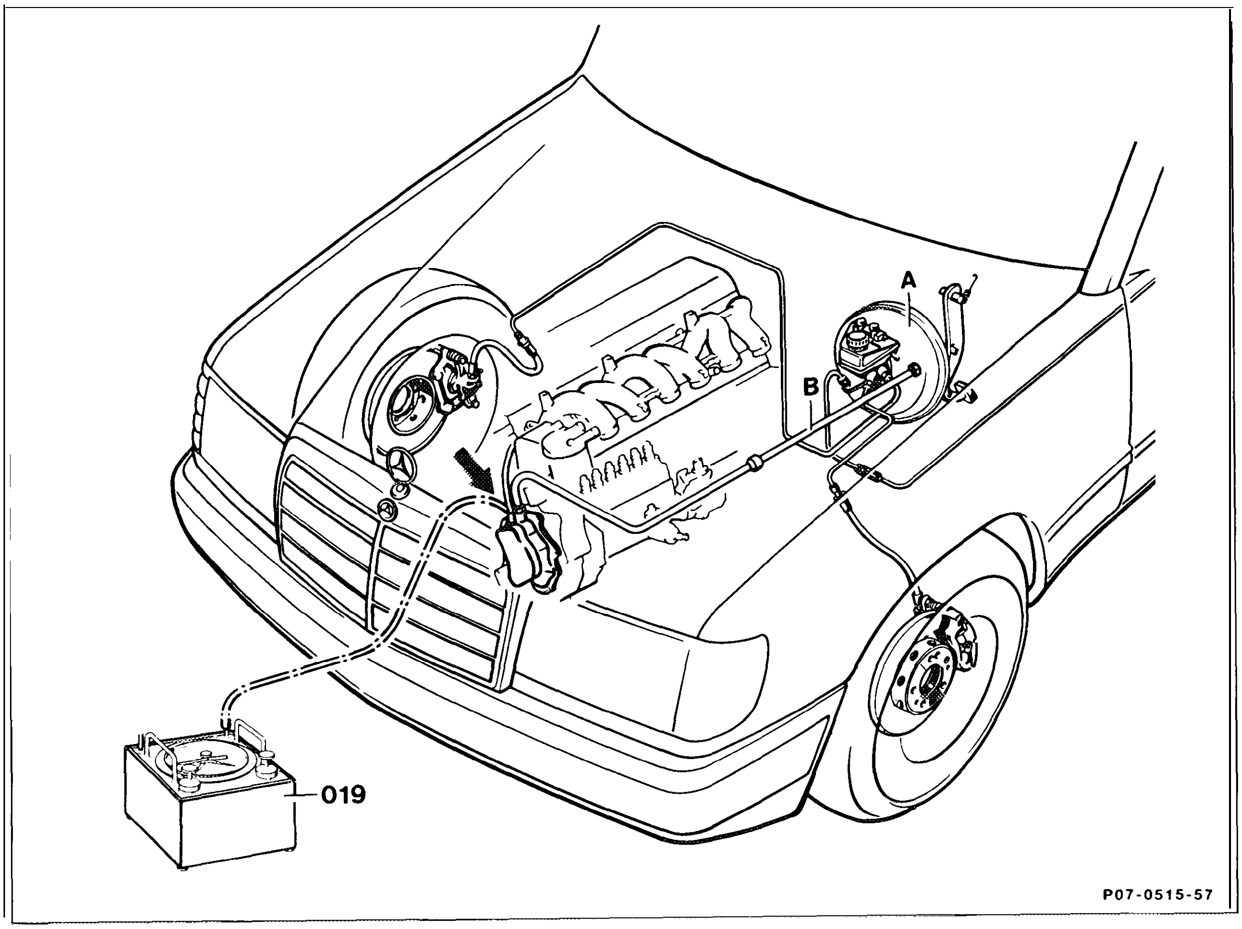
Caution!
Before replacing the vacuum unit, check hose lines and connectors.

9 Replace vacuum unit (07.1-220).

EXIT

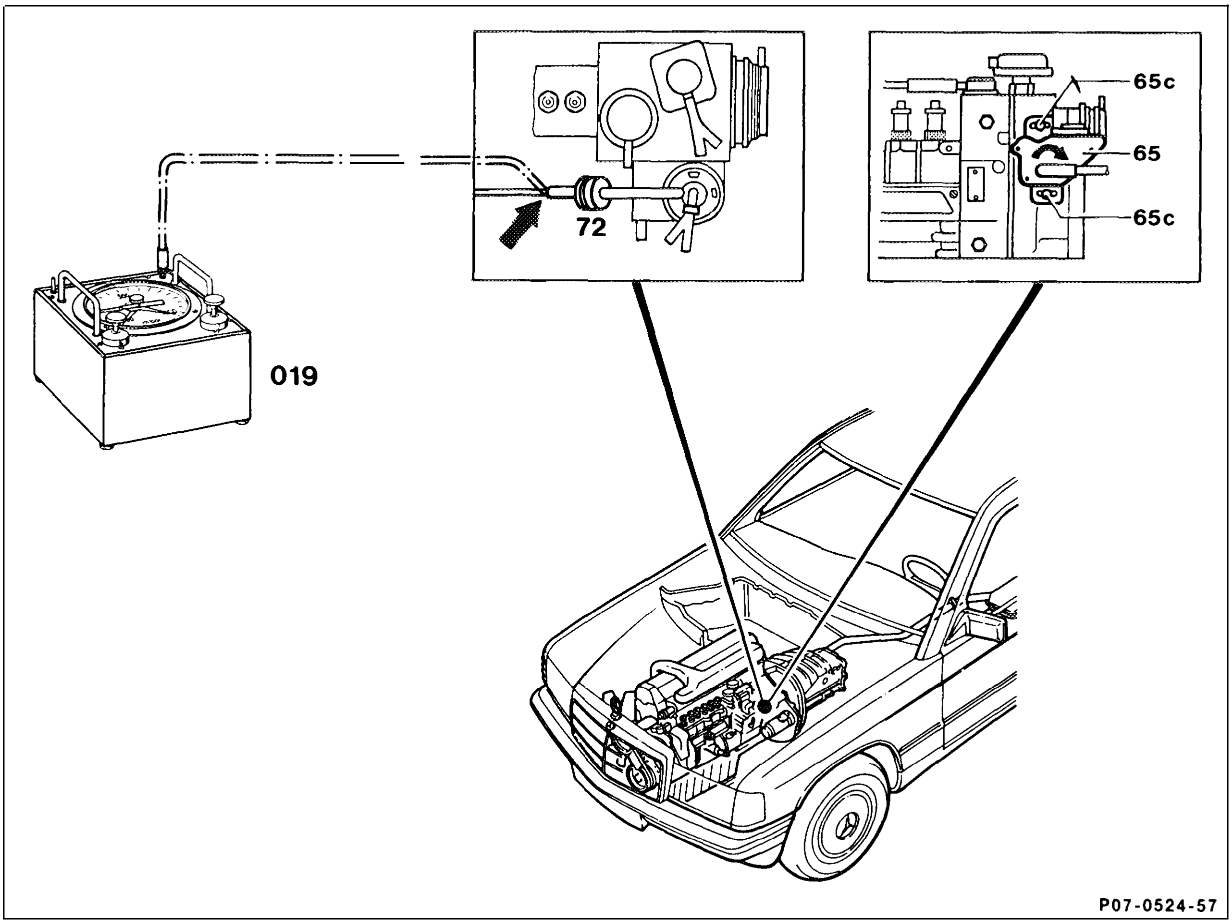
EXIT

07.1-160 Testing vacuum pump



Engine temperature	< 20 °C (reference value)
Main vacuum line (B)	disconnect from brake booster (A), ventilate and reconnect.
Vacuum line on auxiliary user connection	disconnect and check choke orifice with 0.8 mm gauge for open passage.
Vacuum tester (019) to auxiliary user connection	connect and check vacuum at idle speed.
	Nominal value: 700 mbar after 30 s.
	If the vacuum value is not achieved, replace vacuum pump.

07.1470 Testing and adjusting vacuum control valve for automatic transmission



Vacuum tester (019) to damper (72) of vacuum line .... connect and read vacuum at idle (set values and test values see next page).

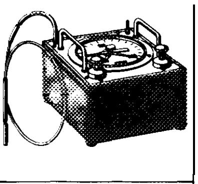
With engine off, move control to full-throttle stop position.

Nominal value: 0 mbar, adjust vacuum control valve if required. Check vacuum lines, check vacuum pump, replace vacuum control valve.

EXIT

Mounting bolts (65c) .... loosen, fully open throttle until the control lever of the injection pump contacts the full-load stop. Turn vacuum control valve (65) in the direction of the arrow until resistance can be felt. In this position secure vacuum control valve.

Special tool



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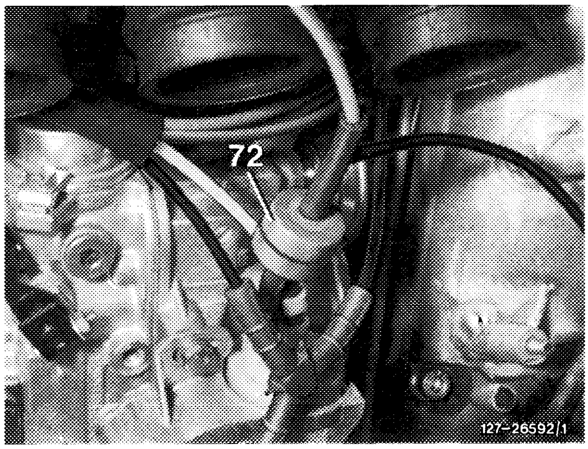
Test and adjusting values, characteristics

Engine	Pressure control flap		Cap identification	Part no.	EGR valve identification	Vacuum adjustment mbar
	mech.	pneu.				
602 with EGR and automatic transmission	–	yes	black [1]	123 300 10 33	blue	385 ± 25
602 with EGR and manual transmission	–	yes	green	123 300 12 33	blue	> 300
602	yes	–	yellow	124 300 03 33	brown	> 300

[1]) as of February 1987 with red cap

EXIT

Checking



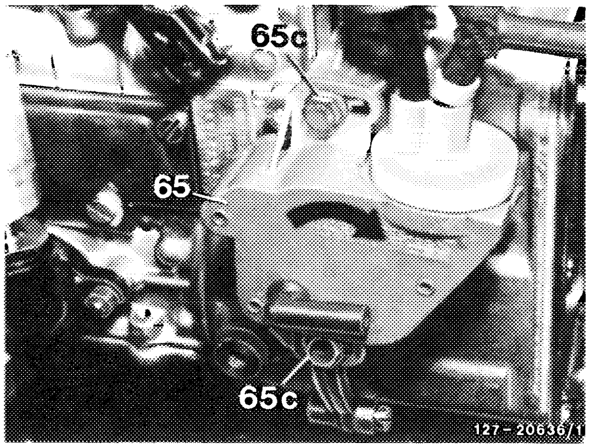
1 Pull off vacuum line, connect vacuum tester to damper (72) and check vacuum at idle.

Nominal values see table.

2 With the engine off, move control linkage into full throttle stop position. Check vacuum. Nominal value: 0 mbar.

3 If nominal values are not achieved:
a) Check vacuum control valve adjustment.
b) Check vacuum lines according to vacuum diagram, check vacuum pump, replace vacuum control valve if necessary.

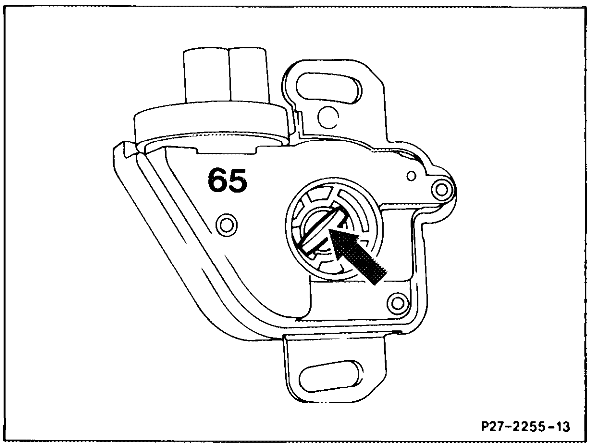
Adjusting



4 Loosen mounting screws (65 c).

5 Fully open throttle so that the control lever of the injection pump contacts the full load stop.

6 Turn vacuum control valve (65) in the direction of the arrow until resistance can be felt. In this position secure mounting screws.



A sealing boot (arrow) is installed together with the vacuum control valve to prevent dust and dirt from entering the vacuum control valve.

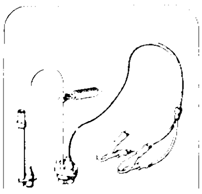
Repair instructions
Vacuum control valves differ for manual and automatic transmissions.

07.1-195 Testing exhaust gas recirculation

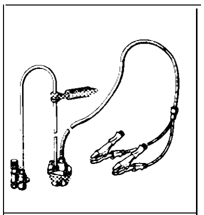
A. Performance test

B. Testing individual parts

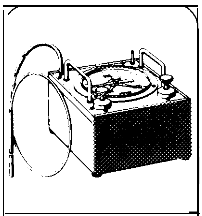
Special tools



603 589 00 21 00
07



601 589 04 21 00
07



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00 42 80

201 589 00 99 00
15 54

Commercially available tools	
Digital tester	Bosch, MOT 001.03
	e.g. Sun, DIT 9000
Multimeter	e.g. Sun, DMM-5

Note
Use Y-distributor, part no. 117 078 01 45 for vacuum tester.

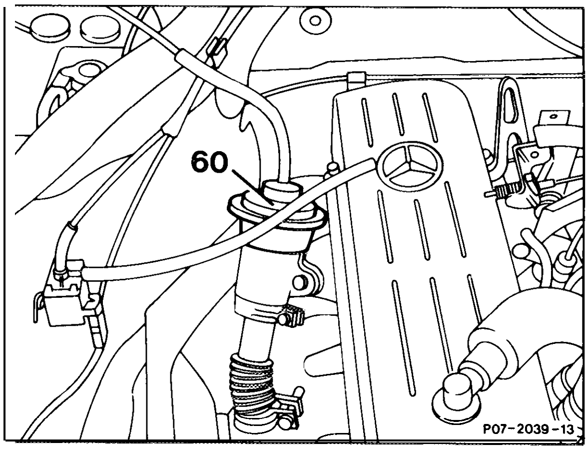
Test condition
Coolant temperature 60-80 °C.

EXIT

A. Performance test

Testing EGR valve (60) with engine off
Apply vacuum of approx. 300 mbar to EGR valve. Pull off vacuum line.

EGR valve audibly closes.	EGR valve does not close.



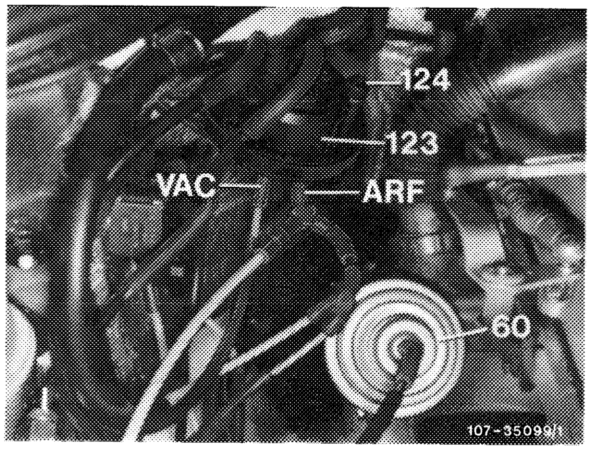
Test individual components

End of test

Testing vacuum amplifier (123) and vacuum adjustment

Connect vacuum tester with Y-distributor to connection "A" and read vacuum value with engine at idle. If the vacuum is above or below the nominal value, adjust vacuum. For this purpose pull off protective cap (124) and adjust with socket wrench insert (4 mm) according to specified Nominal value.

Nominal value: 350 ± 5 mbar.
as of model year 1986 may not be adjusted.



OK	Not OK

Check vacuum supply at connection "C", replace vacuum amplifier if necessary. Check vacuum lines according to vacuum diagram. Check supply vacuum on vacuum pump (07.14 60).

Nominal value: greater than 700 mbar

End of test

Testing vacuum control
Connect vacuum tester with Y-distributor to EGR valve (60). Check vacuum values and position of vacuum unit (100) and vacuum control flap. Take vacuum readings at the following engine speeds:

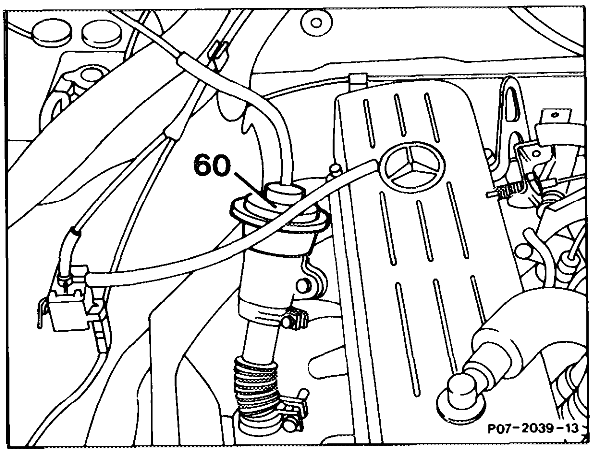
EGR Model Year 1986

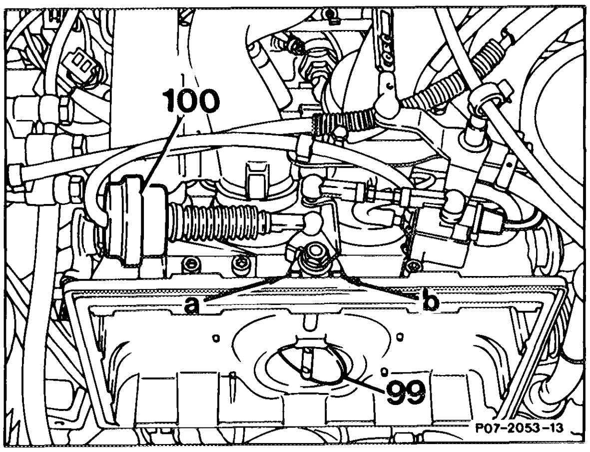
rpm	EGR valve mbar	Pressure control flap position
680 ± 20	0	**Not** activated
1200 ± 50	150 – 350	Fully activated
3000 ± 50	0	Not activated

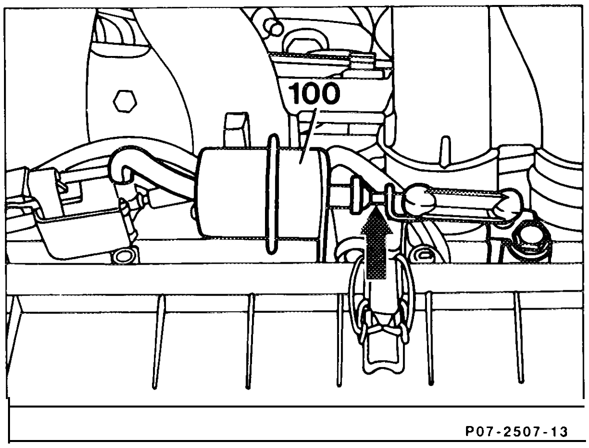
EGR Model Years 1987 through 1989

rpm	EGR valve mbar	Pressure control flap position
680 ± 20	Approx. 30	**Not** activated
1000 ± 50	150 – 360	Fully activated
2500 ± 50	150 – 360	Not activated
3000 ± 50	0	Not activated

OK	Not OK

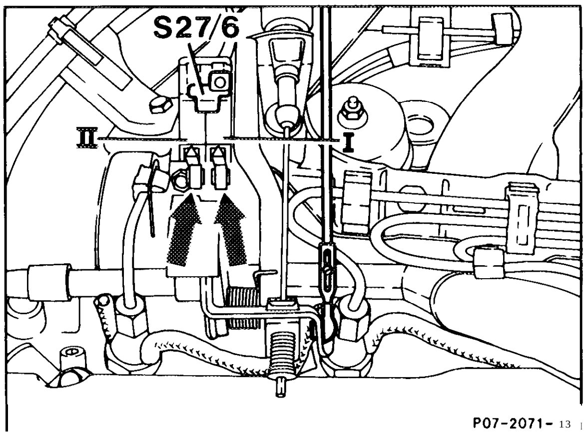






Piston rod of vacuum unit retracted - pressure control flap closed (arrow).

Check vacuum supply and individual components.
End of test



Testing microswitch (S27/6, I + II)

Connect vacuum tester with Y-distributor to EGR valve (60).

Run engine at 1200 ± 50 rpm (M.Y. 1986).
Run engine at 1000 ± 30 rpm (M.Y. 1987- 89)

Actuate microswitch (S27/6 I), the vacuum on the EGR valve (60) should drop to 0 mbar. The pressure control flap (in the air filter housing) should move into "not activated" position.

Actuate microswitch (S27/6 II), the pressure control flap (100) in the air filter housing should move into the "not activated" position.

OK	Not OK

Check individual components.

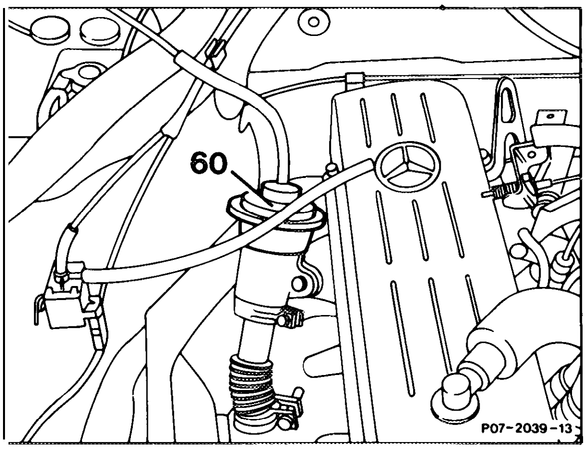
EXIT

B. Testing individual components

Testing EGR valve (60) with engine stopped

Apply approx. 300 mbar of vacuum to EGR valve (60). Pull off vacuum line.

EGR valve audibly closes .	EGR valve does not close.

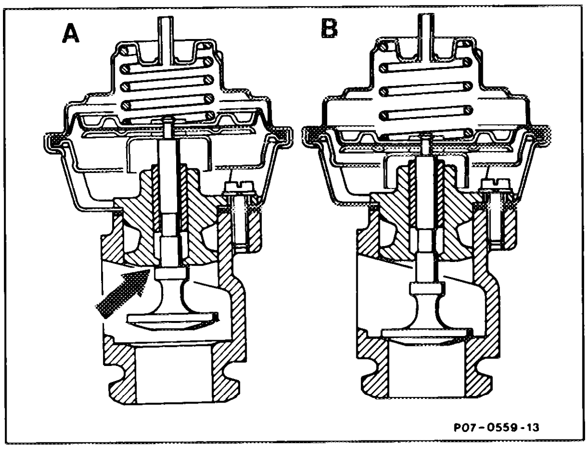


Remove EGR valve and apply approx. 300 mbar of vacuum with vacuum tester.

EGR valve lifts approx. 4 or 6 mm off the seat (end stop → arrow).

Pull off vacuum hose, the EGR valve must audibly snap back onto its seat

If one of these test steps is not successful, replace EGR valve.



A open
B closed

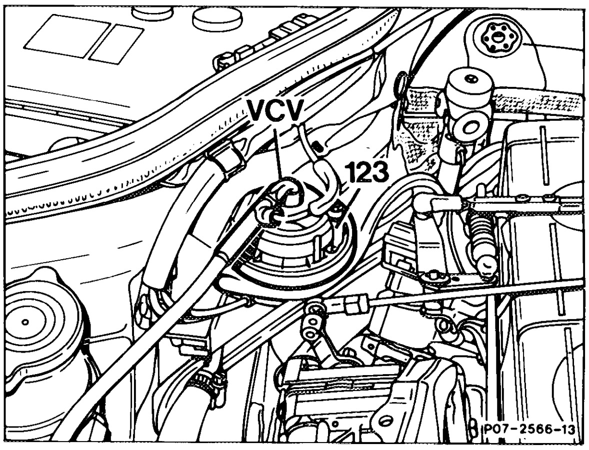
End of test

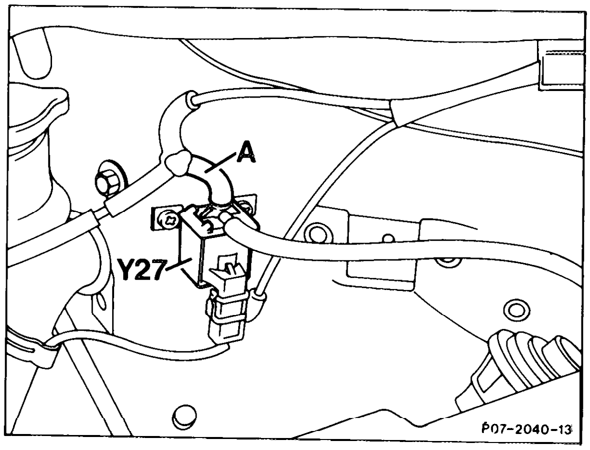
EXIT

Testing vacuum control valve (65)

Connect vacuum tester with Y-distributor to connection "B" of vacuum amplifier (123) and check vacuum at idle.
Nominal values:
At 680 ± 20 rpm:
approx. 360-410 mbar (M.Y. 1986-1988)
above 300 mbar (M.Y. 1989)

With engine off and control linkage at full load stop: 0 mbar.

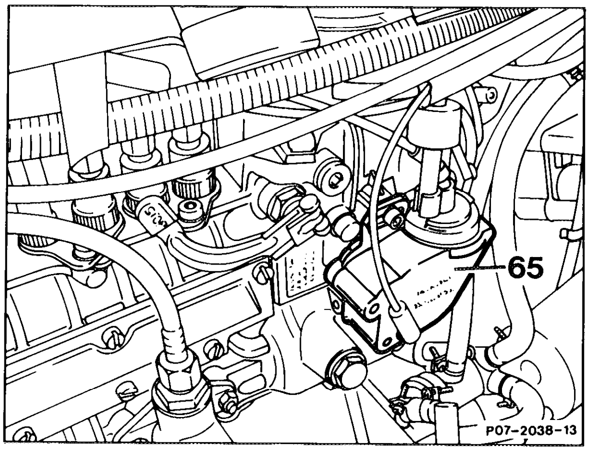




Test values correct.	Test values not in order.

Check vacuum lines according to vacuum diagram.
Check vacuum supply at vacuum pump.

Nominal Value:
greater than 700 mbar
Adjust vacuum control valve (65) (07.1-l 70), replace if necessary.



End of test

EXIT

Testing switchover valves (Y27 and Y28)
Connect voltmeter to connector of switchover valve and measure voltage at 1000 ± 50 rpm for model years 1987 through 1989 and 1200 ± 50 for model year 1986.

Nominal value: approx. 12 V.

OK	Not OK

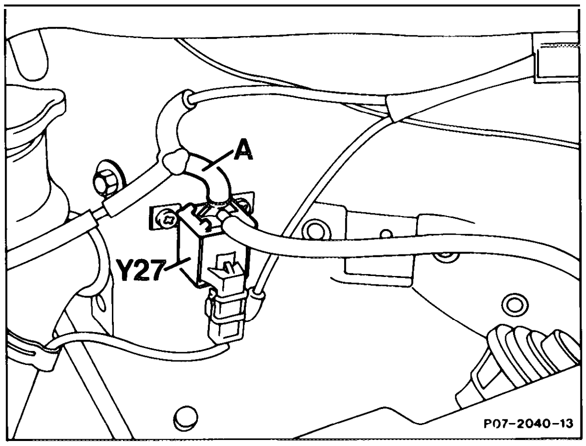
(Not OK:)
Check electrical actuation according to wiring diagram, replace EGR control unit (N37 or N37/2) if necessary.

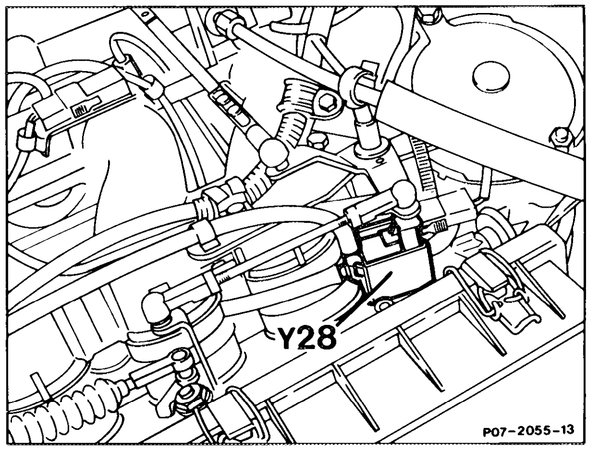
End of test

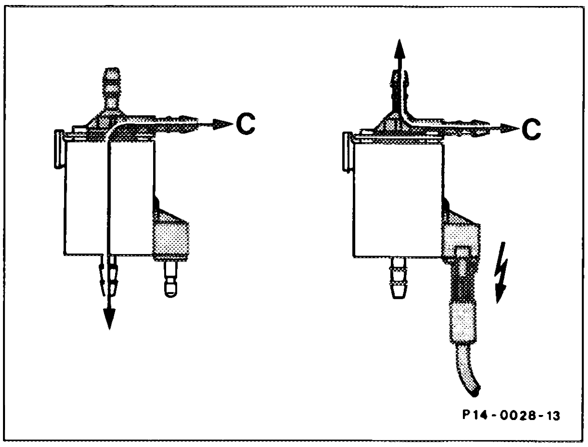
(OK:)
Connect vacuum tester with Y-distributor to connection "C" and check vacuum at 1000 ± 50 rpm (or 1200 ± 50 for 1986, 12 V applied) valves Y27 and Y 28
300-400 mbar

Check engine with mechanical actuation of the pressure control flap at 1000 ± 50 rpm (1200 ± 50 for M.Y. 1986) , applying 12V.

Switchover valve (Y27) 350 – 400 mbar
Switchover valve (Y28) > 700 mbar





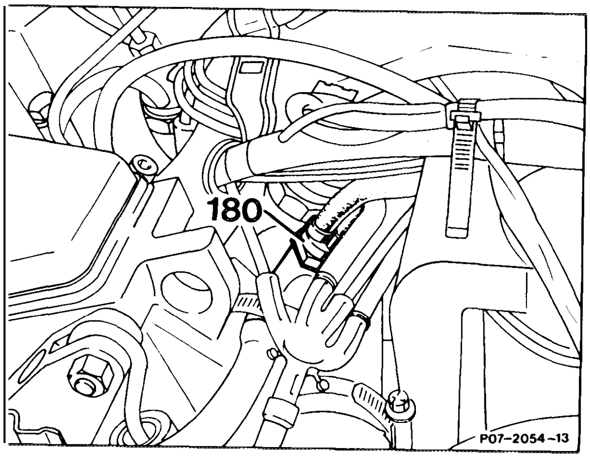


EXIT

OK	Not OK

Check supply vacuum at the vacuum pump (07.1-l 60).
Nominal value greater than 700 mbar.

Check vacuum lines according to vacuum diagram.



End of test

EXIT

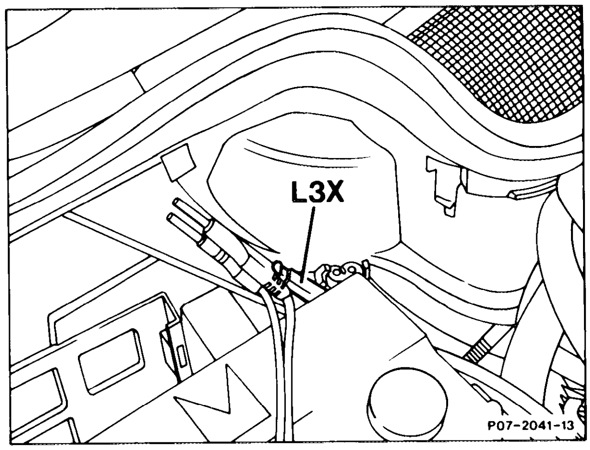
Testing rpm signal

Remove plug connector (L3X). Connect multimeter and press button "V~". Run engine at idle.

Reading: > 1.5 V~
Voltage rises with increasing speed.

OK	Not OK

OK → End of test

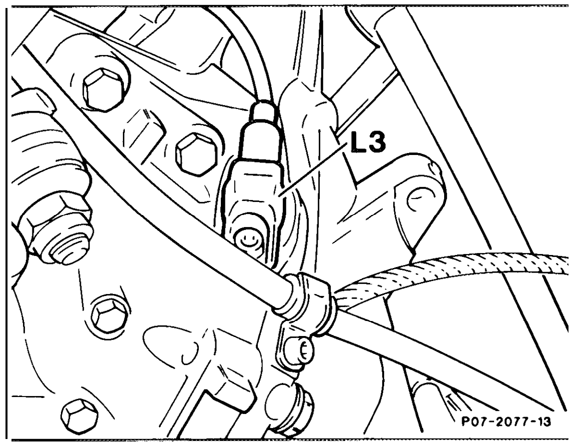


Not OK →

Remove starter ring gear speed sensor (L3). Connect multimeter as above and press "Ω" button on multimeter. Check resistance on pins of connector L3X.

Reading: 1.9 ± 0.2 kΩ

OK	Not OK



OK → Inspect starter ring gear speed sensor (L3) for accumulation of dirt or metal chips, clean or replace if necessary.

Not OK → Replace starter ring gear speed sensor (L3).

End of test

[1]) Measured at 20 °C ambient temperature. (The resistance changes by 4% for each 10 °C change in ambient temperature).

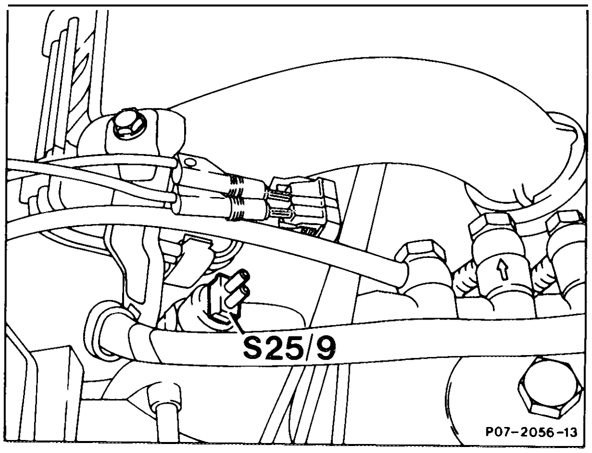
EXIT

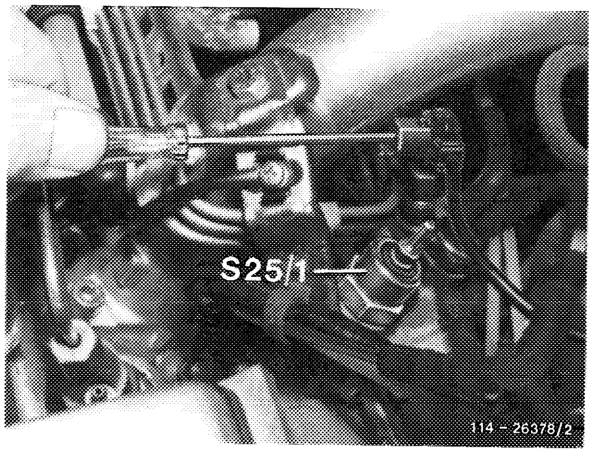
Testing activation of temperature switch (S25/9) 97 **°C**

Connect vacuum tester with Y-distributor to EGR valve.

Run engine at **1200** rpm (M.Y. 1986-1 988)
Run engine at 1000 rpm. (M.Y. 1989)
Pull plug off temperature switch (S25/1) and bridge 2 terminal connection, except l-pole version of temperature switch (S25/1), hold the plug against ground (engagement of electronic clutch should be heard).

Vacuum at EGR valve drops to 0 mbar.





OK	Not OK

Not OK → Check electrical activation according to wiring diagram, replace EGR control unit (N37 or N37 2) if necessary.

End of test

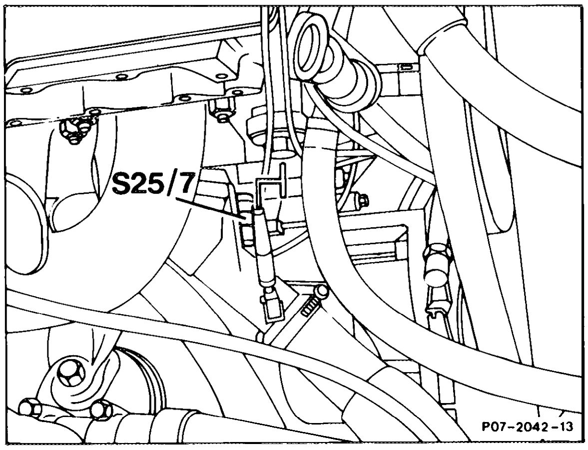
EXIT

Testing activation of 25 °C temperature switch (S25/7)

Connect vacuum tester with Y-distributor to EGW valve.
Engine temperature above 25 °C
Run engine at 1200 rpm (M.Y. 19864988)
Run engine at 1000 rpm (M.Y. 1989)
Pull plug off temperature switch and hold against ground.

Vacuum at EGR valve drops to 0 mbar.

OK	Not OK



Not OK →

Check electrical activation, according to wiring diagram, replace EGR control unit (N37 or N37/2) if necessary.

OK / Not OK →

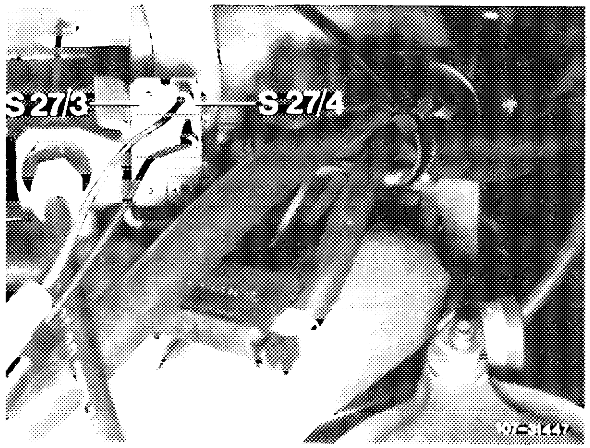
End of test

EXIT

Testing microswitch (S27/3 and S27/4) Model Years 1986 through 1988	
Engine off. Pull off connector on microswitch and test for continuity with ohmmeter between pin 2 and 4 or pin 1 and 3. At idle : 0 Ω At full throttle: ∞ Ω	
OK	Not OK

Replace microswitch.

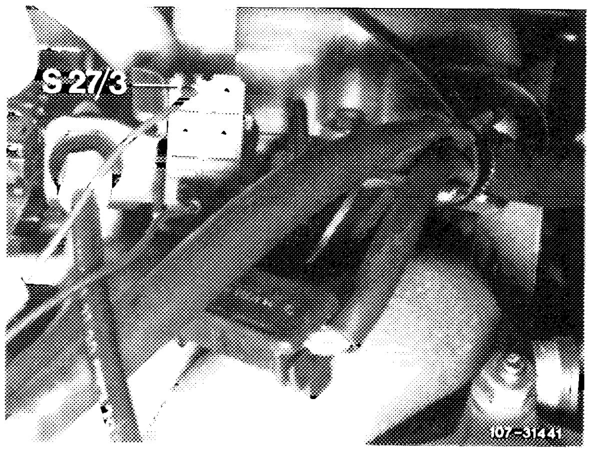
End of test.



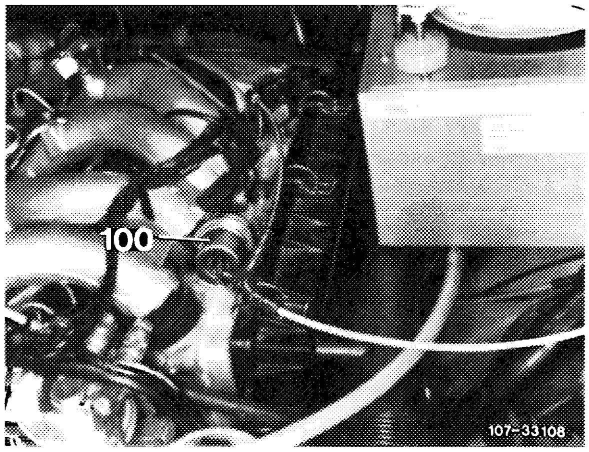
Testing full throttle on microswitch (S27/3) Model Years 1986 through 1988	
Engine off. Pull connector from microswitch. Test for continuity with ohmmeter between pin 1 and 5. At idle: ∞ Ω At full throttle: 0 Ω	
OK	Not OK

Replace microswitch (S27/3).

End of test.



Testing speed shut-off
Model Years 1986-I 988



Connect vacuum tester with Y-fitting to actuator (100) for vacuum control flap. Drive vehicle on dynomometer or open road in 5th gear or “D” at partial load.
Read vacuum at the speeds listed below.

Model Year 1986

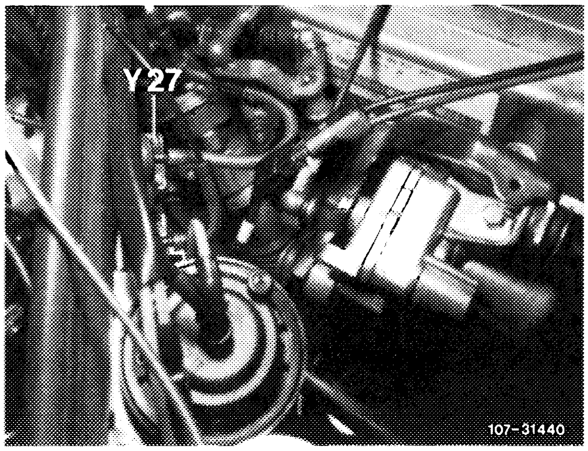
below 56 ± 5 mph:	approx.	700 mbar
above 56 ± 5 mph:	approx.	0 mbar

Model Years 1987, 1988

below 54 mph:	approx.	150 mbar
above 54 mph:	approx.	0 mbar

OK	Not OK

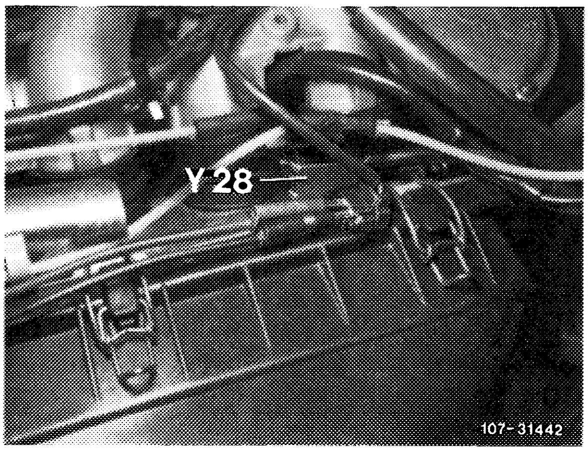
Model Year 1986
Pest electrical activation of switchover valve (Y27). For this purpose, connect multimeter to connector (arrow) of switchover valve and repeat test drive.



If voltage (approx. 12 V) is indicated at speeds above 56 mph (90 km/h), test electrical activation of switchover valve according to wiring diagram. Replace defective parts, if required.

If there is no voltage, replace switchover valve.

Model Years 1987, 1988
Test electrical activation of switchover valve (Y28). For this purpose, connect multimeter to plug of switchover valve and repeat test drive.



If voltage (approx. 12 V) is indicated at speeds above 54 mph (87 km/h), test electrical activation of switchover valve according to wiring diagram. Replace defective parts, if required.

If there is no voltage, replace switchover valve.

End of test.

Testing microswitch (S27/6)
Model Year 1989

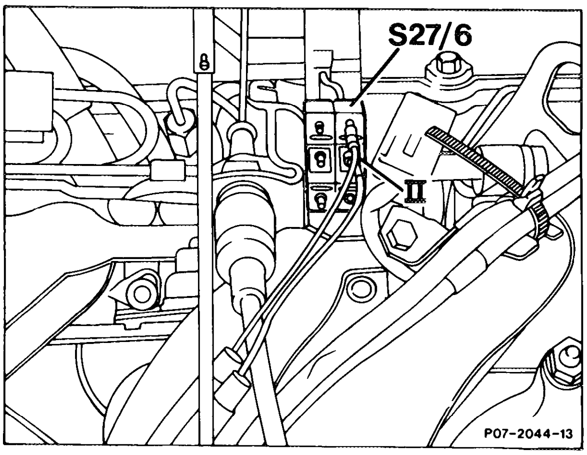
Engine off. Pull off connector on microswitch (S27/6) and test for continuity with ohmmeter between pin 2 and 4 and/or pin 1 and 3.

At idle : 0 Ω
At full throttle: ∞ Ω

OK	Not OK

Not OK → Replace microswitch (S27/6).

End of test.



Testing full load contact on microswitch (S27/6) Model Year 1989

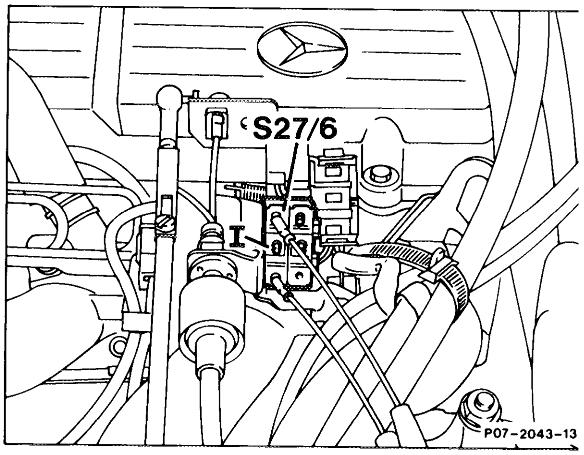
Engine off. Pull off connector on microswitch (S27/6, pos. I). Test for continuity with ohmmeter between pin 1 and 5.

At idle: ∞ Ω
At full throttle: 0 Ω

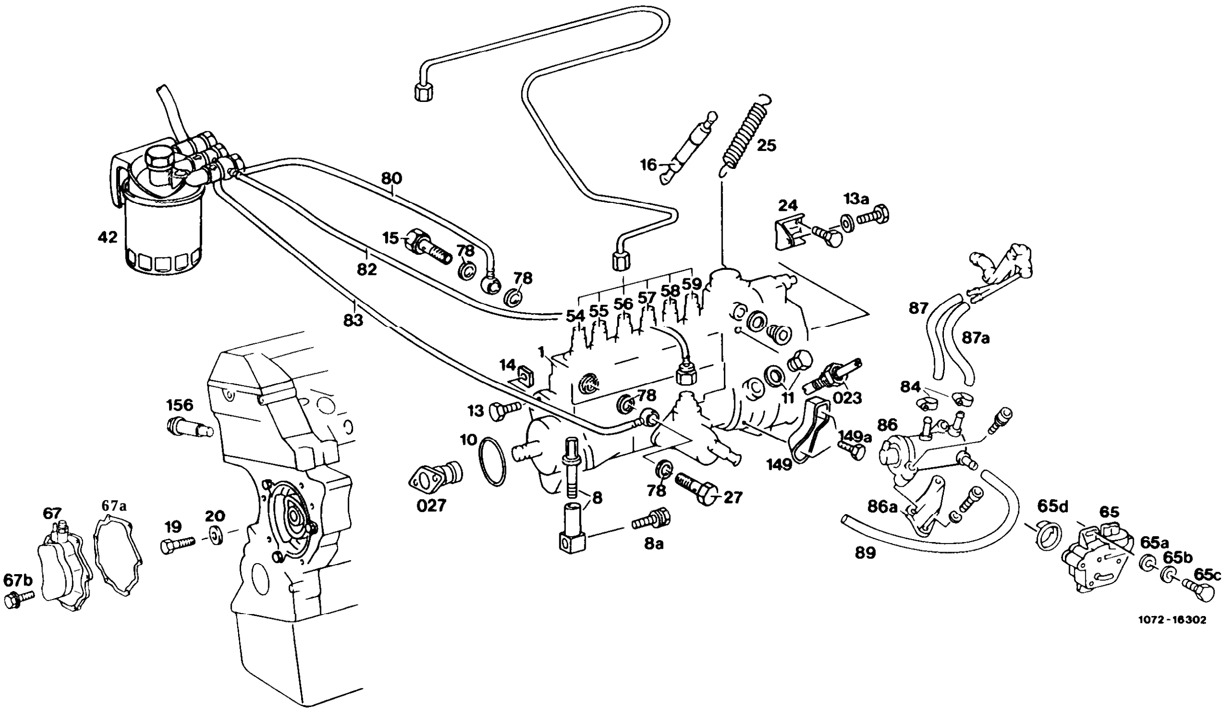
OK	Not OK

Not OK → Replace microswitch (S27/6).

End of test.



07.1-200 Removal, installation of injection pump

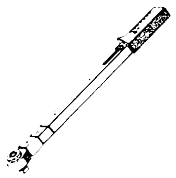


Noise capsule lower part	remove, mount (94-0050).
Belt tensioning device	remove, reinstall (13340).
Fan shroud and fan	remove, reinstall (20-310/335).
Vacuum pump (67)	remove, reinstall (43-610). Gasket (67a), replace.
Adjusting element of cruise control	remove, reinstall (54541).
Assembly cage	remove, reinstall Special tool 601 589 05 14 00 Note: Assembly cage deleted on all engines as of 09/89 (see 07.1-240).

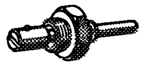
EXIT

Central mounting bolt (19)	remove, reinstall **'@left-hand thread"** Tightening torque 40-50 Nm.
Turn crankshaft in direction of rotation	to -15° ATDC of 1 st cylinder.
Chain tensioner (156)	remove, reinstall, tightening torque 80 Nm (05-310).
Control damper (16)	remove, reinstall (only manual transmission).
Injection lines (54-59)	on injection pump disconnect, connect, tightening torque 10-20 Nm., special tool 000 589 770 300
Fuel lines (80, 82, 83)	disconnect, connect.
Sealing rings (78)	replace.
Vacuum lines on stop unit	remove, fit.
Couplings on electromagnetic actuators	disconnect, connect.
Control linkage	disconnect, connect.
Vacuum control valve (65)	remove, reinstall, adjust (07.1-l 70).
Mounting bolts (13 and 13a)	remove, reinstall, tightening torque 20-25 Nm.
Combination screw (8a)	loosen.
Fuel thermostat (86)	remove, reinstall.
Injection pump	pull out to the rear while counterholding injection timing device.
O-ring (10)	replace, lubricate with oil for injection pump installation.
Check if engine	is positioned on -15° ATDC of 1 st cylinder, correct if necessary. **Caution!** Turn engine only in direction of rotation.
Screw plug (11)	remove.
Injection pump	turn in removed condition with splined wrench (027) and lock with locking bolt (023).
Start of delivery	check (07.1-l 12), adjust if necessary (07.1-l 17).

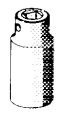
Special tools



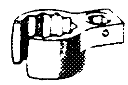
001 589 66 21 00 00



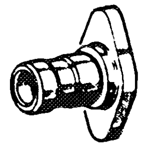
601 589 05 21 00 **07**



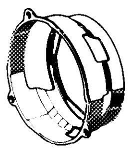
001 589 65 09 00 **03 07 32**



000 589 77 03 00



601 589 00 08 00



601 589051400 **07**

Note

Until the production breakpoints shown, a gasket with oil pocket must be installed when replacing the gasket (67a) of the vacuum pump.

As of the production breakpoint, a gasket without an oil pocket is installed.

Engine model design.	Transmission	As of engine end no.
602.911	manual	019187
	automatic	004738

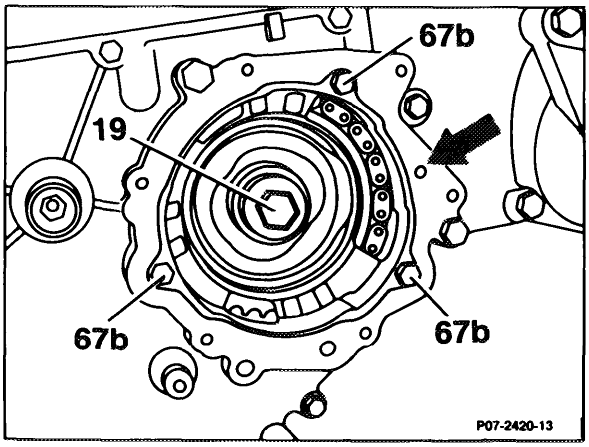
EXIT

Removal, installation

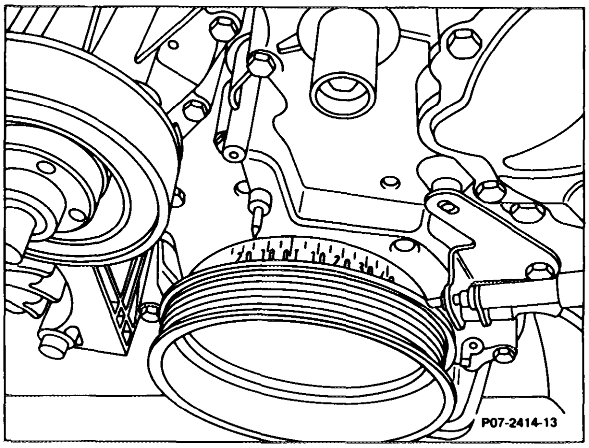
1 Remove assembly cage (arrow).

2 Loosen central mounting bolt (19), unbolt and hold crankshaft against rotation.

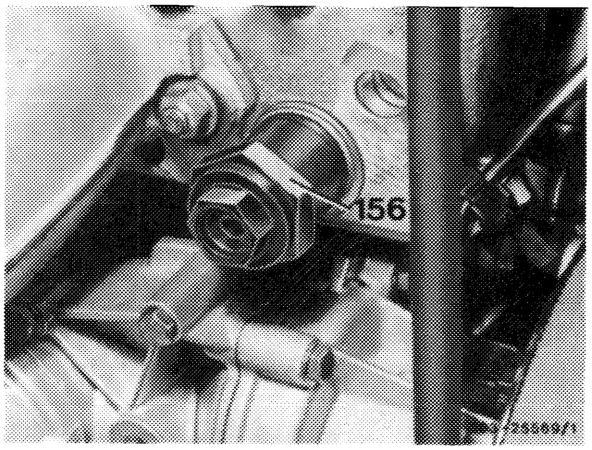
Caution!
LEFT-HAND THREAD



3 Turn crankshaft in direction of rotation to -15" ATDC of 1 st cylinder.

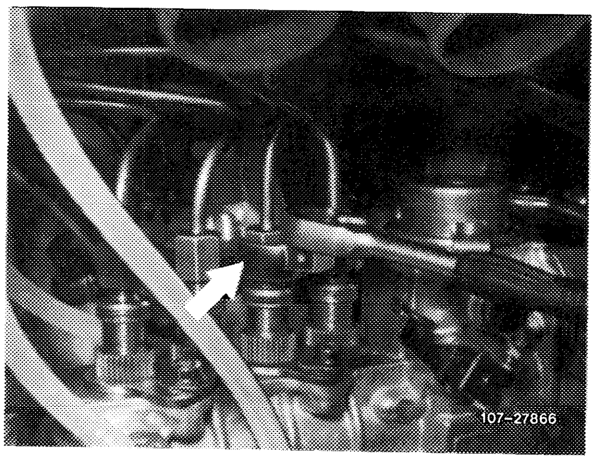


4 Remove chain tensioner (156) (05310).



Socket wrench insert
Special tool 001 589 65 09 00

5 Disconnect injection and fuel lines from injection pump.



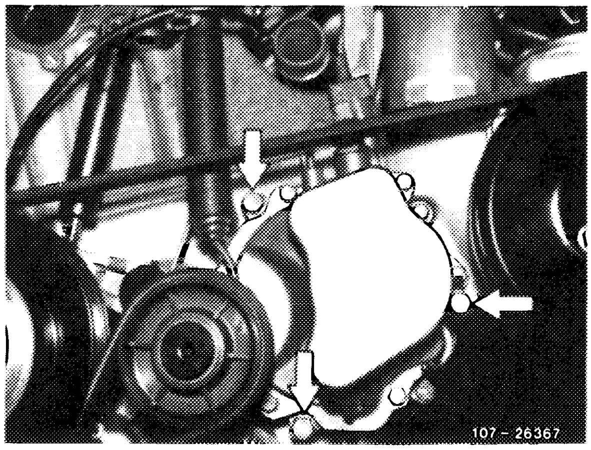
Socket wrench insert (arrow)
Special tool 000 589 77 03 00
with 1/4" ratchet

6 Pull off vacuum lines for idle speed increase, stop unit and vacuum control valve vacuum unit. Pull off ELR double couplings with electromagnetic actuators.

7 Disconnect control linkage on control lever as well as shock absorber and spring.

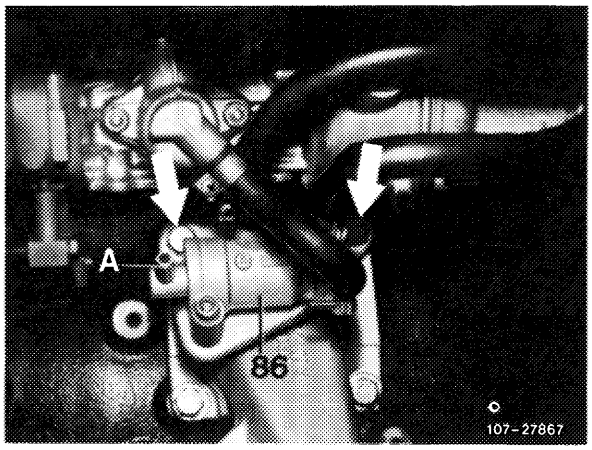
8 Remove vacuum control valve (only with automatic transmission or EGR).

9 Remove mounting bolts (arrows) and install bracket.

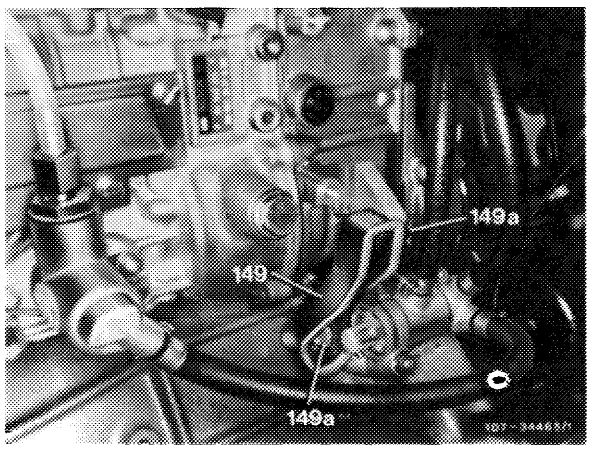


10 Completely remove fuel thermostat (86) by removing bolts (arrows).

A = Supply from fuel tank

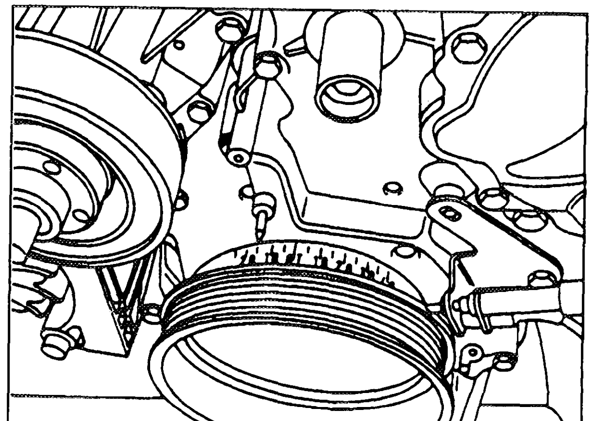


11 Pull injection pump out to the rear while holding the injection timing device.

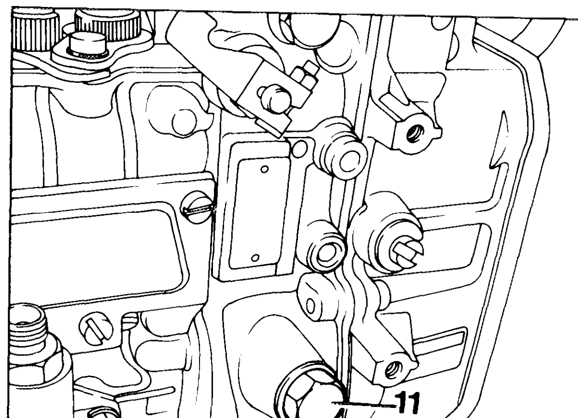


12 Check if the engine is positioned at -15° ATDC of 1 st cylinder, correct if necessary.

Caution!
Turn engine only in direction of rotation with the installed centering sleeve!

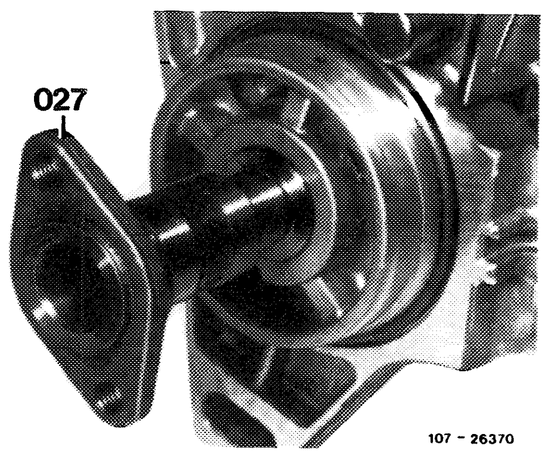

P07·2414·13

13 Remove screw plug (11).



P07-2240-13

14 Turn injection pump with splined wrench (027) on the injection pump camshaft until the lug of the governor is visible in the hole, then insert locking bolt (023) in this position and engage in the lug, tighten by hand.

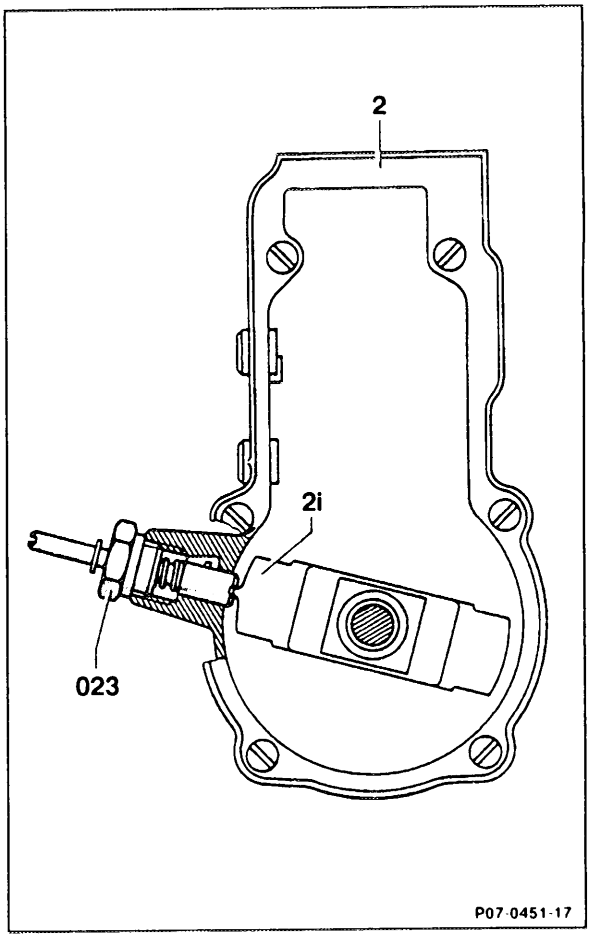


107 - 26370

027 Splined wrench
Special tool 601 589 00 08 00

EXIT

Caution!
Remove locking bolt (023) after installation of the injection pump to avoid damage to the injection pump during starting.



023 Locking bolt
Special **tool601** 589 05 21 00

15 Reassemble engine in reverse order.

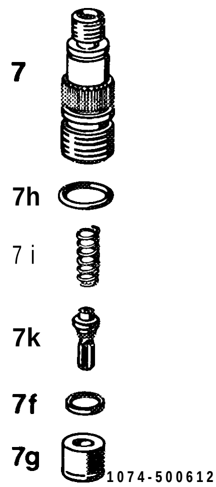
Note
Bleeding of the injection system is automatic when starting the engine.

16 Check start of delivery 07.1-I 12, adjust if required 07. I-I 17.

17 Install, adjust vacuum control **valve** 07.1- 170.

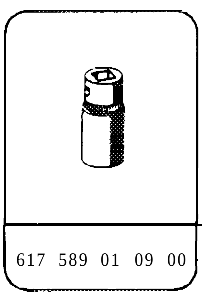
EXIT

07.1-210 Replacing delivery valve seal



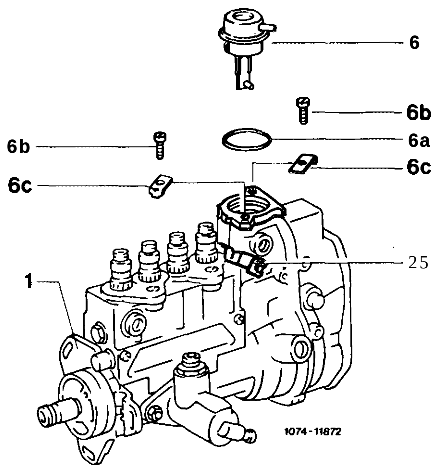
Air cleaner complete	remove, reinstall (09-400).
Delivery valve holder (7)	remove, reinstall, tightening torque 35 Nm, special tool 617 589 01 09 00.
Compression spring (7i) Copper sealing ring (7f)	replace.
Delivery valve (7k)	rinse in fuel before installation.
Delivery valve carrier (7g)	observe installation position.
O-ring (7h)	lubricate prior to installation.

Special tool



EXIT

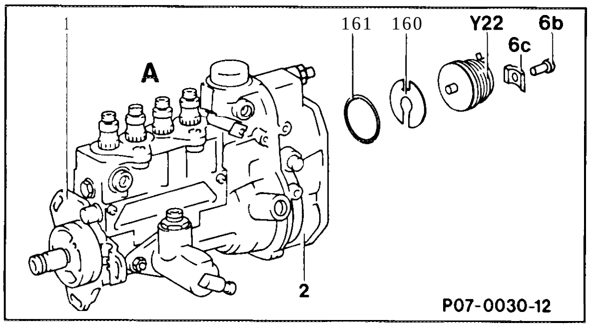
07.1-220 Replacing vacuum unit

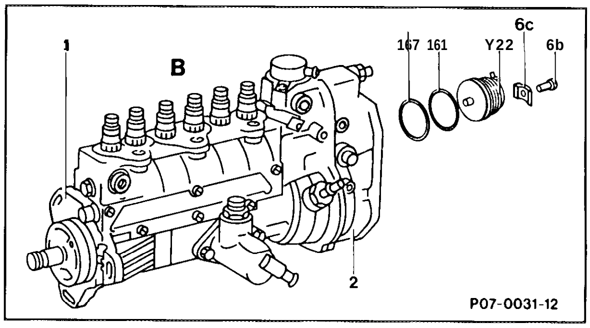


Air cleaner complete	remove, reinstall (09-400).
ADA unit	remove, reinstall (engines with EGR).
Screw (6b)	remove, reinstall. For TORX screws use wrench "T30".
Bracket (6c)	remove, reinstall.
Vacuum unit (stop) (6)	slightly raise during removal, tilt backward to the engine side and pull out.
O-ring (6a)	remove, reinstall.
Emergency stop lever (25)	push during installation and allow vacuum unit connecting rod to engage in the toggle of the emergency stop lever.

EXIT

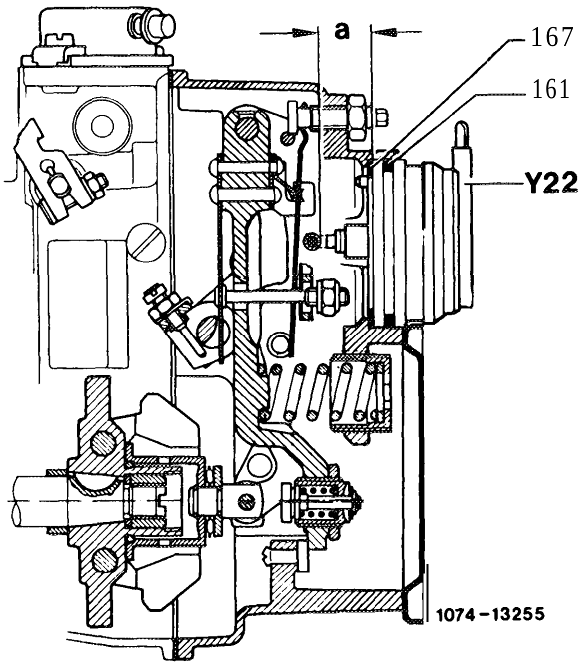
07.1-225 Replacing electromagnetic actuator (ELR)





A	1st version
B	2nd version
1	Injection pump
2	Governor
160	Intermediate plate

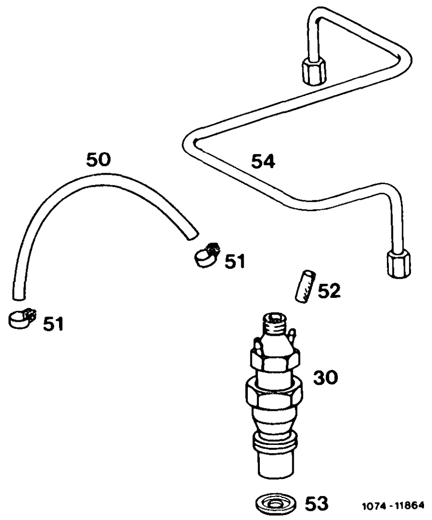
Air cleaner complete	remove, reinstall (09-400).
Screw (6b)	2 off remove, reinstall. For TORX screws use wrench "T30".
Bracket (6c)	2 off remove, reinstall.
Electromagnetic actuator (Y22)	remove, reinstall, electrical connection must face up.
O-ring (161)	replace.
Shim (167) (no replacement part)	for adjusting dimension “a”. (During repairs the previous shims must be reinstalled to ensure that the dimension “a” is correct).



Dimension "a"
14.6-15.7 mm

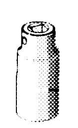
EXIT

07.1-230 Removal and installation of injectors



Fuel bleed hose (50)	pull off, fit.
Plug (52)	material (fabric),
Injection line cylinder no. 1(54)	10-20 Nm (reference value).
Injection nozzle (30)	70-80 Nm, special tool 001 589 65 09 00, with inclined injection 30 Nm.
Nozzle plate (53)	replace

Special tool



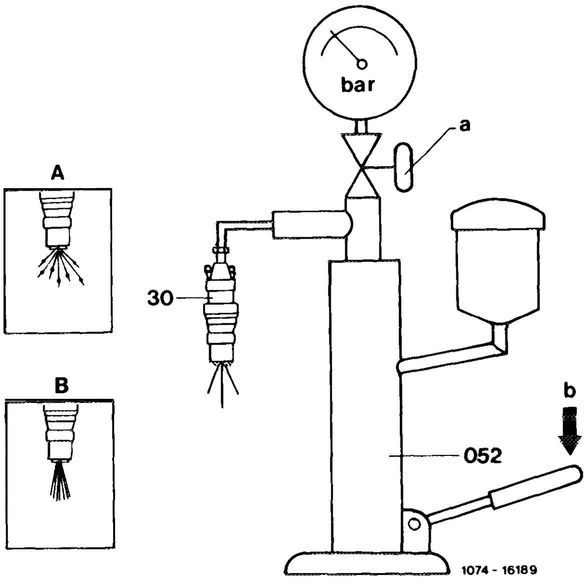
001 589 65 09 00
03 07 32

EXIT

07.1-231 Checking injectors

Injection nozzles removed 07.1-230

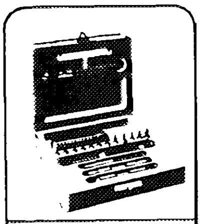
A. Facet-type pintle nozzle
B. Hole-type pintle nozzle



Injection nozzle **(30)**	on tester (052) vigorously pump through 5 times, while keeping valve "a" closed.
Buzzing test	**slowly** actuate hand lever "b" approx. 1 stroke per second.
Spray pattern test	With rapid short strokes, approx. 2 strokes per second, the spray pattern should be closed and should break off well. A - Spray pattern frayed "poor" B - Spray pattern closed "good"
Pre-spray	check (only with hole-type pintle nozzles).
Shut-off pressure or opening pressure	check by opening valve "a" and slowly operating hand lever "b" at least 1 stroke per second. **Set value:** 115-125 bar with new nozzles, mtn. 100 bar with used nozzles.

EXIT

Special tool


000 589 00 68 00

Commercially available tools

Tester **EFEP 60 H**	**e.g.** Bosch, **O-7000** Stuttgart Order no. 0 **681 200 502**
Cleaning needle 0.18 mm dia.	e.g. Bosch, D-7000 Stuttgart Order no. KDEP 2900/4

⚠ **Warning**

Use only clean test oil or filtered diesel oil for testing. On no account should the hand be brought in contact with the spray of a nozzle during testing. The spray enters deeply and destroys the tissue. The fuel entering the blood stream may lead to blood poisoning.

Production breakpoint: August 1989

Model	Engine	Engine end no. Manual transmission	Engine end no. Automatic transmission
201.126	602.911')	082780	016395
Identification	1) 2 green color dots 2) 2 violet color dots		

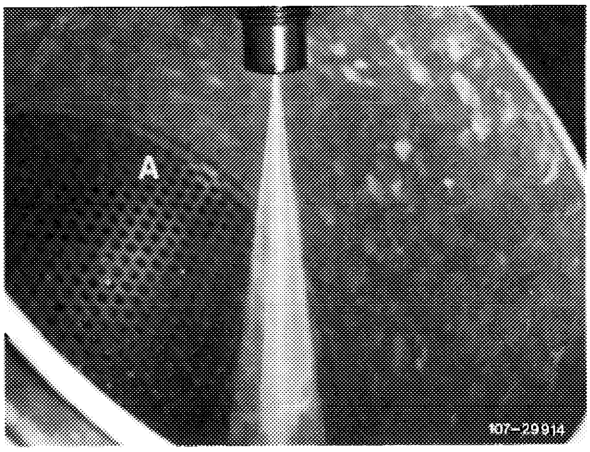
Since August 1989 engine 602 has been equipped with finely ground injection nozzles.

A. Facet-type pintle nozzle

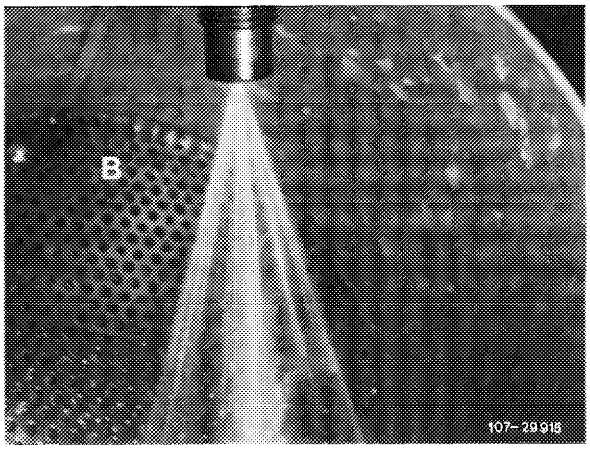
Checking

1 Vigorously pump injection nozzle 5 times with the tester. Then **check buzzing of the nozzle** by slowly actuating the hand lever (approx. 1 stroke per second).

2 **Checking spray:** With short rapid part strokes (at least 2 strokes per second) the spray pattern should be rather closed and break off well.



A Closed spray pattern, well atomized



B Broken spray pattern, too wide and frayed

3 **Checking injection pressure:** Set value 115-125 bar with new nozzle, at least 100 bar with used nozzles.

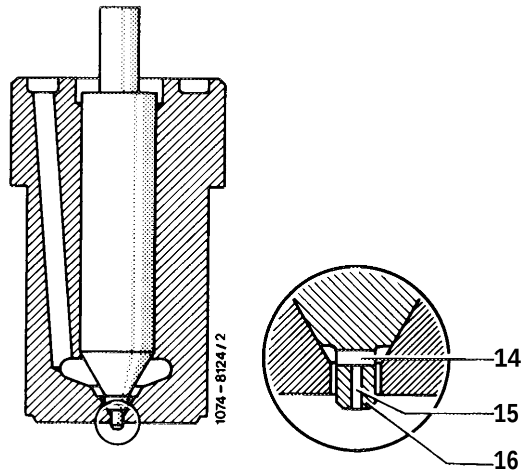
Slowly move down the hand lever (at least 1 stroke per second) and read injection pressure off pressure gauge.

Shut-off valve must be open for this test.

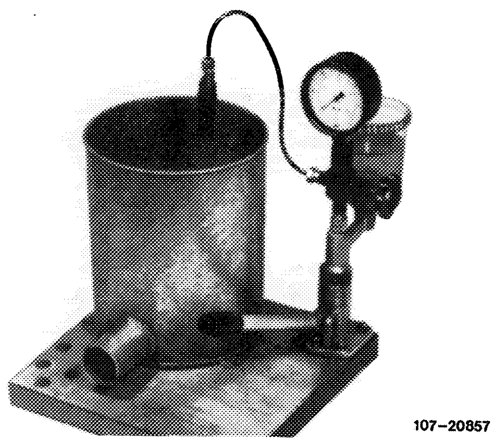
EXIT

B. Hole-type pintle nozzle

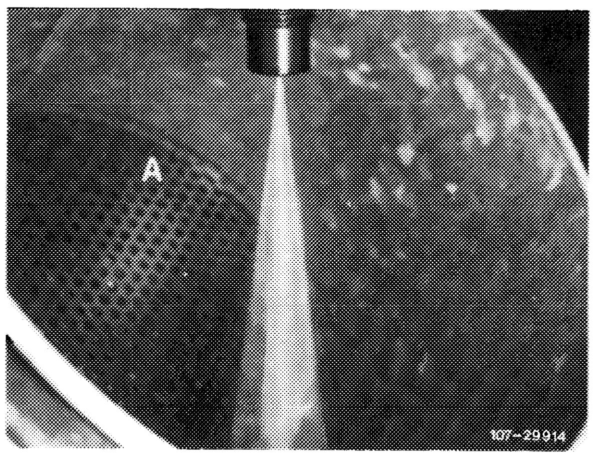
1 Before checking: Ensure that the longitudinal bore (15) is unobstructed by means of a cleaning needle 0.18 mm dia.



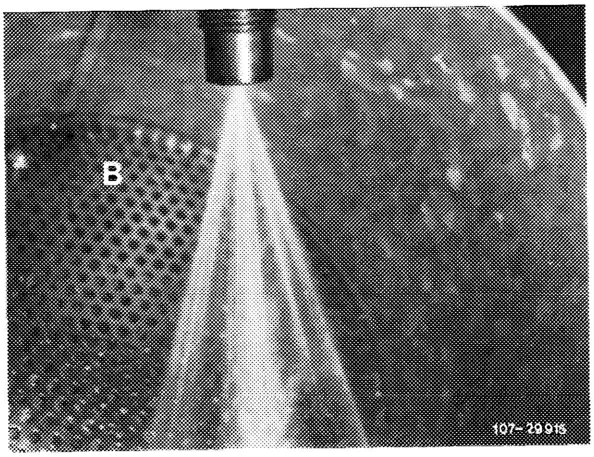
2 Vigorously pump injection nozzles 5 times on tester. After this carry out **buzzing** test by slowly actuating hand lever (at least 1 stroke per second).



3 **Spray test:** With short rapid part strokes (approx. **2** strokes per second) the spray should be rather closed and break off well.

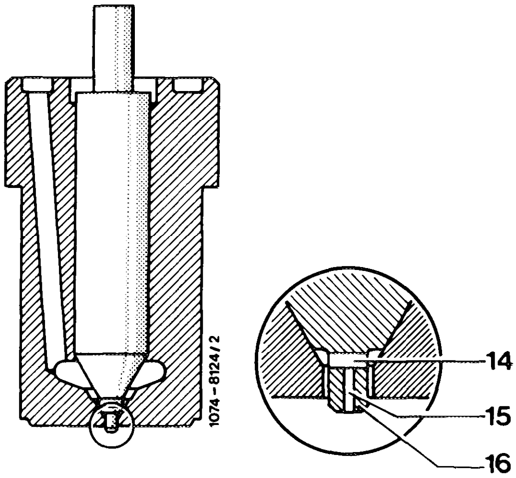


A Closed spray pattern, well atomized



B Broken spray pattern, too wide and frayed

4 Create **pre-spray** by slowly moving the hand lever down (1 stroke 4-6 s).



A vertical string-type spray pattern should emerge from the center bore (15).

Note
On new nozzles the pre-spray is very difficult to create, therefore check longitudinal bore with cleaning needle 0.18 mm dia. for open passage.

5 Checking injection pressure:

Set value: 115-125 bar with new nozzle, at least 100 bar with used nozzle.

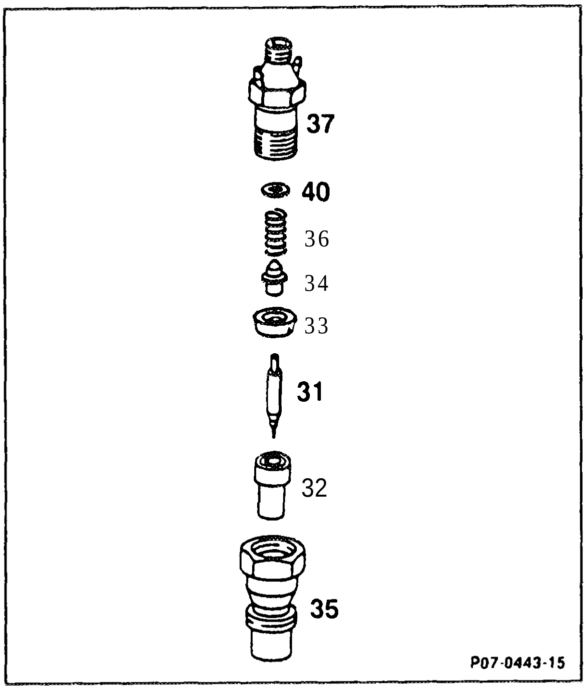
Slowly move hand lever down (approx. 1 stroke per second) and read injection pressure off pressure gauge.

Shut-off valve must be open for testing.

EXIT

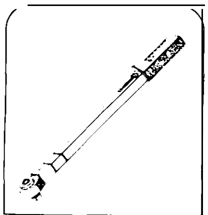
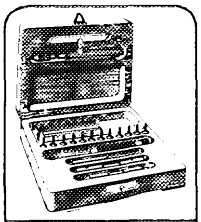
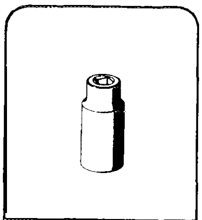
07.1-232 Reconditioning injectors

Injectors removed (07.1-230).



injector needle (31)	Visual and sliding test; on hole-type pintle injectors clean center and longitudinal bores; install in the same injector body.
Injector body (32)	remove combustion residue.
Intermediate plate (33)	polish on surface plate.
Thrust pin (34)	Tip must face to the upper part.
Injector clamping nut (35)	70-80 Nm.
Compression spring (36)	
Retaining body (37)	clamp in protective jaws.
Steel shim (40)	adjust to injection pressure. Set value 115-1 25 bar for new injector or injector to be newly adjusted, at least 100 bar for used injector. Depending on the shim thickness higher or lower injection pressure. 0.05 mm produce a pressure differential of approx. 3 bar.

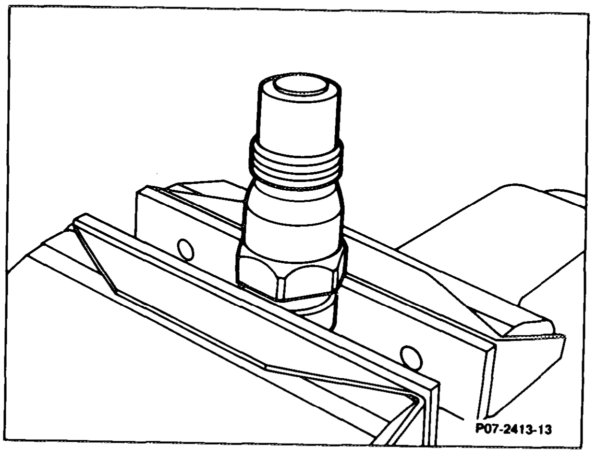
Special tools

		
001 589 66 21 00 00	000 589 00 68 00	001 589 65 09 00

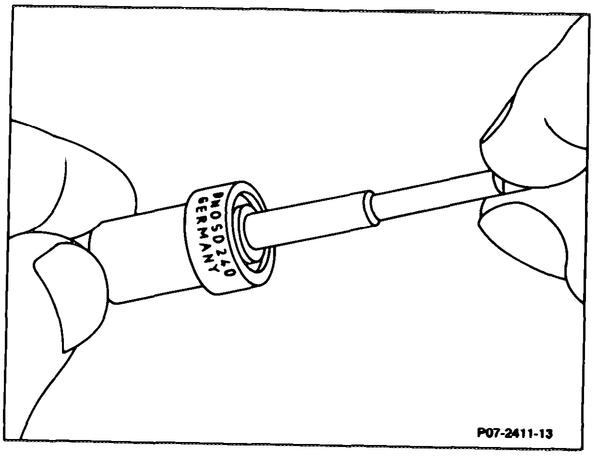
Commercially available tool

Cleaning needles 0.18 mm dia.	e.g. Bosch, D-7000 Stuttgart Order no. KDEP 2900/4

Reconditioning

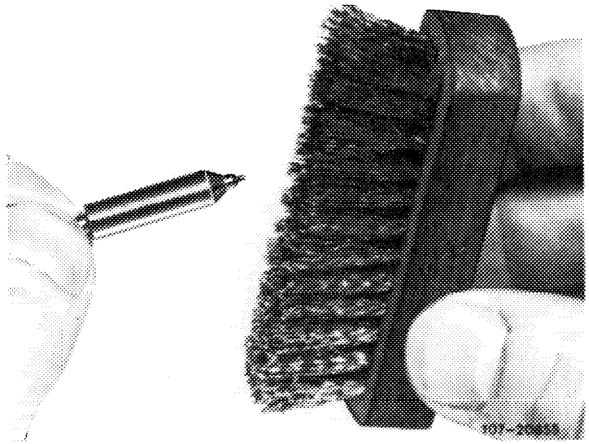


1 Dismantle by placing retaining body with protective jaws in the vise so that the bleed fuel connections are not damaged.



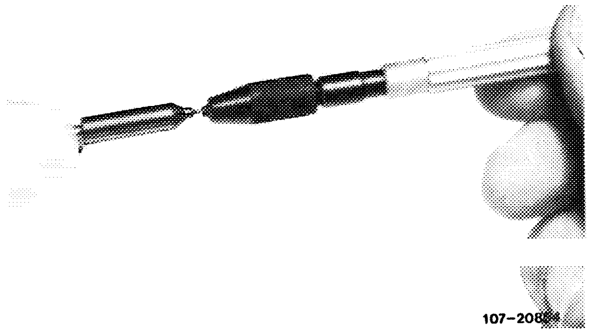
2 Clean, remove combustion residue on injector needle seat with the cleaning miller.

Clean injector needle and injector body with brass brush.



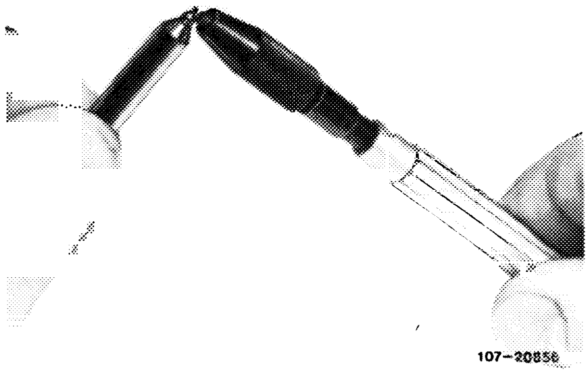
On the hole-type pintle injector additionally clean longitudinal and transverse bores.

Clean longitudinal bore with cleaning needle 0.18 mm dia.



Longitudinal bore

Clean transverse bore with cleaning needle 0.35 mm dia.



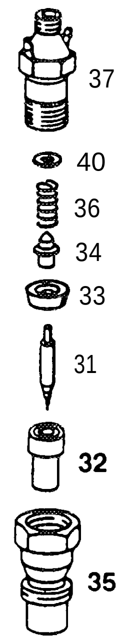
Transverse bore

3 Visual and sliding test.

Immerse injector in filtered diesel fuel. With the injector body held vertically, the injector needle should slide towards the injector seat by its own weight.

EXIT

4 Polish intermediate plate (33) on both sides on the surface plate.



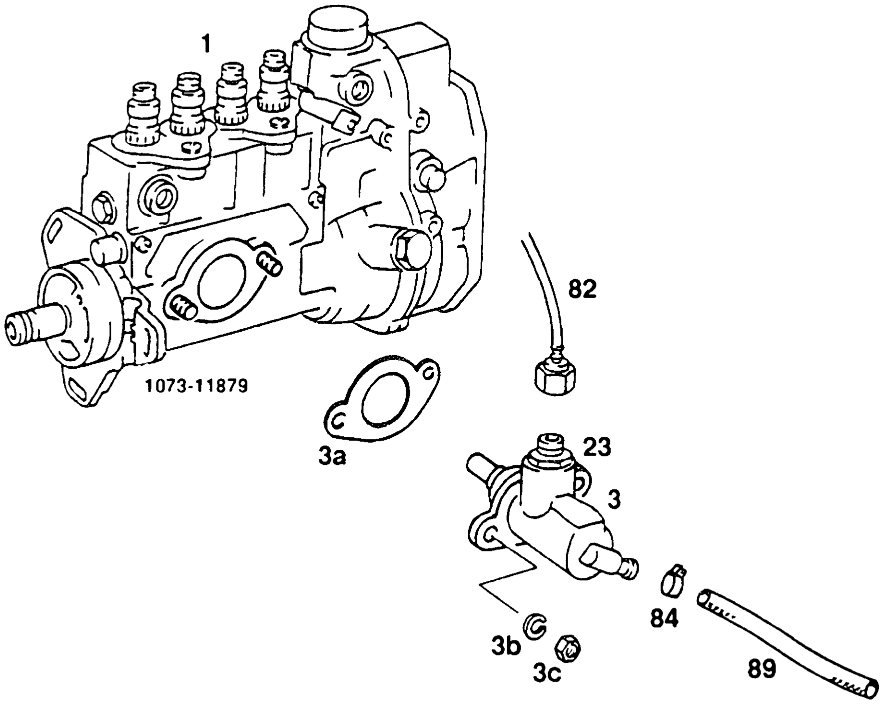
P07-0443-15

5 Assemble injector holder with injector. Depending on the shim thickness (40) higher or lower injection pressure; 0.05 mm correspond to approx. 3 bar pressure differential.

6 Check function of injector (07.1-231), adjust if required.

07.1-235 Removal and installation of fuel pump

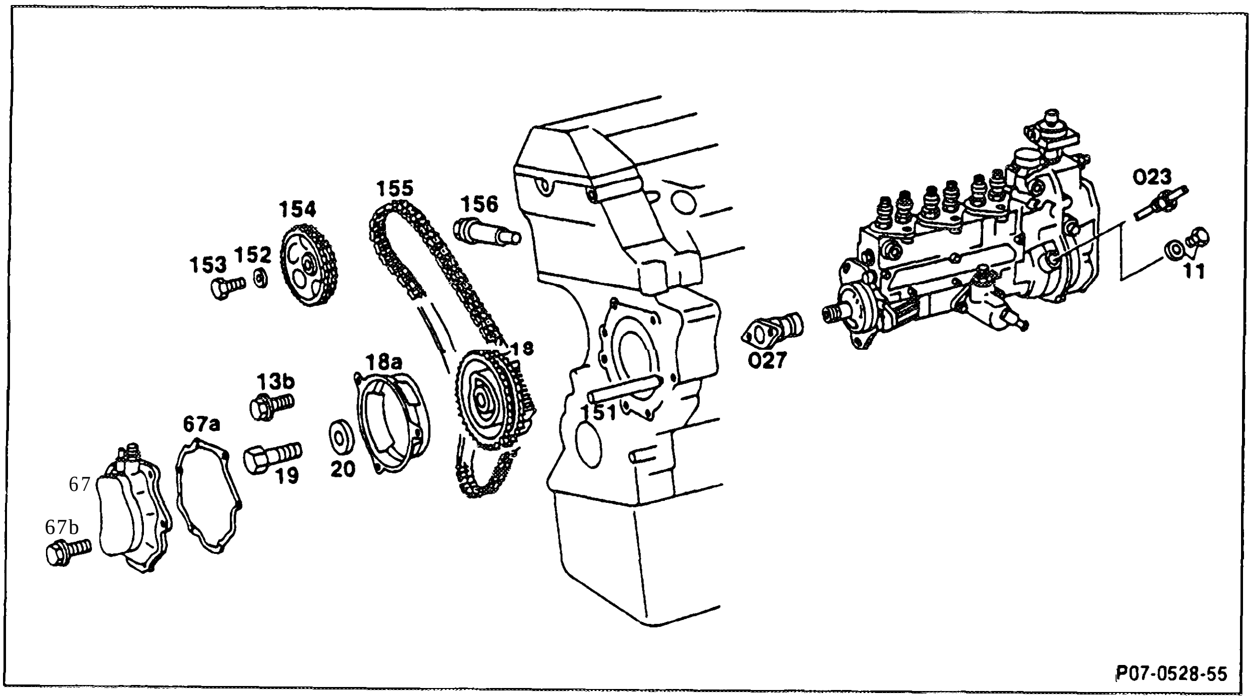
Air cleaner cover removed (09-400).



Clamp (84)	open, close.
Suction line (89)	pull off, fit.
Supply fuel filter (82)	disconnect, connect.
Nut, 2 off (3c)	remove, reinstall.
Washer, 2 off (3b)	remove, reinstall.
Fuel pump (3)	collect engine oil running out during removal.
Gasket (3a)	replace
Delivery outlet (23)	
Injection pump (1)	

EXIT

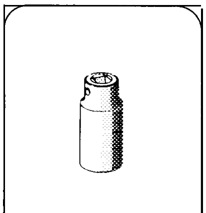
07.1-240 Removal and installation of injection timing device



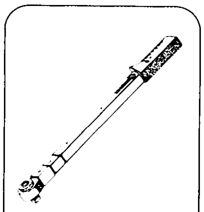
Vacuum pump (67)	remove, reinstall (43-610).
Gasket (67a)	replace. **Caution!** **2** versions, see table.
Combination bolt (67b)	dismount, mount.
Cylinder head cover	remove, install.
Camshaft sprocket (154) and injection timing device (18)	remove, reinstall, with paint mark relative to timing chain (155).
Central mounting bolt (19)	remove, tightening torque 40-50 Nm. **Caution!** Left-hand thread.
Washer (20), bolt - camshaft sprocket (153)	remove, tightening torque 45 Nm.
Washer - camshaft sprocket (152), engine	set to 15° ATDC.
Chain tensioner (156)	remove, reinstall (05-310), tightening torque 80 Nm.

Camshaft sprocket (154)	remove, reinstall.
Locking pin (151)	remove with threaded pin part no. 116 589 01 34 00 and impact puller part no. 116 589 20 33 00.
Assembly cage (18a)	remove, reinstall. **Note:** The assembly cage (18a) and the fixing bolts (13b) are deleted on the engines, see table below.
Timing chain (155)	with sheet metal strip (approx. 0.5 x 70 x 120) force outward and pull out injection timing device (18) with combination pliers.
Screw plug with gasket (11)	remove from injection pump (1).
Injection pump (1)	turn with splined wrench (027) and lock with locking bolt (023). **Caution!** Remove locking bolt.
Engine	manually turn 1 revolution and check TDC mark crankshaft-camshaft.
Start of delivery	check (07.1-l 12), adjust if required (07.1-117).

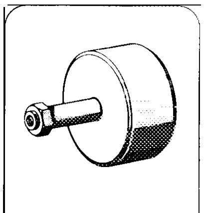
Special tools



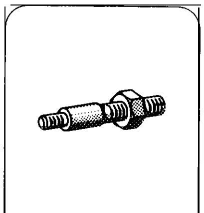
001 589 65 09 00



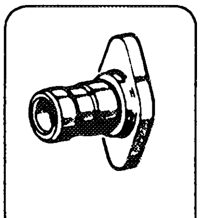
001 589 66 21 00
00



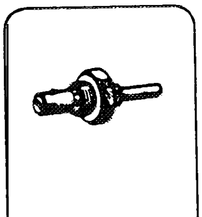
116 589 20 33 00
05



116 589 01 34 00
05



601 589 00 08 00



601 589 05 21 00

EXIT

Note

Up to the production breakpoints mentioned it is necessary to install a gasket with oil pocket when replacing the gasket (67a) of the vacuum pump.

As of the production breakpoint a gasket without oil pocket has been installed.

Production breakpoint: May 1986

Engine model designation	Transmission	
602.911	manual	019187
	automatic	004738

Note

The assembly cage (18a) and the fixing bolts (13b) on the timing device drive are deleted on the 602 engine.

Production breakpoint: September 1989 (assembly cage deleted)

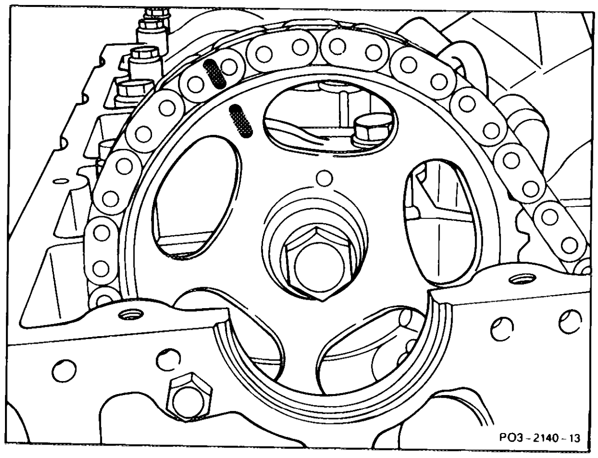
Model	Engine	Engine end no. Manual transmission	Engine end no. Automatic transmission
201.126	602.911	085358	016711

EXIT

Removal, reinstallation

1 Remove cylinder head cover.

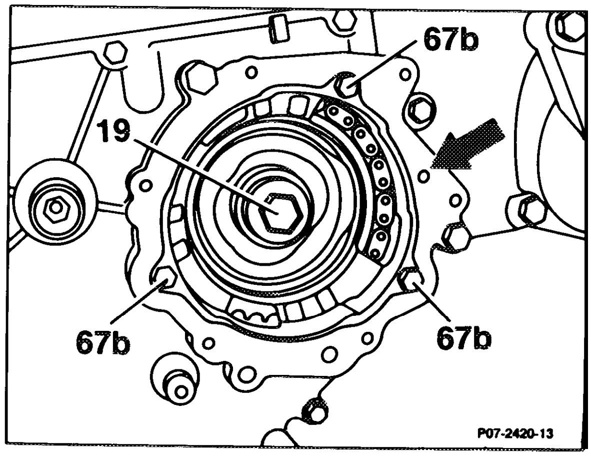
2 Mark camshaft sprocket and injection timing device with paint relative to the timing chain.



Camshaft sprocket

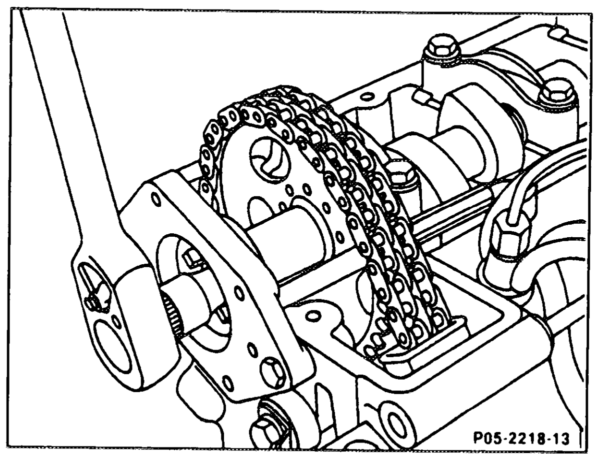
3 Remove center mounting bolt (19) by counterholding the crankshaft.

Caution!
LEFT-HAND THREAD

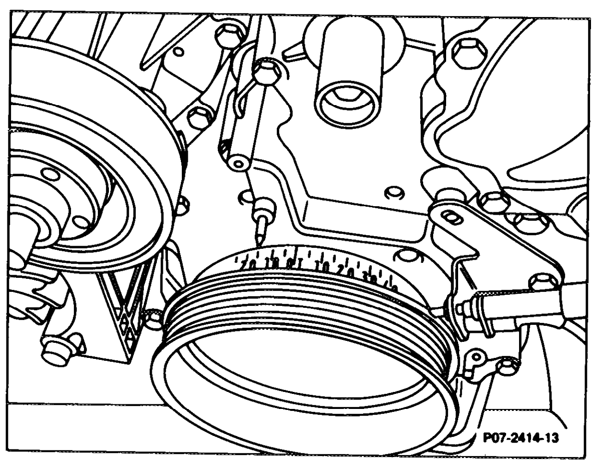


4 Remove camshaft sprocket bolt from camshaft while counterholding the crankshaft.

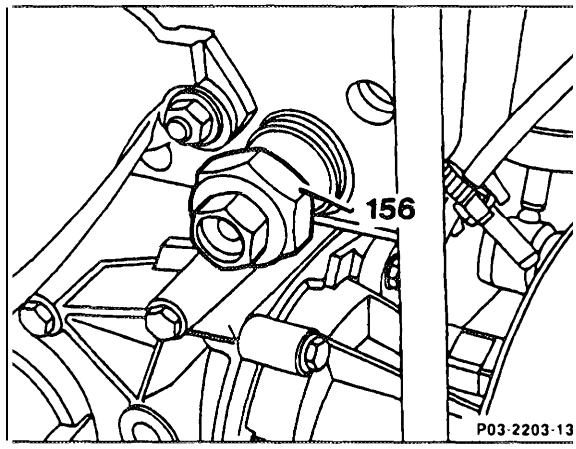
Tightening torque 45 Nm.



5 Turn engine to 15° ATDC of 1 st cylinder.



6 Remove camshaft sprocket and chain tensioner (156) to loosen the timing chain (05-310).

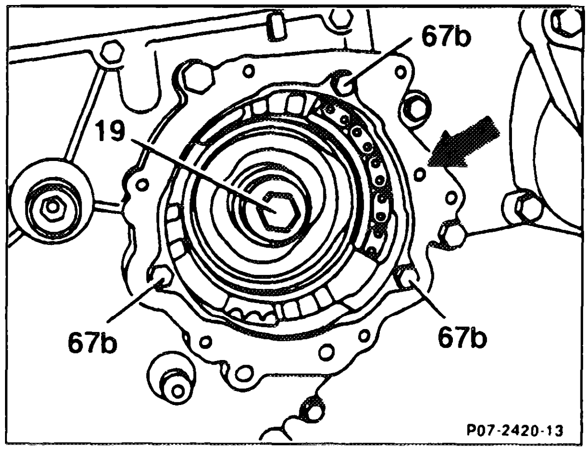


7 Pull out locking pin (arrow) and remove assembly cage.

Note

Assembly cage is deleted on all engines, see table.

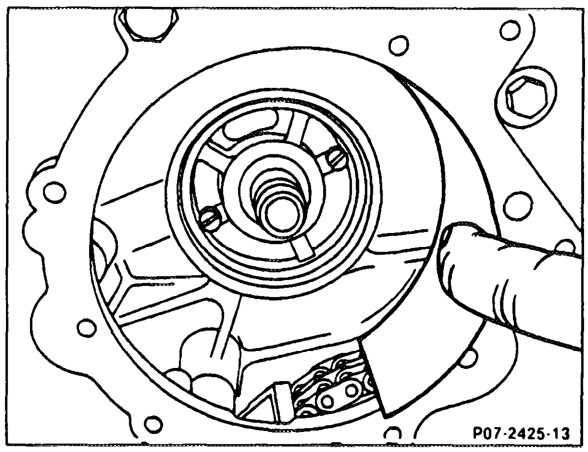
impact puller
Special tool 116 589 20 33 00
Threaded pin M 6
Special tool 116 589 01 34 00



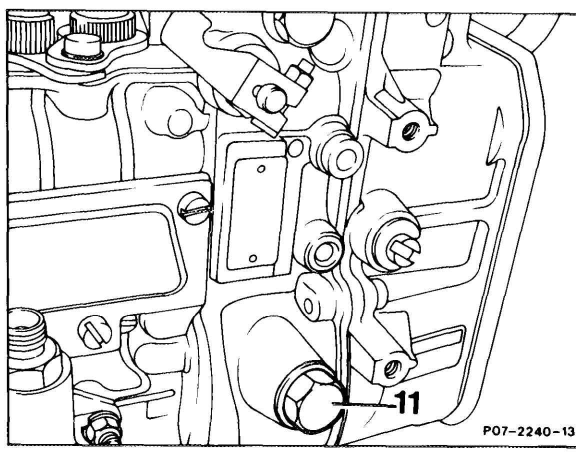
8 Force timing chain with sheet metal strip to the outside and pull out injection timing device with combination pliers.

Self-made sheet metal strip

Thickness	approx.	0.5 mm
Length	approx.	140mm
Width	approx.	70 mm

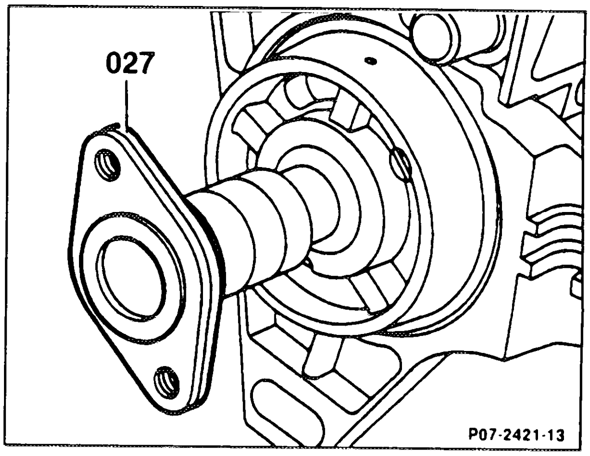


9 Remove screw plug (11).



EXIT

10 Turn injection pump with splined wrench (027) on the injection pump camshaft until the lug of the governor is visible in the bore. In this position insert locking bolt (023) and engage in the lug, then tighten union nut by hand.



027 Splined wrench
Special tool 601 589 00 08 00

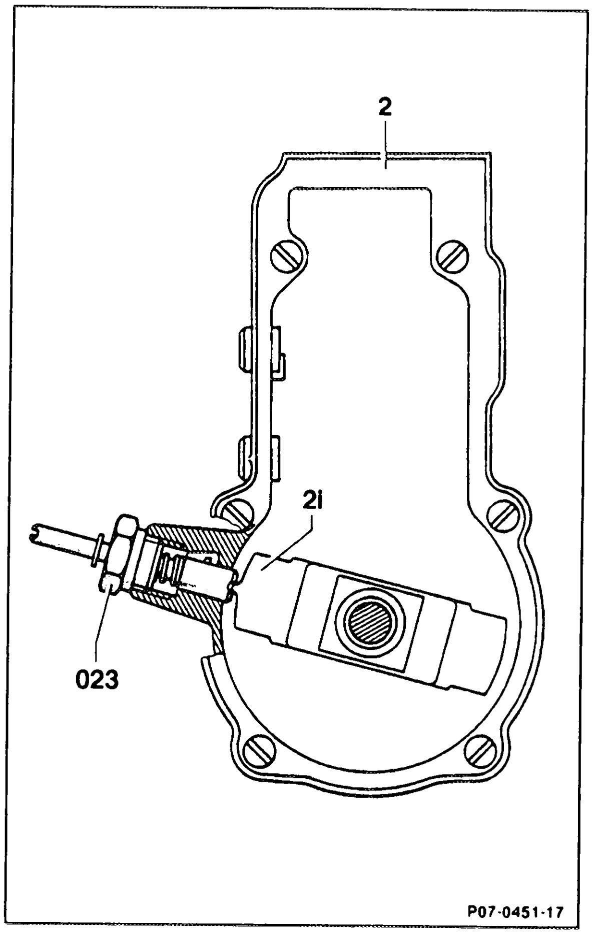
11 Install injection timing device. Secure central mounting bolt **(left-hand thread)** to 40-50 Nm (observe paint mark).

12 Remove locking bolt (023) in order to avoid damage to the injection pump during starting.

13 Reassemble engine.

14 Manually crank engine 1 revolution and recheck TDC mark of crankshaft and camshaft.

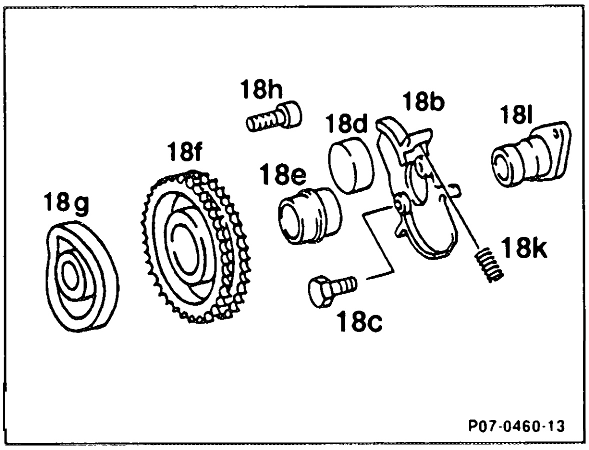
15 Check start of delivery with digital tester (07.1-l 12) and correct if required (07.1-l 17).



023 Locking bolt
Special tool 601 589 05 21 00

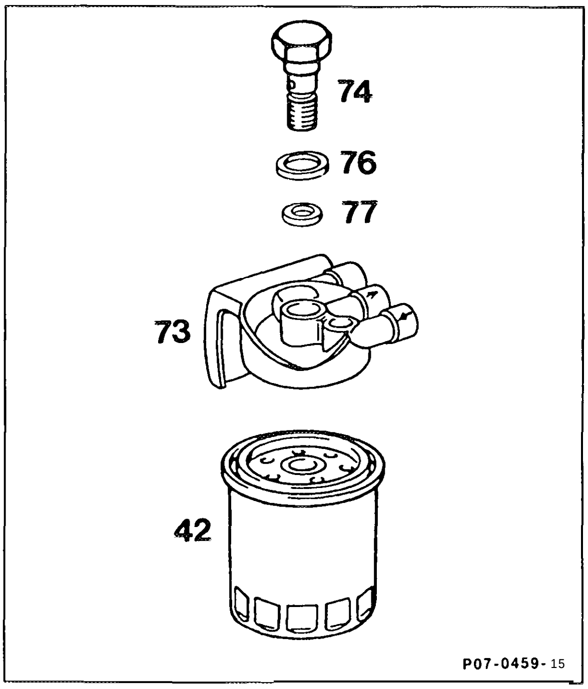
07.1-241 Reconditioning injection timing device

Injection timing device removed (07.1-240).



Bolt (18h)	2 off M 6 x 16, remove, reinstall, 15 Nm.
Drive hub (181)	remove, reinstall.
Bolt (18c)	2 off M 8 x 16, remove, reinstall, 25 Nm.
Cam (18g)	check wear.
Sprocket (18f)	check wear.
Bushing (18e)	remove, reinstall, check wear.
Segment flange (18b)	check wear.
Compression springs (18k)	2 off remove, reinstall.
Governor weights (18d)	2 off M 8 x 16 remove, reinstall, check wear.

07.1-245 Replacing fuel filter

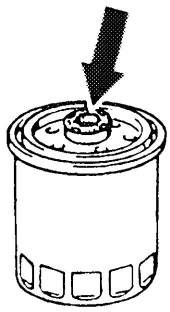


Bolt (74)	remove, reinstall.
O-ring (76)	remove, reinstall, replace.
O-ring (77)	remove, reinstall, replace.
Filter (42)	remove from the bottom, replace.
Fuel filter upper part (73)	

Note
The fuel system is self-bleeding during starting. This is due to the increased delivery rate of the fuel pump and the restrictors in the filter upper part and the injection pump.

Run engine and check for leaks.

Function diagram see 07.1-010 section "O".

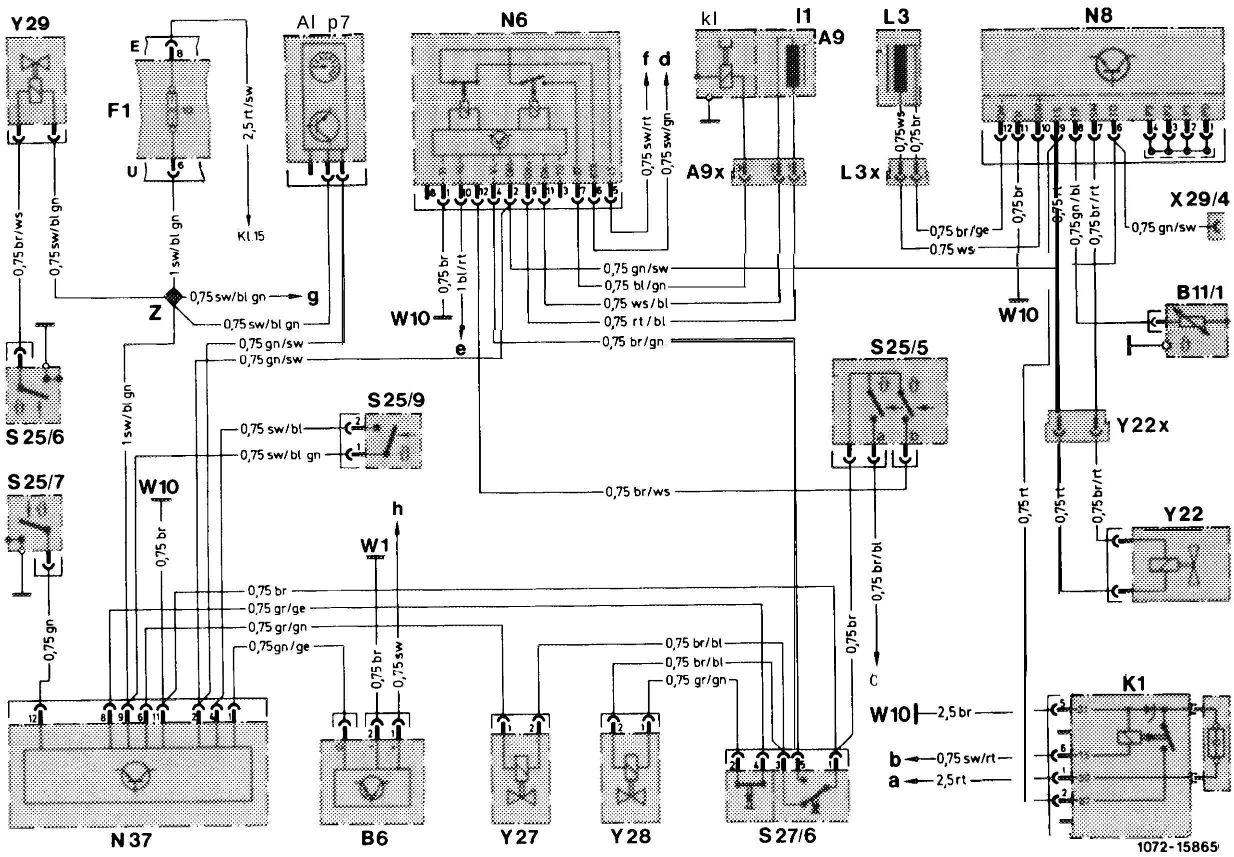


1074-12138

Fuel filter with additional sealing ring (arrow)

EXIT

07.1400 Electrical wiring diagrams



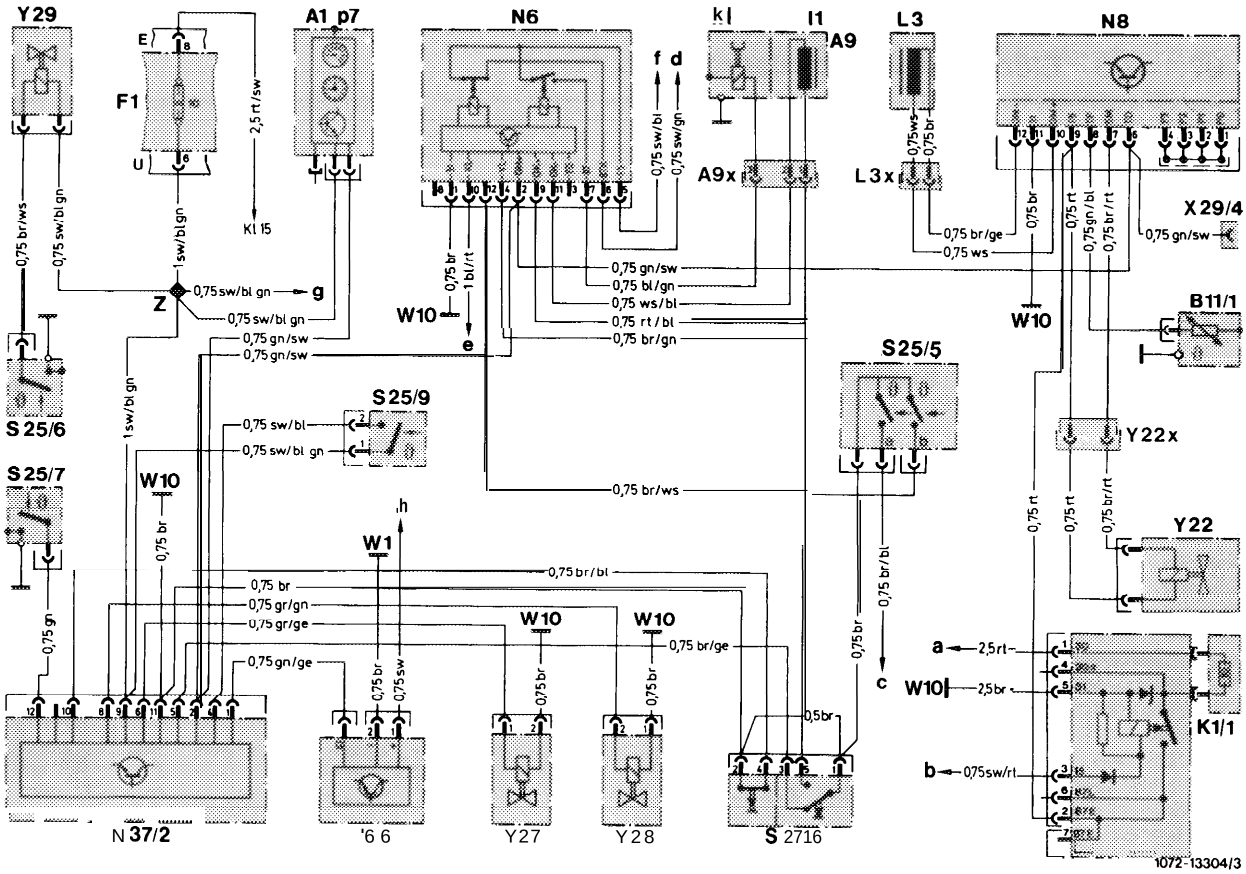
Engine 602 in model 201
model year 1986
Electrical wiring diagram exhaust gas recirculation

Al p7	Electronic clock/tachometer
A9	A/C compressor
A9 kl	Electromagnetrc coupling
A9 I1	Speed sensor
A9x	Connector A/C compressor
B6	Hall-effect speed sensor
B11/1	Coolant temperature sensor (ELR)
F1	Fuse/relay box
E	Coupling
U	Coupling
K1	Overvoltage protectton relay
L3	Speed sensor starter ring gear
L3x	Connector speed sensor starter ring gear
N6	Control unit compressor cutout
N8	Control unit ELR
N37	EGR control unit
S25/5	Temperature switch 105/115 °C
S25/6	50 °C Temperature switch
S25/7	25 °C Temperature switch (EGR)
S25/9	97 °C Temperature switch (EGR)
S27/6	Microswitch compressor cut-out (EGR
x29/4	Test coupling TD
Y22	Electromagnetic actuator (ELR)
Y22x	Connector (ELR electromagnetic actuator)
Y27	Switchover valve exhaust gas recirculation
Y28	Switchover valve vacuum control flap
Y29	Swrtchover valve vacuum transducer (automatic transmission)
Z	Soldered connector sleeve
a	Terminal block engine terminal 30/terminal 61 (battery)
b	Central electrics, coupling U jack 5
c	Relay fan, terminal 85, jack 5
d	Connector 1-pole tail lamp cable harness
e	Pressure switch (S31) AC compressor
f	Relay fan, terminal 86, jack 4
g	Washing nozzle heater left
h	Terminal block interior (X5/1)

Note

Unidentified grounding points are connected to engine ground or battery ground.

EXIT



Engine 602 in model 201

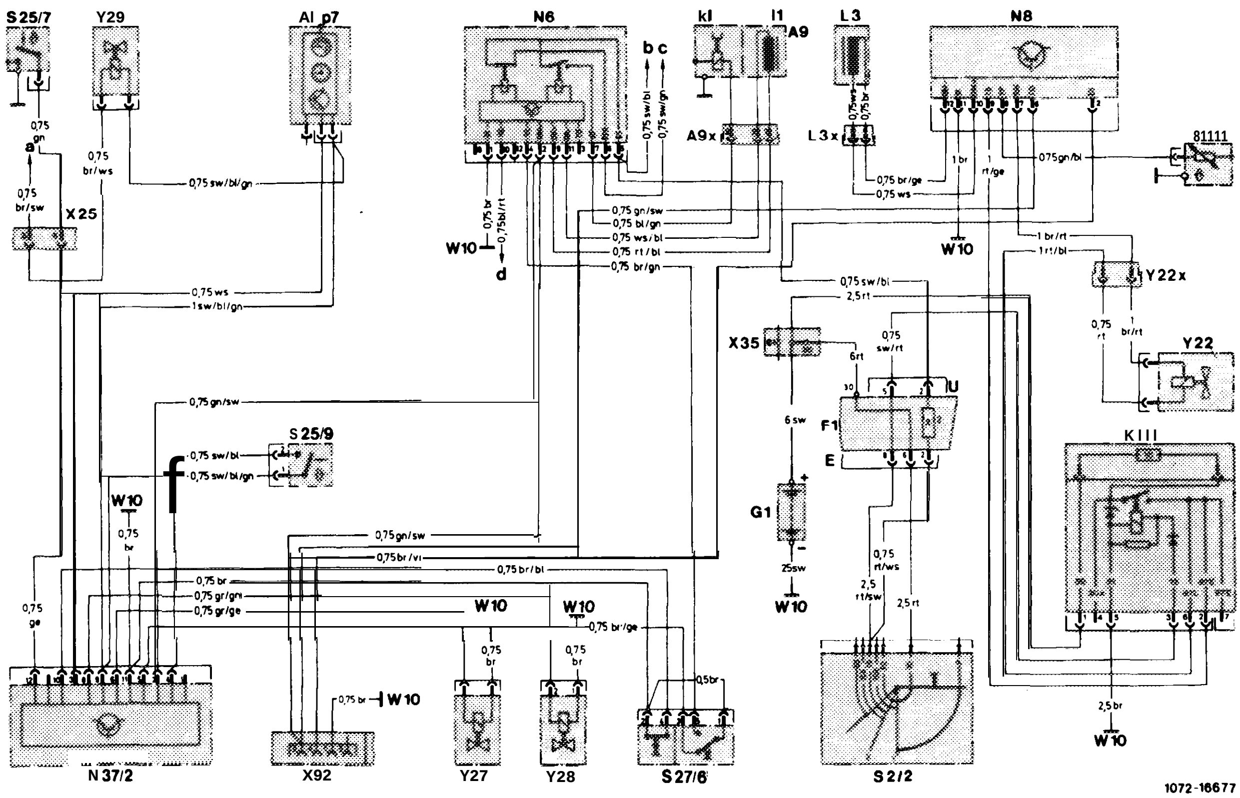
model years 1987 and 1988

Electrical wiring diagram exhaust gas recirculation

Al p7	Electronic clock/tachometer
A9	A/C compressor
A9 kl	Electromagnetic coupling
A9 I1	Speed sensor
A9x	Connector A/C compressor
B6	Hall-effect speed sensor
B11/1	Coolant temperature sensor (ELR)
F1	Fuse/relay box
E	Coupling
U	Coupling
K1/1	Overvoltage protection relay
L3	Speed sensor starter ring gear
L3x	Connector speed sensor starter ring gear
N6	Control unit A/C compressor cut-out
N8	Control unit ELR
N37/2	Control unit exhaust gas recirculation
S25/5	Temperature switch 105/115 °C
S25/6	Temperature switch 50 °C
S25/7	Temperature switch 25 °C (EGR)
S25/9	Temperature switch 97 °C (EGR)
S27/6	Microswitch compressor cut-out (EGR)
x29/4	Test coupling TD
Y22	Electromagnetic actuator ELR
Y22x	Connector (ELR electromagnetic actuator)
Y27	Switchover valve exhaust gas recirculation
Y28	Switchover valve vacuum control flap
Y29	Switchover valve vacuum transducer (automatic transmission)
Z	Soldered connector sleeve
a	Terminal block engine terminal 30/terminal 61 (battery)
b	Central electrics, coupling U jack 5
c	Relay fan, terminal 85, jack 5
d	Connector 1 -pole tad lamp cable harness
e	Pressure switch (S31) A/C compressor
f	Relay fan, terminal 86, lack 4
g	Washing nozzle heater left
h	Terminal block interior (X5/1)

Note

Unidentified grounding points are connected to engine ground or battery ground.



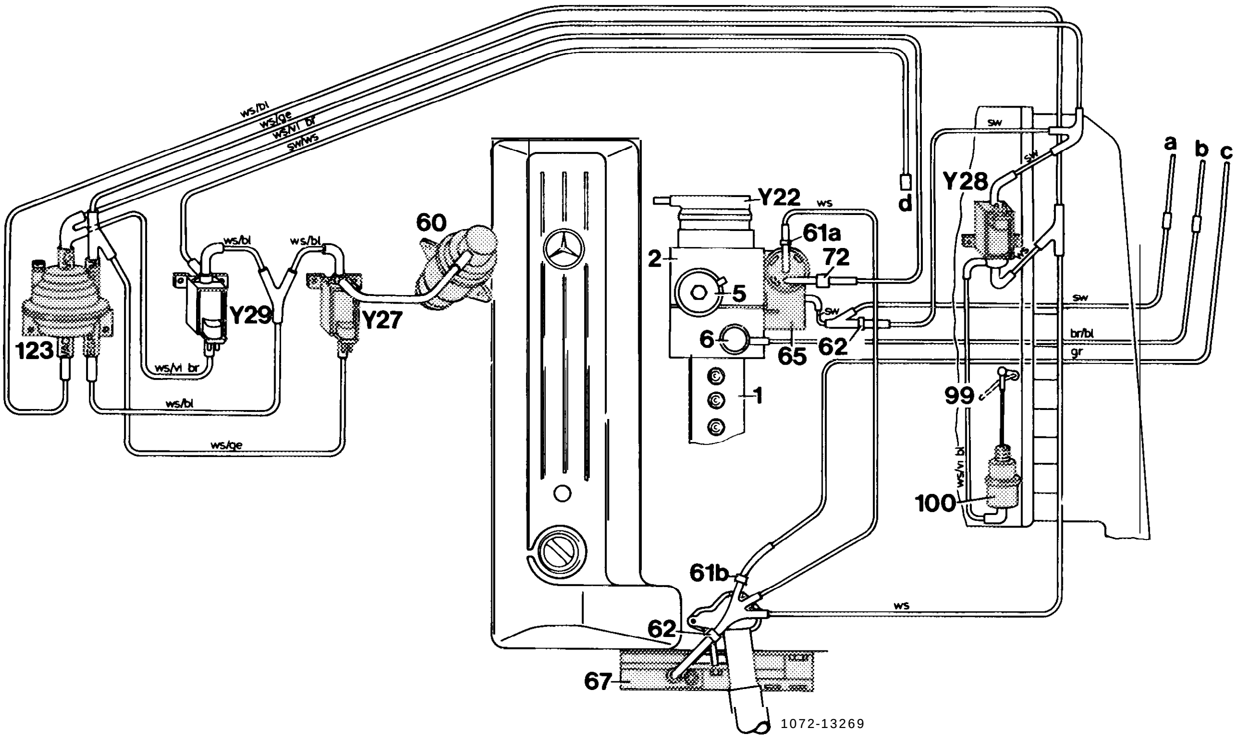
Engine 602 in model 201
model year 1989
Electrical wiring diagram exhaust gas recirculation

A9	A/C compressor
A9 kl	Electromagnetic coupling
A9 l1	Speed sensor
A9x	Connector A/C compressor
B1 I/I	Coolant temperature sensor (ELR)
F1	Fuse/relay box
G1	Battery
K1/1	Overvoltage protection relay 87E (7-pole)
L3	Speed sensor starter ring gear
L3x	Connector speed sensor starter ring gear
N6	Control unit A/C compressor cut-out
N8	Control unit ELR
N37/2	Control unit exhaust gas recirculation
S2/2	Glow starter switch
S25/7	Temperature switch 25 °C (EGR)
S25/9	Temperature switch 97 °C (EGR)
S27/6	Microswitch compressor cut-out (EGR)
W10	Ground, battery
X25	Connector, preglow winng harness
x35	Terminal block, battery terminal 30/61
X92	Diagnostic test coupling
Y22	Electromagnetic actuator ELR
Y22x	Connector (ELR electromagnetic actuator)
Y27	Switchover valve exhaust gas recirculation
Y28	Switchover valve vacuum control flap
Y29	Swltchover valve vacuum transducer
a	To temperature switch S25/6
b	To washer nozzle heating left R2/2
c	To connector engine cable harness X26/5
d	. To pressure switch A/C compressor S31/1

Note

Unidentified grounding points are connected to engine ground or battery ground.

07.1-500 Vacuum diagrams



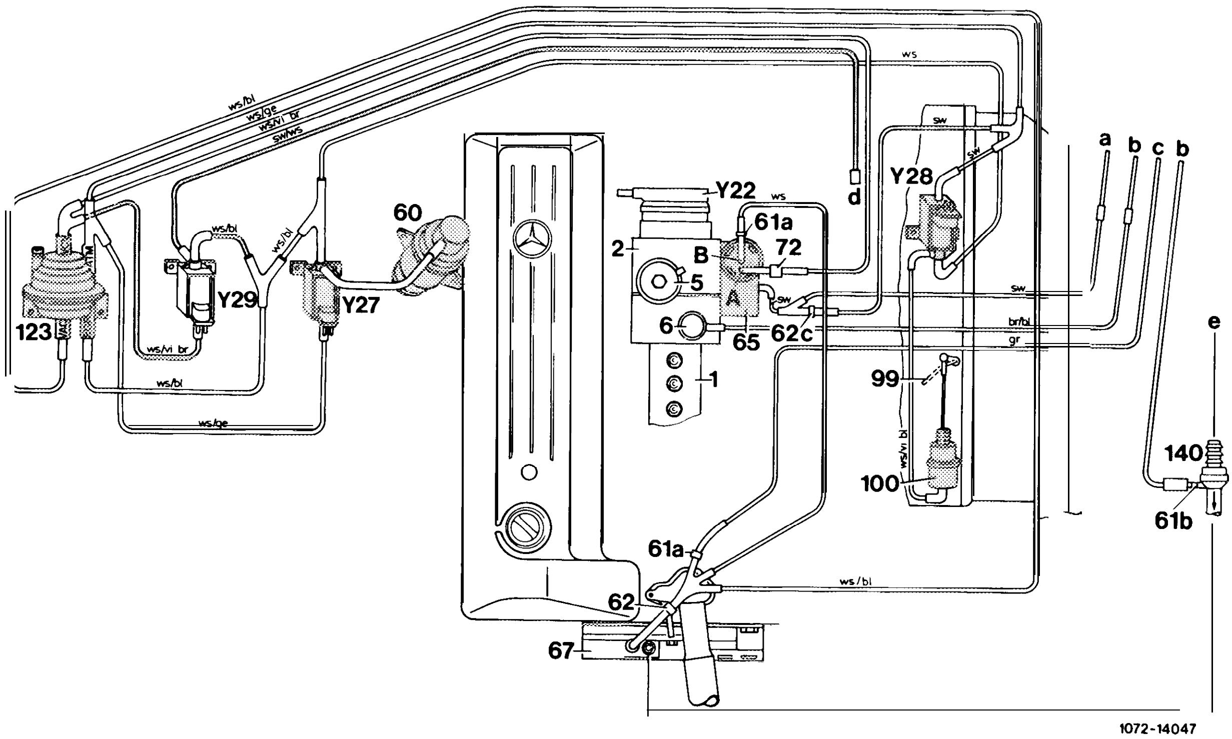
Engine 602 in model 201

Model year 1986

Vacuum circuit diagram exhaust gas recirculation

	Injection pump
2	Governor
5	ADA unit
6	Vacuum unit (stop)
60	EGR valve
61a	Choke blue
61b	Choke orange
62	Filter
62c	Ventilation filter
65	Vacuum control valve
67	Vacuum pump
72	Damper
99	Vacuum control flap
100	Vacuum unit/vacuum control flap
123	Transducer
Y22	Electromagnetic actuator ELR
Y27	Switchover valve EGR
Y28	Swftchover valve vacuum control flap
Y29	Switchover valve (automatic transmission)
a	Ventilation to vehicle interior
b	Key cut-out
c	Remaining users
d	Vacuum unit automatic transmission

EXIT



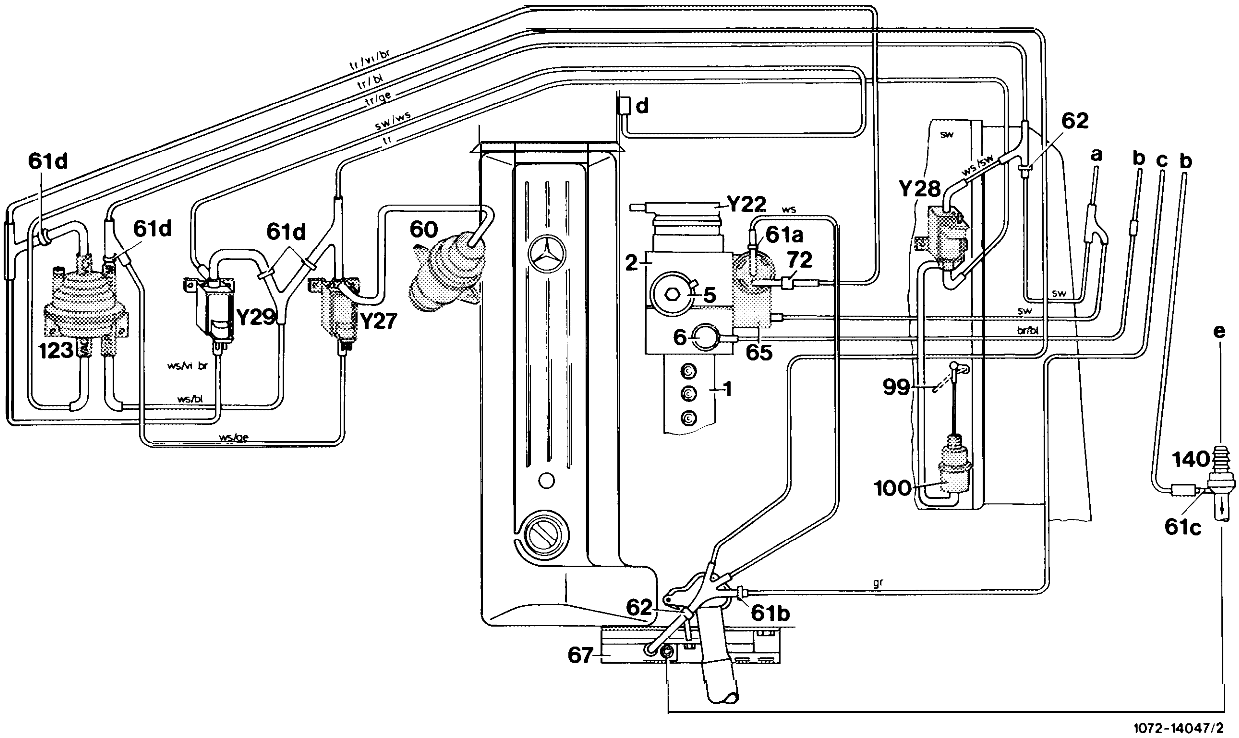
Engine 602 in model 201

Model years 1987 and 1988

Vacuum circuit diagram exhaust gas recirculation

	Injection pump	Y22	Electromagnetic actuator
2	Governor	Y27	Swrtchover valve EGR
5	ADA unit	Y28	Switchover valve vacuum control flap
6	Vacuum unit (stop)	Y29	Swrtchover valve (automatic transmission)
60	EGR valve	a	Ventilation to vehicle interior
61a	Choke blue	b	Key cut-out
61b	Choke orange	c	Remaining users
62	Filter	d	Vacuum unit automatic transmission
62c	Ventilation filter	e	Brake booster
65	Vacuum control valve		
67	Vacuum pump		Vacuum connections on vacuum transducer
72	Damper		
99	Vacuum control flap	VAC	Vacuum from vacuum pump
100	Vacuum unit/vacuum control flap	v c v	To vacuum control valve
123	Vacuum transducer	ATM	Ventilation to vehicle interior
140	Check valve brake booster	EGR	Exhaust gas recirculation to exhaust gas recirculation valve
A	Control line		
B	Suction line		

EXIT



Engine 602 in model 201

Model year 1989

Vacuum circuit diagram exhaust gas recirculation

	Injection pump
2	Governor
4	PLA unit
5	ADA unit
6	Vacuum unit (stop)
60	EGR valve
61a	Choke blue
61b	Choke orange
61c	Choke 0.5 mm orifice diameter
61d	Connector
62	Filter
65	Vacuum control valve
67	Vacuum pump
72	Damper
99	Vacuum control flap
100	Vacuum unit/vacuum control flap
123	Transducer
140	Check valve brake booster

Y22	Electromagnetic actuator ELR
Y27	Swrtchover valve EGR
Y28	Switchover valve vacuum control flap
Y29	Switchover valve (automatic transmission)
a	Ventilation to vehicle interior
b	Key cut-out
c	Remaining users
d	Vacuum unit automatic transmission
e	Brake booster

Vacuum connections on vacuum transducer

VAC	Vacuum from vacuum pump
v c v	To vacuum control valve
ATM	Ventilation to vehicle interior
EGR	Exhaust gas recirculation to exhaust gas recirculation valve

Diesel injection system - Turbodiesel Engines 07.1

	Job No.
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Survey - injectors - Turbodiesel	07.1 – 002
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Testing electronic idle speed control with test connector (X92 and Xl 1/4) - Turbodiesel	07.1 – 105
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Testing vacuum pump - Turbodiesel	07.1 – 160
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Vacuum Circuit Diagrams - Turbodiesel	07.1 – 500

07.1–001 Survey - injection pumps - Turbodiesel

Survey of injection pumps

Engine	Injection pump Bosch designation	Part No.	Bosch combination No.	Test data MB sheet	Issue
602.96	PES 5 M 55 C 320 RS 158	602 070 13 01	0 400 075 980	2.5 g	01.04.87
603.96	PES 6 M 55 C 320 RS 157	603 070 10 01	0 400 076 992	3.0 w	02.04.87
602.962 [1])	PES 5 M 55 C 320 RS 177	602 070 45 01	0 400 075 944		
603.970 [1])	PES 6 M 55 C 320 RS 178	603 070 32 01	0 400 076 968		

[1]) from 09/89.

EXIT

Delivery pump Bosch designation
FP/KG 24 M 150 is identical on all engines.

Note

It is only possible to properly inspect and set an injection pump on an injection pump test stand. Test data on microfilm for the various injection pumps are available for repair shops which possess such a test stand.

EXIT

07.1-002 Survey - injectors - Turbodiesel

Injection nozzles/Nozzle holder

Engine		602.96	603.96197 [3])
Injection nozzle	Bosch designation	DN 0 SD 265	DN 0 SD 265
	MB Part No.	001 017 49 12	001 017 49 12
Nozzle holder	Bosch designation	KCA 27 S 55[2])	KCA 30 S 44 KCA 27 S 55 [2])
	MB Part No.	002 017 40 21[2])	002 01728 21 002 01740 21 [2])
Ejection pressure or opening pressure in bar [1])	when injection nozzles are new	135-145	135-145
	when injection nozzles are used, at least	120	120

[1]) The difference in ejection pressure of the injection nozzles within an engine must not be greater than 5 bar gauge pressure.
[2]) With oblique injection.
[3]) Engine 603.97 only oblique injection.

EXIT

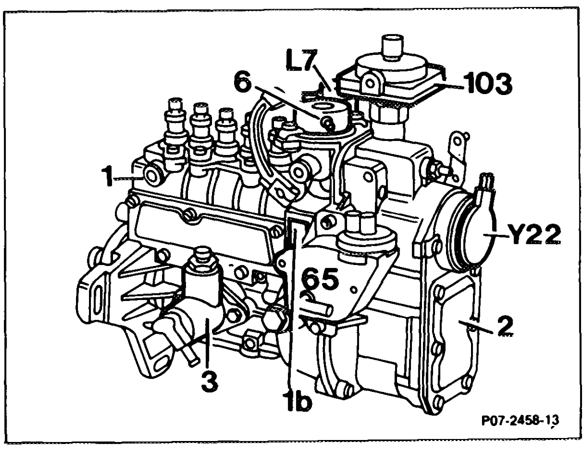
07.1-003 Explanation of injection pump type plate - Turbodiesel

e.g.	**PES 5 M 55 C 320 RS 158/1**
P	Pump
E	Self-driven
S	Face flange mounting
5	Number of cylinders
M	Pump size
55	Element diameter in 1/10 mm
C	Modification code letter
320	Installation index
R	Direction of rotation
S158/1	Special version

RSF	
R	Governor
S	Helical spring
F	Drive control

Location of components with ELR

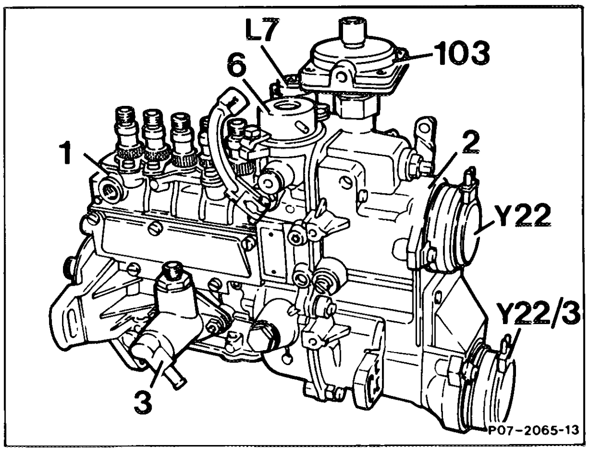
1	Injection pump
1b	Type plate
2	Governor
3	Fuel pump
6	Stop unit
65	Vacuum control valve
103	ALDA unit
Y22	ELR actuator
L7	Control rod travel sensor (connector not operational with cap closed)



EXIT

Location of components with ELR

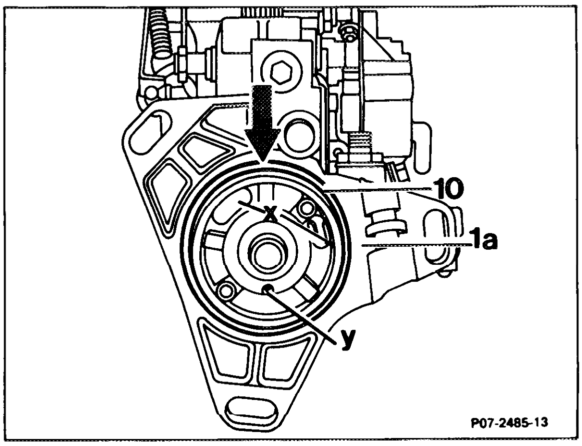
1	Injection pump
2	Governor
3	Fuel pump
6	Stop unit
103	ALDA unit
Y22	ELR actuator



07.1–010 Function - injection system - Turbodiesel

A. Lubrication of injection pump

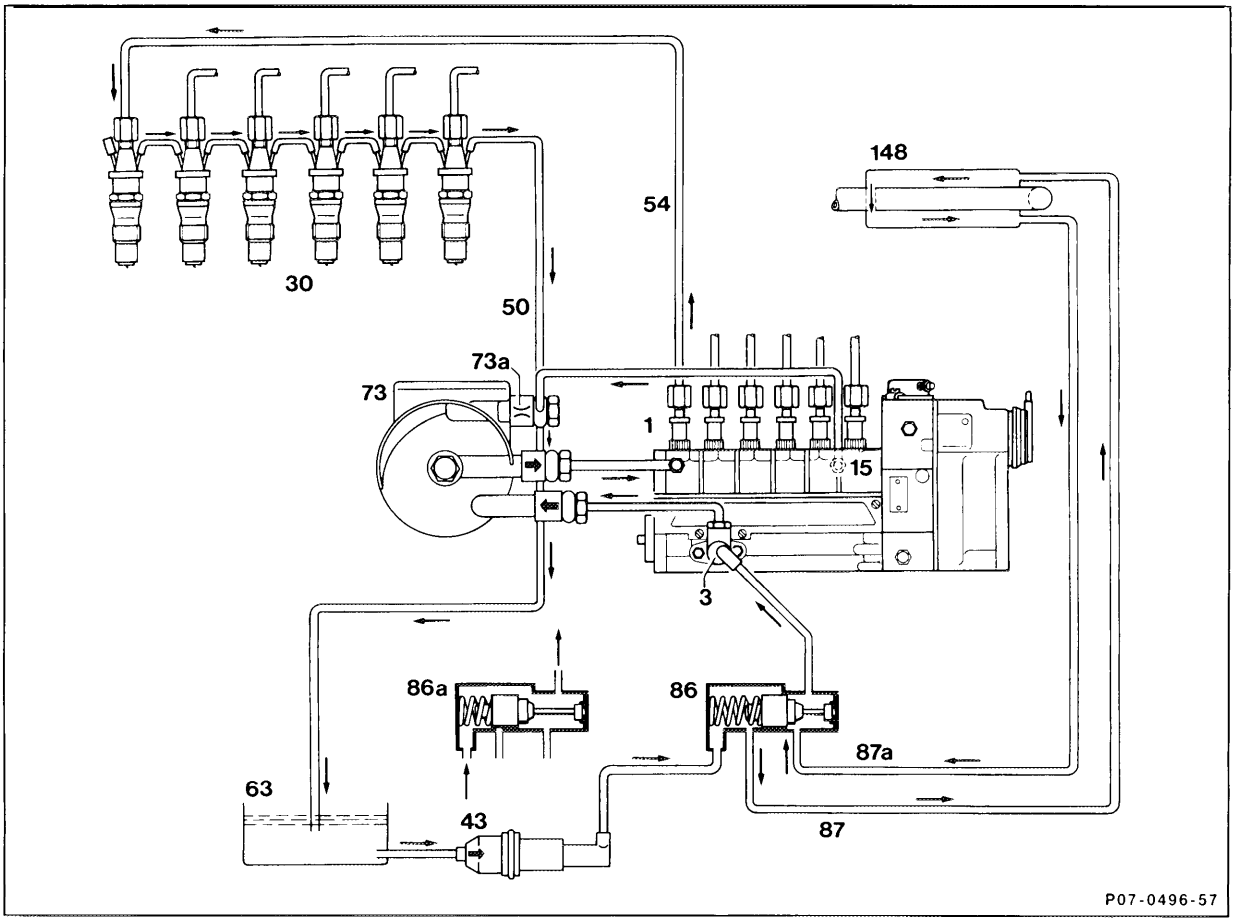
The injection pump is connected through an oil passage (arrow) to the engine oil circuit. The oil flows back into the crankcase through the annular gap (x) between bearing and housing.



The O-ring (10) on the flange (1 a) acts as a seal. The drilling (y) serves to relieve oil from the radial seal.

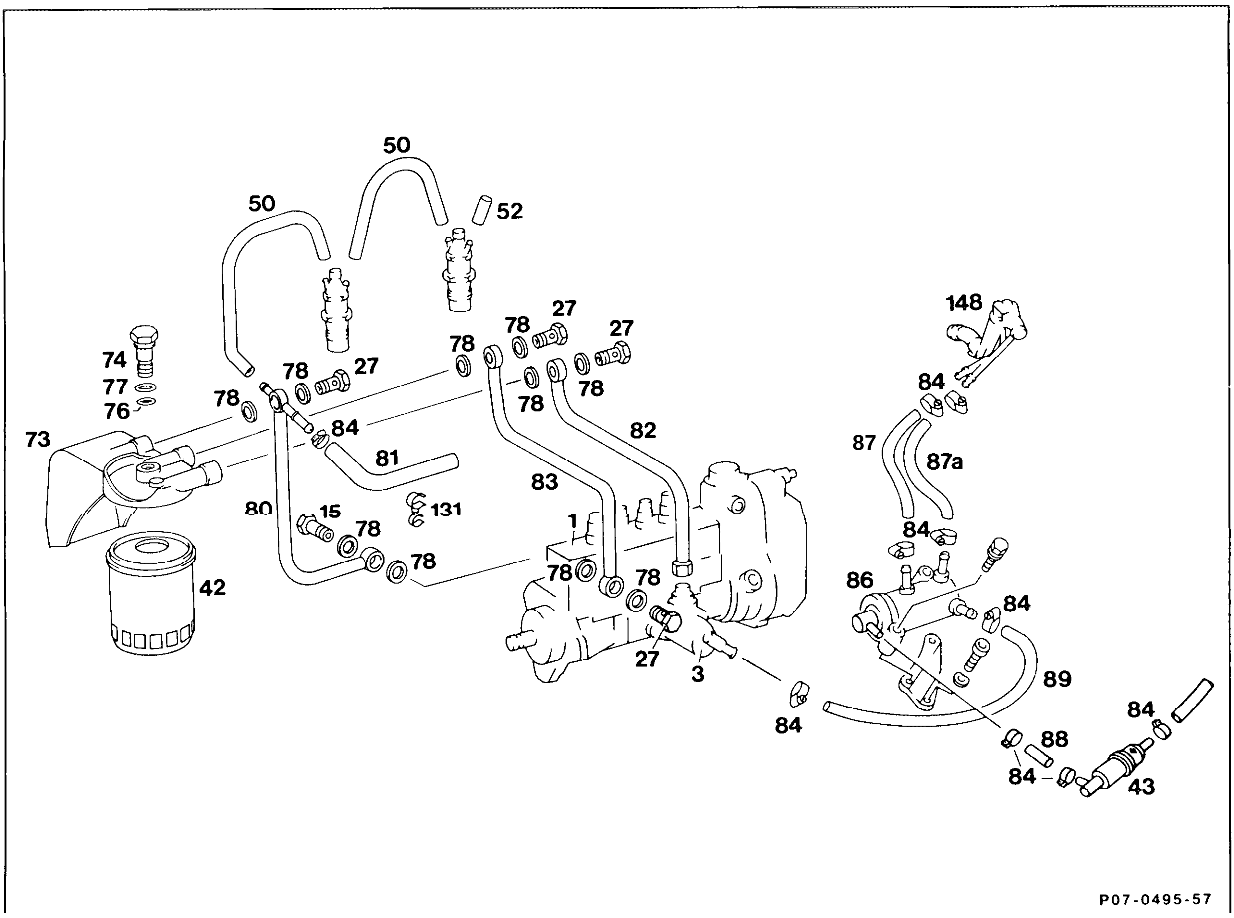
B. Fuel circuit

a) Fuel circuit diagram



	Injection pump	73a	Restriction orifice in fuel filter top section Ø 0,8 mm
3	Fuel pump	86	Fuel thermostat open, position up to + 8 °C, fuel is preheated
15	Bypass valve with restriction Ø 1,5 mm	86a	Fuel thermostat closed, position from + 25 °C, fuel is no longer preheated
30	Injection nozzles	87	Inlet line - cold fuel
43	Fuel prefilter	87a	Return line - preheated fuel
50	Fuel leak-off hose	148	Heater inlet pipe with fuel heat exchanger
54	Injection line, No. 1 cylinder		
63	Fuel tank		
73	Fuel filter top section		

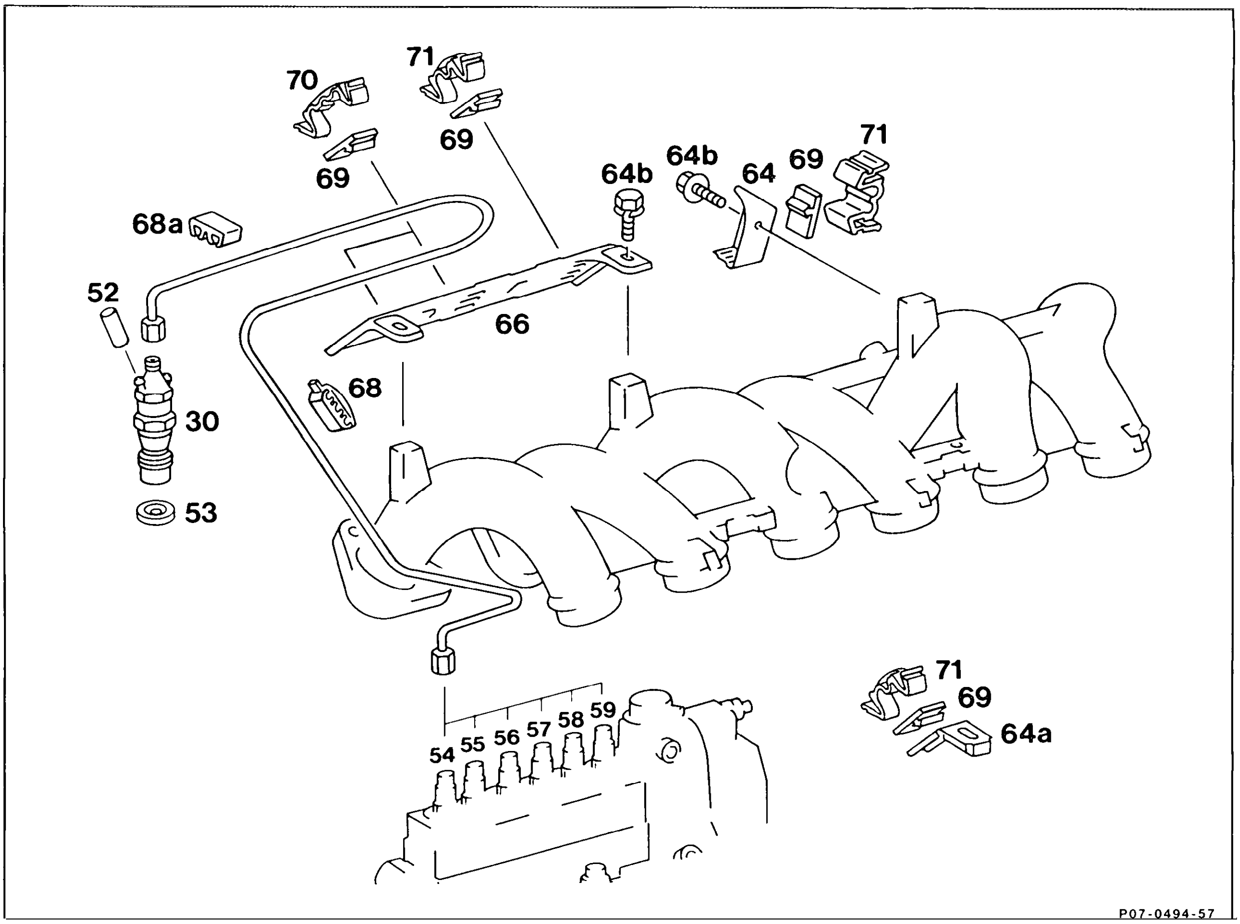
b) Low-pressure side



	Injection pump	80	Return line
3	Fuel pump	81	Fuel hose return line
15	Bypass valve with restriction Ø 1,5 mm	82	Fuel filter inlet line
27	Hollow screw	83	Injection pump inlet line
42	Fuel filter	84	Hose clip
43	Fuel prefilter	86	Fuel thermostat
50	Fuel leak-off hose	87	Fuel heat exchanger inlet line
52	Plug	87a	Fuel heat exchanger return line
73	Fuel filter top section	88	Fuel thermostat inlet line
74	Fuel filter hollow screw	89	Fuel pump suction line
76	0-nng	131	Plastic holder
77	Fuel filter seal	148	Heater inlet pipe with fuel heat exchanger
70	Seal		

EXIT

c) **High-pressure side**



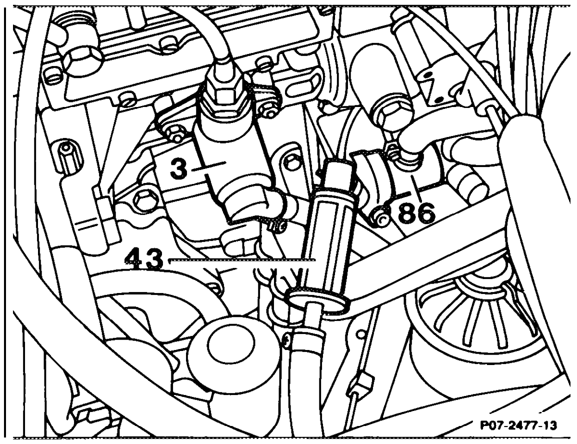
30	Injection nozzle - complete	64	Bracket, cylinder 4, nozzle end
52	Plug	64a	Bracket, cylinder 4, injection pump end
53	Nozzle shim	64b	Bolt
54	Injection line 1	66	Line mounting bracket
55	Injection line 2	68	Plastic clips for 3 lines
56	Injection line 3	68a	Plastic clips for 2 lines
57	Injection line 4	69	Rubber base
58	Injection line 5	70	Plastic holder for 3 lines
59	Injection line 6	71	Plastic holder for 2 lines

Note

Injection lines for cylinders 2-6 are not illustrated.
Bracket for injection lines of cylinders 5-6 as bracket of cylinder 4.

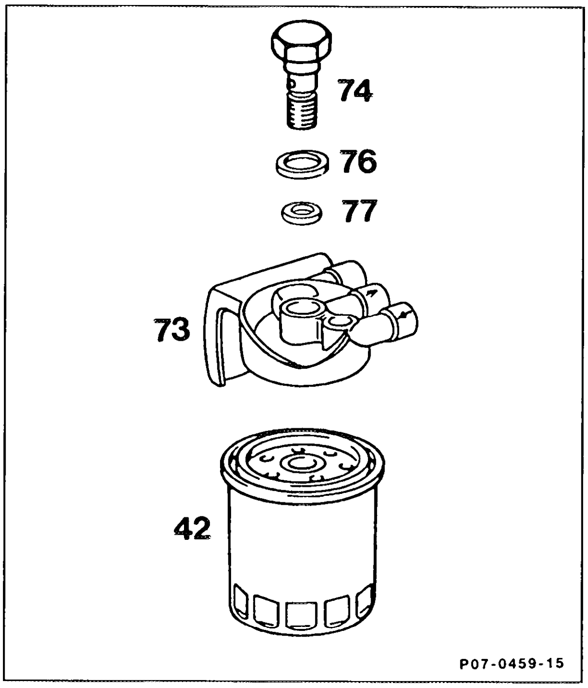
C. Fuel prefilter (43)

Installed in the suction line upstream of the fuel pump (3). The filter housing is of transparent plastic.
The mesh size is 600 µm (0.6 mm).



D. Fuel filter (42)

The fuel filter is installed in the pressure line between fuel pump and injection pump.
The paper filter element is integrated in a metal housing. The element has a mean pore width of 6-10 µm (0.006-0.01 mm).



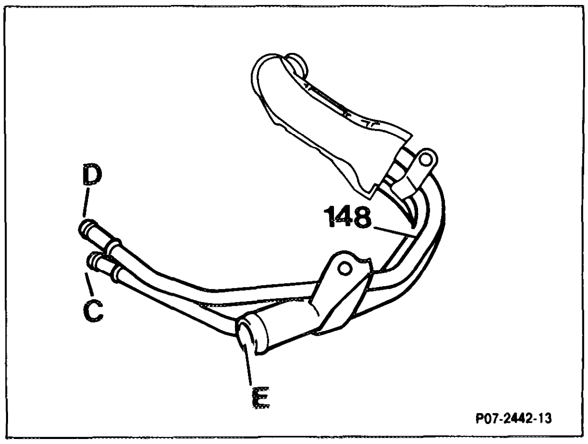
42	Filter
73	Fuel filter top section
74	Bolt
76	O-ring
77	Sealing ring (alu)

Note
When the engine is started, the fuel system is bled automatically due to increased delivery of the fuel pump and the restrictions in the top section of the filter as well as at the injection pump.

EXIT

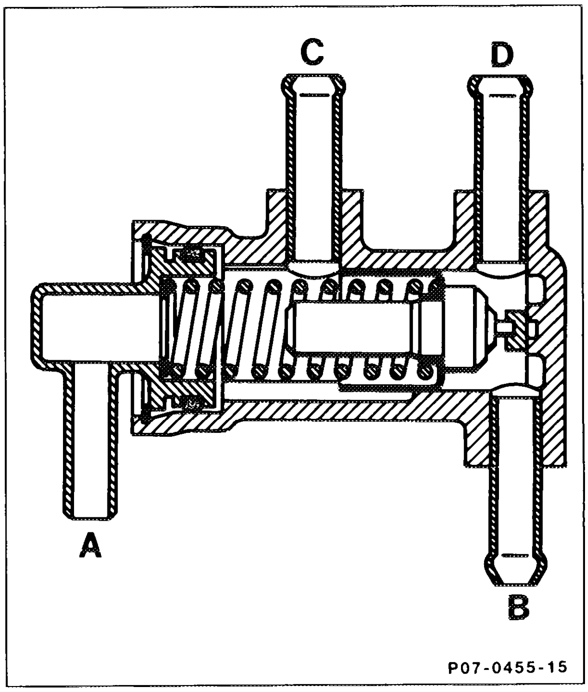
E. Fuel preheater (148)

A heat exchanger (148) is installed in the inlet line of the heater in order to preheat the fuel.



Heat exchanger
C Inlet line
D Return line
E Heater inlet
148 Heat exchanger

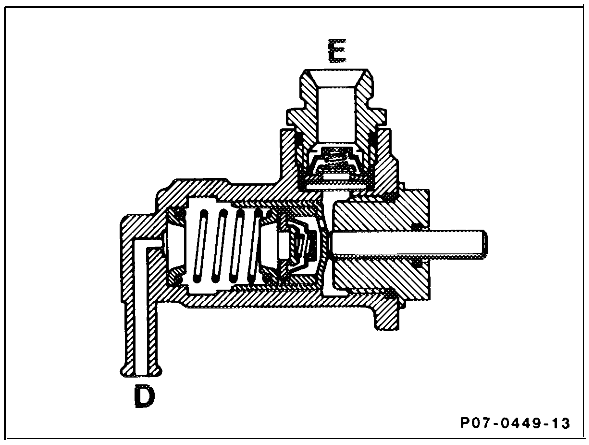
Function
Full preheating up to + 8 °C fuel temperature; the required fuel is drawn in through the heat exchanger by the fuel pump.
From + 8 °C to + 25 °C mixed operation; the required fuel flows partially through the heat exchanger.
Above + 25 °C the heat exchanger is bypassed by the thermostat; the fuel is drawn in directly by the fuel pump. Fuel preheating ensures trouble-free operation with winter-grade diesel fuel as a rule down to approx. - 25 °C ambient temperature.



Fuel thermostat
A Inlet line from fuel tank
B Suction line to fuel pump
C Inlet to heat exchanger
D Return line from heat exchanger

F. Fuel pump (3)

As a result of the high delivery of the fuel pump, the fuel system is self bleeding, which eliminates the need for a hand priming pump. Delivery > 150 cm^3/30 s, at a starting speed > 150/min, measured in the fuel return line.



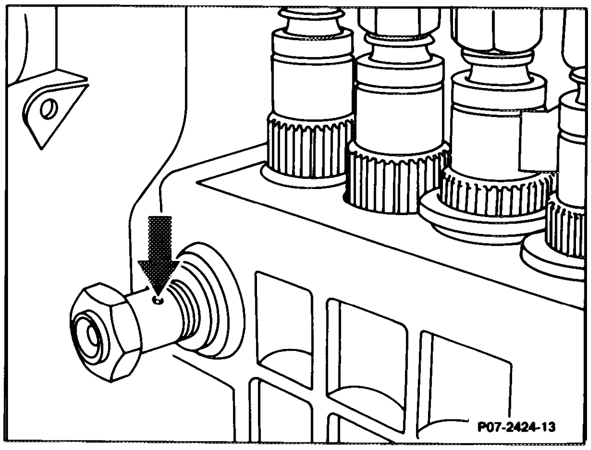
E Pressure side
D Suction side

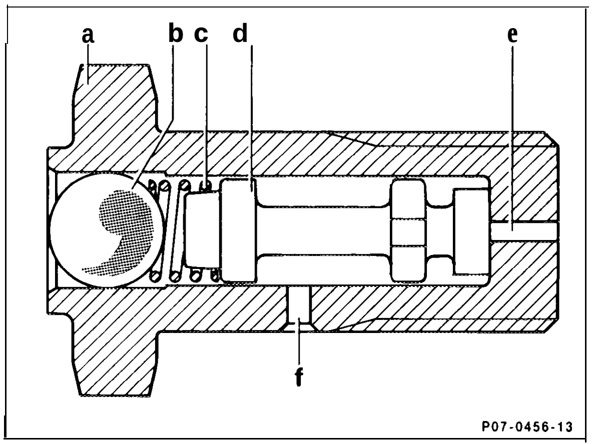
EXIT

A restriction in the bypass valve at the injection pump is required for bleeding the injection pump.

Bypass valve with restriction 1,5 mm dia. (arrow).

The bypass valve prevents unfiltered fuel flowing along the return line into the injection pump if the inlet line is clogged (e.g. filter).

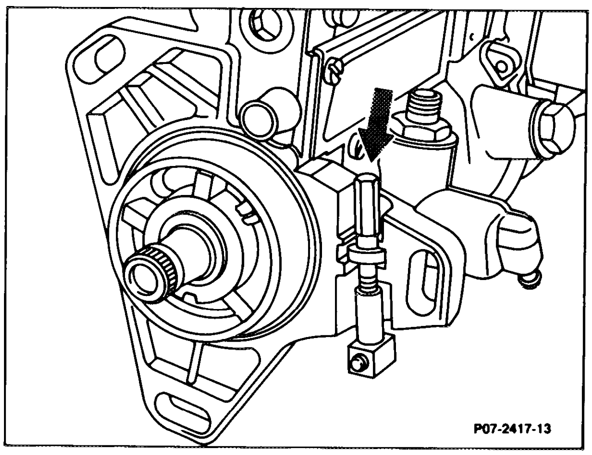




Restriction with bypass valve
a Housing
b Ball
c Spring
d Slide
e Inlet
f Restriction orifice 1,5 mm dia.

G. Start of injection adjusting equipment

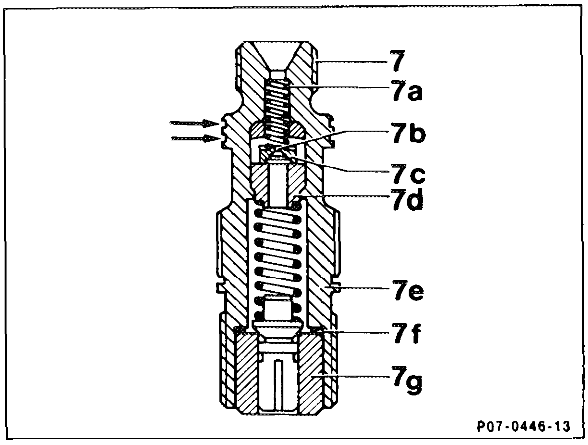
An adjusting device (arrow) is attached to the injection pump flange in order enabling adjustment of the start of delivery while the engine is running.



EXIT

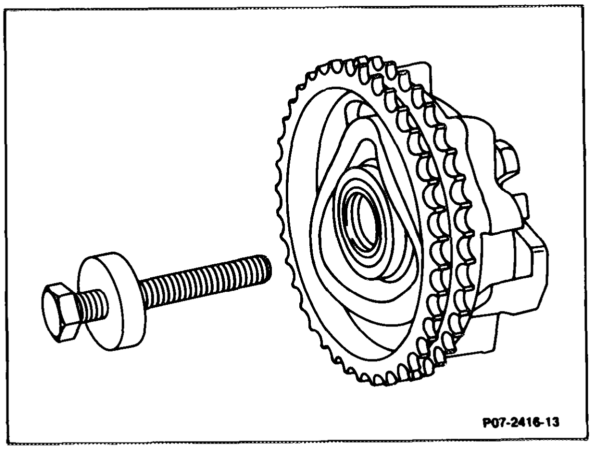
H. Reverse flow damping valve in delivery valve holder

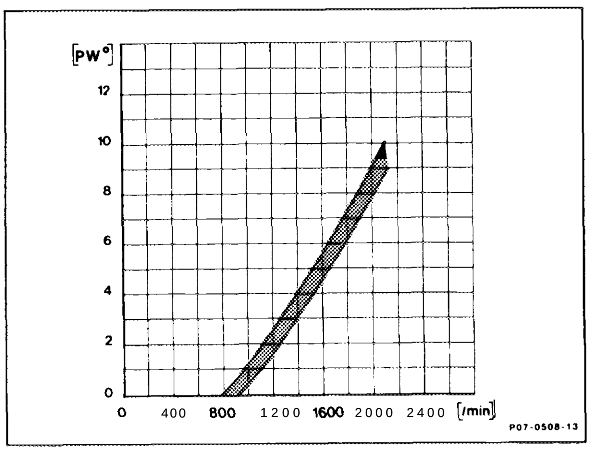
Reverse flow damping valves (7b) are installed in the delivery valve holders (7) of the injection pump in order to reduce the hydrocarbon content in the exhaust gas through prevention of afterspraying of the injection nozzles.
Two annular grooves act as identification marks on the delivery valve holder (7) (arrows). The reverse flow damping valve (7b) is a disc valve (7c) opening in the direction of the injection nozzle with a restriction orifice of 0.5 mm dia..
The valve seat (7d) is riveted into the delivery valve holder.



I. Timing device

The time device is mounted on the injection pump shaft and is attached with a central bolt having a **left-hand thread.**





Timing device adjustment curve
n = rpm of injection pump
PW° = Adjustment angle of injection pump

EXIT

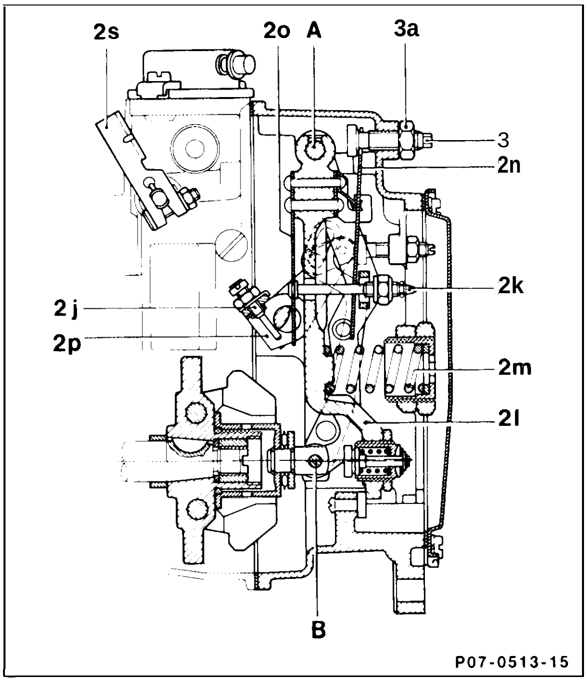
J. RSF governor

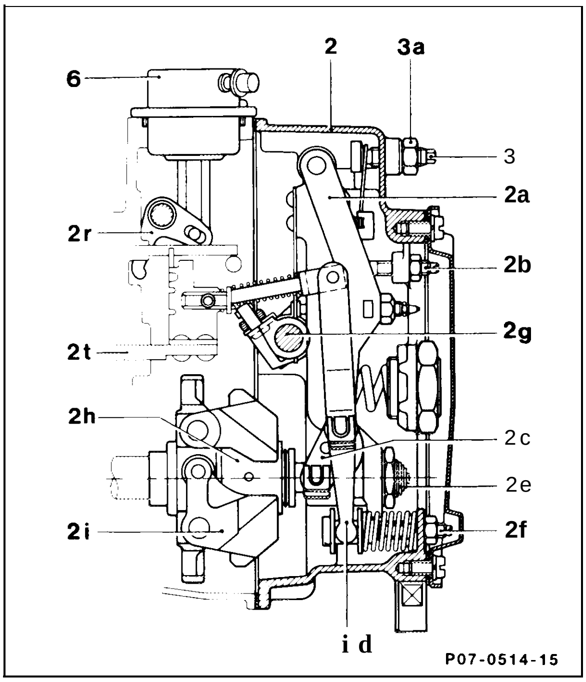
a) Design and operating principle

The governor is a minimum/maximum speed governor. Its governor spring (2m) is sized and set in such a way that it does not govern in the part load range, with the exception of torque control (refer to “Control when starting and at full load”).

In the part load and full load range, the control rod (2t) of the injection pump is operated only from the accelerator pedal, which is connected through the accelerator control linkage to the control lever (2g) of the governor.

The position spring (2n) is pretensioned and the position speed set by the adjusting screw (3).





2 Governor
2a Guide lever
2b Stop screw for position quantity
2c Relay lever
2d Fulcrum lever
2e Spring retainer (torque control)
2f Full load adjusting screw
2g Control lever
2h Sliding sleeve
2i Flyweights (pump governor group)
21 Position auxiliary spring cutoff
2k Adjusting screw for position auxiliary spring (position stabilizer)
2l Tensioning lever
2m Governor spring
2n Position spring
20 Position auxiliary spring (position stabilizer)
2P Steering arm
2r Stop lever
2s Emergency stop lever
2t Control rod
3 Adjusting screw for position speed
3a Locking nut
6 Vacuum unit (stop)

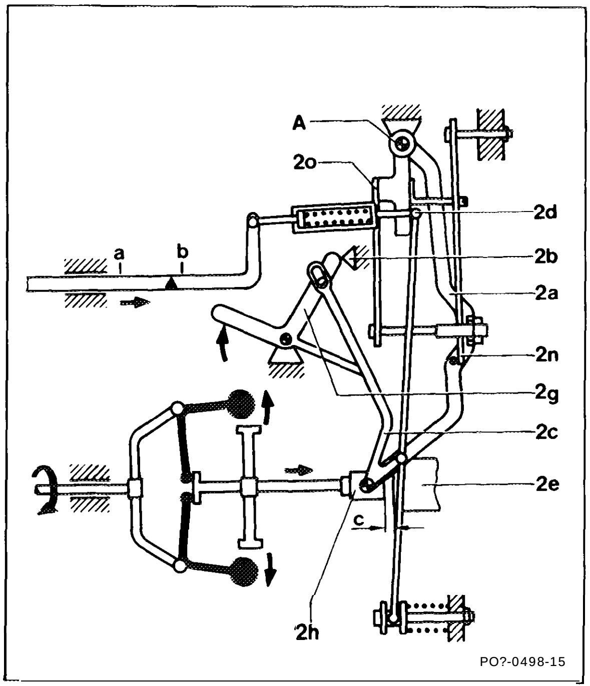
EXIT

b) Control positions

Control lever (2g) rests against the idle stop screw (2b). As the engine speed increases, the sliding sleeve (2h) passes through the idle position. Guide lever (2a) swivels around the pivot point "A" and thus operates against the idle spring (2n).

At a certain engine speed, the guide lever (2a) moves against the adjusting nut of the idle auxiliary spring (20). The movement of the sliding sleeve (2h) is transmitted through the relay lever (2c) and fulcrum (2d) in the same direction to the control rod of the injection pump After passing through the idle position, the sliding sleeve (2h) moves against the spring retainer (2e).

If the engine speed increases further (e.g. deceleration), above a certain engine speed, the spring retainer (2e) is over-compressed followed by the governor spring (2m) . The control rod is thus brought into the "stop position" (deceleration fuel cutoff).

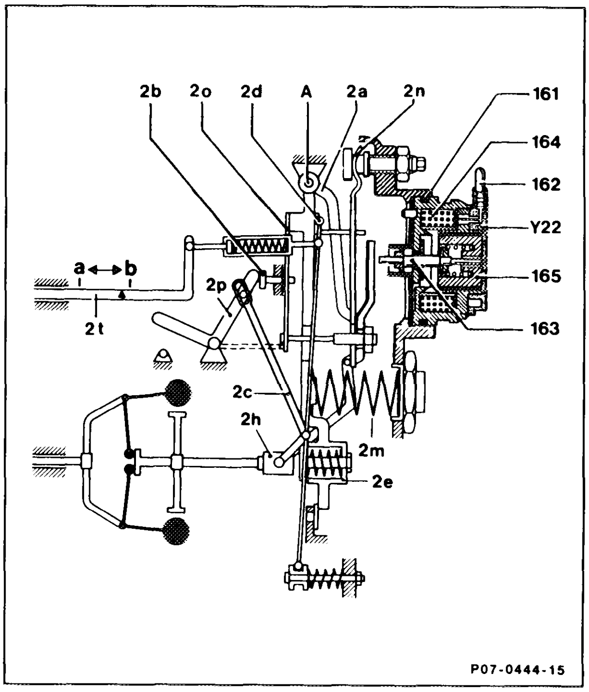


a Start
b Stop
c Position stage

EXIT

c) Control with actuator

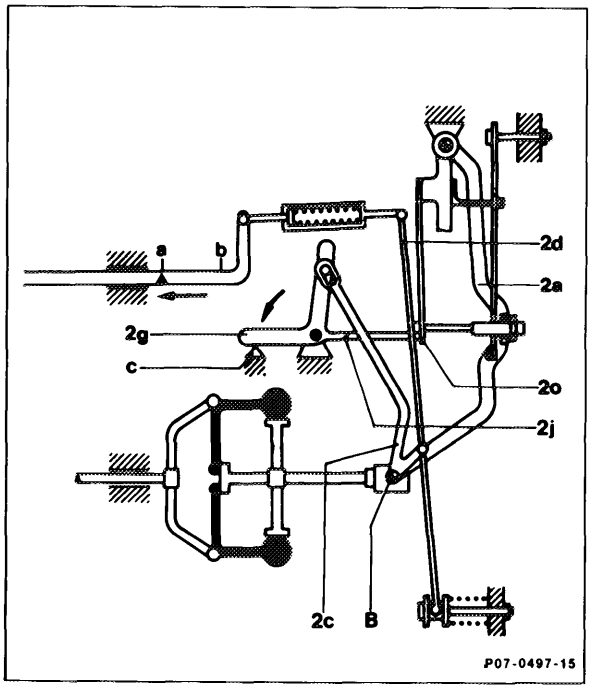
The lift rod (163) rests against the guide lever (2a). The actuator (Y22) is supplied by the electronic idle speed control unit with a clocked D.C. voltage in the frequency range of approx. 50 Hz. If engine speed drops (e.g. drive position engaged or power steering turned to full lock), the actuator is energized with a higher voltage. This causes the lift rod (163) to press against the guide lever (2a) and the control rod (2t) to move in the direction "a" **increased quantity.** As soon as the engine speed increases, the voltage is reduced and the control rod (2t) moves in the direction of "b" **reduced quantity.**



161 Seal
162 Electrical connection
163 Lift rod
164 Solenoid coil

d) Start position

If the control lever (2g) is moved against the full load stop (c) (fixed stop on governor housing) when the engine is not running, the relay lever (2c) moves around pivot point "B" and moves the fulcrum lever (2d) with it in the direction of Start. When the control lever is in the full load position (2g "Full throttle") the idle auxiliary spring (20 idle stabilizer) is pressed away from the guide lever by the idle cutoff auxiliary spring (2j). This enables a more rapid cutoff from the start position of the governor.

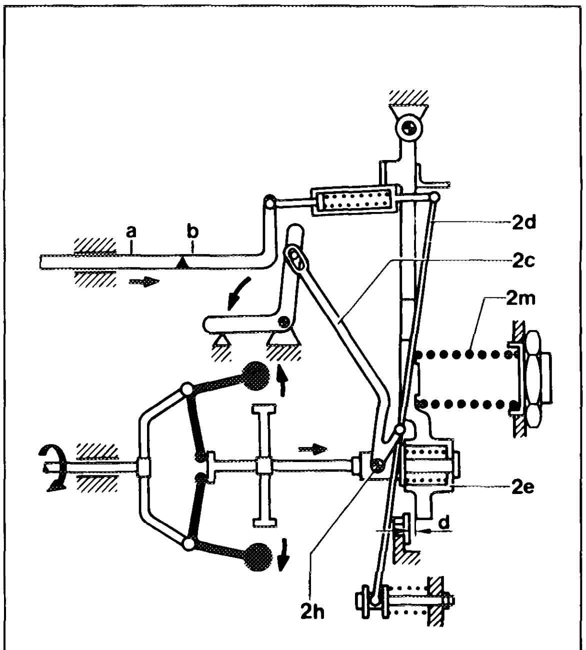


a Star-t
b stop

e) Full load speed regulatlon/ compensation

After passing through the idle step (c) (refer to ill. of control when at idle) the governor sleeve (2h) moves against the spring retainer (2e). This causes the relay lever **(2c)** and fulcrum lever (2d) to move the control rod of the injection pump into the full load position.
When a certain engine speed is reached, the spring retainer **(2e)** is over-compressed by a certain distance (d) (compensation).

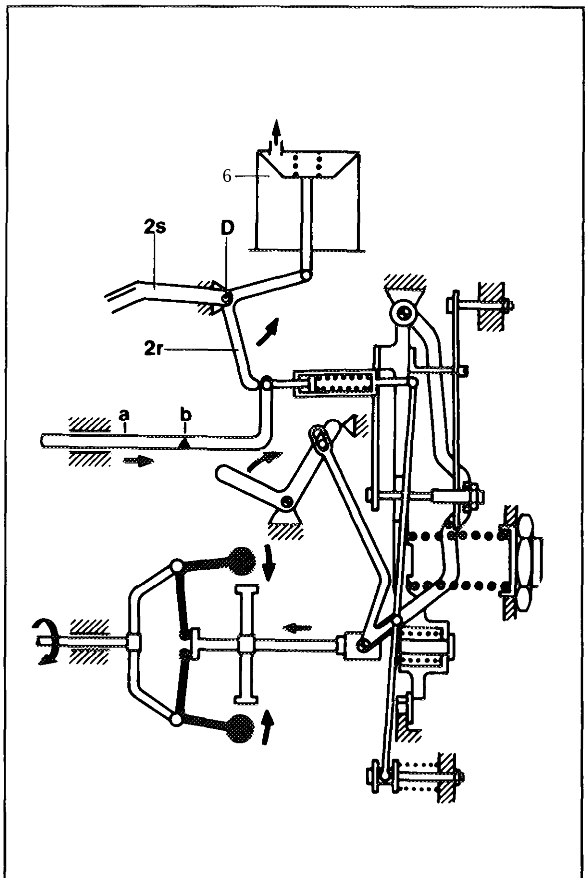
If the engine speed continues to rise, the force of the flyweights is sufficient to over-compress the governor spring (2m) (full load speed regulation). The start of cutoff depends on the preload of the governor spring (2m).



P07-0499-15

f) Engine stop

The vacuum unit (6) is pressurized with vacuum from the vacuum pump through the glow start switch of the vehicle. This causes the diaphragm of the vacuum unit to move against the compression spring.
The vacuum unit (6) is connected to a stop lever **(2r),** which swivels about the pivot point "D", pulling the control rod of the injection pump into "Stop" position. This causes the deflecting spring of the fulcrum lever to be over-compressed. The control rod can be pulled into the "Stop" position from the outer side of the governor in the same way by means of the emergency stop lever (2s).

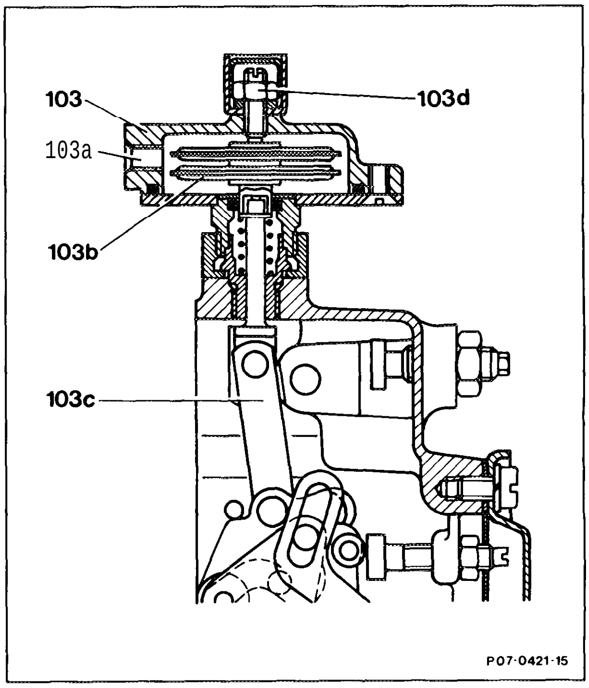


P07-0500-17

a Start
b Stop

K. Intake manifold pressure compensator(ALDA)

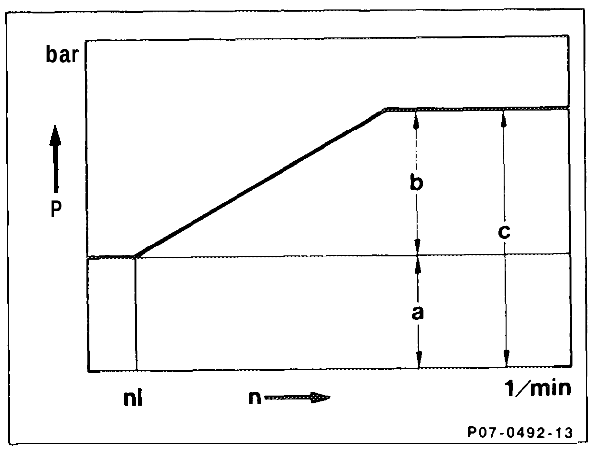
The intake manifold pressure compensator (ALDA device) is comprised of a housing (103) with barometer unit (103b). The absolute pressure acts upon the barometer units through a port (103a) to the charge air pipe of the engine. Accordingly, the barometer units react to each pressure change with a change of length. All movements are transmitted to the compound lever of the governor and to the control rod.
As the absolute pressure drops, the barometer units expand. The correction linkage (103c) of the units is pressed downwards and acts on the compound lever to move the control rod in the direction of "reduced quantity". As the absolute pressure rises, caused by a higher air and/or charge pressure, the movement is performed in the opposite direction - i.e. in the direction of " increased quantity". As the effect of the ALDA device diminishes, the more the control lever is moved in the idle direction. When the control lever is in the idle position, the effect is approximately zero.



103d Adjusting screw
(factory-set by manufacturer)

Absolute pressure with charge operation

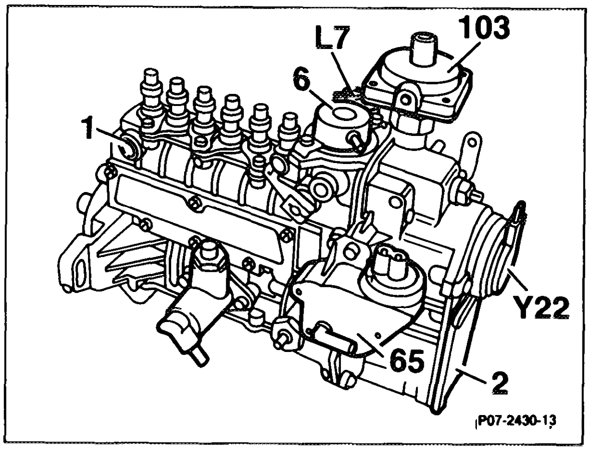
The intake air under atmospheric pressure is further compressed by the turbocharger. Atmospheric and charge pressure together produce the absolute pressure prevailing in the charge air pipe of the engine.



- nl Speed at the start of charge operation
- a Atmospheric pressure, corresponding to suction quantity
- b Charge pressure
- c Absolute pressure, corresponding to charge quantity
- n Engine speed
- p Pressure in bar

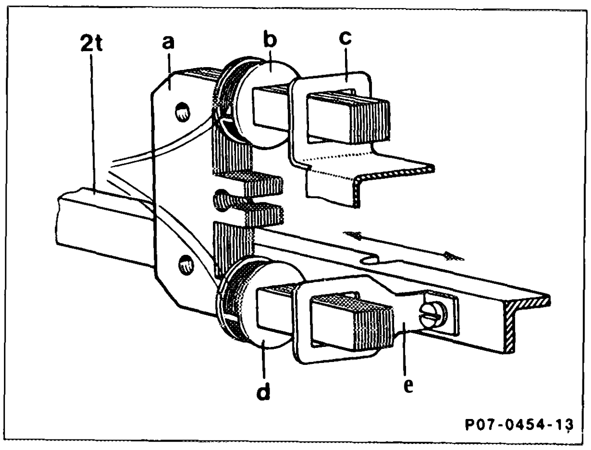
L. Control rod travel sensor (L7)

The control rod travel sensor is installed in the governor of the injection pump. It consists of an iron core, two coils (measured value and fixed value coil) and two short-circuit rings. It is connected to the electronic control unit by a 3-pin plug.
The coils (b) and (d) are attached to the iron core (a) which is fixed in the housing. The short-circuit ring (e) is connected to the control rod (2t) and is displaced with the control rod without touching on the bottom leg of the iron core. The fixed value coil (b) and the short-circuit ring (c) are attached to the top leg.



Function

The fixed value coil (b) with the short-circuit ring (c) represents a constant inductance. Depending on the change in position of the control rod (2t), the distance between the short-circuit ring (e) and measuring coil (d) changes. The variable inductance produced is then compared to the constant inductance. From this the electronic unit determines the control rod travel.



EXIT

M. Reference impulse verification(RIV)

Two signals are required for checking start of delivery when the engine is running (dynamic).

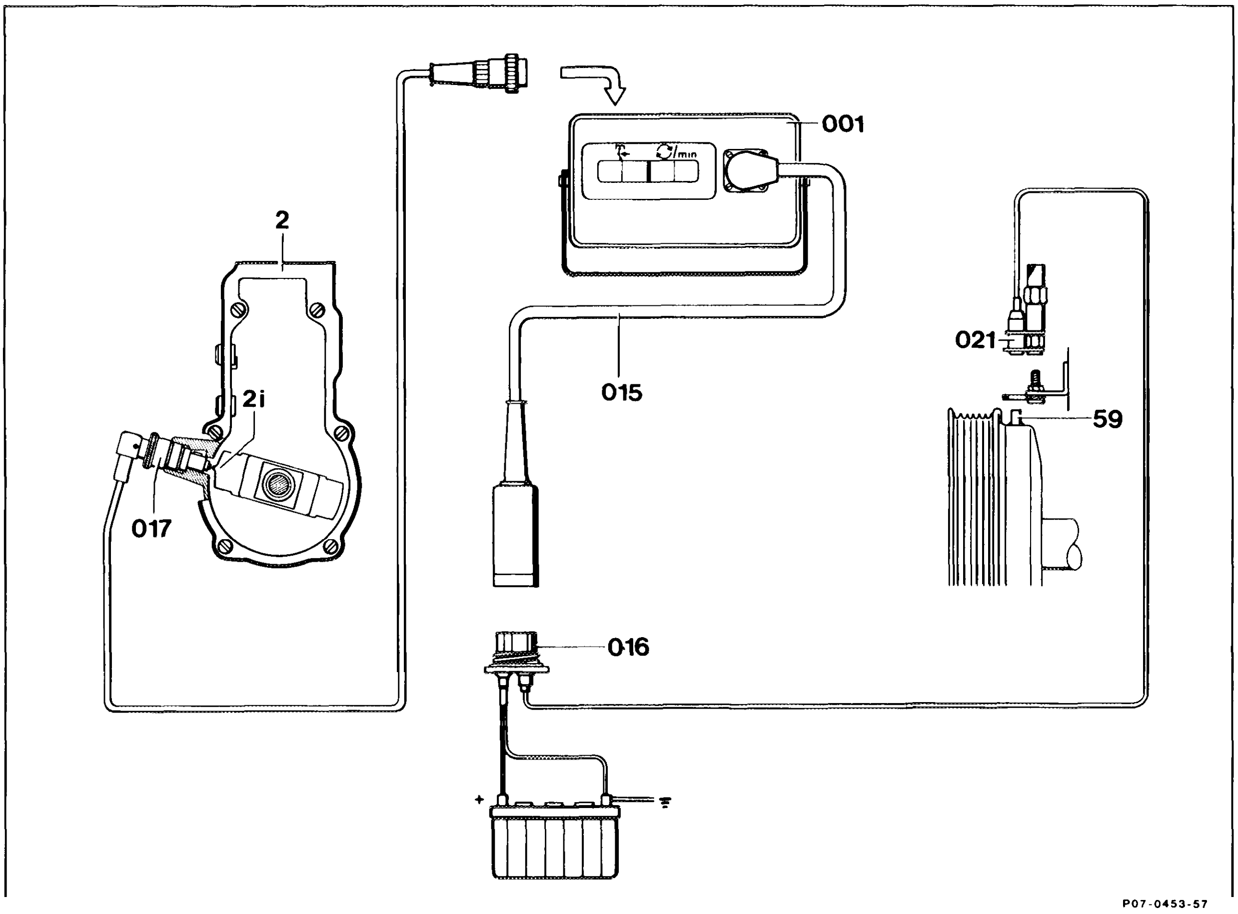
- TDC pulse from the crankshaft
- Reference impulse from the injection pump

Both pulses are supplied by pulse generators. To obtain a signal, the generator pins must be moved past the pulse generators at a minimum rate (position speed).

A measuring instrument measures the time gap of the two pulses and converts the result into an angular value, which is then indicated.

Note

The position sensor can be used, as for naturally aspirated engines, for checking the start of delivery when the engine is not running (stationary).

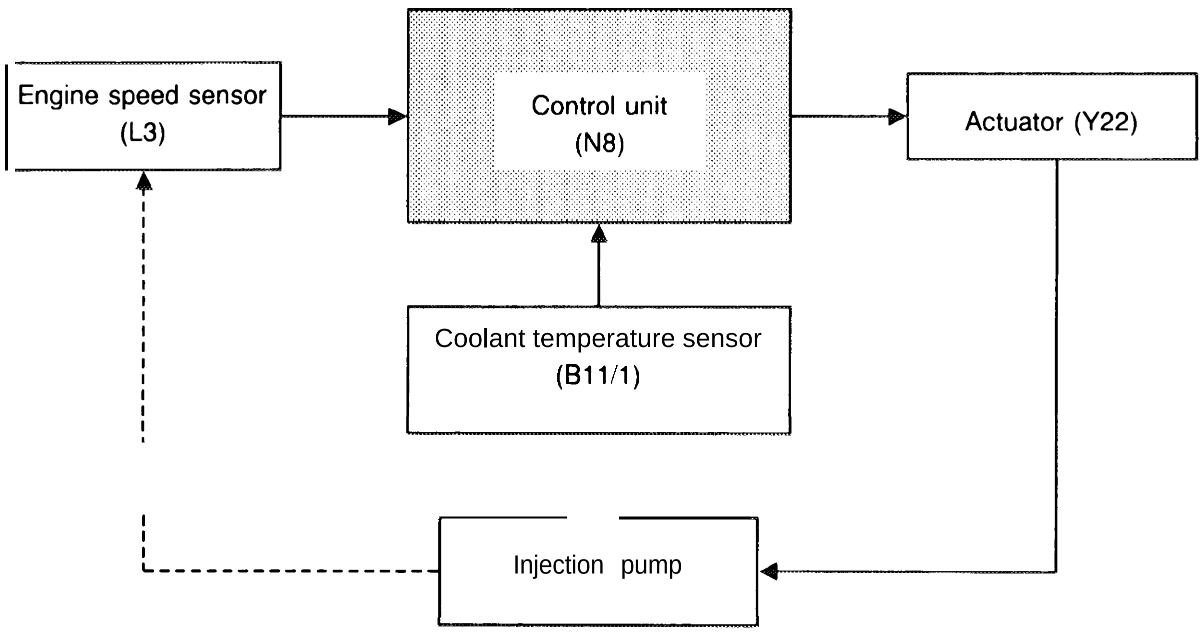


001	Digital tester	016	Diagnostic socket
2	Governor (Injection pump)	017	RI generator
2i	Flyweight with RI generator pin	021	TDC generator
015	Test cable	59	TDC generator pin

N. Electronic position speed control (ELF?)

Function

The engine speed sensor (L3) detects engine speed (144 pulses/revolution) and passes this to the control unit (N8) in the form of an alternating voltage.
This processes the speed signal and performs **a** set/actual value comparison. Position speed is maintained at a constant level by the actuator (Y22) irrespective of engine load.
Set position speed is raised in accordance with a specified characteristic curve by the temperature sensor (B11/1) at coolant temperatures $< 60\,°C$.



EXIT

System diagnostics (Engine 602)

The ELW system can be tested by means of the self-test routine integrated into the control unit. A signal can be retrieved with the test connector (X92 or Xl 1/4), which provides concrete information regarding a component fault. The number of signals indicates whether and which component is faulty, or whether the components in the control loop are faulty.

Note

Engine 603 is fitted with the control unit having system diagnostics as of a later date.

Production breakpoint:

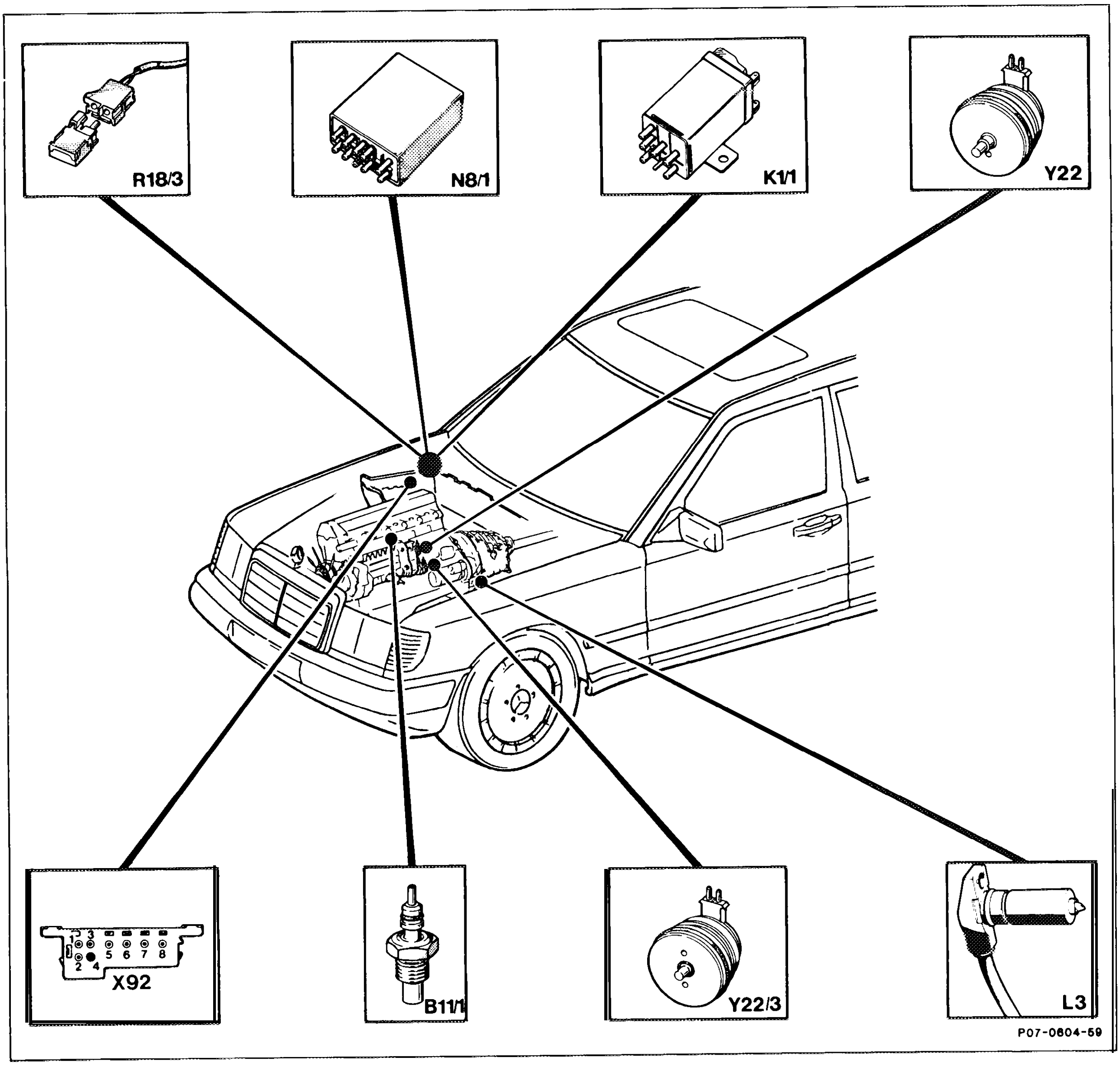
Control unit with **"RO2"** 05188.

Pulse read out	Component
1	All functions "in order"
2	Engine speed signal "fault"
3	Coolant temperature "fault"
6	ELR control loop "fault" [1])

[1]) Only short-circuit faults are detected on control units with the designation "RO1". Control units with "RO2" also detect interrupt.

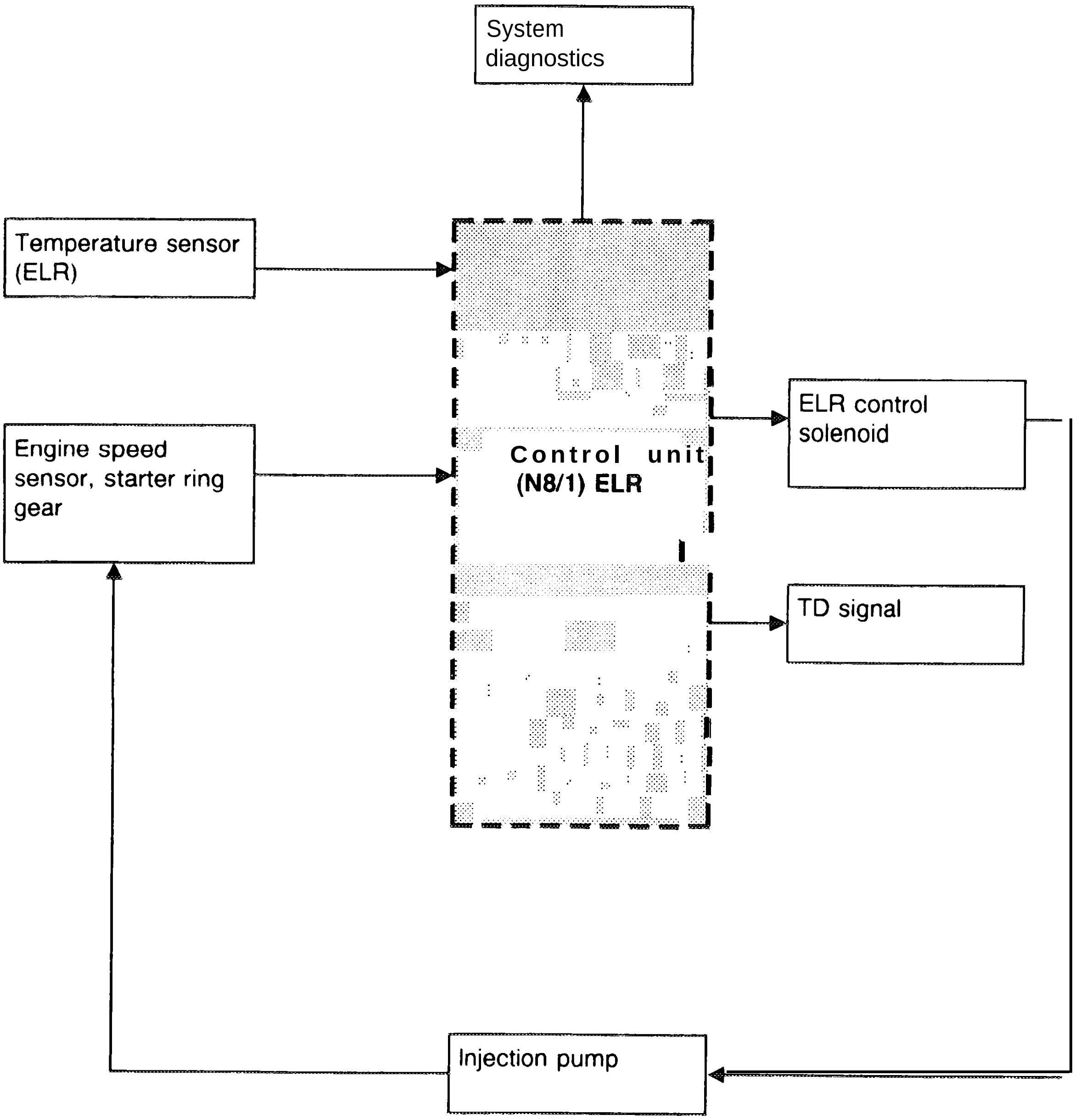
EXIT

Location of components



B11/1	Coolant temperature sensor	N8/1	ELR control unit
K1/1	Overvoltage protection	x92	Test connector
L3	Engine speed sensor	Y22	ELR actuator
L3x	Engine speed sensor plug connection		

ELR block diagram

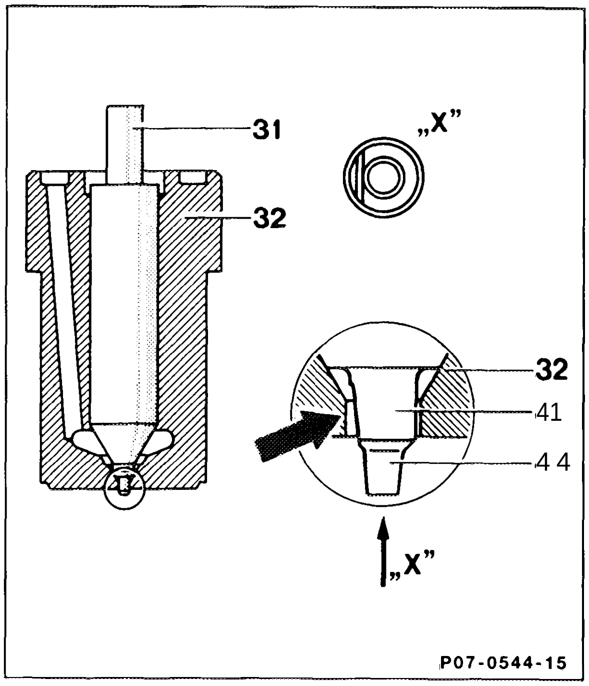


EXIT

O. Facet pintle nozzle

Bosch Designation DN 0 SD 265

The facet pintle nozzle differs from the pintle nozzle in having an oblique face angled at approx. 6° (arrow) on the throttling pintle (41), which improves the throttling effect.



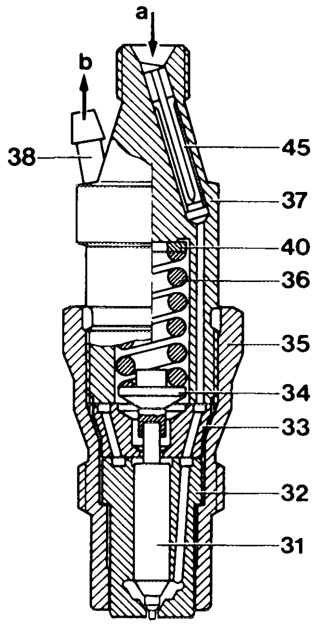
31 Nozzle needle
32 Nozzle body
41 Throttling pintle
44 Spray pintle

EXIT

P. Nozzle holder

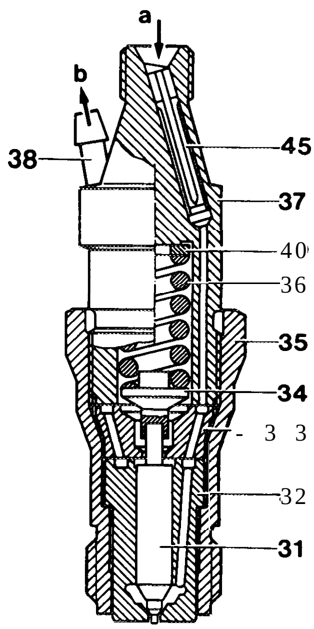
Bosch Designation:
KCA 27 S 55, for oblique injection
KCA 30 S 44, for vertical injection

The thickness of shim (40) determines the pre-load of the compression spring (36) and thus the opening pressure of the injection nozzle. The opening pressure can be set by fitting shims of different thicknesses. The fuel flows to the nozzle seat through the respective inlet orifice (a) in the holder (37), intermediate disk (33) and injection nozzle. During the injection process, the injection pressure raises the nozzle needle, and fuel flows through the annular orifice at the throttling pintle into the pre-chamber. Once the injection pressure drops, the compression spring (36) pushes the nozzle needle (31) back down onto its seat; the Injection process is completed.



P07-0464-15

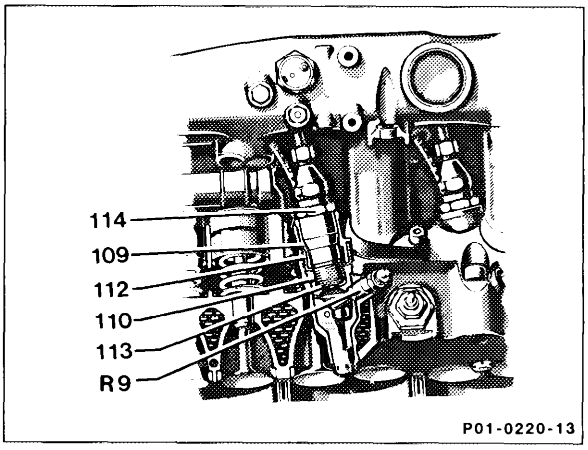
Nozzle holder KCA 27 S 55
(for oblique injection)
31 Nozzle needle
32 Nozzle body
33 Intermediate disk
34 Pressure pin
35 Nozzle tensioning nut
36 Compression spring
37 Holder
38 Fuel bypass port
40 Shim
45 Inlet orifice
a Fuel inlet
b Leak fuel (return)



P07-0503-15

Q. Oblique injection

The nozzle holder combination is fastened to the top section of the prechamber tilted at 5° relative to the longitudinal axis of the prechamber. This oblique Injection produces a more intensive mixing of air and fuel.



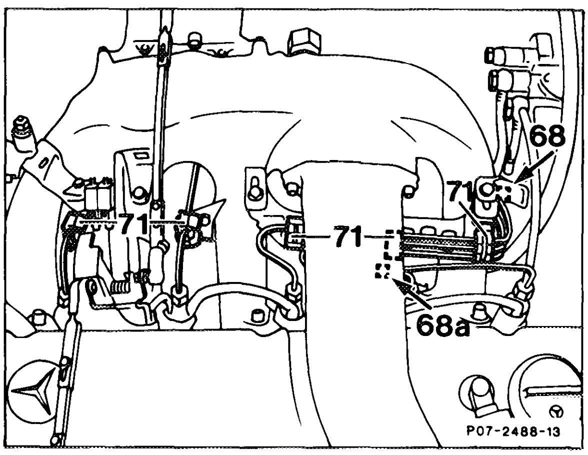
R9 Glow plug
109 Sealing sleeve
110 Prechamber
112 Threaded ring
113 Sealing shim
114 Nozzle holder

Together with the prechamber modification, the following additional benefits result:

- Improved cold start
- More favorable air/fuel mixing as a result of shorter glow plug (now 23 mm was previously 25 and 27 mm) in combination with recess and the concave in the ball pin.
- Particle reduction and improvement in the emission of hydrocarbons and carbon monoxide.

R. Injection lines

The injection lines are designed so as to allow the injection pump to swivel when the engine is running.

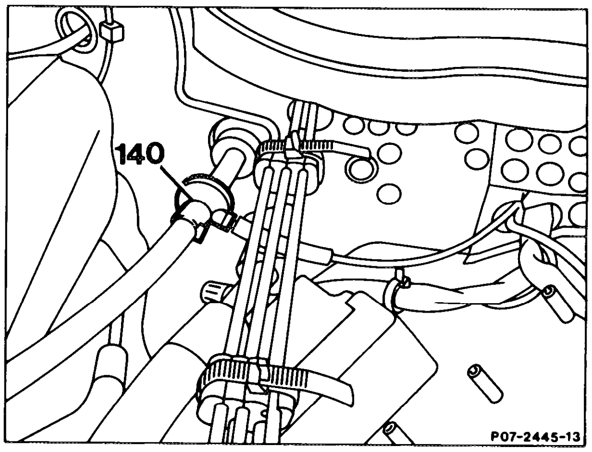


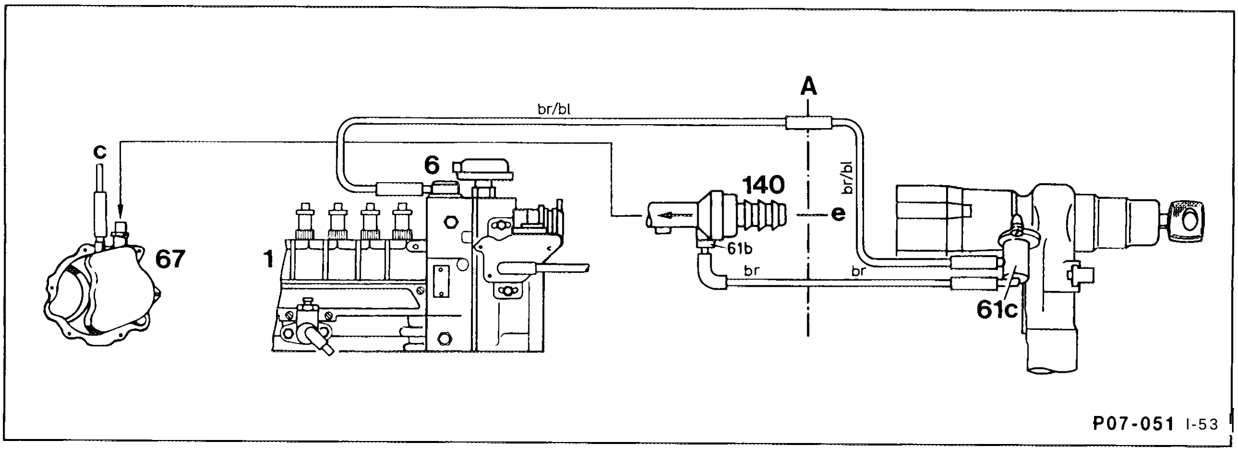
Note

The plastic clips (68 and 68a) must be fitted as close as possible to the radius of the injection lines (arrows). The plastic clips (71) must be locked in place.

S. Vacuum engine stop with car key (glow start switch)

The vacuum for the key-operated engine stop is supplied by the check valve (140) of the main vacuum line.





Vacuum line routing

1	Injection pump	A	Intermediate panel
6	Vacuum unit (stop)	c	Other ancillaries
61c	Valve, glow start switch	e	To brake booster
67	Vacuum pump		
140	Check valve/main vacuum line		

EXIT

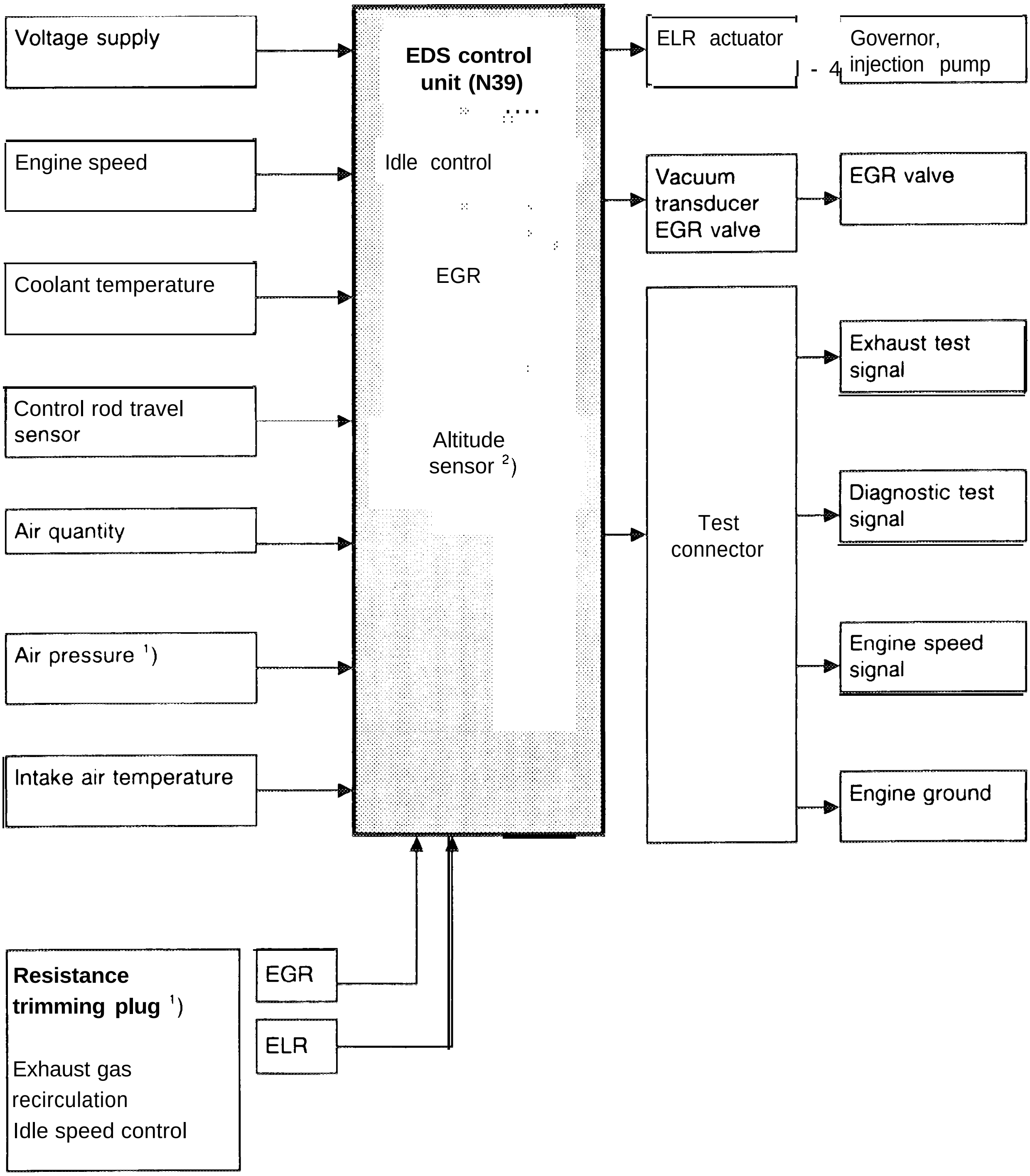
T. Electronic diesel system (EDS)

The electronic control unit processes the following functions:

a) Electronic idle speed control (ELR)
b) Exhaust gas recirculation (EGR)
c) Recirculating air control for trap oxidizer, (California Engine 603.96 Model Year 1986/87 only).
d) Charge pressure control (P2 control) Engine 602.962 from Model Year 1990.
e) System diagnostics

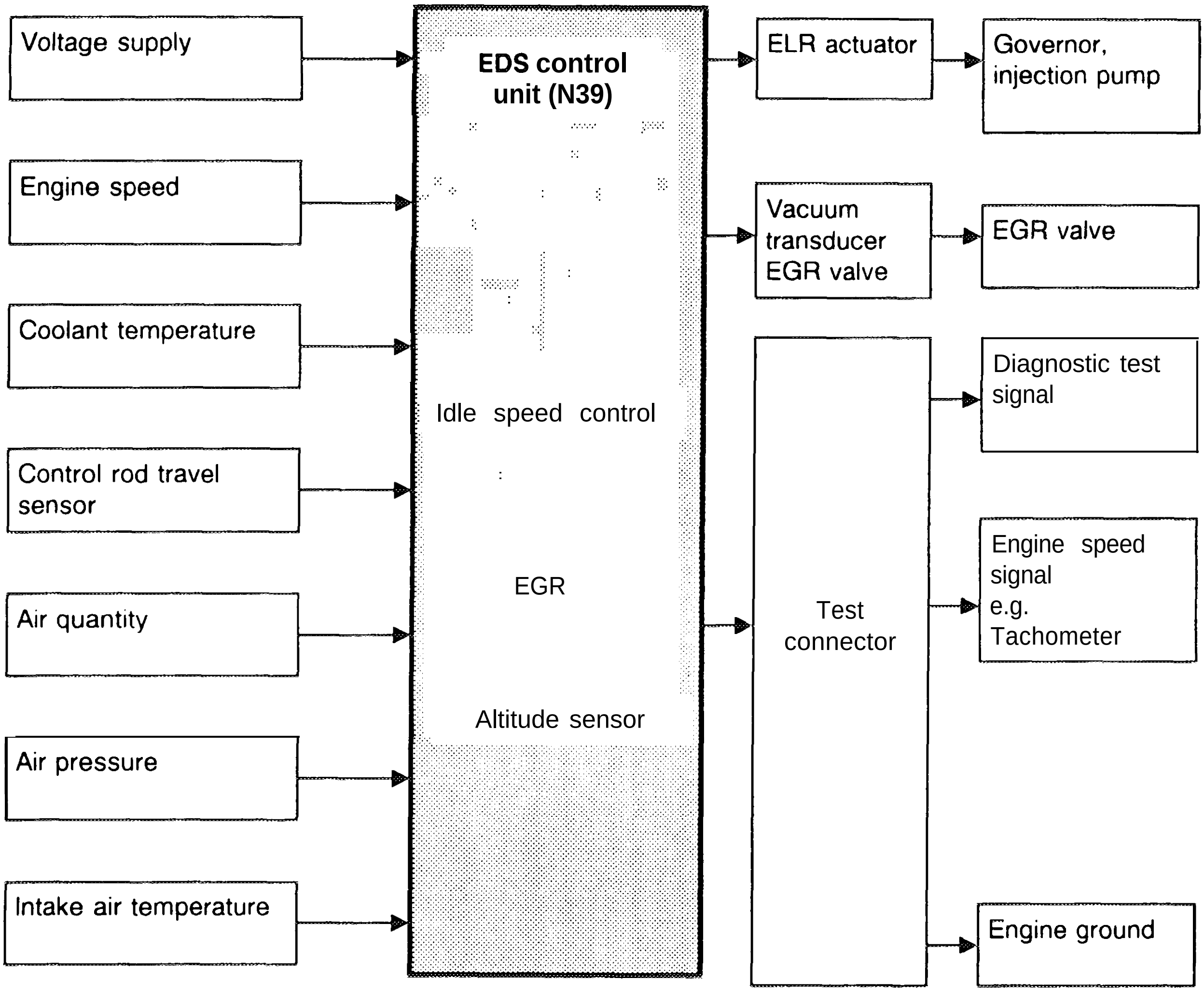
The control unit processes the incoming signals and supplies a current (mA) to the vacuum transducer, as well as to the actuator of the injection pump. The entire system is tested by means of a signal to other outlets, which merge into a test connector.

Influencing variables of Electronic Diesel System (EDS) Engine 602.96 and 603.96

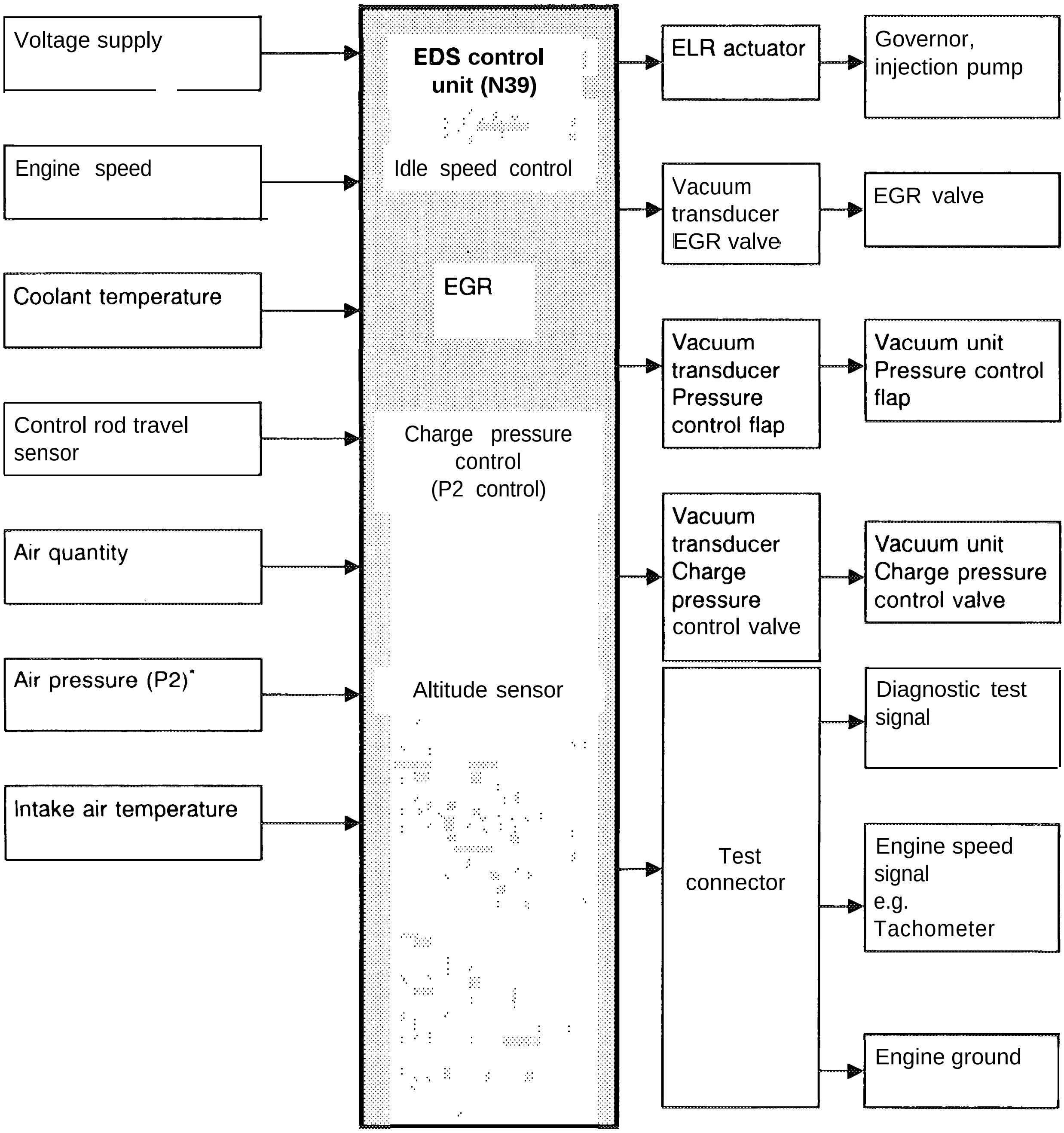


[1]) Model Year 1986187 only
[2]) Effective Model Year 1988 Integrated in control unit.

Influencing variables of electronic diesel system (EDS) Engine 603.970 from Model Year 1990



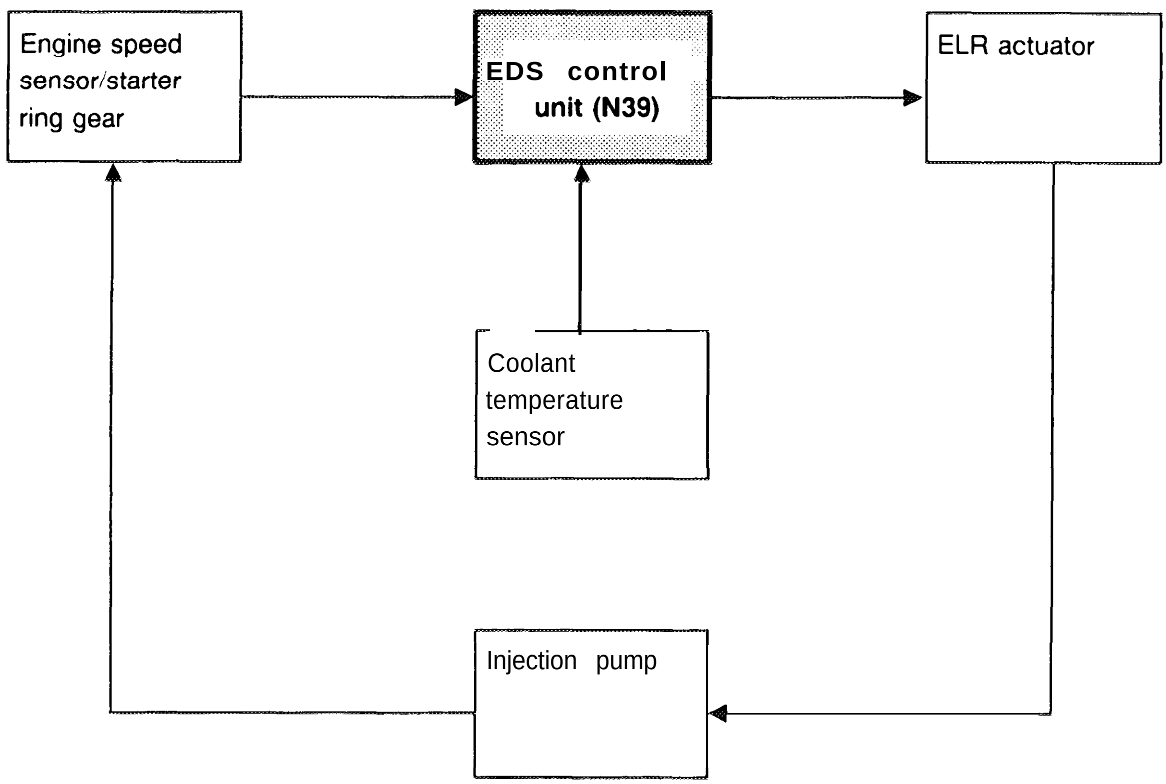
Influencing variables of Electronic Diesel System (EDS) Engine 602.962 from Model Year 1990



* Pressure in front of inlet valves

a) Electronic idle speed control (ELF?)
A speed sensor detects the engine speed **(144** pulses/revolution) and passes it on to the EDS control unit in the form of an alternating voltage. The EDS control unit processes the speed signal and performs the set value/actual value comparison. This enables idle speed to be maintained at a constant level by the actuator irrespective of engine load. Set idle speed is raised in accordance with a fixed characteristic curve by the temperature sensor at coolant temperatures < 60 ° C.

Block diagram of idle speed control (ELR)



EXIT

b) Exhaust gas recirculation (EGR)
Exhaust gas recirculation is initiated as soon as the following conditions are met:

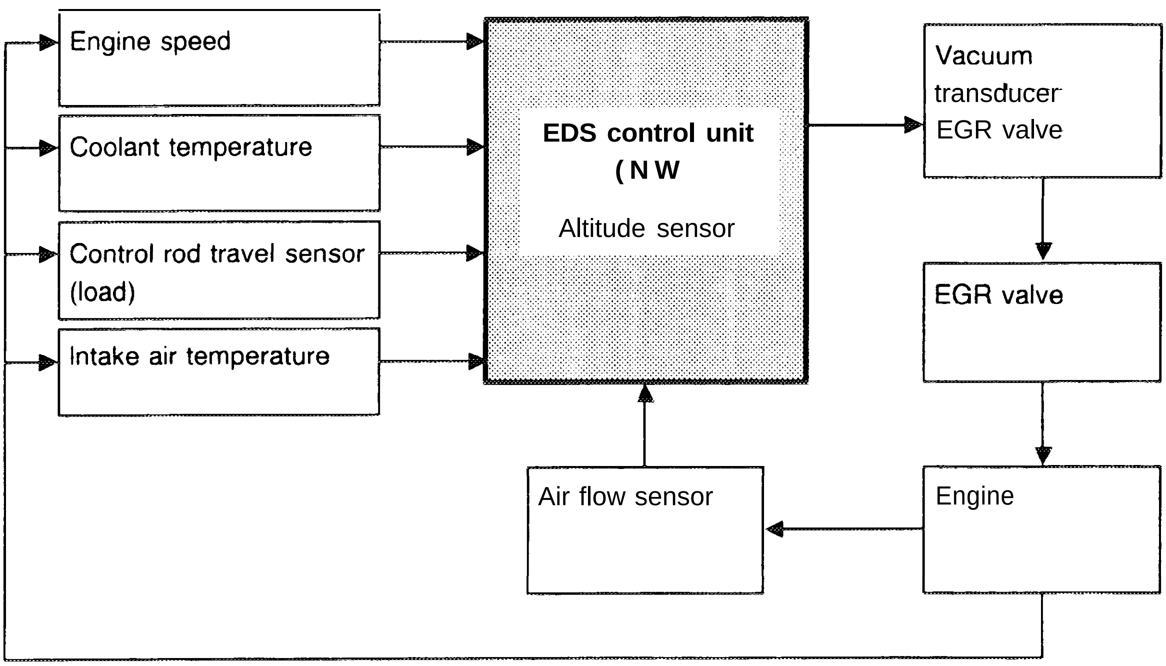
- Coolant temperature between 60°C and 110°C
- Engine speed between idle and 2800 rpm or 3500 rpm on Engine 602.962 from Model Year 1990
- Control rod travel less than 9 mm
- Battery voltage 1 l-1 4 Volts

Depending on the input signals of the sensors e.g. control rod travel, engine speed etc., the EDS control unit determines the matching quantity of recirculated exhaust gas for each operating state. The vacuum transducer is energized and supplies the corresponding vacuum to the EGR valve.

The EGR quantity is reduced as engine load and speed increase. This means
Increase in the control current = increase in EGR quantity.
Reduction in control current = reduction in EGR quantity.

Note
Temperature and engine speed are dependent on the control unit version. Refer to test routine for exact data.

Block diagram EGR



The EGR system with EGR valve, vacuum transducer, air flow sensor and EDS control unit operates as a closed control loop.

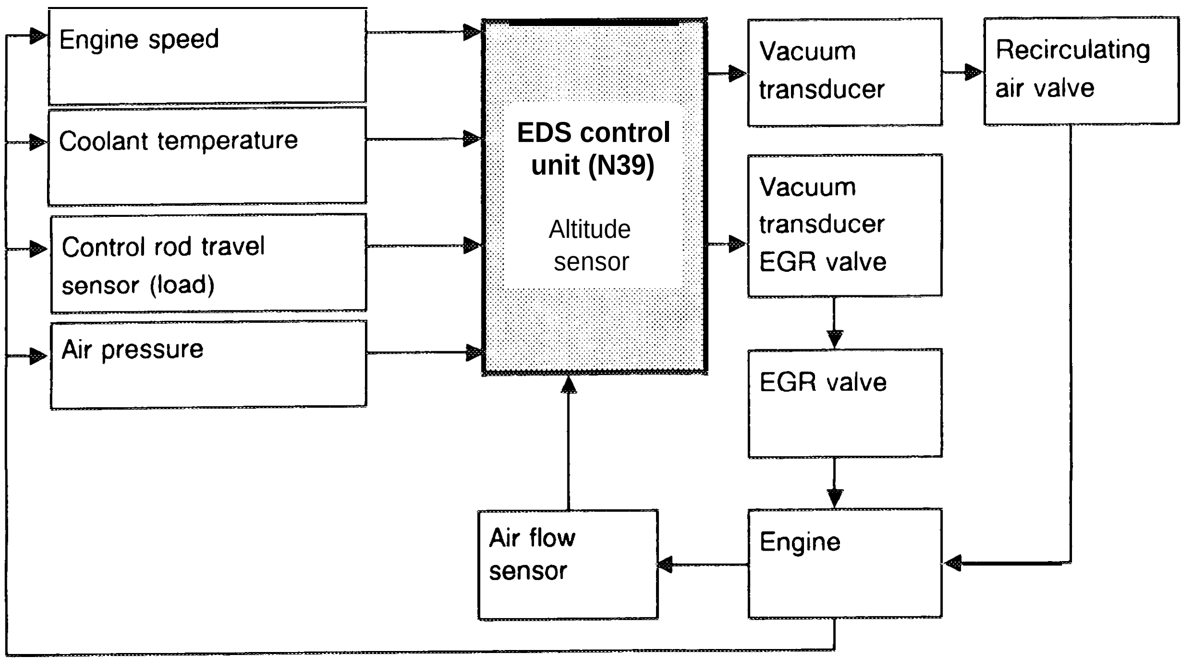
EXIT

c) Recirculating air control for trap oxidizer (California Engine 603.96 Model Year 1986/87 only)

In order to achieve improved combustion conditions for the trap oxidizer, the recirculating air valve is continuously opened or closed according to a performance characteristic map.

Following the closing operation, a residual vacuum of approx. 30 mbar is retained at the recirculating air valve. The recirculating air valve is open between 1000 and 3400 rpm. The control rod travel must be less than 9 mm.

Block diagram recirculating air control



EXIT

d) Charge pressure control (P2 control)
Engine 602.962 from Model Year 1990

A **"characteristic map" (P2** control) is stored in the **EDS** control unit. The pressure values obtained as a function of injection quantity and engine speed produce an optimum engine operation with respect to **performance, NQ,, HC** and **particle emissions.**

Function

Particle emissions are lowered by reducing the pressure (P2) in front of the intake valves under part load conditions.

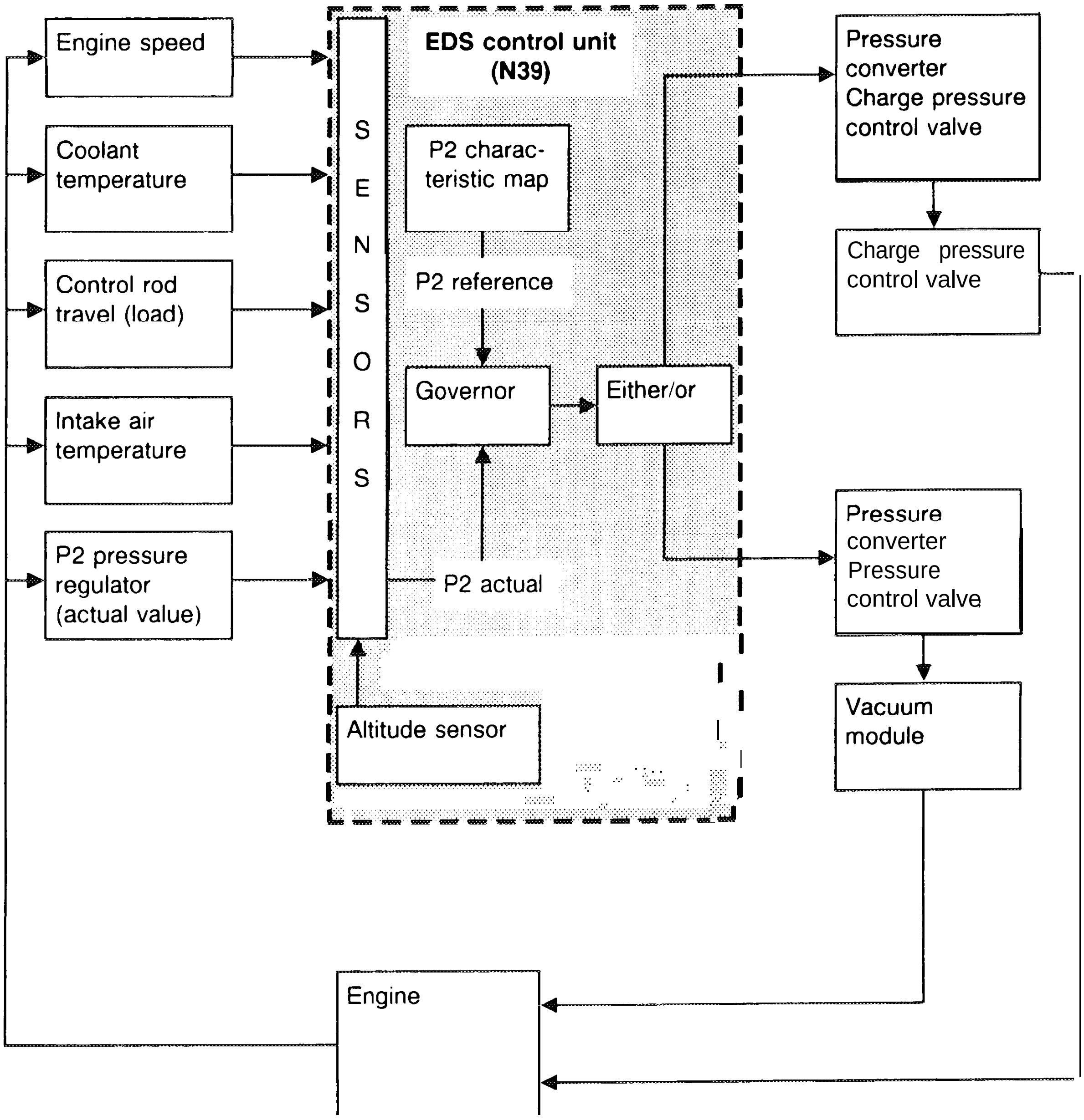
A control circuit exists in the EDS control unit through which a pressure comparison of "P2 **actual" and "P2 reference"** is performed (refer to block diagram).

Any pressure difference is compensated for by the charge pressure control valve or by the pressure control flap.
These pressure actuators are operated by the vacuum transducers by means of an electronically adjustable vacuum.

Charge pressure control is dependent on:
- Coolant temperature
- intake air temperature
- Intake air pressure
- Engine speed
- Position of control rod (control rod travel)

EXIT

Block diagram charge pressure control (P2 control), Engine 602.962 **Model Year 1990**



e) System diagnostics

The “electronic diesel system” can be checked for component faults respectively and stored by means of the self-test routine integrated in the EDS control unit.
Temporary faults, which last longer than 4 seconds, are also stored.
E.g. sensor faults with the exception of speed sensors are memorized, as well as short-circuits in the actuators or their lines.
The pulse display can be tapped via the test connector (Xl 1/4), socket 4 and the individual faults evaluated with the aid of a pulse counter.
Depending on the readout, the defective component or its leads can be determined.

Model Year 1986187
EDS control unit **with** fault detection.
Only permanently occurring faults are detected.

f) Location and function of components

Model Year 1986/87
Test connector (X92) is used for diagnostics.
The diagnostic test signal can be taken from the test connector.

Modull3 Format 1 ,0 **(77 x 58** mm)

Bild-Motiv

Foto/Zg-Nr.

A bgabe

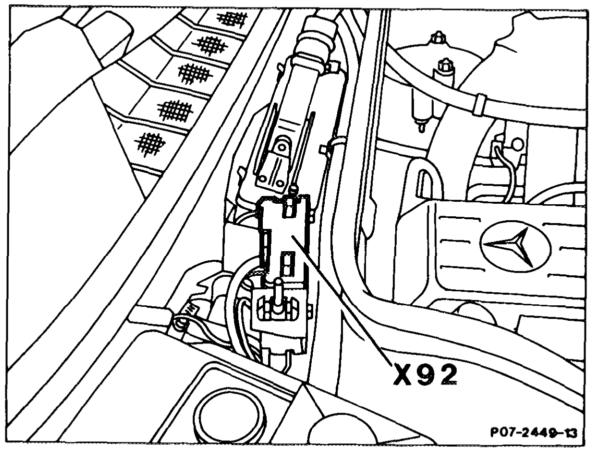
Korrektur

Freigabe

Bild-Nr. **P07-2467- 13**

Models 124 and 201 in component compartment right

EXIT

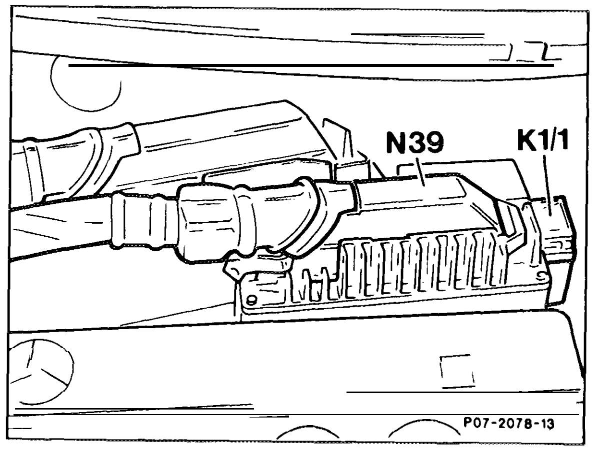


Model 126

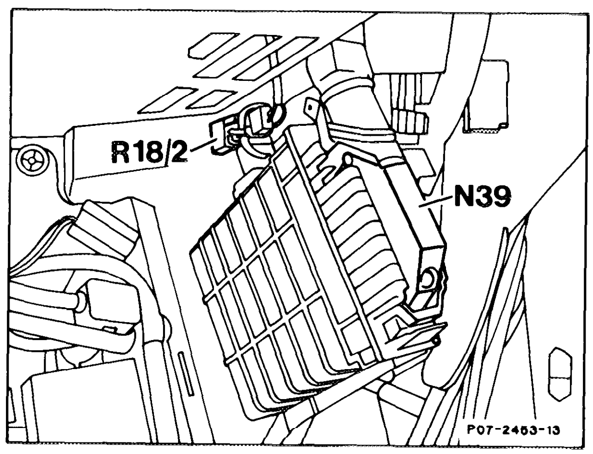
Function of components

Control unit (N39)

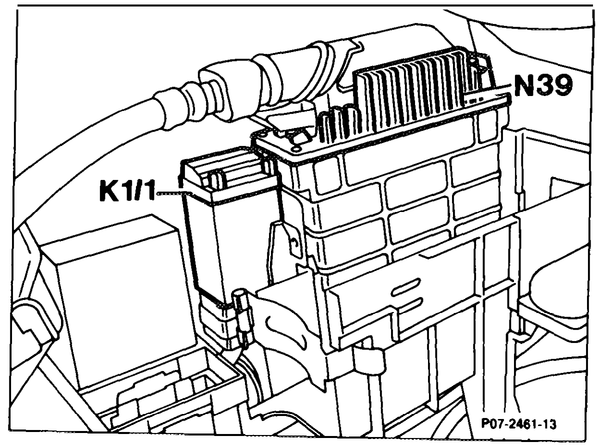
The control unit processes the incoming signals and supplies a current (mA) to the pressure converter, EGR switchover valves, as well as to the actuator of the injection pump. The entire system can be tested by means of a signal passed through four other outlets merging into a test connector.



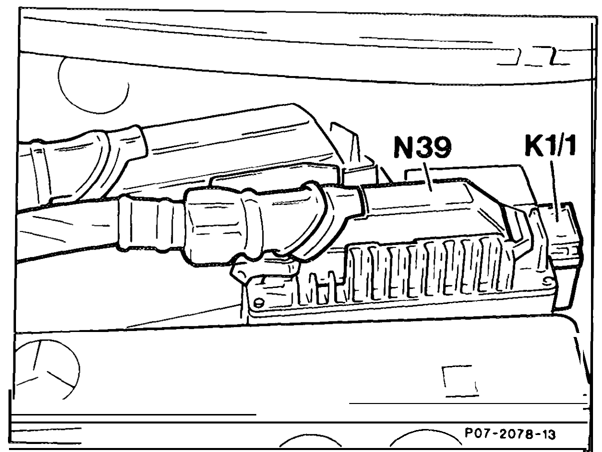
Model 124 behind battery in component compartment



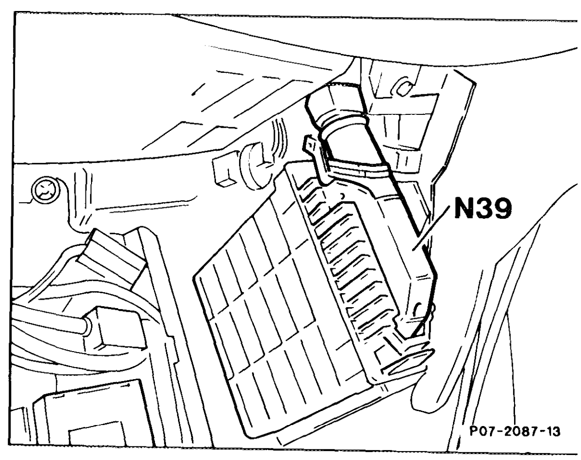
Model 126 in right foot well behind side panelling



Model 201 behind the battery in components compartment



Model 124.128
(Engine 602.962)



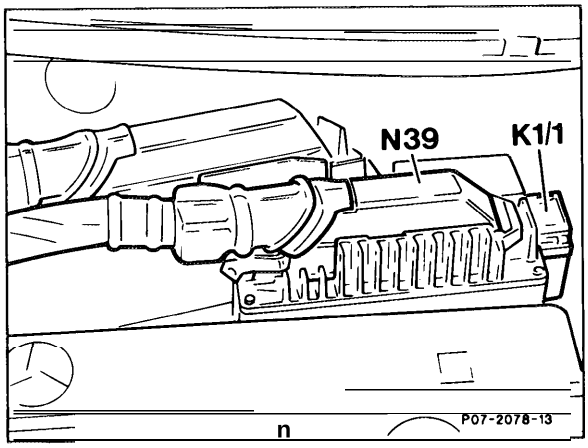
Model 126.13
(Engine 603.970)
Installed on the right in the passenger compartment

Altitude sensor (integrated in control unit) from Model Year 1990

The quantity of recirculated exhaust gas is influenced by the atmospheric pressure sensor as a function of altitude or air pressure. The altitude sensor supplies a voltage signal to the control unit which drops as air pressure drops (increasing altitude). The control unit matches the quantity of exhaust gas recirculated to the respective air pressure by reducing the pressure converter current.

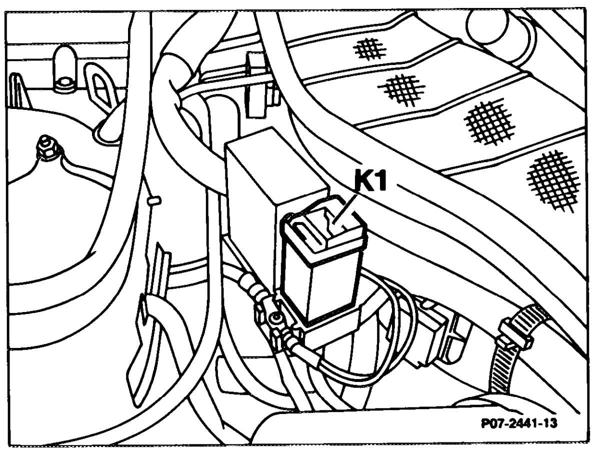
Over-voltage protection (K1 or K1/1)

The power for the electronic control units is supplied through the over-voltage protection relay.



Models 124, 201 behind the battery in the component compartment

The battery voltage is supplied constantly to terminal 30. A 10A fuse is fitted between terminal 30 and 30a. The fault memory is constantly energized through terminal 30a. When the ignition is switched on, the relays are actuated through terminal 15 by an electronic unit. The EDS control unit is thus energized through terminal 87E and other ancillaries through terminal 87. The over-voltage protection is achieved by means of a 22 volt Zener diode. Voltage peaks in excess of 22 volts occurring ahead of the over-voltage protection are switched directly to ground by the Zener diode. An overload is prevented by a fuse. Terminals 87E and 87L are protected separately.

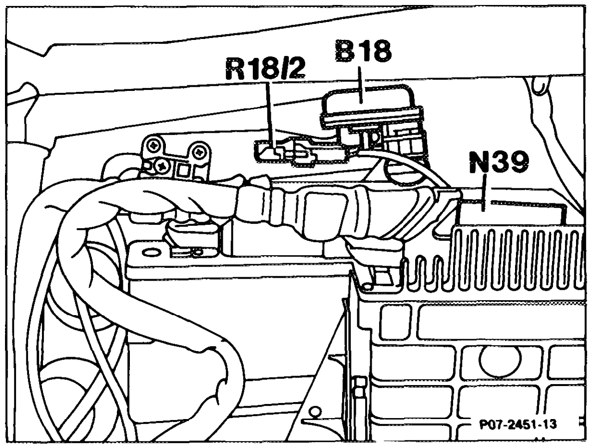


Model 126 in component compartment next to ABS control unit

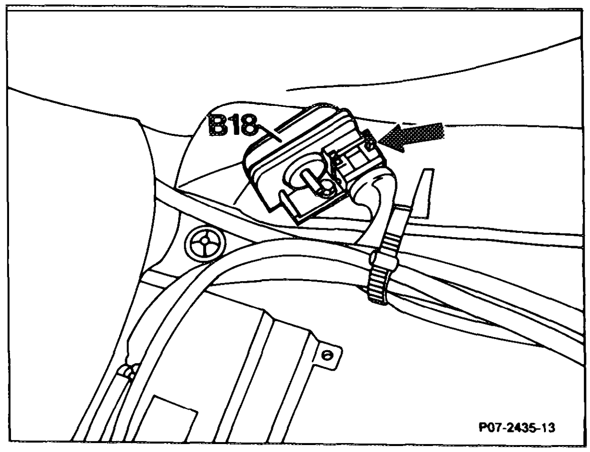
EXIT

Altitude sensor (B18)
Model year 1986/87

The quantity of exhaust gas recirculated is influenced by the altitude correction sensor as a function of altitude or air pressure. The sensor supplies a voltage signal to the control unit which drops as air pressure drops (increase in altitude). The control unit matches the quantity of exhaust gas recirculated to the air pressure by reducing the pressure converter current.



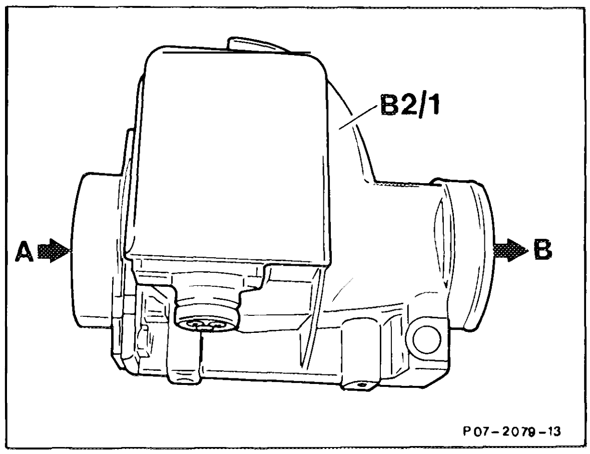
Model 124, 201 in component compartment



Model 126 in right footwell

Air flow sensor potentiometer (B2/1)

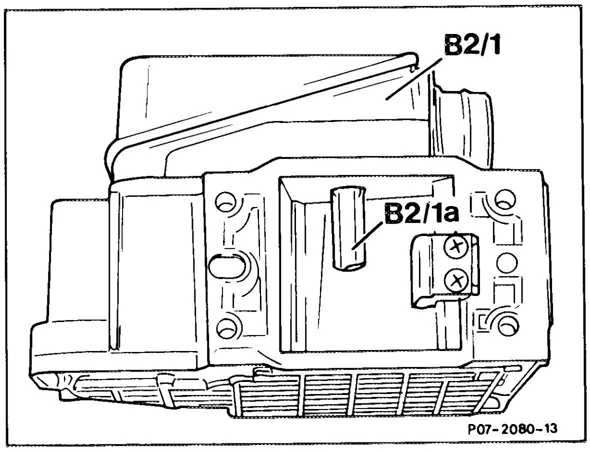
Fitted in the air flow between air filter and exhaust gas turbocharger.



A from air filter
B to exhaust gas turbocharger

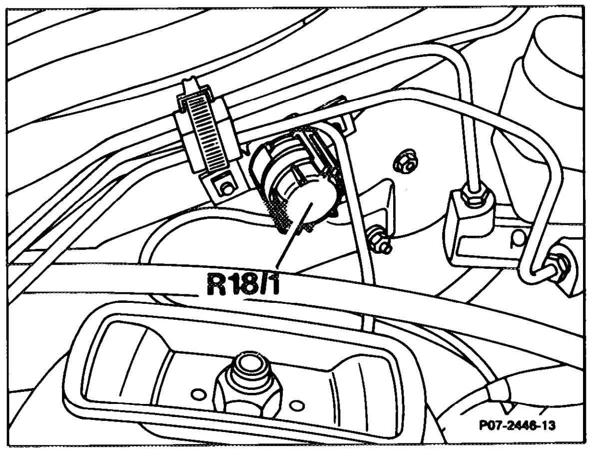
EXIT

The intake air deflects the air flow sensor flap against the restoring force of a spring into a defined angular position. The position is measured by means of a potentiometer, and converted into a voltage.
The intake air temperature is detected by a temperature sensor (B2/1a) in the air flow sensor.

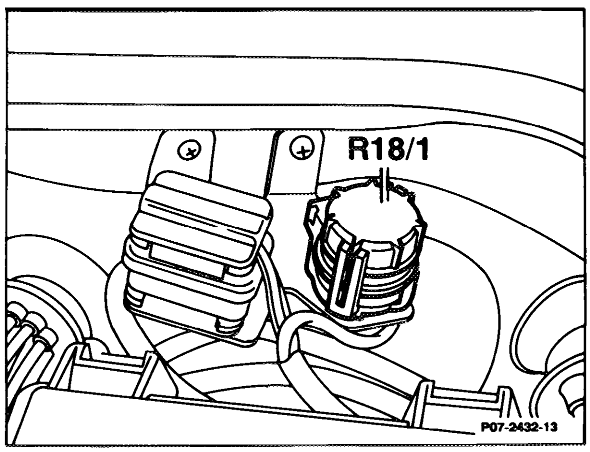


Air flow sensor
Model 201 without round flange

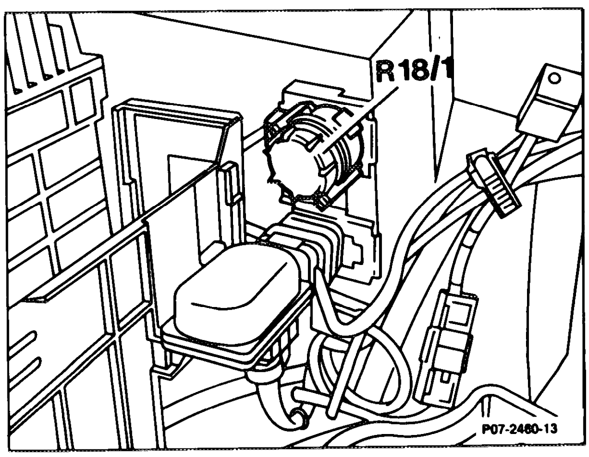
Resistance trimming plug (R18/1) for idle speed
For setting the idle speed.
Specification: 630 ± 20 rpm



Model 124



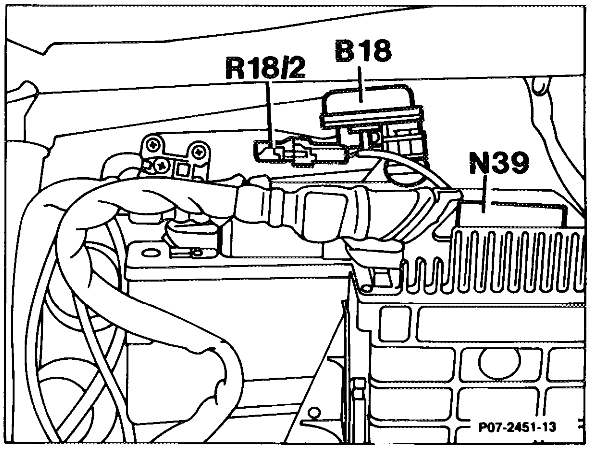
Model 126



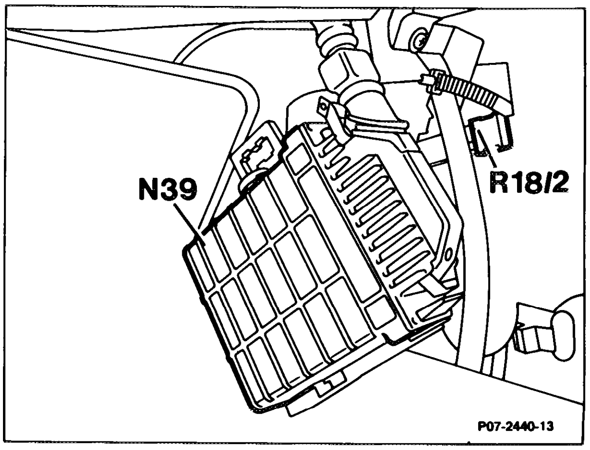
Model 201

EXIT

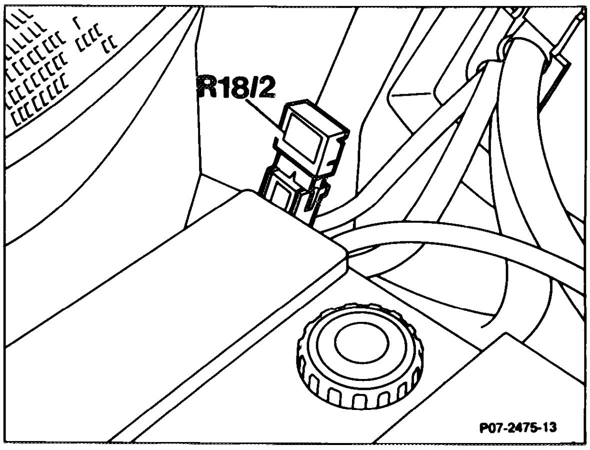
Reference resistor (R18/2) for exhaust gas recirculation



Model 124 in components compartment



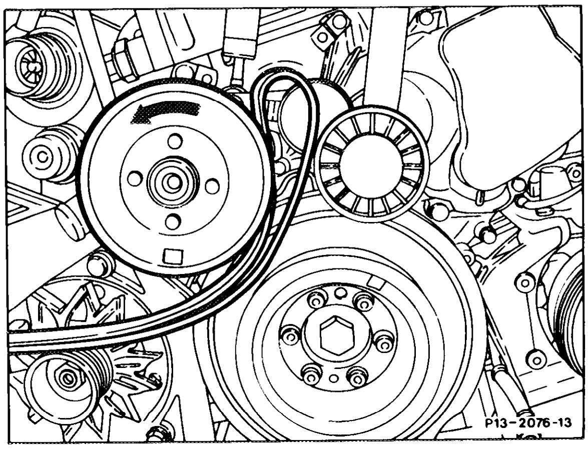
Model 126 at right of car Interior next to control unit (N39)



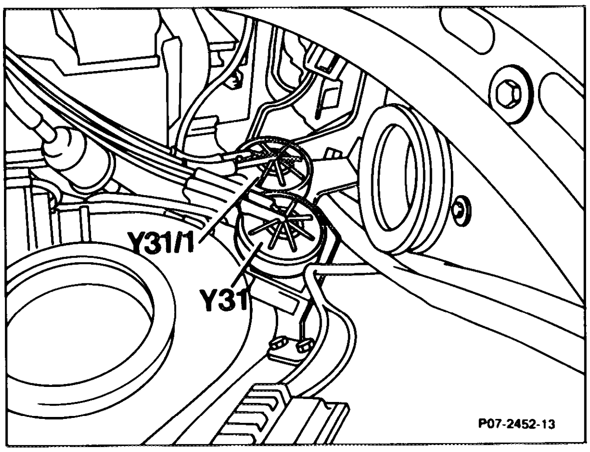
Model 201 in component compartment next to battery

Vacuum transducer (Y31/1, Y31/2 and Y31/3)

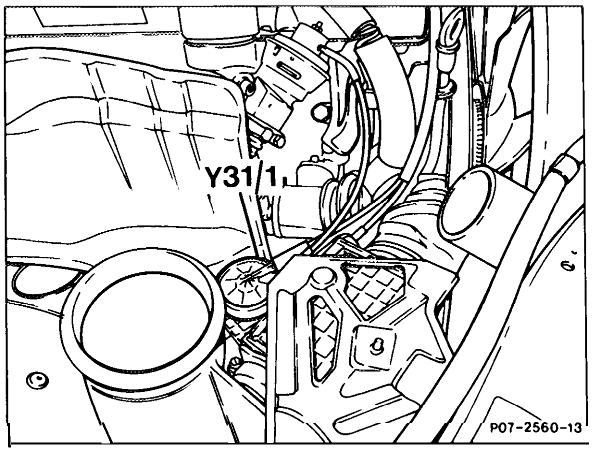
The vacuum transducers are supplied with a control current as an input signal depending on the operating state. The pressure converter then supplies the matching vacuum for the actuators.



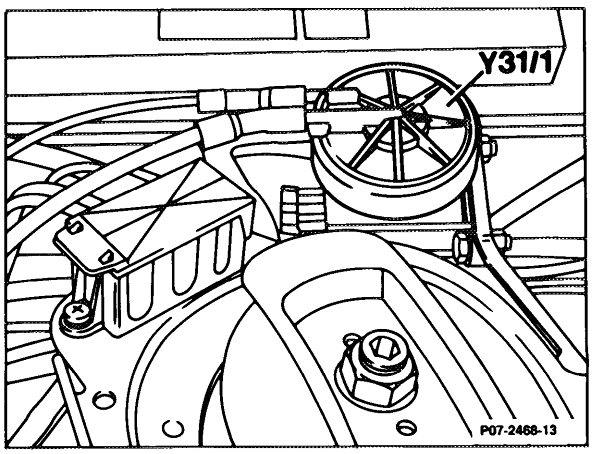
Engine 602.962 Model Year 1990
Y31/1 Vacuum transducer - EGR valve
Y31/2 Vacuum transducer - pressure control flap
Y31/3 Vacuum transducer - charge pressure control



Engine 603.96 in Model 124



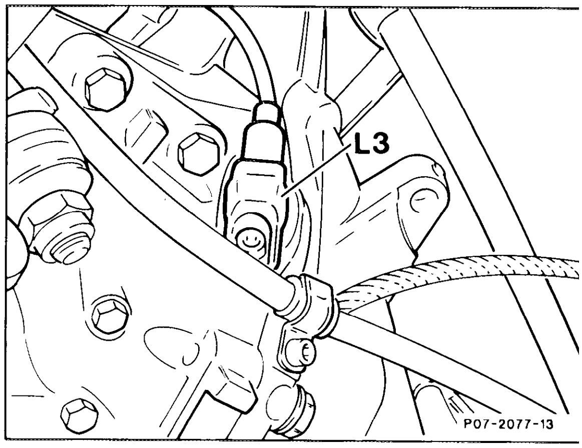
Engine **603.96/97**
Y31/1 Vacuum transducer EGR valve in Model 126



Engine 602.96 in Model 201

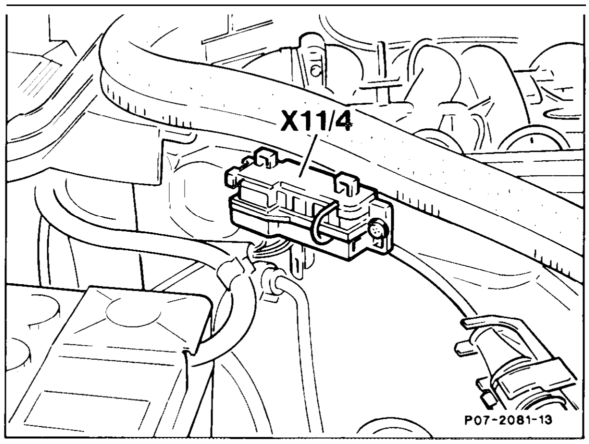
EXIT

Engine speed sensor (L3)
It detects engine speed at the starter ring gear (144 pulses/revolution) and sends it to the control unit in the form of an alternating voltage.

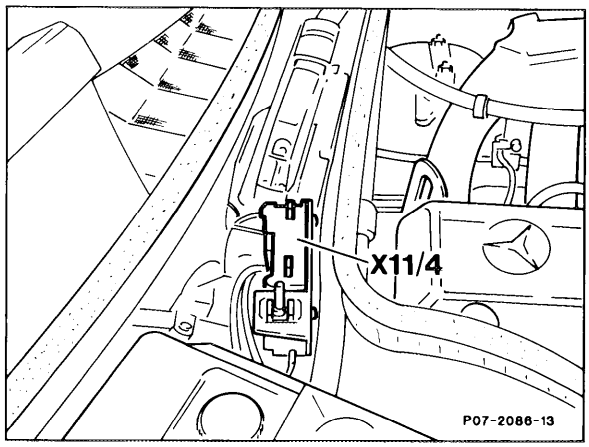


Test connector (XI 1/4)
The pulse display can be tapped by the test connector.

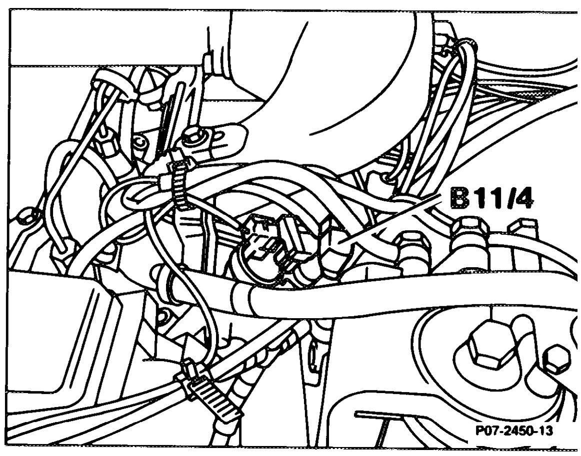
Model 124



Model 126



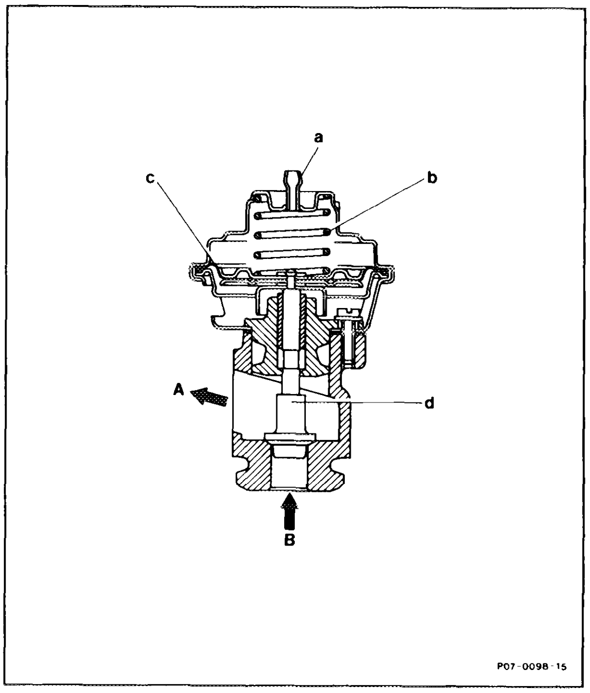
Coolant temperature sensor EDS (B11/4)
The coolant temperature is detected by the temperature sensor (EDS) (B11/4) and is actuated by the EDS control unit.
The resistance of a coolant temperature sensor EDS varies as a function of coolant temperature.



EXIT

EGR valve

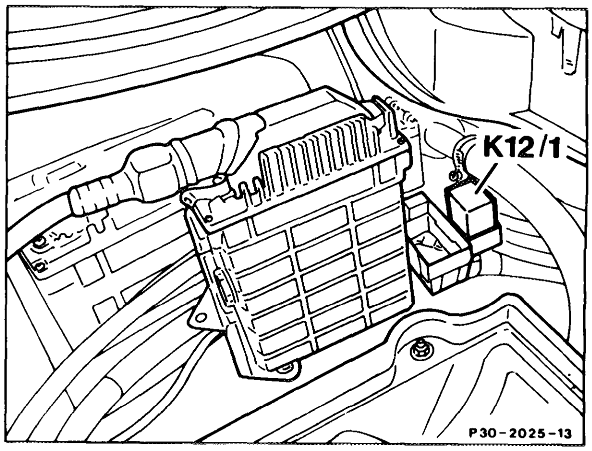
The EGR valve is bolted to the mixing pipe on the side of the cylinder head. It is connected to the exhaust manifold, charge air distribution pipe and a corrugated pipe. The EGR valve is opened by means of a controlled vacuum from the vacuum transducer.



A Exhaust gas to charge air distribution pipe
B Exhaust gas from exhaust manifold
a Vacuum connectron
b Spring
c Diaphragm
d Valve

Cruise control (Tempomat), Model Year 1990

In order not to influence the control of the cruise control in the part load area, the charge pressure is rendered inoperative by the cruise cont./charge pressure relay (K12/1) during cruise control operation.

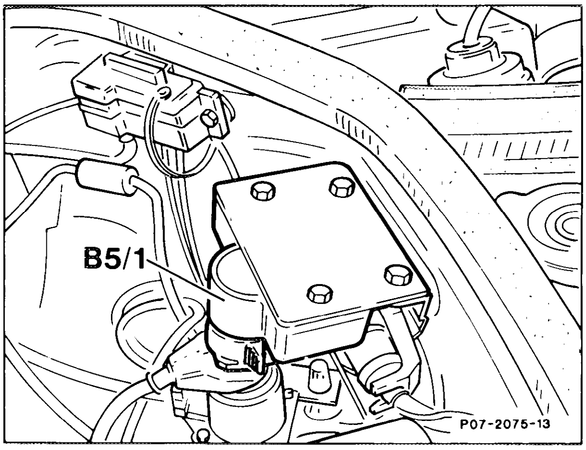


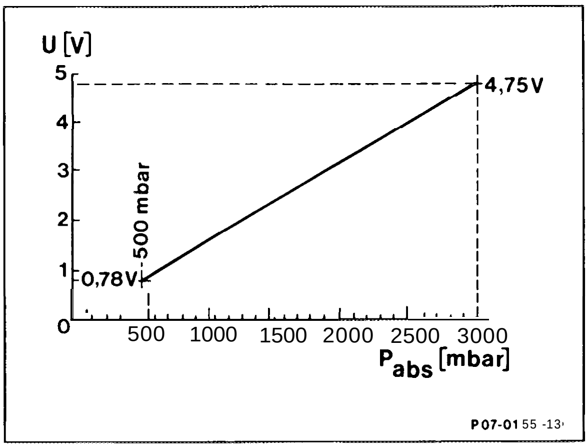
Model 124
K12/1 Cruise control/charge pressure shutoff relay

Model 201
K12/1 Cruise control/charge pressure shutoff relay

EXIT

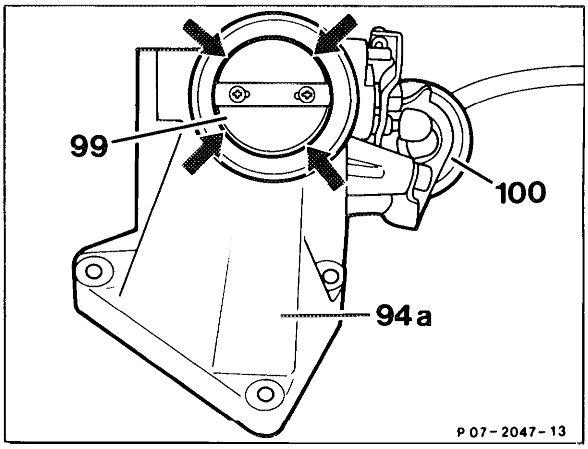
Pressure sensor (B5/1) Engine 602.962
Fitted right behind the bulkhead in the direction of travel. The pressure sensor detects the pressure and converts it into a voltage, which is processed by the EDS control.

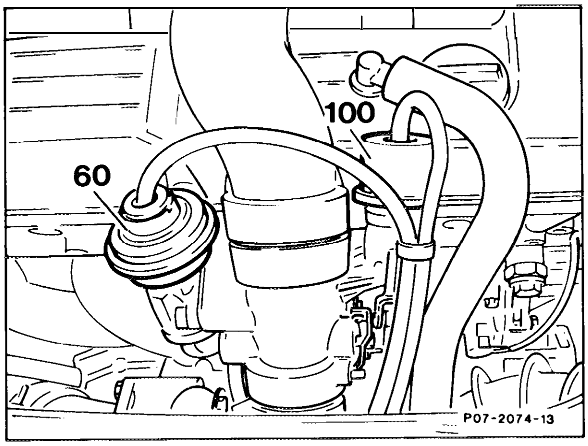




Absolute pressure characteristic (Pabs in mbar) with 5 V voltage supply

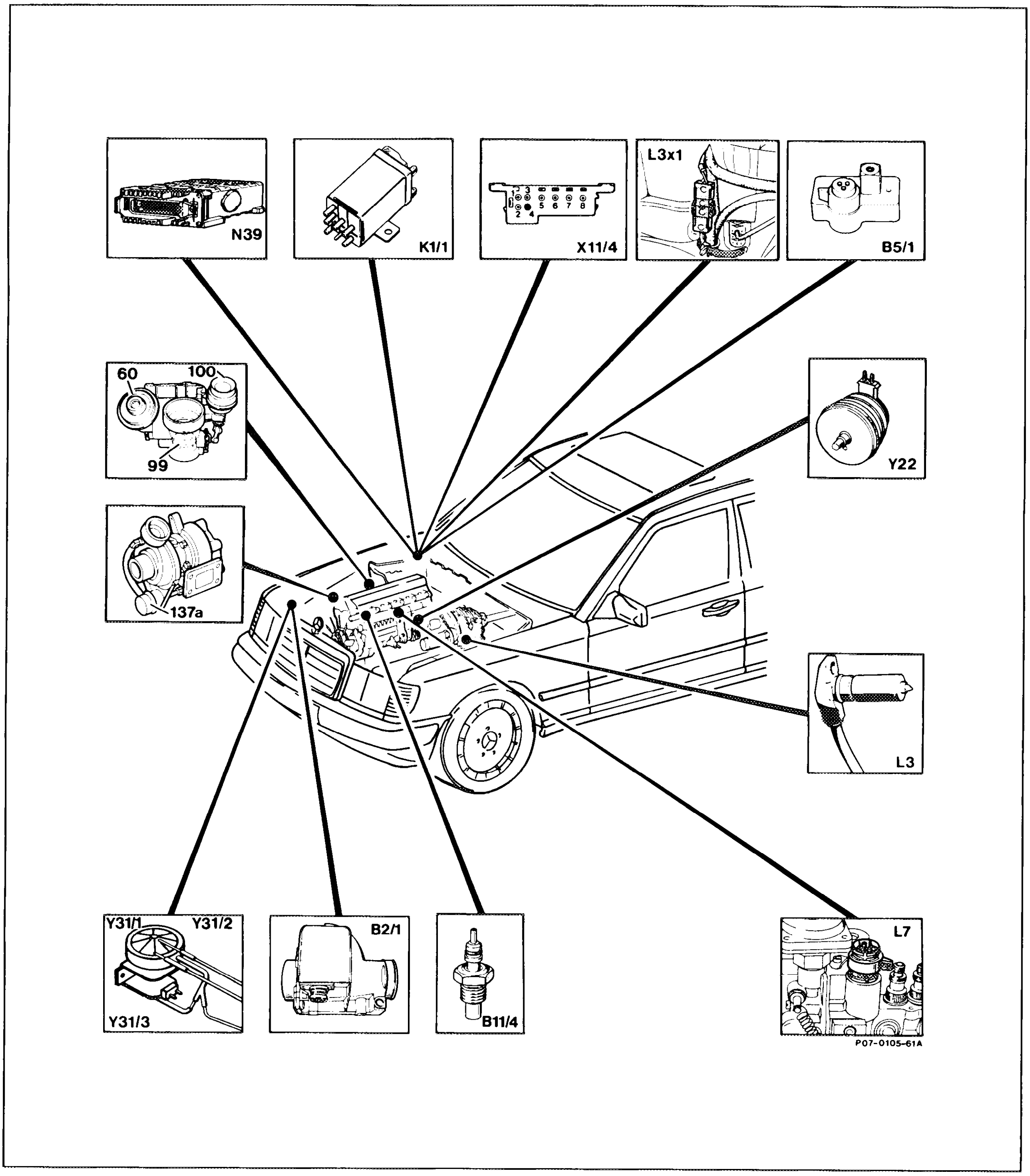
Mixture housing (94a) with pressure control flap (99) and vacuum unit (100) (Engine 602.962 only) from Model Year 1990
In order to increase the vacuum in the charge air distribution pipe, a pneumatically operated pressure control flap is fitted to the mixture housing. The pressure control flap closes the fresh air port during engine operation with EGR. A minimum opening (arrows) between the pressure control flap and the mixture housing is maintained. The vacuum unit (100) is actuated by the pressure convertor pressure control flap (refer to function diagram).





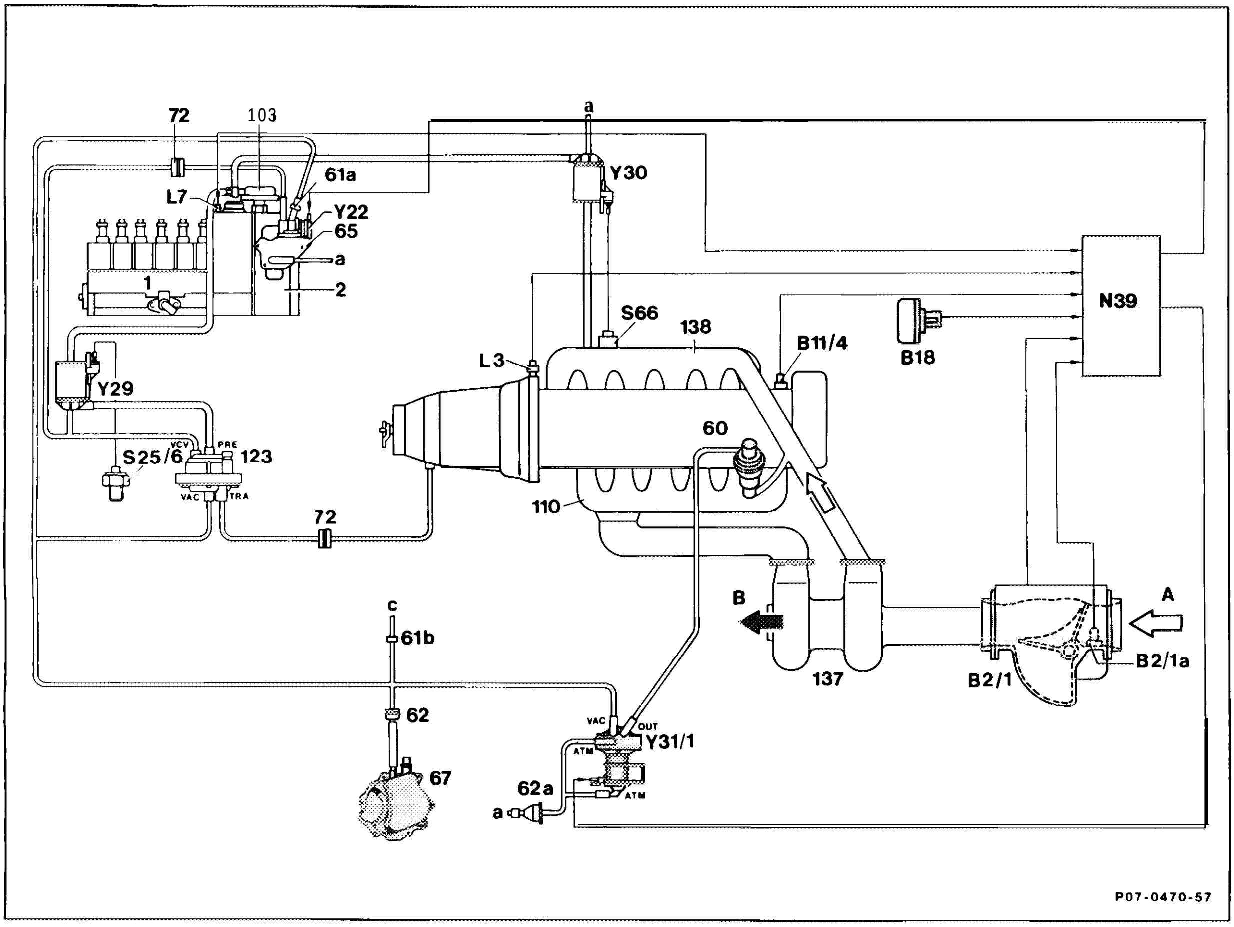
60 EGR valve
100 Vacuum unit

EXIT



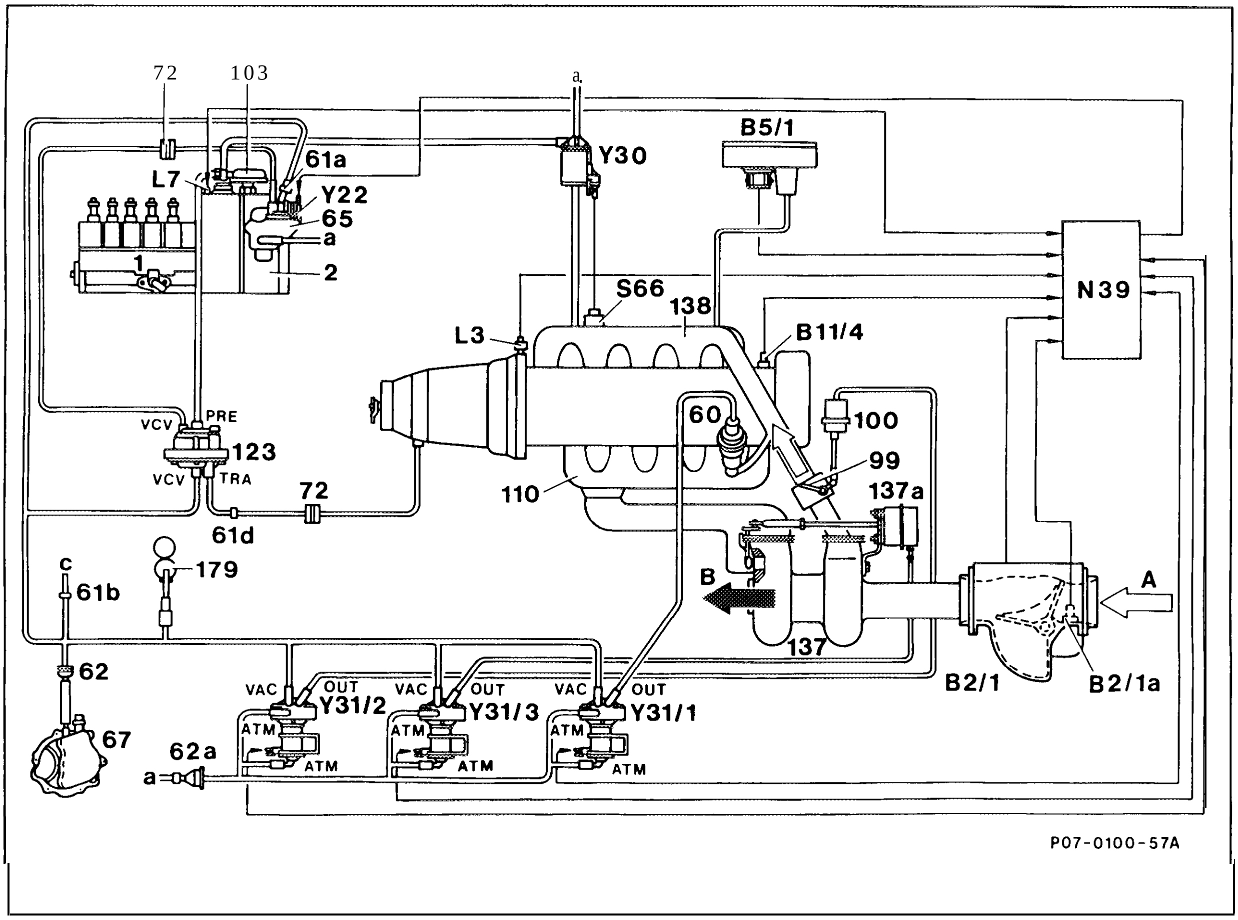
Model Year 1990, Engine 602.962

B2/1	Air flow sensor potentiometer with intake air temperature sensor, EDS
B5/1	Pressure sensor (EDS)
B11/4	Coolant temperature sensor
K1/1	Over-voltage protection relay
L3	Engine speed sensor - starter ring gear
L3x1	Plug connector, engine speed sensor - starter ring gear
L7	Control rod travel sensor
x1114	Test connector
Y22	ELR actuator
Y31/1	EGR vacuum transducer
Y31/2	Pressure convertor - pressure control flap
Y31/3	Pressure convertor - charge pressure control
60	EGR valve
99	Pressure control flap in mixture housing
100	Vacuum unit, pressure control flap
137a	Vacuum unit, charge pressure control valve



Engine 603.960 in Model 126, Model Year 1986 Federal
Engine 602.961 in Model 201, Model Year 1987 Federal

1	Injection pump	S25/6	Temperature switch 50 °C
2	Governor	S66	Switch, engine overload protection
60	EGR valve	Y22	Actuator
61a	Restriction, blue	Y29	Switch-over valve, vacuum amplifier
61b	Restriction, orange	Y30	Switch-over valve, engine overload protection
62	Filter	Y31/1	Vacuum transducer, exhaust gas recirculating valve
62a	Filter		
65	Vacuum control valve	a	Fresh air flow to car interior
67	Vacuum pump	A	Intake air
72	Damper	B	Exhaust gas
103	ALDA unit		
110	Exhaust manifold		Pressure and vacuum connections at vacuum transducer or vacuum amplifier
123	Vacuum amplifier		
137	Exhaust gas turbocharger		
138	Charge air distribution pipe	PRE	Charge pressure from ALDA unit
B2/1	Air flow sensor potentiometer	TRA	To vacuum unit of automatic transmission
B2/1a	Intake air temperature sensor	VAC	Vacuum from vacuum pump
B11/4	Coolant temperature sensor	VCV	To vacuum control valve
B18	Altitude sensor	ATM	Fresh arr flow to car interior
L3	Engine speed sensor, starter ring gear	OUT	Exhaust gas recirculation to exhaust gas recirculating valve or recirculating air valve
L7	Control rod travel sensor		
N39	EDS control unit		



Engine 602.962, Model Year 1990

1	Injection pump
2	Governor
60	Exhaust gas recirculating valve
61a	Restriction
61b	Restriction
61d	Connector (without restriction)
62	Filter
62a	Filter
65	Vacuum control valve
67	Vacuum pump
72	Damper
99	Pressure control flap in mixture housing
100	Vacuum unit, pressure control flap
103	ALDA unit
110	Exhaust manifold
123	Vacuum amplifier
137	Exhaust gas turbocharger
137a	Vacuum unit, charge pressure control valve
138	Charge air distribution pipe
179	Vacuum reservoir
B2/1	Air flow sensor potentiometer with intake air temperature sensor, EDS
B2/1a	Intake air temperature sensor
B5/1	EDS pressure sensor
B11/4	EDS coolant temperature sensor
L3	Engine speed sensor, starter ring gear
L7	Control rod travel sensor

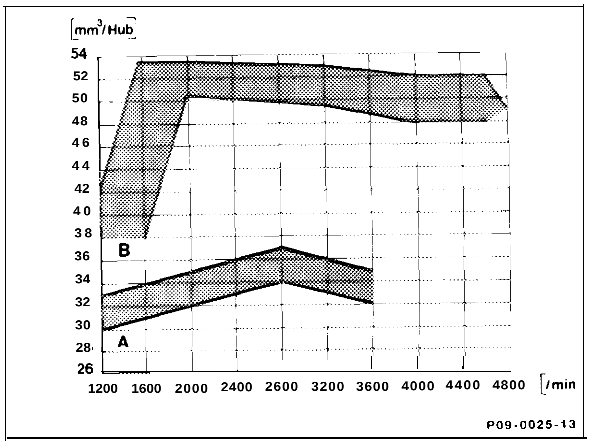
N39	EDS control unit
S66	Switch, engine overload protection
Y22	ELR actuator
Y30	Switch-over valve, engine overload protection
Y31/1	Vacuum transducer, exhaust gas recirculating valve
Y31/2	Vacuum transducer, pressure control flap
Y31/3	Vacuum transducer, charge pressure control
a	Fresh air flow to car interior
c	Other ancillaries
A	Intake air
B	Exhaust air

Pressure and vacuum connections at vacuum transducer or vacuum amplifier

PRE	Charge pressure from ALDA unit
TRA	To vacuum unit of automatic transmission
VAC	Vacuum from vacuum pump
VCV	To vacuum control valve
ATM	Fresh air flow to car interior
OUT	Output from vacuum transducer Y31/1 to EGR valve
OUT	Output from vacuum transducer Y31/2 to vacuum unit of pressure control flap
OUT	Output from vacuum transducer Y31/3 to vacuum unit of charge pressure control valve

V. Engine overload protection

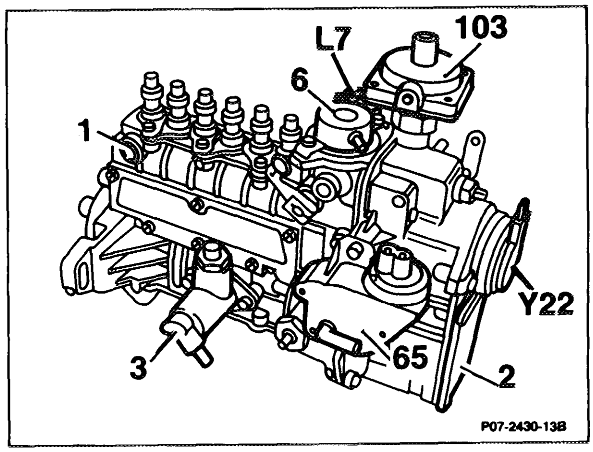
A pressure switch is fitted in the charge air pipe for overload protection of mechanical parts in the engine. If the charge pressure rises above 1 .1± 0.15 bar gauge pressure, air is admitted to the ALDA unit through the switchover valve and the quantity of fuel is limited to that of a naturally aspirated engine.



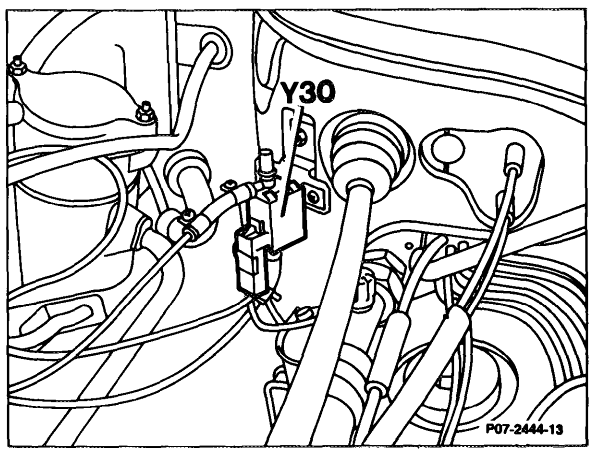
A Full load quantity without charge pressure (P = 1050 mbar)

B Full load quantity with charge pressure

Location of components

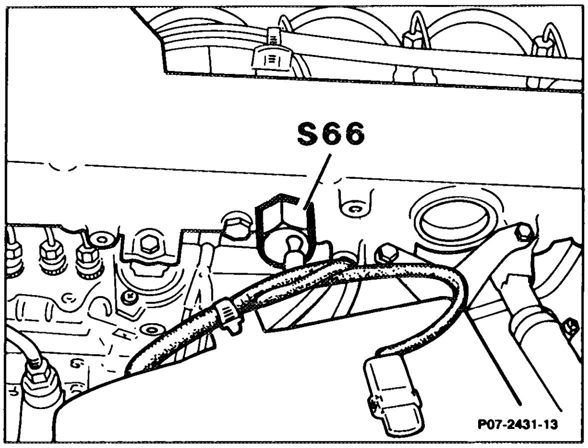


	Injection pump
2	Governor
3	Fuel pump
6	Stop unit
103	ALDA unit
Y22	Actuator



Y30 Switchover valve, engine overload protection

S66 Switch, engine
overload protection

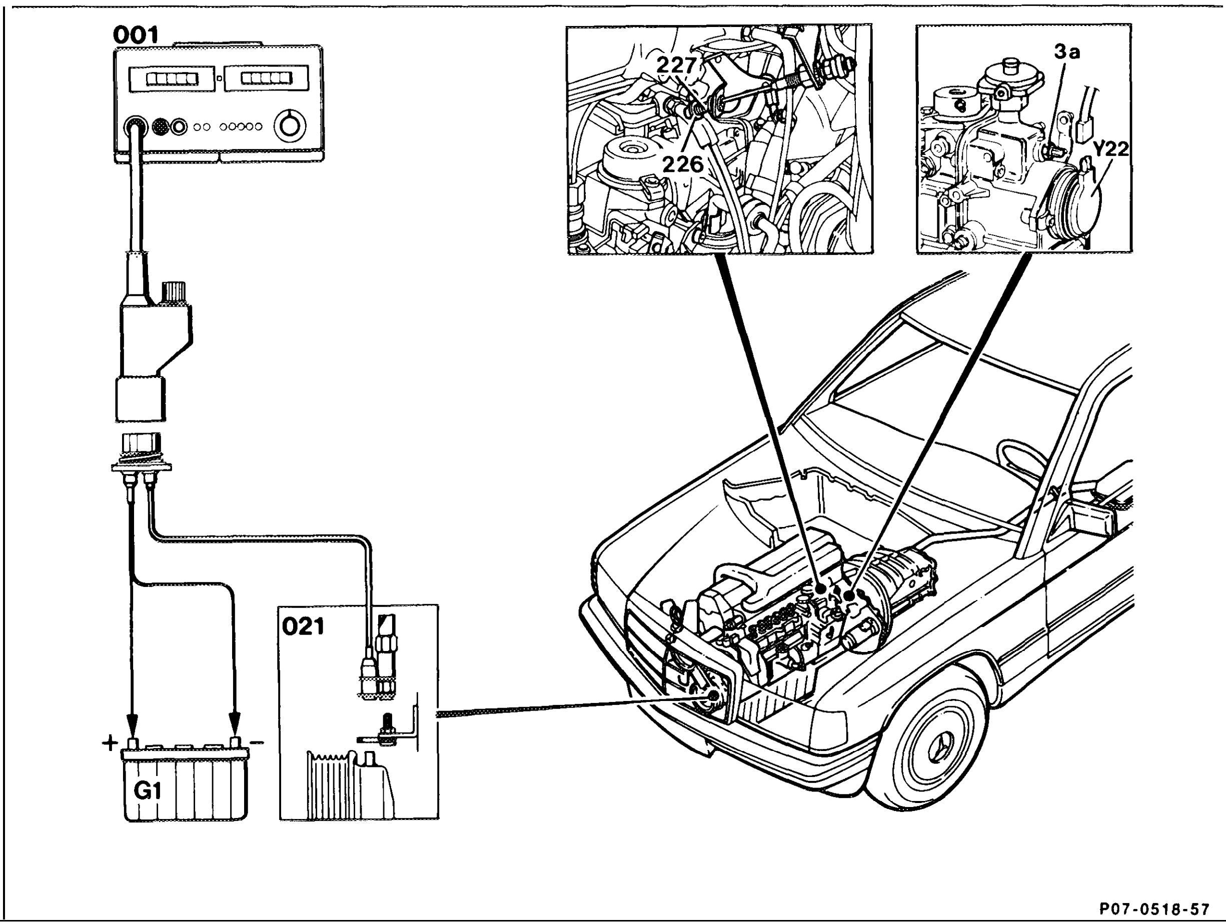


W. Handling electronic control units after accident repair

It is necessary to change electronic control units after an accident if at least one of the following conditions is met:

1. The housing is recognizably deformed or damaged.
2. The supporting surface or console is deformed; the outside of the unit exhibits no damage.
3. The plug connector is damaged or corroded by moisture.
4. The functional check or the self-test of the equipment indicates faults.
   When electrical components, e.g. ELR control unit, have been removed for repair work and then used again, these are to be checked in accordance with the existing documents after assembly.

07.1400 Testing, adjusting idle speed - Turbodiesel



Tester (001) and pulse generator (021)	connect and disconnect.
Accelerator control	examine for ease of operation.
Idle stop on Bowden cable	check, the spring plate (226) must be resting against the compression spring (227) free of tension.
Engine	raise to coolant temperature of approx. 80°C.
2-pin connector on actuator (Y22)	detach, fit on again.
Idle speed	check, adjust. Loosen locking nut (3a) for this step.
Engine running	check. Turn on all ancillary components for this step.

EXIT

Test and adjustment data

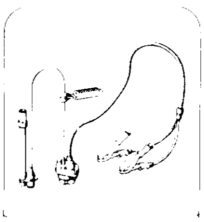
Engine	Electronic idle speed control		Position of resistance trimming plug
	Idle speed rpm **with control**	Idle speed rpm Plug on actuator detached **without control**	
602.96	680 ± 20	620 ± 40	4
603.96/97	630 ± 20	570 ± 40	4

Adjusting idle speed by means of resistance trimming plug

If problems arise regarding idle speed, it is possible to vary idle speed. The positions of the resistance trimming plug are listed in the table opposite.

Position of resistance trimming plug	Engine 602	Engine 603
1	610 ± 20	570 ± 20
2	630 ± 20	590 ± 20
3	650 ± 20	610 ± 20
4 ---	680 ± 20	630 ± 20
5	700 ± 20	650 ± 20
6	720 ± 20	670 ± 20
7	740 ± 20	700 ± 20

Special tool



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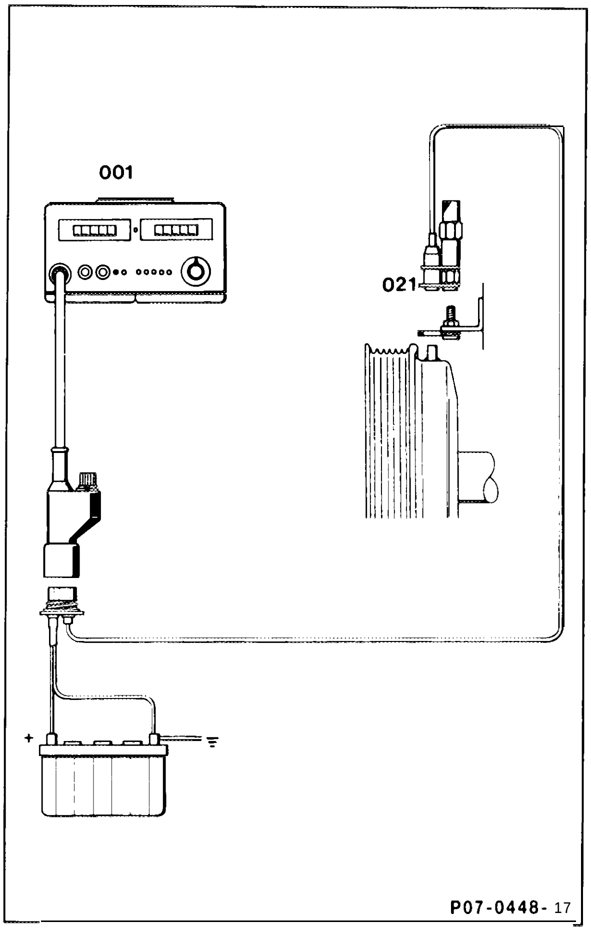
Commercial tools

Multimeter	e.g.	Sun, DMM-5
Digital tester	e.g.	Bosch, MOT 002.01 Sun, DIT 9000

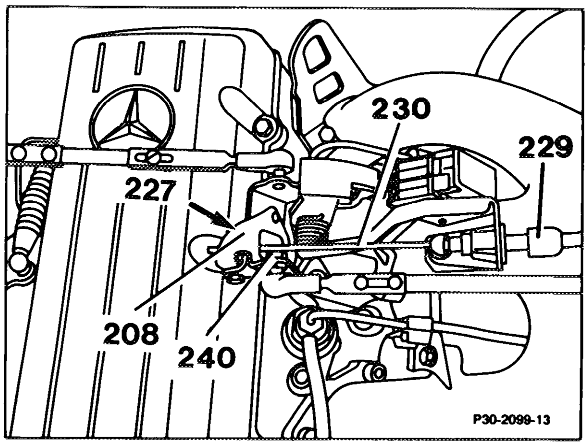
Setting

1 Connect the digital tester (001) and the pulse generator (021).

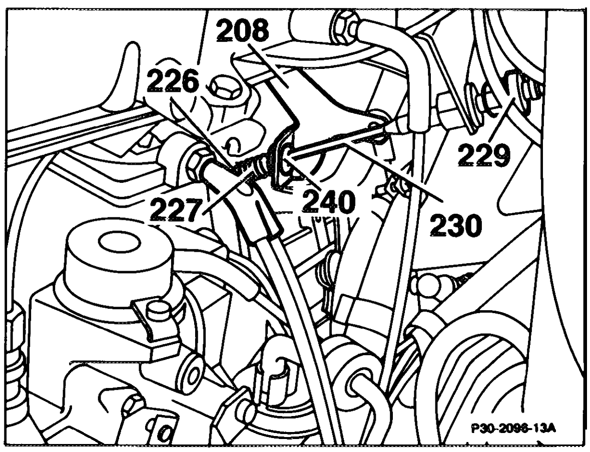


2 Examine accelerator control for ease of movement and condition.

Checking idle stop:
For this step, the spring plate (226) of the Bowden cable (230) must be resting against the compression spring (227), free of tension.

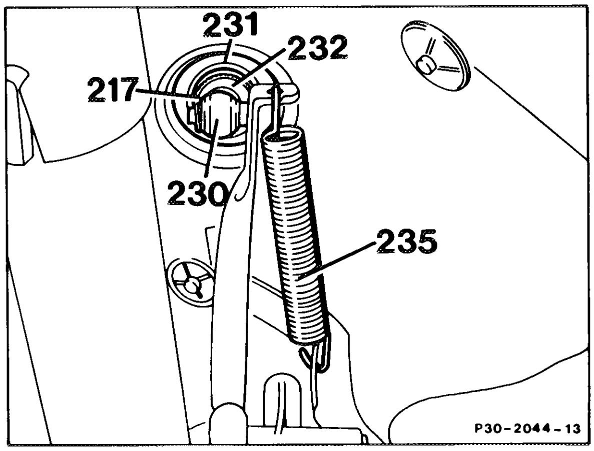


Engine 602.96



Engine 603.96

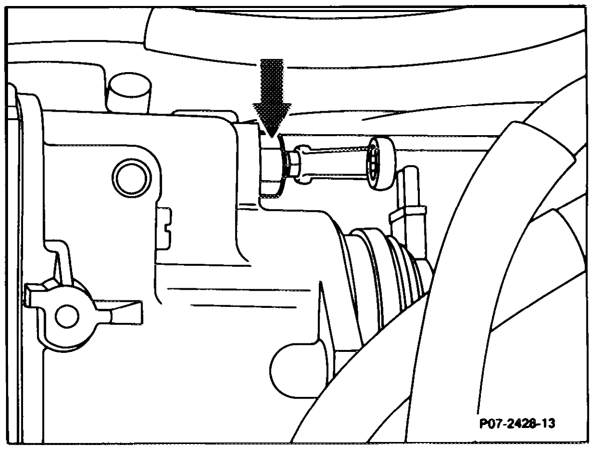
EXIT



Set Bowden cable (230) with the adjusting nut (232) from the car interior, if necessary.

3 Raise engine to coolant temperature of approx 80 ° C.

4 Detach 2-pin connector at actuator.



5 Set idle speed. Loosen locking nut (arrow) for this step.

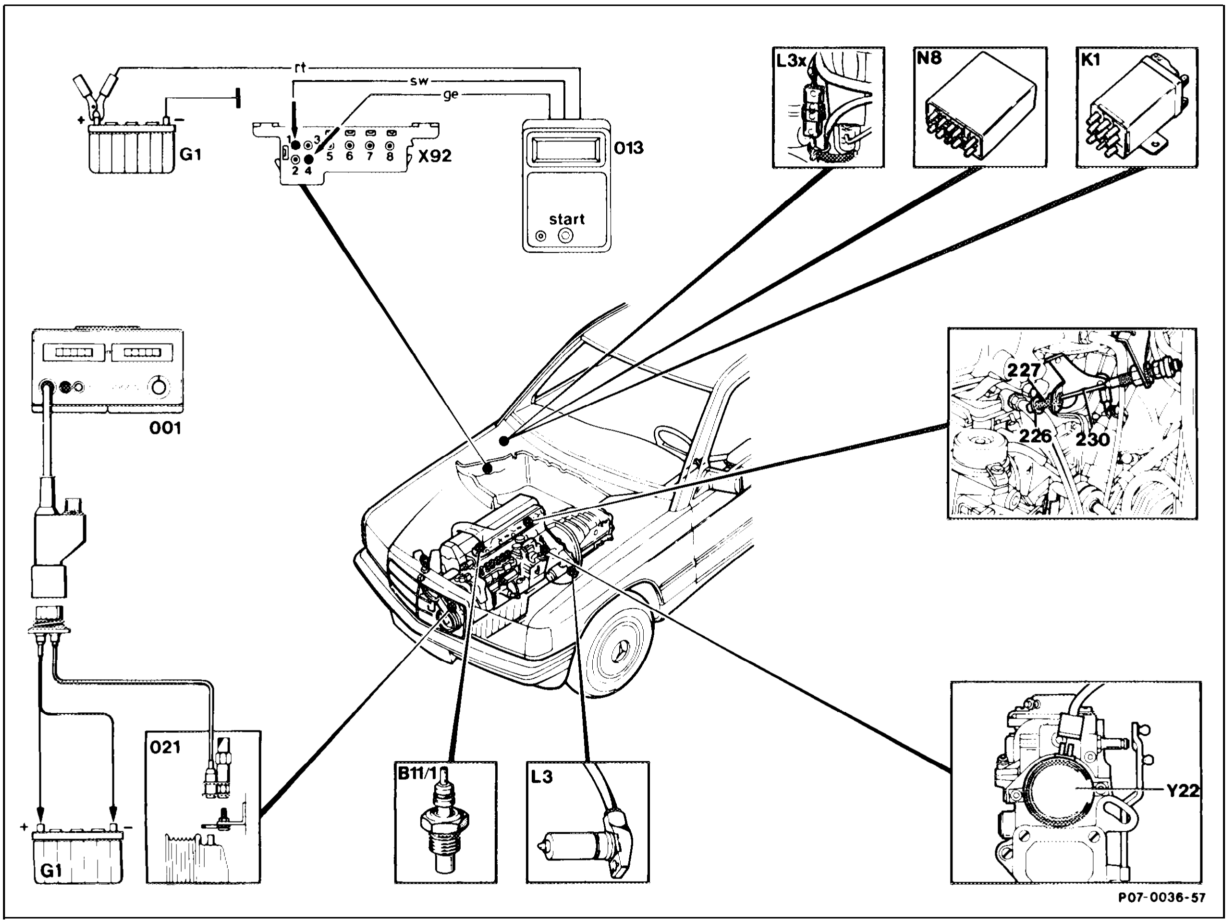
Specifications:

Engine	Idle speed in rpm **with control**	Idle speed in rpm **without control** Plug on actuator detached
602.96	680 ± 20	620 ± 40
603.96197	630 ± 20	570 ± 40

6 Turn on all ancilliary components and check for smooth engine running.

EXIT

07.1-105 Testing electronic Idle speed control with test connector (X92 and XI 1/4) - Turbodiesel



Digital tester (001) and pulse generator (021) . . .	connect.
Pulse counter (013)	connect to battery (G1) and to test connector (X92).
Accelerator control	check for ease of movement.
idle stop at Bowden cable (230)	check, the spring plate (226) must be resting against the compression spring (227) free of tension.
Fuse of over-voltage protection	check.
Engine	raise to coolant temperature of approx. 80°C.
Engine	run at idle speed.
Start button of pulse counter (013)	operate for 2 to 4 seconds
Display	read and note.
Start button	press again, no new display appears if no further fault in system.

Number of pulses indicates whether and which component is faulty, or whether components in the control circuit are defective.

Assignment (X92)

Jack 1	ground
Jack 2	TD signal
Jack 4	pulse output, EDS control unit (N39)

Pulse readout	Component/faulty circuit
1	all functions "in order"
2	engine speed signal "fault"
3	coolant temperature "fault"
6	ELR control loop "fault"

Only short-circuit faults are detected with control units designation " R01". Control units with designation "R02" also detect interrupts. Production breakdate: control unit with "R02", May 1988.

P07-0531-13

P07-0532-13

Pulse readout "2"

Engine speed sensor (L3) to connector (L3x) . . . test, resistance 0.4–2.5 kΩ
engine idle voltage > 4 V ~.

Pulse readout "3"

Coolant temperature sensor (B11/1) . . . . test, specified value + 20 °C 2.2-2.8 kΩ

Pulse readout "6"

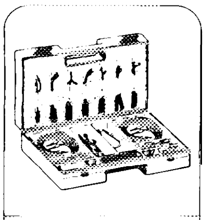
2-pin connector of ELW actuator (Y22) detach (for at least 3 s) and fit on again. . . . . Engine speed increases briefly.

Test idle speed, adjust if necessary.

Test and adiustment values

Engine	Idle speed in rpm **with control**	Idle speed in rpm **without control** Plug on actuator detached
602.96	680 ± 20	620 ± 40
603.96197	630 ± 20	570 ± 40

Special tools



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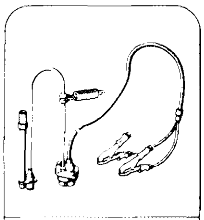

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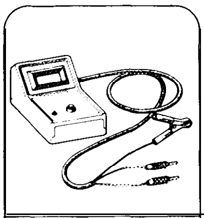

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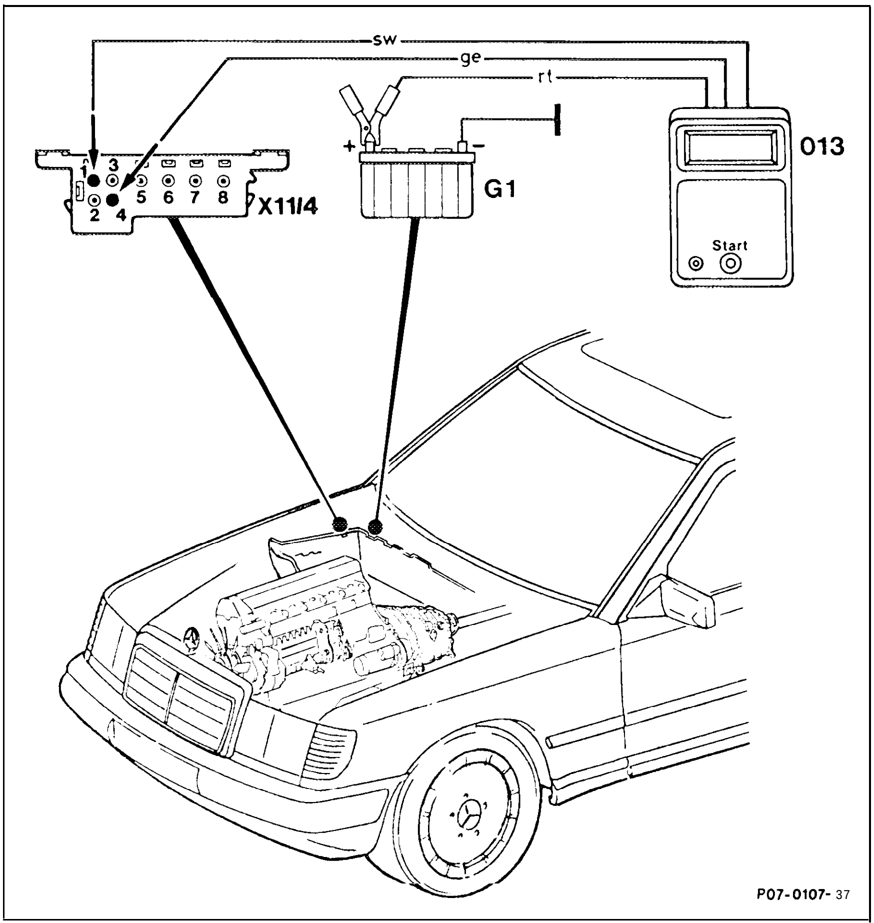
Commercial tools

Multimeter	e.g.	Sun, DMM-5
Digital tester	e.g.	Bosch, MOT 002.02 Sun, DIT 9000

EXIT

Connection diagram
Connect digital tester and pulse generator.

Connect pulse counter (013) to battery (G1) and test connector (Xl 1/4).



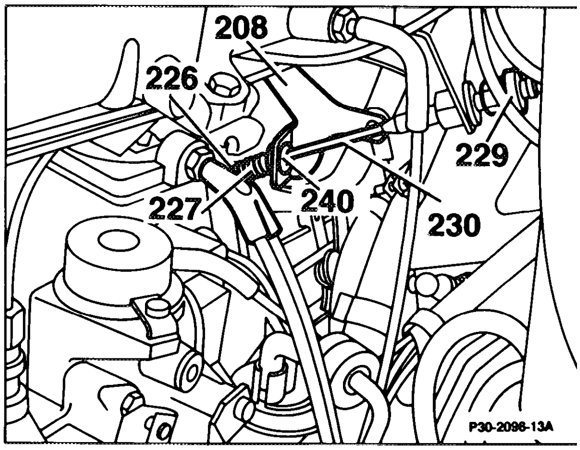
Note
The U-batt LED in display panel must light up;
if not:

a) Test fuse of pulse counter
b) Test jack 1 of test connector (Xl 1/4) to battery positive (approx. 12 V)
c) Test jack 4 of test connector (Xl 1/4) to battery positive (approx. 12 V).

EXIT

Check accelerator control for ease of movement. Check idle stop at Bowden cable (230).

The spring plate (226) of the Bowden cable (230) must be resting against the compression spring (227) free of tension in the idle position.



Test fuse in the over-voltage protection.

Raise engine to coolant temperature of approx. 80°C.
Run engine at idle speed.

Operate start button of pulse counter (013) for between 2 and 4 seconds.
Check readout on the display of the pulse counter (013) and note.
Again press start button for between 2 and 4 seconds. If there is no other fault in the system, no new readout appears.
Rectify noted faults according to test routine or perform test of components.

Note regarding pulse readout
Numbers from 1 to 6 appear on the display panel of the pulse counter.
The number 1 means that no fault has been detected in the electronic system. All the other numbers are assigned to a certain fault circuit.

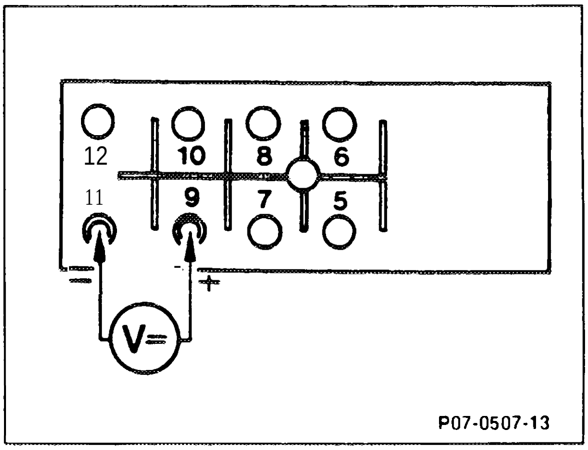
Testing components

Testing over-voltage protection (K1/1)

Turn on ignition, detach control unit (N8) and test voltage between the jacks 9 and 11.

Readout: approx. 12 V.

Yes	No



Test fuse at over-voltage protection, actuation according to wiring diagram.

End of test

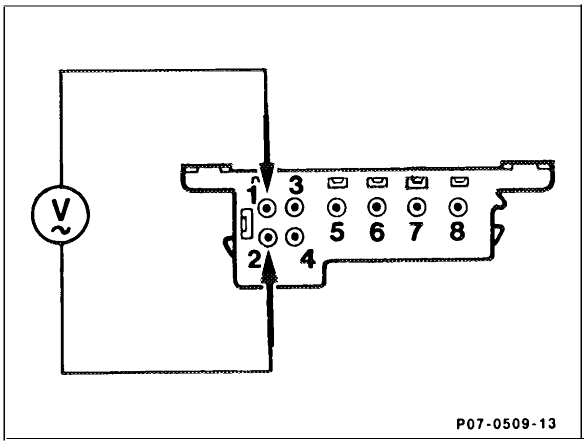
Pulse readout "2"

Testing engine speed signal
Connect multimeter to the terminal 1 and 2 of the test connector (X92 and XI 1/4). Press button V~. Run engine at idle.

Specification: > 2.8 V~

Yes	No

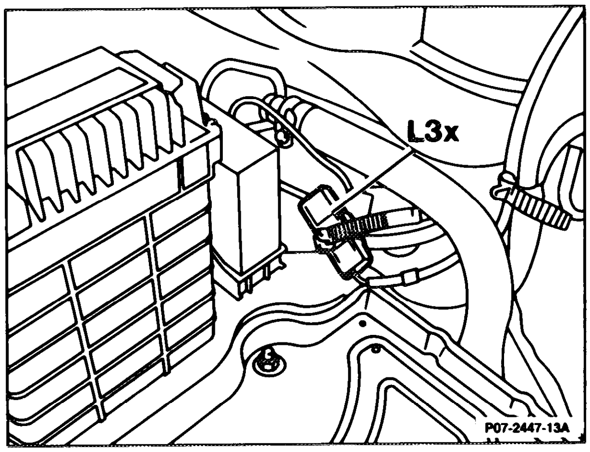
End of test



Engine off. Detach plug connection (L3x). Connect multimeter to engine speed sensor plug connection (L3x) and press button "Ω". Test resistance.

Specification: 0.4–2.5 kΩ

Yes	No



Replace engine speed sensor on starter ring gear (L3).

End of test

Multimeter connected as above, press button "V~". Run engine at idle.

Readout: > 4 V~

Voltage increases as engine speed rises.

Yes	No

Examine engine speed sensor on starter ring gear (L3) for dirt deposits and metal chips, clean if necessary.

EXIT

Test electric leads from plug connector (L3x) to control unit and on to test connector (X92 or Xl 1/4), replace control unit (N8 or N8/1) if necessary.

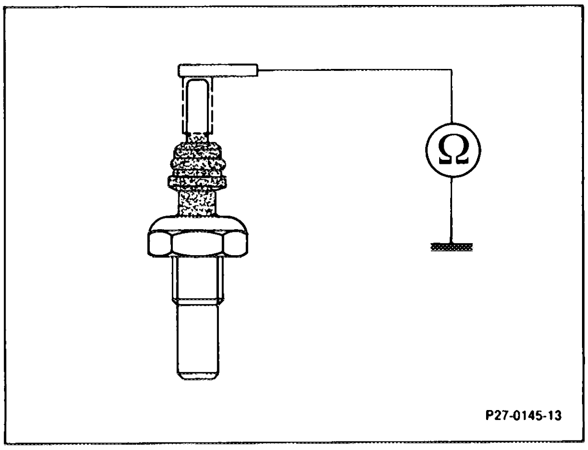
End of test

EXIT

Pulse read out "3"

Testing coolant temperature sensor (B11/1) Engine off. Detach plug on temperature sensor and test resistance to ground. Refer to diagram for specified values. Measure resistance at two temperature measuring points. Example: + 20 °C = 2.2-2.8 kΩ + 80 °C = 290-370 Ω

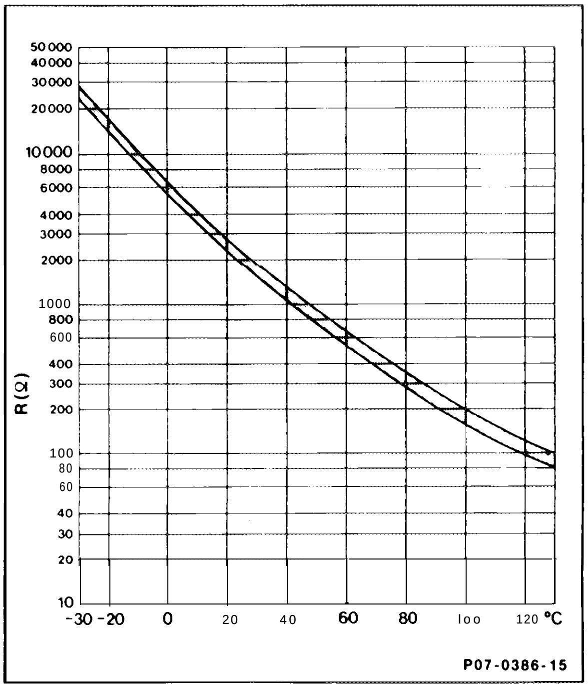
Yes	No



No →

Replace coolant temperature sensor (B11/1).

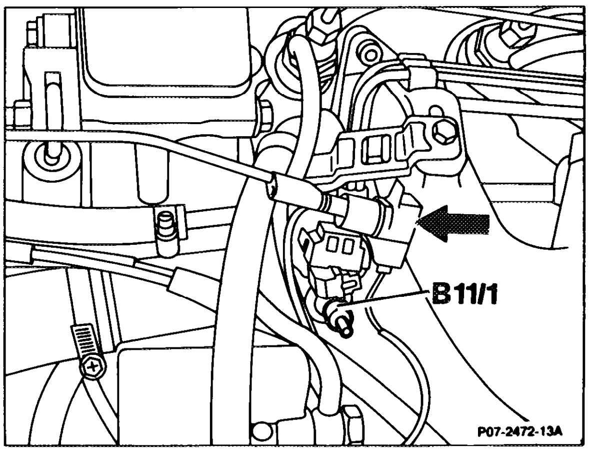
End of test



Yes →

Test voltage at l-pin connector (arrow). "Ignition" on.
Readout: approx. 5 Volts

Yes	No



No →

Rectify cable interrupt.
Replace control unit (N8).

Yes →

End of test

EXIT

Pulse readout "6"

Engine at idle. Detach 2-pin connector (arrow) at ELR actuator (Y22) for at least 3 seconds and refit.
Engine speed increases briefly.

Yes	No

Briefly apply battery voltage (approx. 12 V) to ELR actuator (Y22).

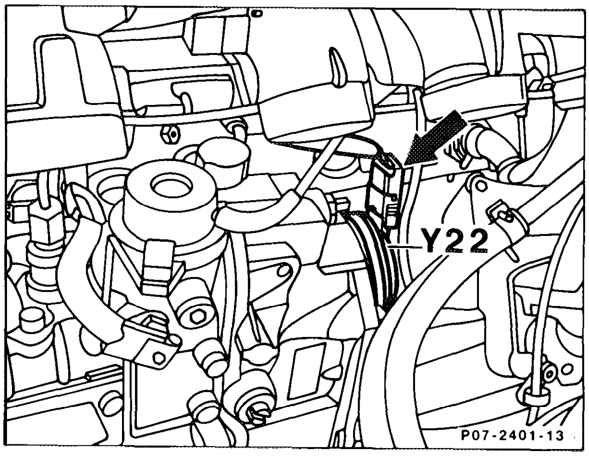
Caution!
The ELR actuator is damaged if battery voltage is applied for longer than 3 sec.

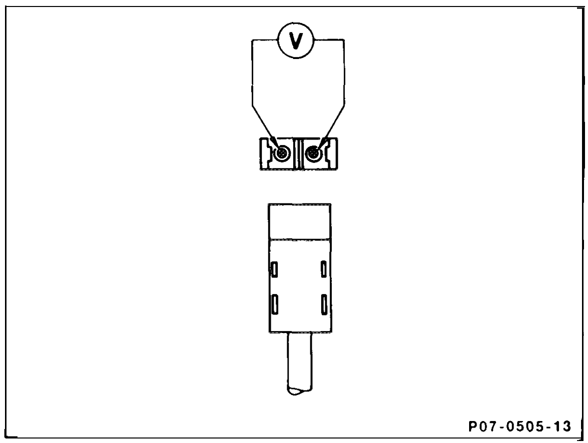
Idle speed increases.

Yes	No

Replace ELR actuator (Y22).

End of test





EXIT

Engine at idle. Detach 2-pin connector (arrow) from ELR actuator (Y22). Connect multimeter and press button "V = ".

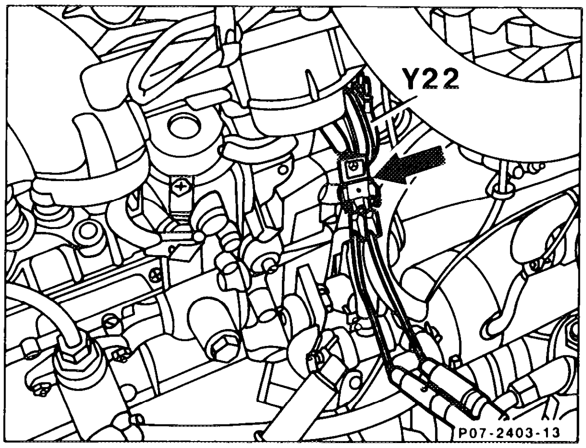
Readout: approx. 12 V

Yes	No

Check cables according to wiring diagram. Test fuse of over-voltage protection relay (K1/1).

If the cables are in order, replace control unit (N8 or N8/1).

End of test



Engine at idle. Detach 2-pin connector (arrow) at the ELW actuators (Y22).

Test idle speed:
Specification:

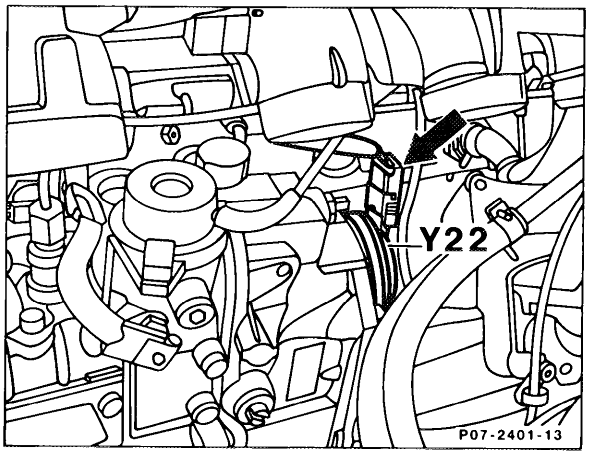
M602	690 ± 40 rpm	manual transmission
	620 ± 40 rpm	automatic transmission
M603	570 ± 40 rpm	

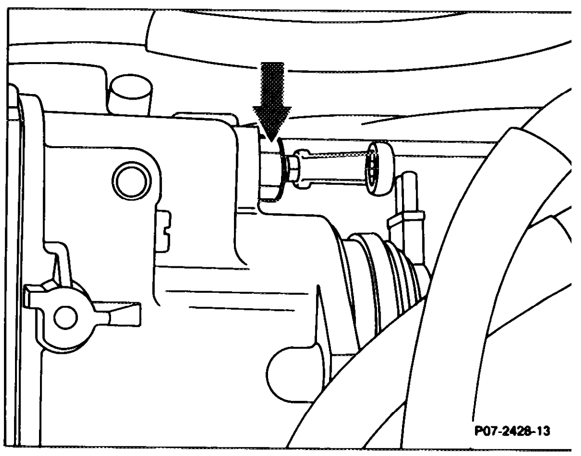
Yes	No

Loosen locking nut and adjust idle speed (arrow).

To the left = higher
To the right = lower

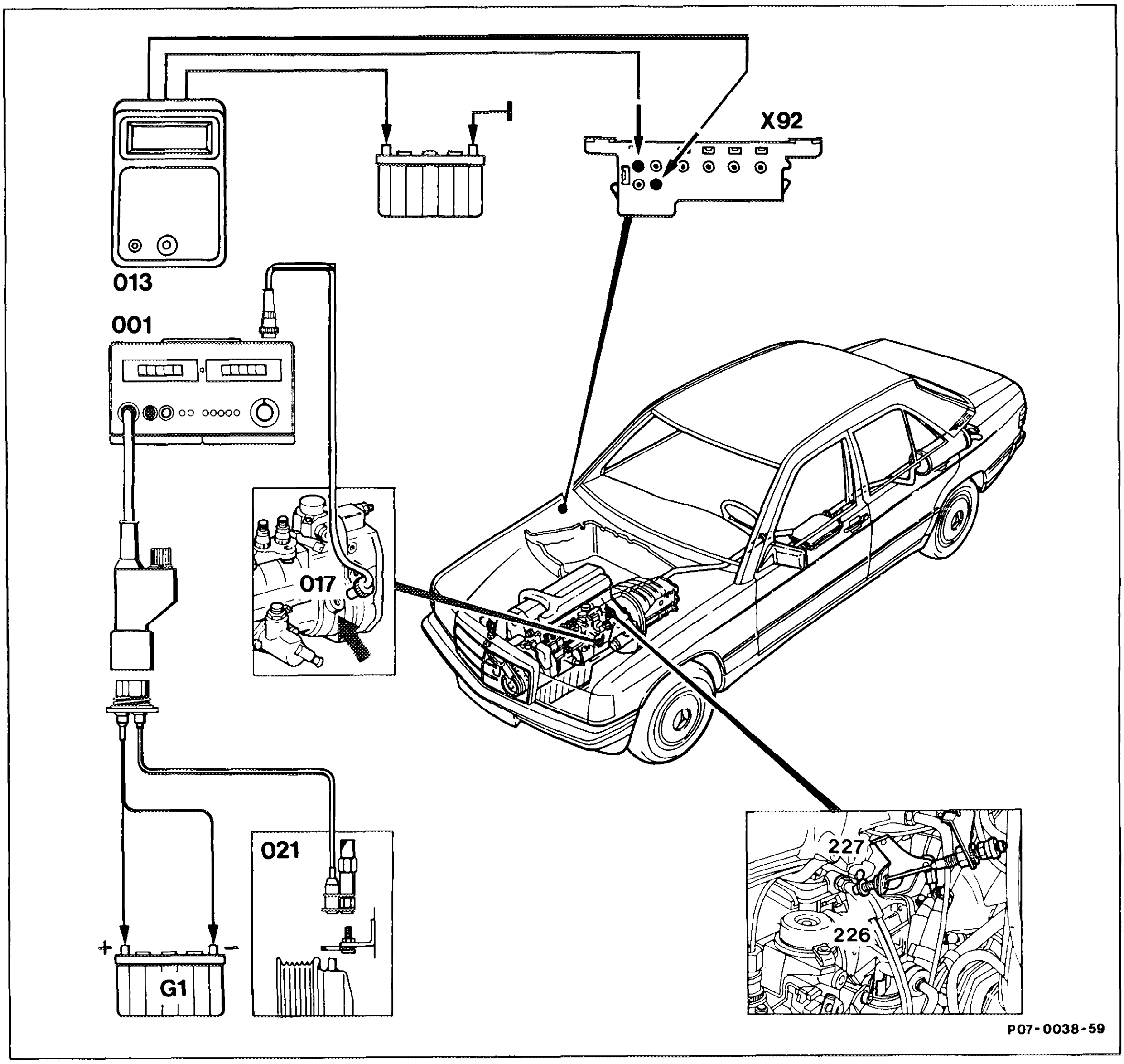
End of test





EXIT

07.1-110 Testing, tuning engine - Turbodiesel



Test sheet	Complete, enter measured values.
Coolant level	check, correct.
Engine oil level	check; pay attention to oil level (visual inspection).
Oil level in automatic transmission	check, correct.
Air filter	remove and install.
Tester (001, 013, 017)	connect.
Pulse generator (021)	connect.

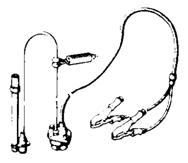
EXIT

Accelerator control linkage	check ease of movement, condition. Lubricate bearing points, relay levers, ball sockets.
Full throttle stop	check from accelerator pedal; adjust Bowden cable if necessary.
Idle stop	check. Min. specified value 11.5 Volts.
Engine	raise to coolant temperature of approx. 80°C.
Air conditioning or automatic climate control	turn off.
Idle speed	check, adjust if necessary. Detach plug from actuator.
Start of delivery	check. RI specified value 15° ATDC
Max. speed at no-load	check. Specified value: 5150 ± 150 rpm
Timing device	check. Specified value: at 5100 rpm approx. + 3° to + 5° using governor pulse method (RIV).
Electronic diesel system (EDS)	check, with pulse counter (013) (07.1-190).

Test and adjustment data

Engine	Idle speed in rpm with control	Idle speed in rpm without control Plug at actuator disconnected	Start of delivery with digital tester RI specification	Maximum speed at no-load or end of cutoff in rpm	Timing device at no-load or end of cutoff RIV method in degrees
602.96	680 ± 20	620 ± 40	14 ± 0.5" ATDC	5150 ± 150	+ 3° to + 5°
603.96/97	630 ± 20	570 ± 40	15 ± 1° ATDC		

Special tools



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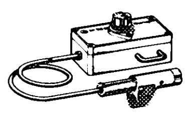

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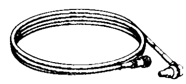
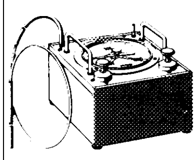


617 589 10 21 00
07



201 589 13 21 00
00 42 80

Commercial testers

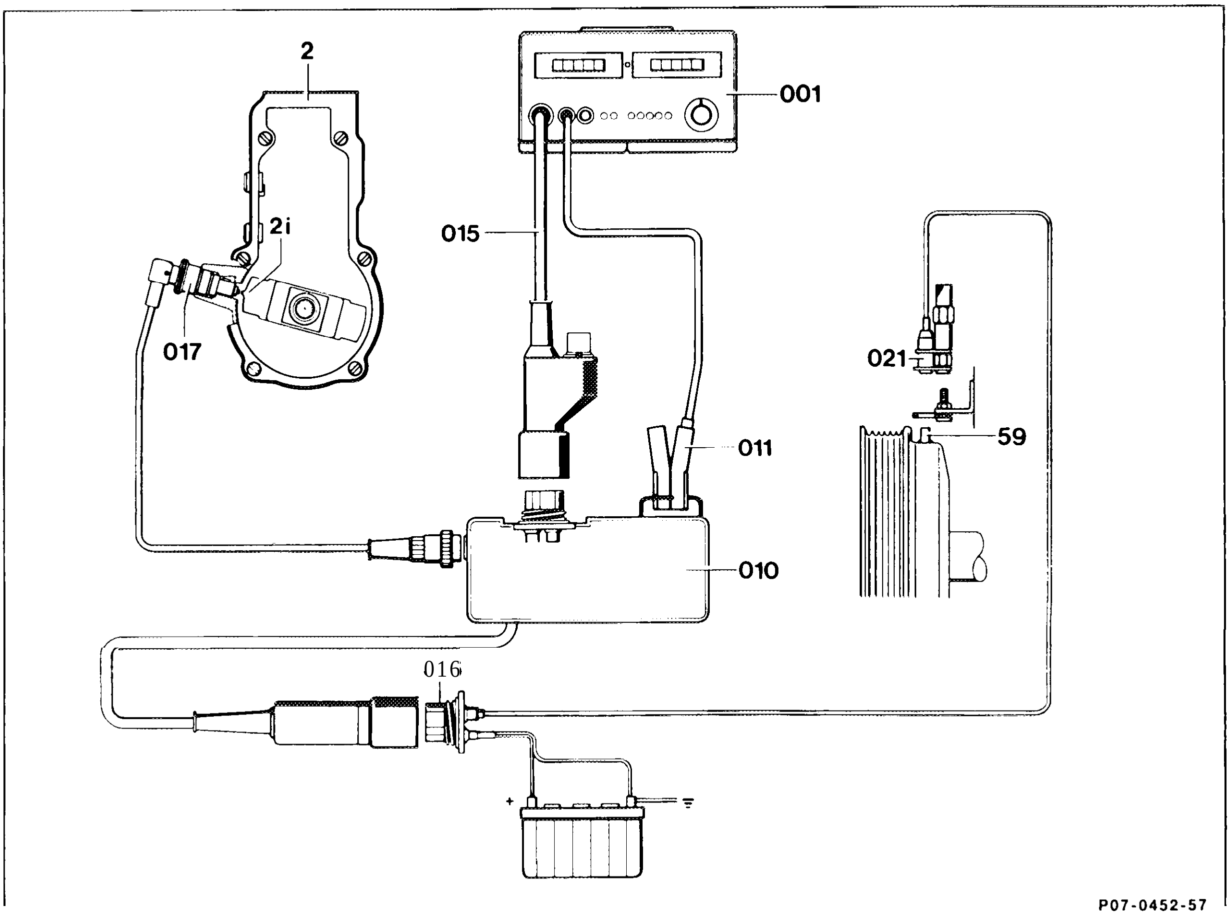
Used without adapter

Digital testers	e.g. Bosch, ETD 019.02 or MOT 350/500/501 Sun, DIT 9100 AVL, Diesel-Tester 873

Used with adapter

Digital testers	e.g. Bosch, MOT 001.03
Lambda tester (with EDS only)	e.g. Bosch, KDJE-P 600 Hermann, L 115

EXIT



Connection diagram for existing testers with adapter

001	Digital tester	017	RI generator
010	Adapter	021	TDC pulse generator
011	Trigger clamp	2	Governor
015	Test cable with connector	2i	RI generator pin
016	Diagnostic socket	59	TDC generator pin

EXIT

Testing, tuning

1 Complete test sheet. Enter test values.

2 Check coolant level, correct.

3 Check engine oil level, paying attention to condition of oil. Visual inspection.

4 Check oil level and automatic transmission.

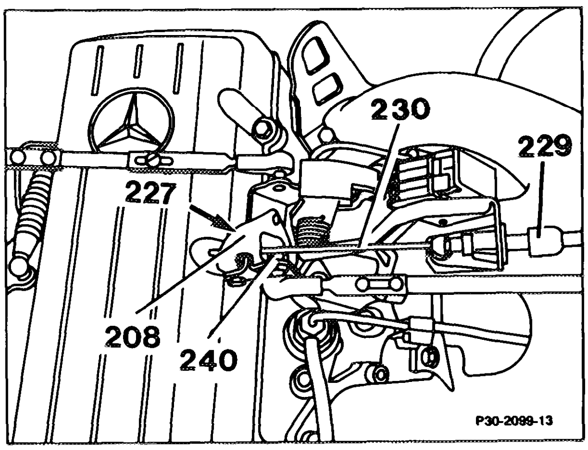
5 Connect tester (013, 001, 017) according to connection diagram.

6 Connect pulse generator (021).

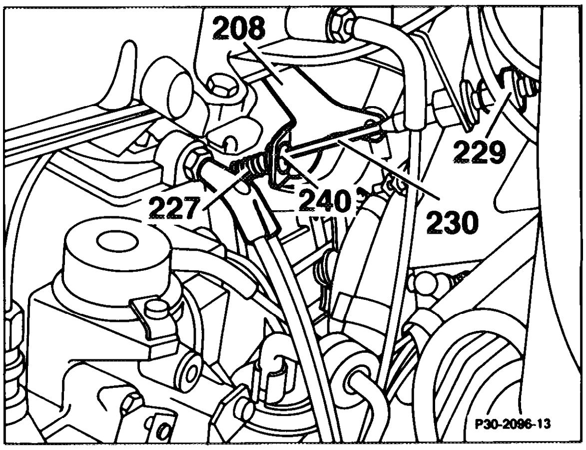
7 Remove and install air filter element.

8 Check accelerator control for ease of movement and condition. Lubricate bearing points, relay levers, ball sockets.

9 Check full throttle stop from accelerator pedal; adjust at adjusting screw (229) if necessary.

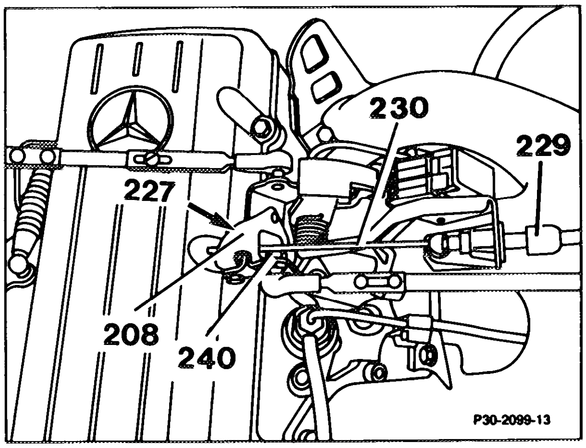


EXIT

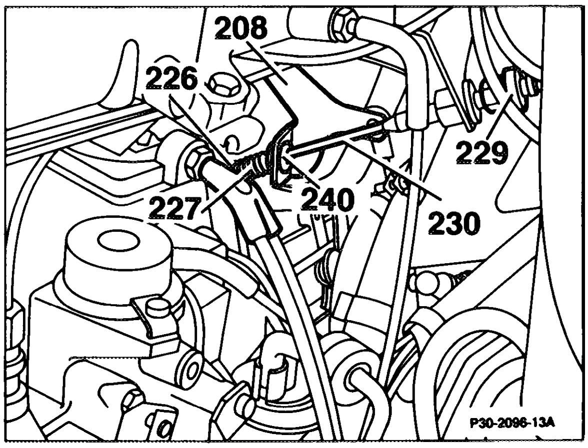


Engrne 603.96

10 Check idle stop.
The spring plate (226) of the Bowden cable (230) must be contacting the compression spring (227).

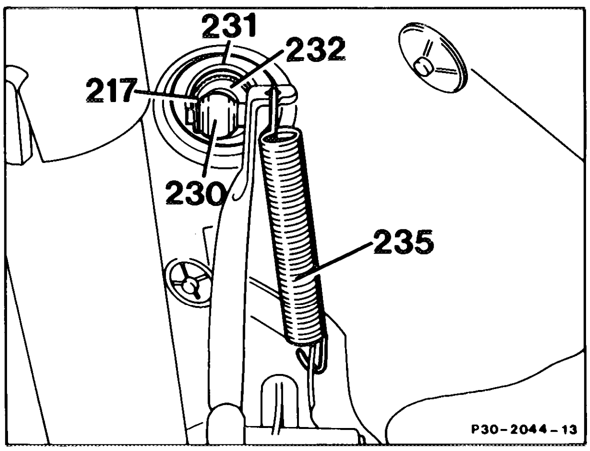


Engine 602.96



Engine 603.96

Set Bowden cable (230) with adjusting nut (232) from the car interior, if necessary.



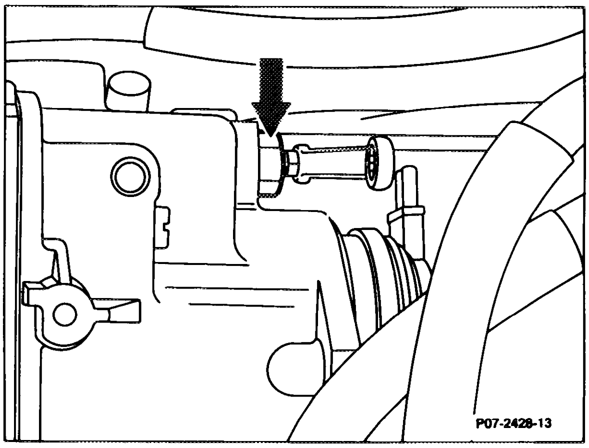
EXIT

11 Test voltage at the battery.
Specification: at least 11.5 V.

12 Raise engine to coolant temperature of approx. 80° C.

13 Turn off air-conditioning or automatic climate control.

14 Test idle speed.
Detach to 2-pin connector on actuator. Set idle speed. Loosen locking nut (arrow) for this step.



Engine	Idle speed in rpm **with control**	Idle speed in rpm **without control** Plug on actuator disconnected
602.96	680 ± 20	620 ± 40
603.96197	630 ± 20	**570 ± 40**

Read off start of delivery
RI specification 15 ± 1 ° ATDC.

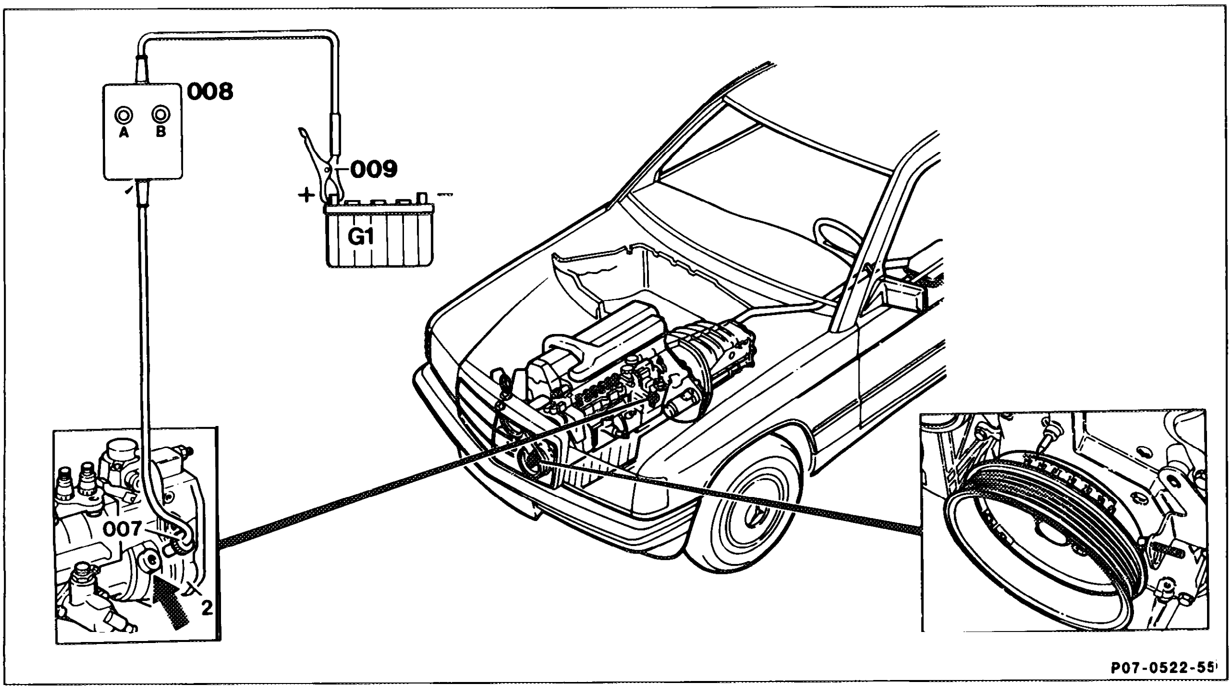
15 Test "maximum speed" at no-load.
Specification: 5150 rpm ± 150

16 Test timing device at no-load.
Specification: at approx. 5100 rpm
+ 3 to + 5° using RIV method.

17 Test electronic diesel system.
(07.1-190).

EXIT

07.1-1 11 Testing start of delivery (position sensor RIV method) - Turbodiesel



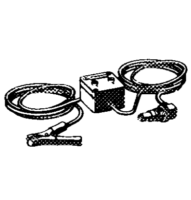
Screw plug (arrow) on governor housing (2)	unscrew, tightening torque 30 - 35 Nm.
Position sensor (007)	install.
Battery terminal (009)	connect to B +.
Crankshaft, crank by hand until	lamps "A" and "B" on indicating instrument (008) light up simultaneously; take reading on scale. Adjust the start of delivery if necessary (07.14 16) RI value (indirect start of delivery).

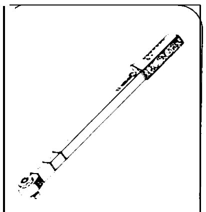
Test and adjustment data

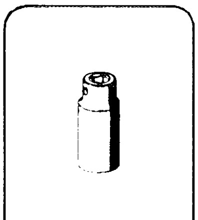
Engine	Start of delivery (governor pulse) test value, ° ATDC
602.96	15 ± 1
603.96	15 ± 1
602.962 From 09/89	14 ± 0.5 [1])
603.970 From 09/89	14 ± 0.5 [1])

[1]) Adjust once 15,000 mi; adjustment value 14.5° ATDC

Special tools


617 589 08 21 00
07

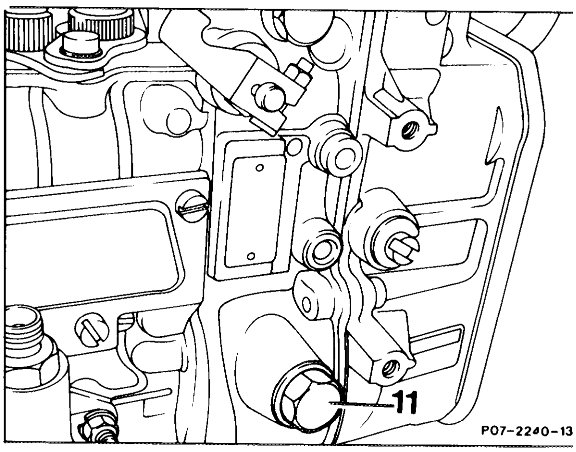

001 589 66 21 00
00


001 589 65 09 00

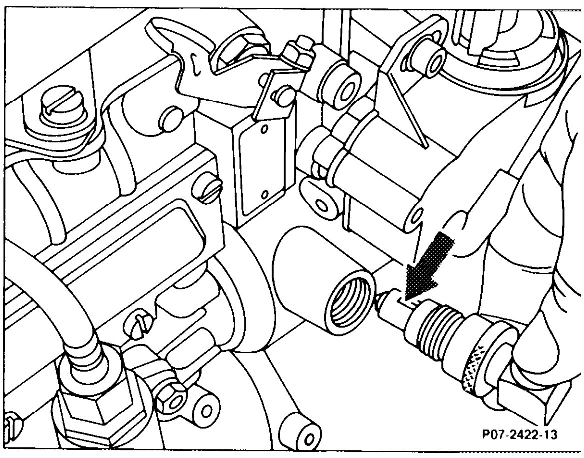
Test

1 Remove plug (11).

Caution!
Collect leaking oil.

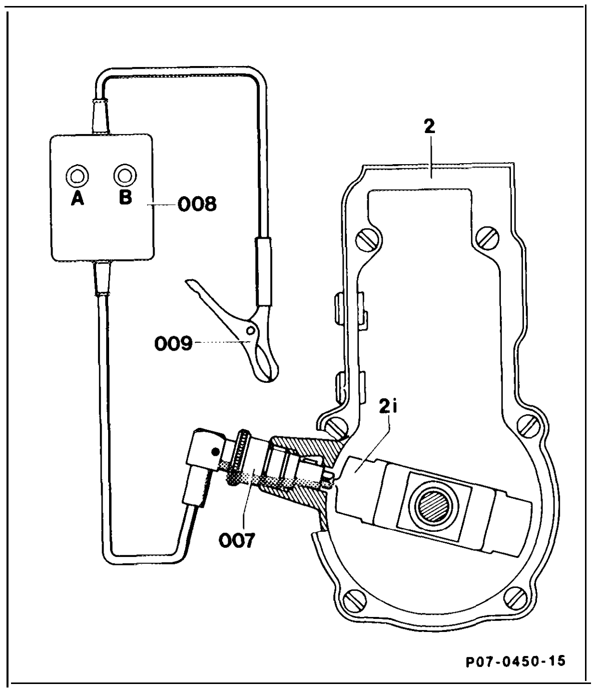


2 Install position sensor into governor housing, ensuring that the guide pin of the position sensor (arrow) is facing upwards. Tighten union nut by hand.



EXIT

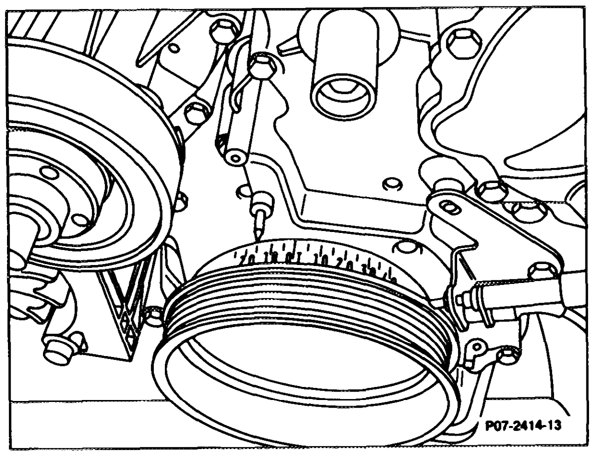
3 Connect position sensor as shown in connection diagram.



007 Position sensor
008 Indicating instrument
009 Battery terminal (battery positive)
2 Governor
2i Flyweight (RI generator pin)

4 Use special tool to turn crankshaft by hand (in direction of rotation only) until lamp "B" lights up. Turn on carefully until **both** lamps "A + B" light up. In this position take reading of RI value (indirect start of delivery) on the scale.

If only lamp "A" lights up, repeat the test.

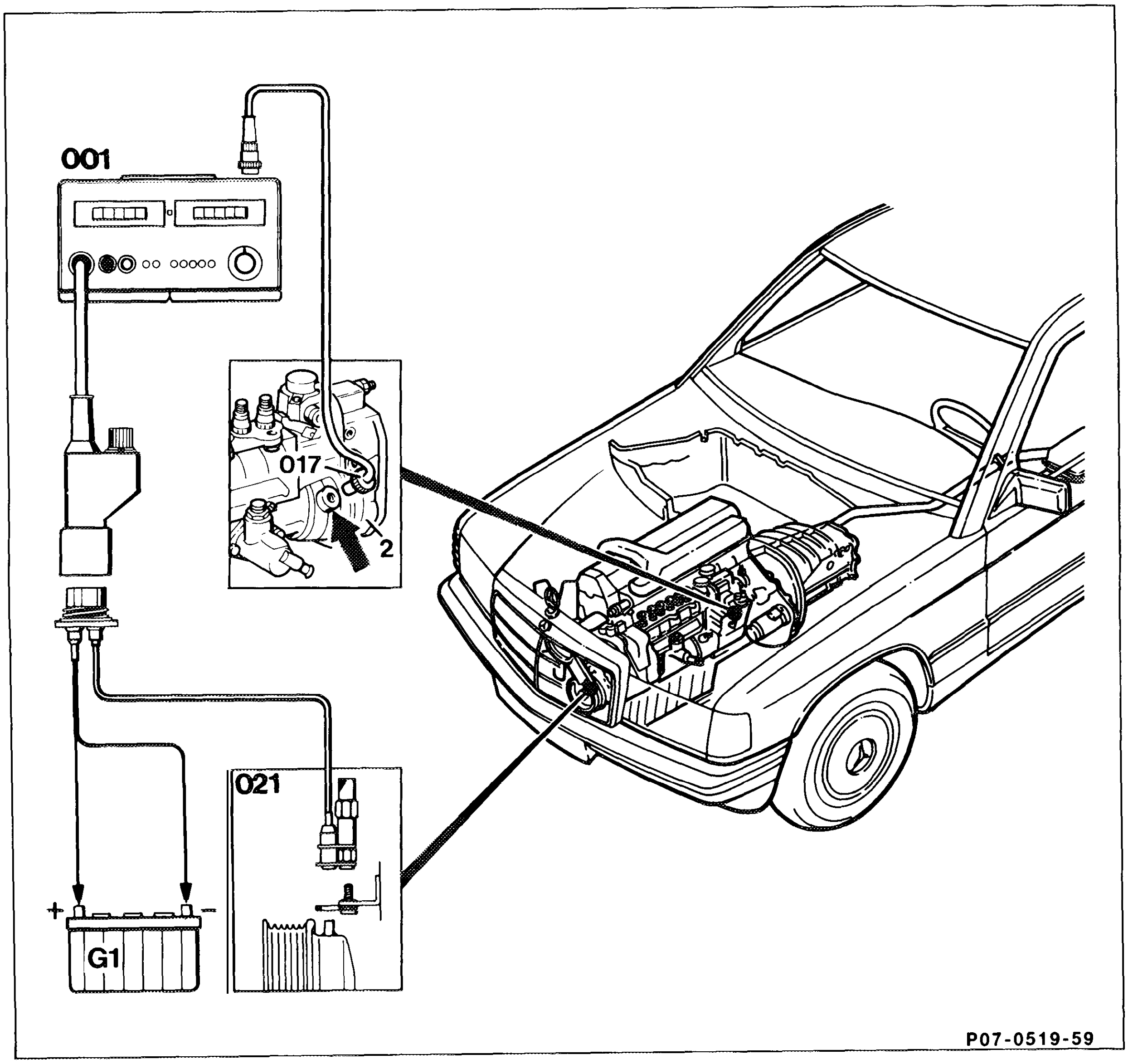


5 Remove position sensor.

6 Install plug.
Tightening torque 30-35 Nm.

7 Perform leak tightness inspection with engine running.
8 Check oil level, correct if necessary.

07.1-I 12 Testing start of delivery - digital tester (RIV method) - Turbodiesel



Screw plug (arrow) on governor housing (2)	unscrew, tightening torque 30 - 35 Nm.
Tester (001, 017, 021)	connect.
Engine, run at idle	read off RI value, adjust start of delivery if necessary (07.14 16 or 07.1-I 17).

EXIT

Test and adjustment values

Engine	Start of delivery (governor pulse) test value, °ATDC
602.96	15 ± 1
603.96	15 ± 1
602.962 From 09/89	14 ± 0.5 [1])
603.970 From 09/89	14 ± 0.5 [1])

[1]) Adjustment once at 15,000 mi; adjustment value 14.5" ATDC

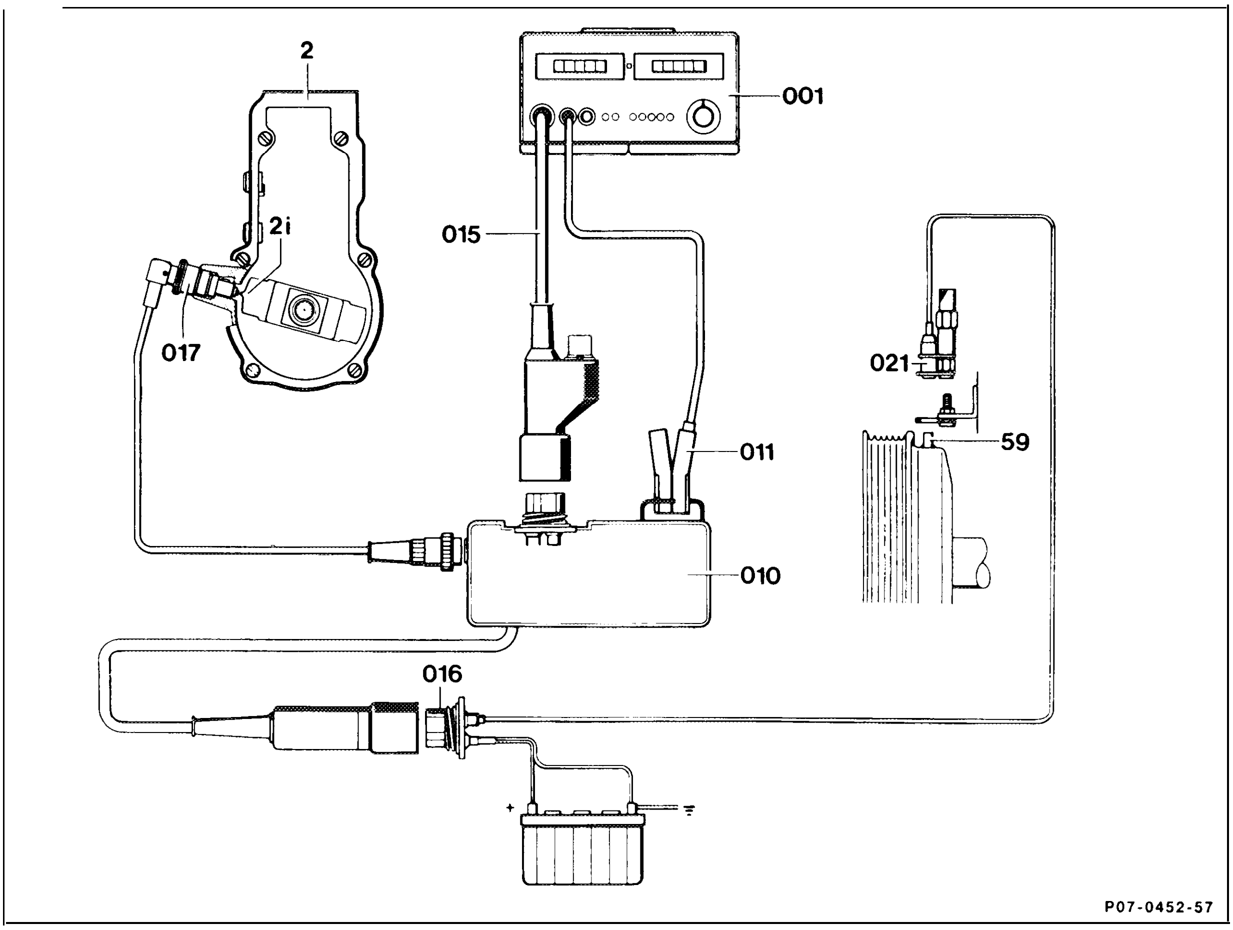
Conventional tools

Used without adapter

Digital testers	e.g. Bosch, ETD 019.002 Sun, DIT 9100 AVL, Diesel-Tester 873

Used with adapter

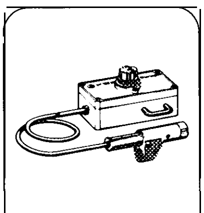
Digital testers	e.g. Bosch, MOT 001.03



Connection diagram for existing testers with adapter

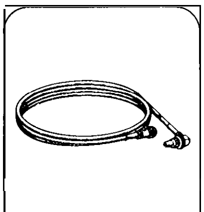
001	Digital tester	017	RI generator
010	Adapter	021	TDC pulse generator
011	Trigger clamp	2	Governor
015	Test cable with connector	2i	RI generator pin
016	Diagnostic socket	59	TDC generator pin

Special tools



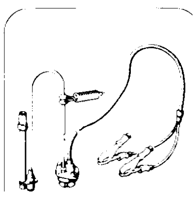
617 589 09 21 00

07



617 589 10 21 00

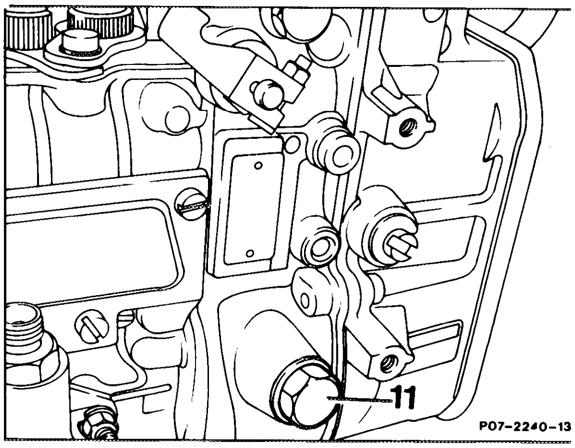
07



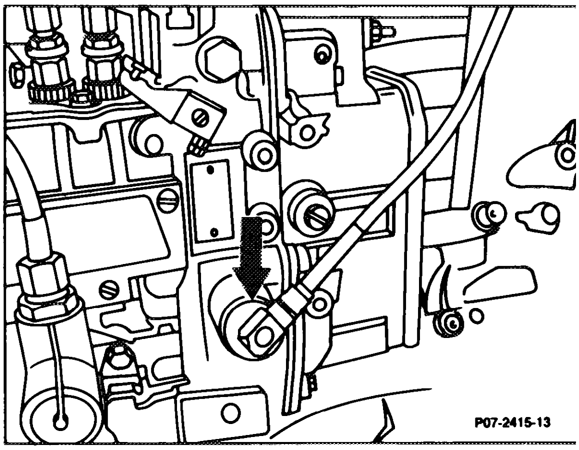
603 589 00 21 00

07

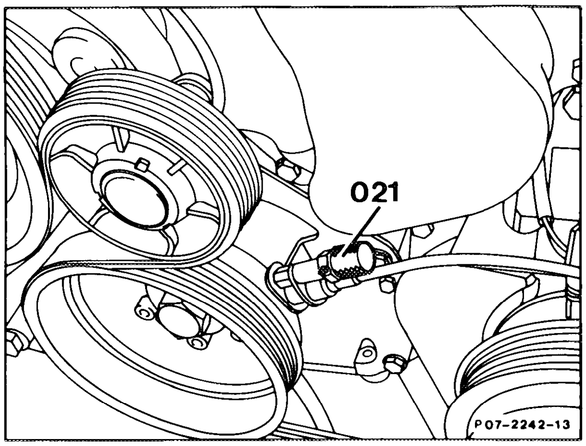
1 Unscrew plug (11) on the governor housing.



2 Thread in RI generator (017, arrow) at governor (injection pump).



3 Screw in TDC pulse generator (021) at bracket (engine).



EXIT

4 Connect the digital tester as shown in the connection diagram.

5 With engine at idle, take reading of RI value (indirect start of delivery) at the digital tester at idle speed and compare with specification.

6 Turn off engine.

7 Disconnect digital tester.

8 Screw in plug at governor. Tightening torque 30-35 Nm.

9 Perform leakage test with engine running.

10 Check engine oil level, correct if necessary.

07.1-1 13 Establishing fuel consumption by road test - Turbodiesel

1 Fill up vehicle tank in the presence of the customer with the vehicle on level ground.

2 Drive approx. 100 km (62 mi.), of this approx. 40 km (25 mi.) highway and approx. 60 km (37 mi.) back roads and city traffic.

3 After driving fill up again and calculate fuel consumption.

Example 1:
Fuel consumption in liters/l00 km

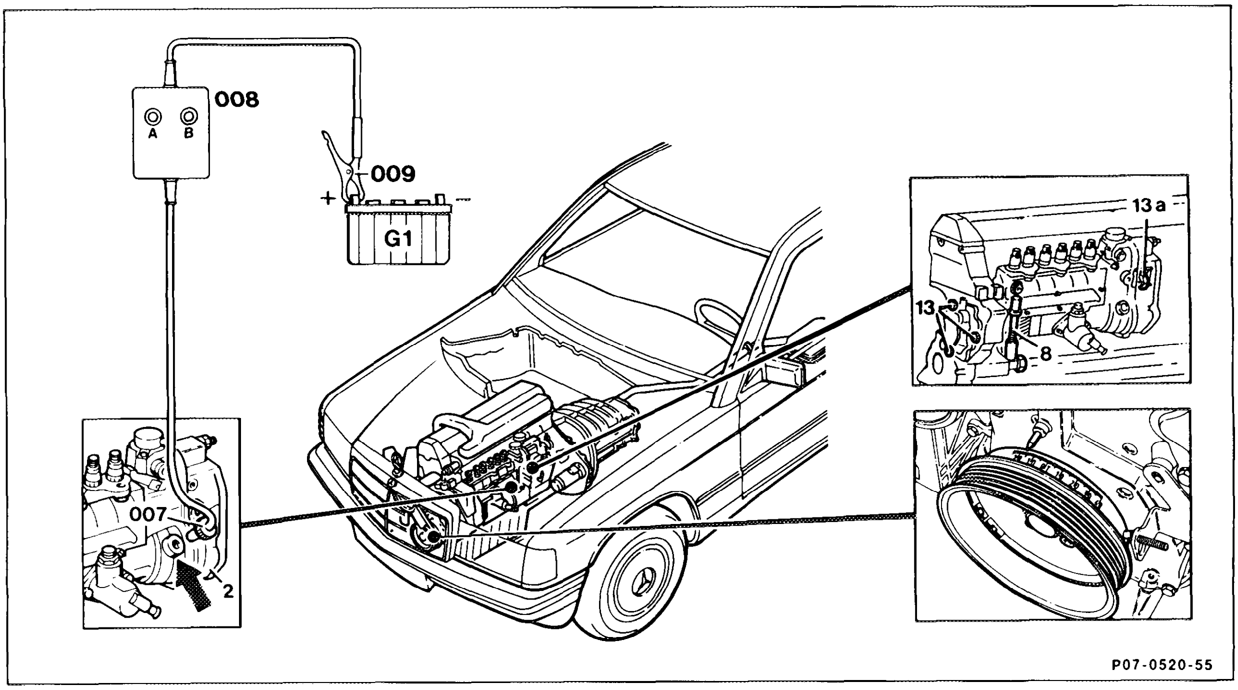
$$= \frac{\text{Fuel quantity consumed in liters}}{\text{Kilometers driven}} \times 100$$

Example 2:
Fuel consumption in miles/gallon

$$\frac{\text{Miles driven}}{\text{Fuel quantity consumed in gallons}}$$

EXIT

07.1-l 16 Setting start of delivery (position sensor RIV method) following test - Turbodiesel



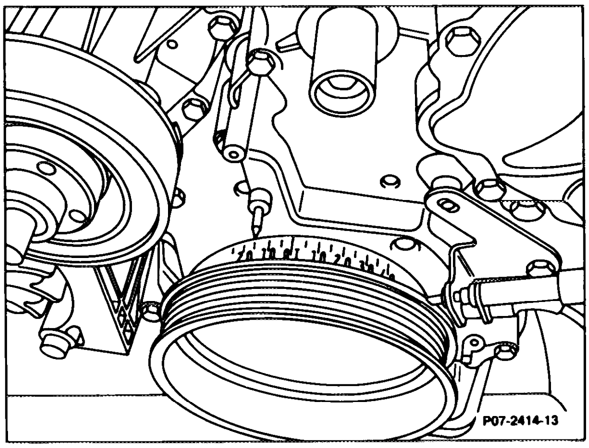
Crankshaft	crank in direction of rotation to 15° ATDC of No. 1 cylinder.
Fastening bolts (13 and 13a) on injection pump flange and on supporting bracket	loosen, tightening torque 20 - 25 Nm.
Indicating instrument (008) and terminal (009) ...	connect.
Injection pump	swivel by turning adjusting screw at start of delivery adjusting device (8) Both lamps "A" and "B" in indicating instrument (008) must light up. **Direction of rotation of adjusting device (8) or screw** to right = start of delivery retarded to left = start of delivery advanced RI specification 15° ATDC.
Position sensor (007)	remove.
Screw plug (arrow)	screw in.
Accelerator control linkage	check, adjust if necessary (30 - 300).
Leakage test	perform with engine running.

Engine oil level . . . . check, correct.
Leakage check . . . . perform with engine running.
Engine oil level . . . . check, correct.

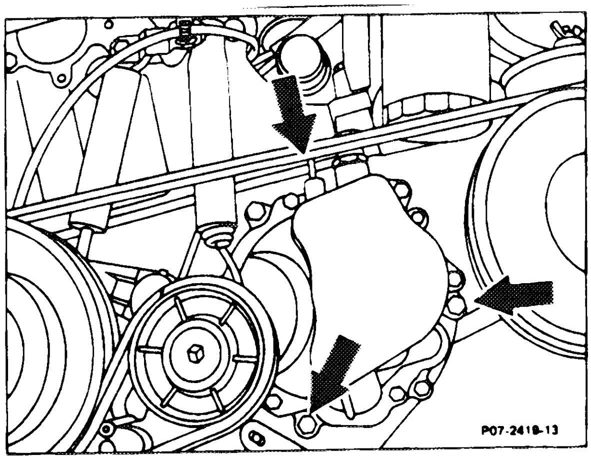
Note

Check start of delivery before performing setting work (07.1411).

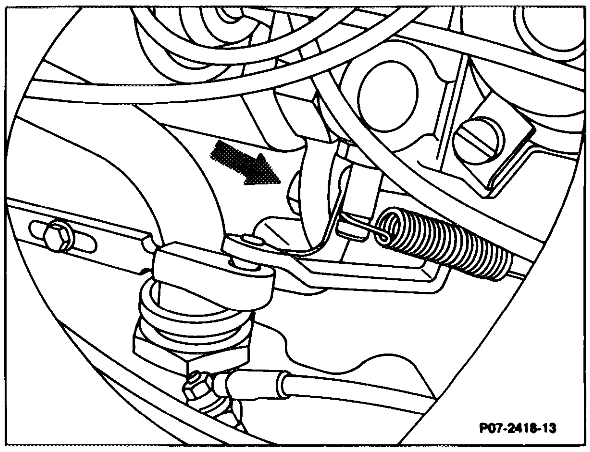
Setting



1 Turn crankshaft in direction of rotation to 15° ATDC of No. 1 cylinder.

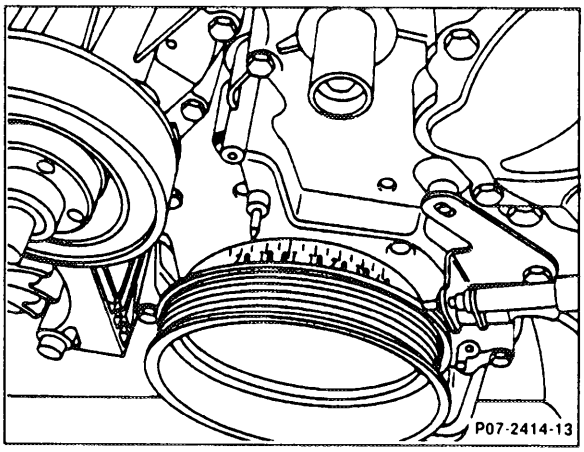


2 Loosen fastening bolts (arrows) on the injection pump flange and on supporting bracket.



Bolt on supporting bracket (arrow)

3 Connect indicating instrument (008) and terminal (009) to battery positive.



4 Swivel injection pump by turning the adjusting screw on the start of delivery adjusting device until both lamps light up.

Direction of rotation of adjusting screw

to right = start of delivery retarded
to left = start of delivery advanced

RIV specification: 15° ± 1 ° ATDC

Note
If the adjustment facility is not adequate, the injection pump must be moved over. Remove, install injection pump (07.1-200).

5 Tighten fastening bolts on injection pump flange and on supporting bracket. Tightening torque 20-25 Nm.

6 Remove position sensor.

7 Screw in plug. Tightening torque 30-35 Nm.

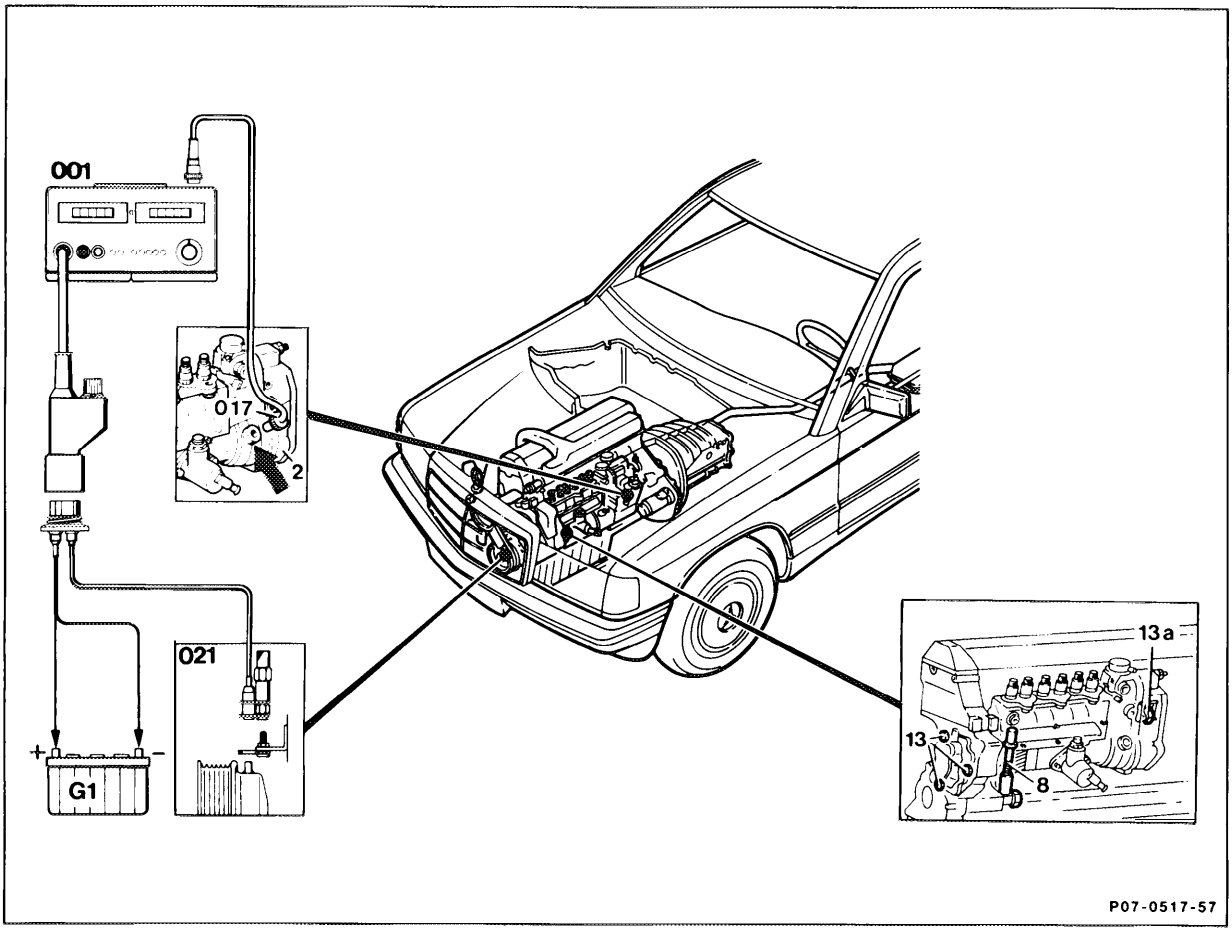
8 Check accelerator control linkage, adjust if necessary (30-300).

9 Perform leakage test with engine running.

10 Check engine oil level, correct if necessary.

EXIT

07.1-117 Setting start of delivery with digital tester (RIV Method) following testing - Turbodiesel



Fastening bolts (13 and 13a) on injection pump flange and on supporting bracket . . . . loosen.

Engine . . . . run at idle speed.

RI value (indirect start of delivery) . . . . set by turning adjusting device (8).

Direction of rotation of adjusting device (8) or screw

to right = start of delivery retarded

to left = start of delivery advanced

RI specification 15° ± 1° ATDC

Engine . . . . turn off.

Fastening bolts (13 and 13a) on injection pump flange and on supporting bracket .... tighten, tightening torque 20-25 Nm.

EXIT

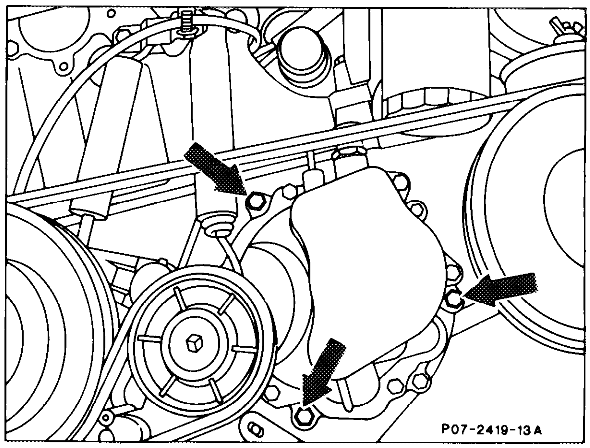
Tester (001)	disconnect.
Screw plug (arrow) on governor	screw in, tightening torque 30-35 Nm.
Accelerator control linkage	check, adjust if necessary (30-300).
Leakage check	perform with engine running.
Engine oil level	check.

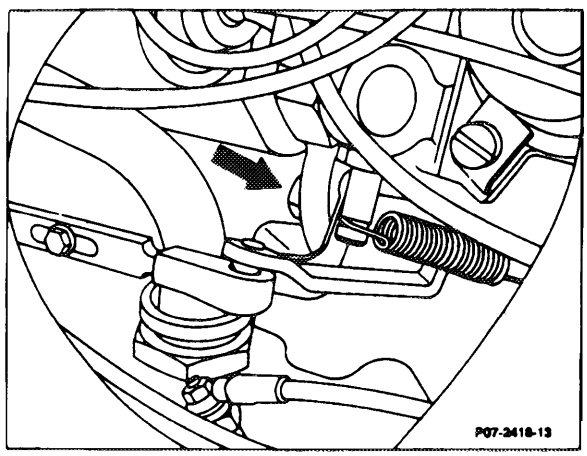
Note

Check start of delivery before performing setting work (07.1-l 12).

Setting

1 Loosen fastening bolts (arrows) on the injection pump flange and on supporting bracket.

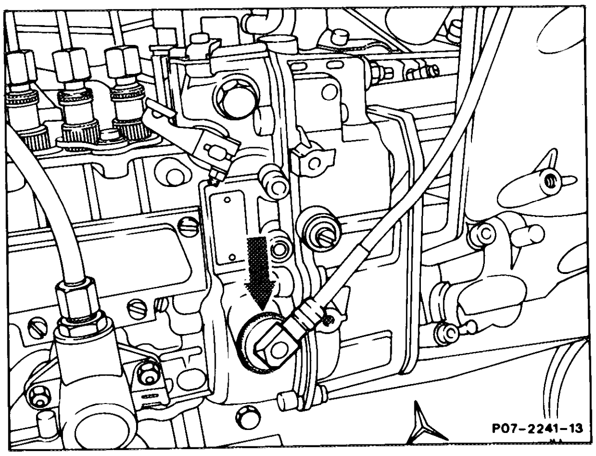




Bolt on supporting bracket(arrow)

EXIT

2 Run engine at idle.



3 Set RIV value (indirect start of delivery) by turning the adjusting screw on the start of delivery adjusting device.

Direction of rotation of adjustlng screw

to right = start of delivery retarded
to left = start of delivery advanced

RIV specification: 15° ± 1 ° ATDC

Note

If the adjustment facility is not adequate, the injection pump must be moved over. Remove, install injection pump (07.1-200).

4 Turn off engine.

5 Disconnect tester.

6 Screw in plug on governor, tightening torque 30-35 Nm.

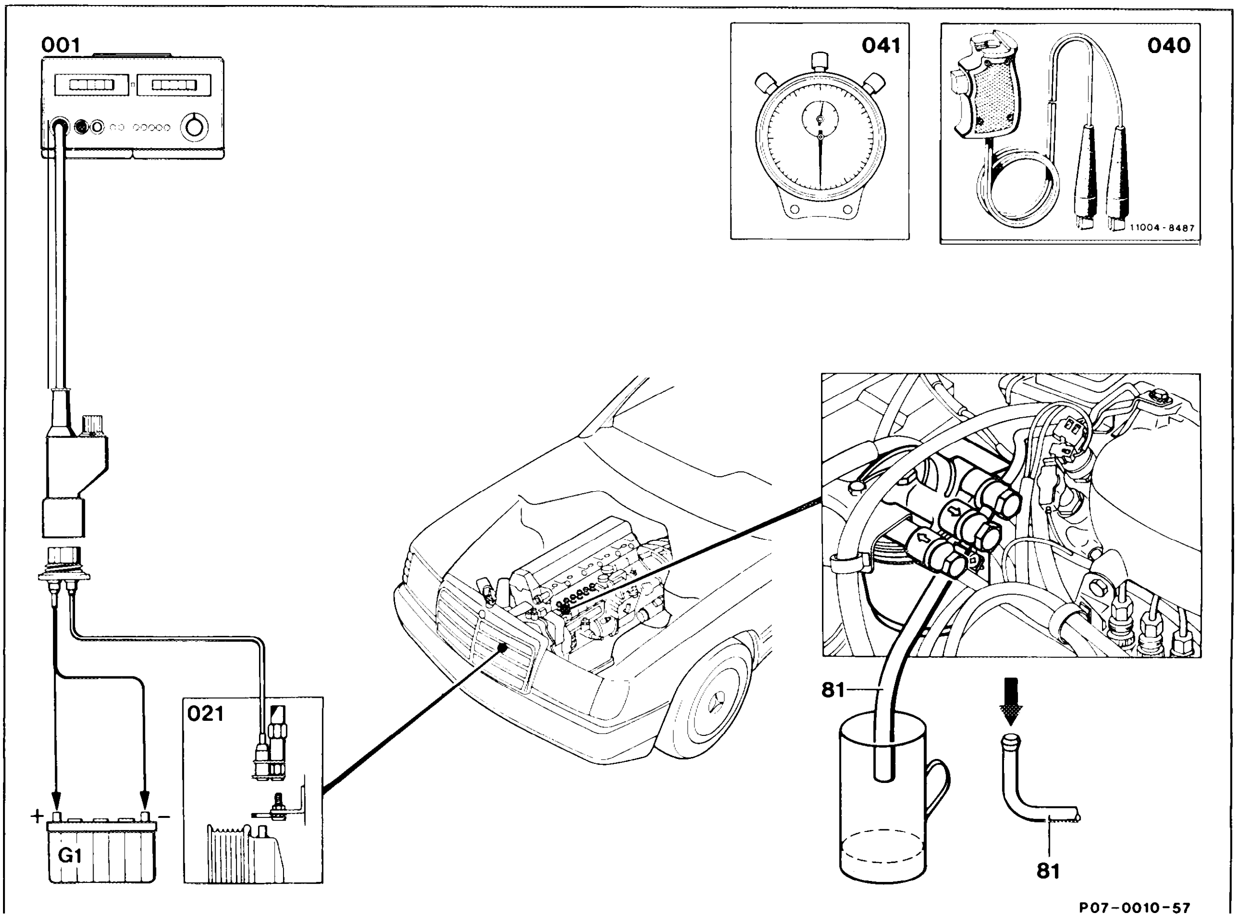
7 Tighten fastening bolts on injection pump flange and on supporting bracket. Tightening torque 20-25 Nm.

8 Check accelerator control linkage, adjust if necessary (30-300).

9 Perform leakage test with engine running.

10 Check engine oil level, correct if necessary.

07.1-145 Testing fuel pump - Turbodiesel



Testers (001, 021)	connect.
Return line (81)	disconnect and hold in measuring vessel (approx. 1 l). **Note** The return line to the fuel tank must be sealed.
Glow start switch	move into position "0", the injection pump is in the zero delivery position.

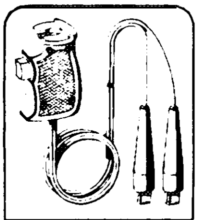
Contact handle (040) .... connect to terminal 30 and terminal 50 and start engine for 30 seconds. Use stop watch (041). Specification: delivery at least 150 $cm^3/30$ seconds at 150 rpm. Replace fuel filter and/or delivery pump if necessary.

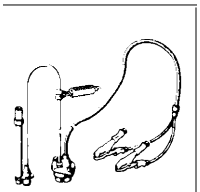
Fuel pressure .... test (07.1-I 46).

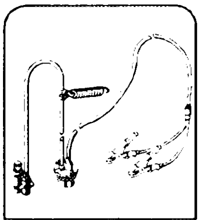
Test data

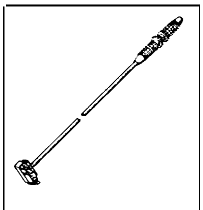
Engine	602, 603
Delivery at least 150 rpm	At least 150 $cm^3/30$ s
Test condition	Glow start switch in position "0"

Special tools


001 589 46 21 00


603 589 00 21 00 07


601 589 04 21 00

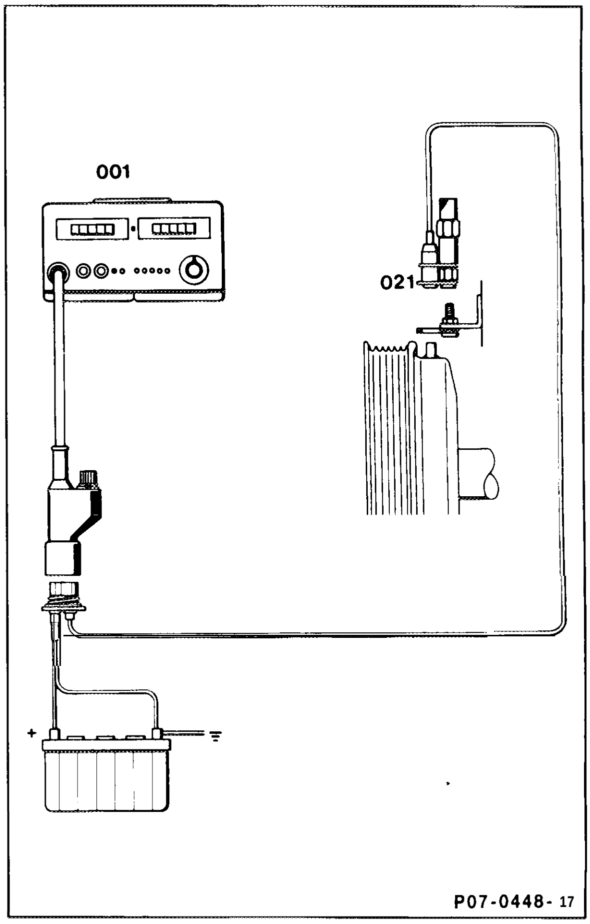

124 589 36 63 00 01

Commercial tools

Digital tester	e.g. Bosch, MOT 001.03
Graduated glass or beaker (at least 1 litre)	
Stop watch	

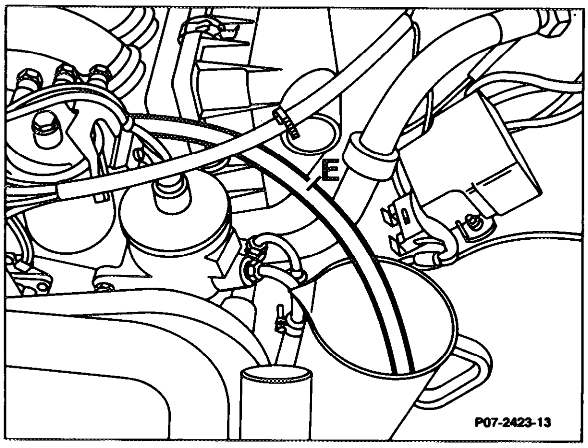
Testing

1 Connect digital tester (001) as shown in connection diagram.



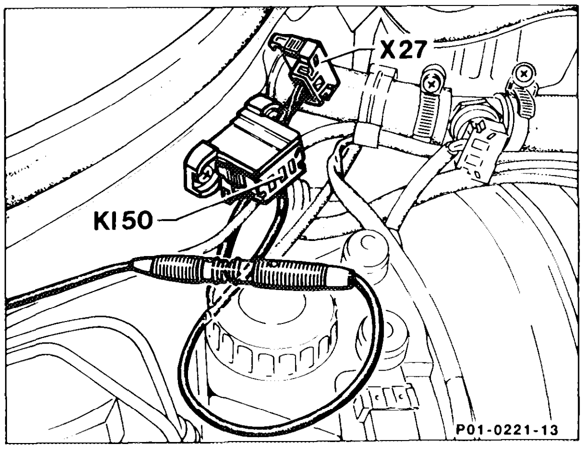
001 Digital tester
021 TDC pulse generator

2 Disconnect return line (E) and hold in measuring vessel.

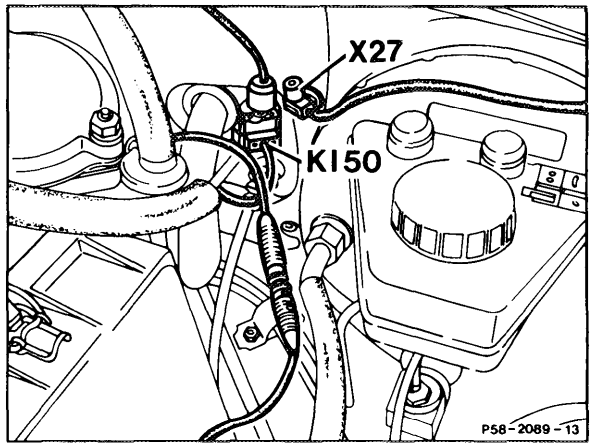


3 Turn glow start switch into position "0", the injection pump is in the “zero” delivery position.

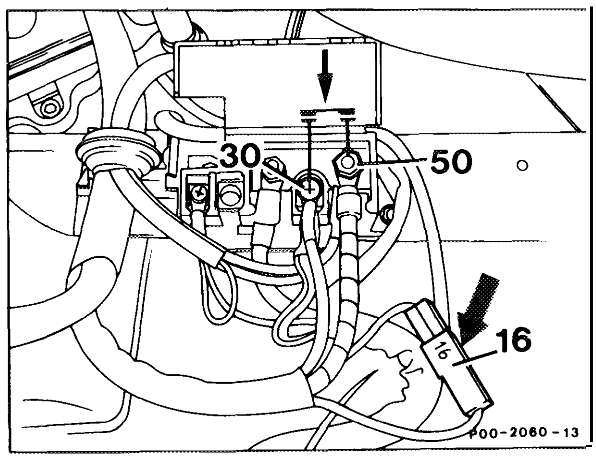
4 Detach connector (X27) and plug adaptor cable to terminal 50.



Model 124



Model 201



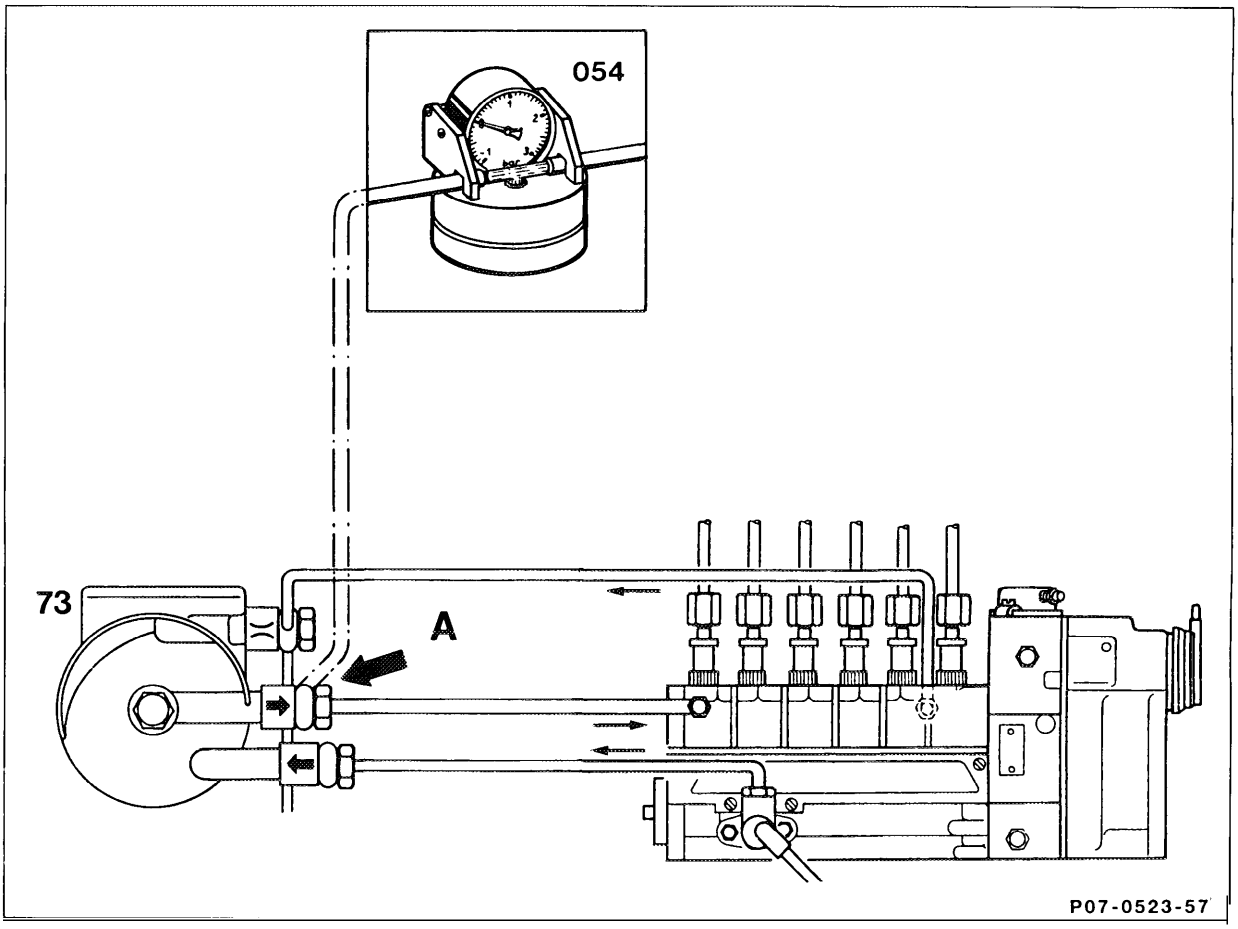
Model 126

5 Connect contact handle to adaptor cable or terminal 50 (term. 50) and to terminal 30 (term. 30) and start engine for 30 seconds.
(Starting voltage at least 10 V)

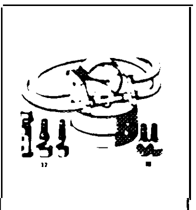
Delivery: at least 150 cm^3/30 seconds.

If the specified value is not reached, test fuel pressure (07.1- 146).

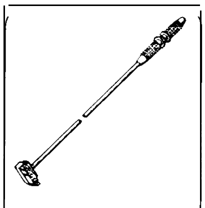
07.1-146 Testing fuel pressure (after testing fuel delivery) - Turbodiesel



Fuel line "A" on filter top section (73)	remove, reinstall.
Tester (054)	disconnect, connect.
Run engine	specified values at idle speed > 0.3 bar at full-load > 0.5 bar. If the specified values are not reached, replace fuel filter.

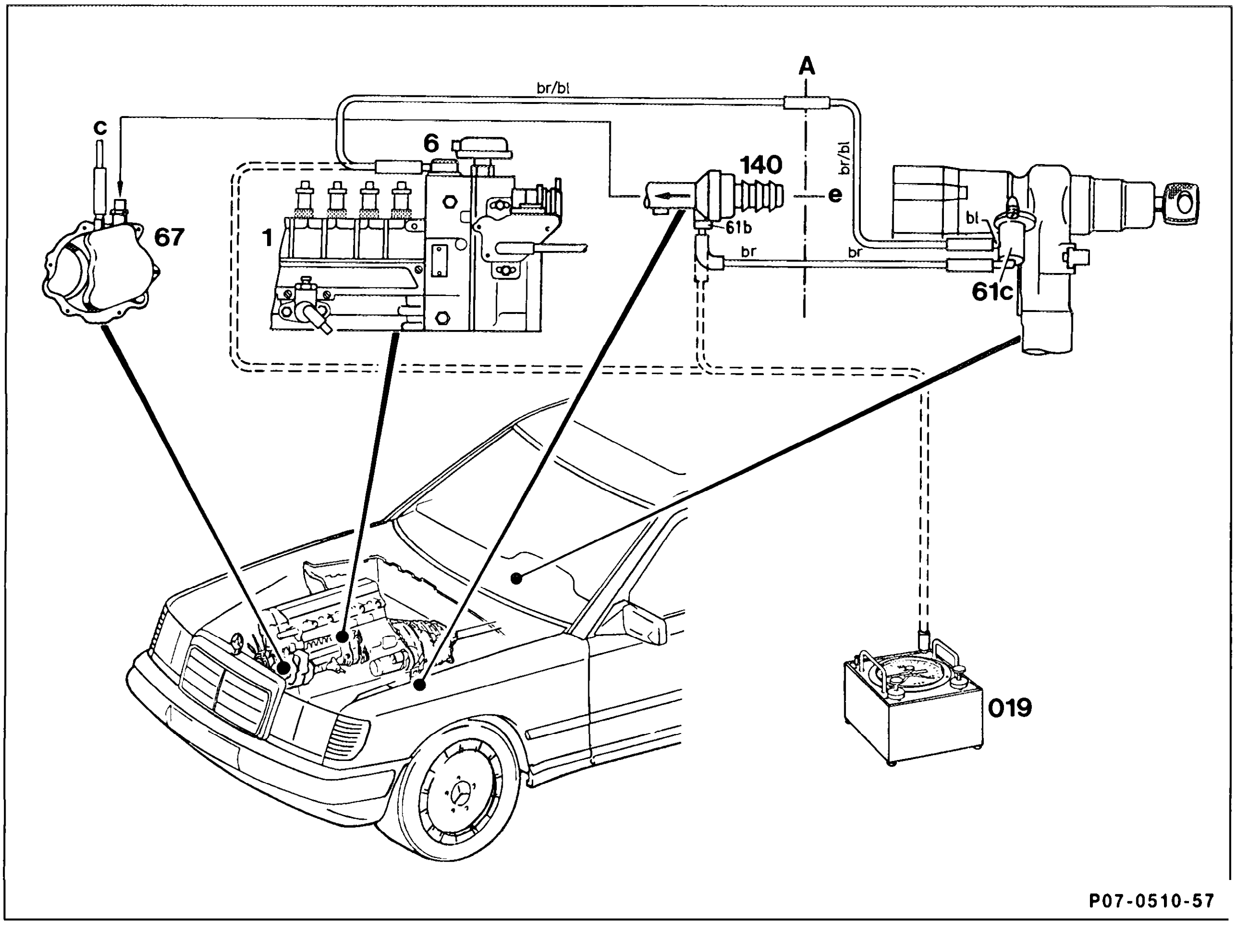


617 589 04 21 00



124 589 36 63 00
01

07.1450 Testing vacuum engine stop for leaks - Turbodiesel



1	Injection pump	A	Intermediate panel
67	Vacuum pump	c	Other ancillaries
140	Check valve/main vacuum line	e	To brake booster

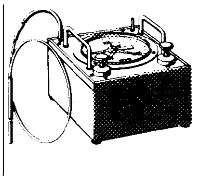
Key in steering lock .... turn to position "2".

Tester (019) 201 589 13 21 00 .... connect to "brown" suction line and pressurize with 400 + 50 mbar vacuum (maximum permissible vacuum drop 6 mbar/min.).

EXIT

Tester (019) 201 589 13 21 00 . . . . connect to vacuum unit (6) and pressurize with 300 + 50 mbar vacuum (maximum permissible vacuum drop 5 mbar/min.). If there is too much vacuum loss, determine cause and rectify.

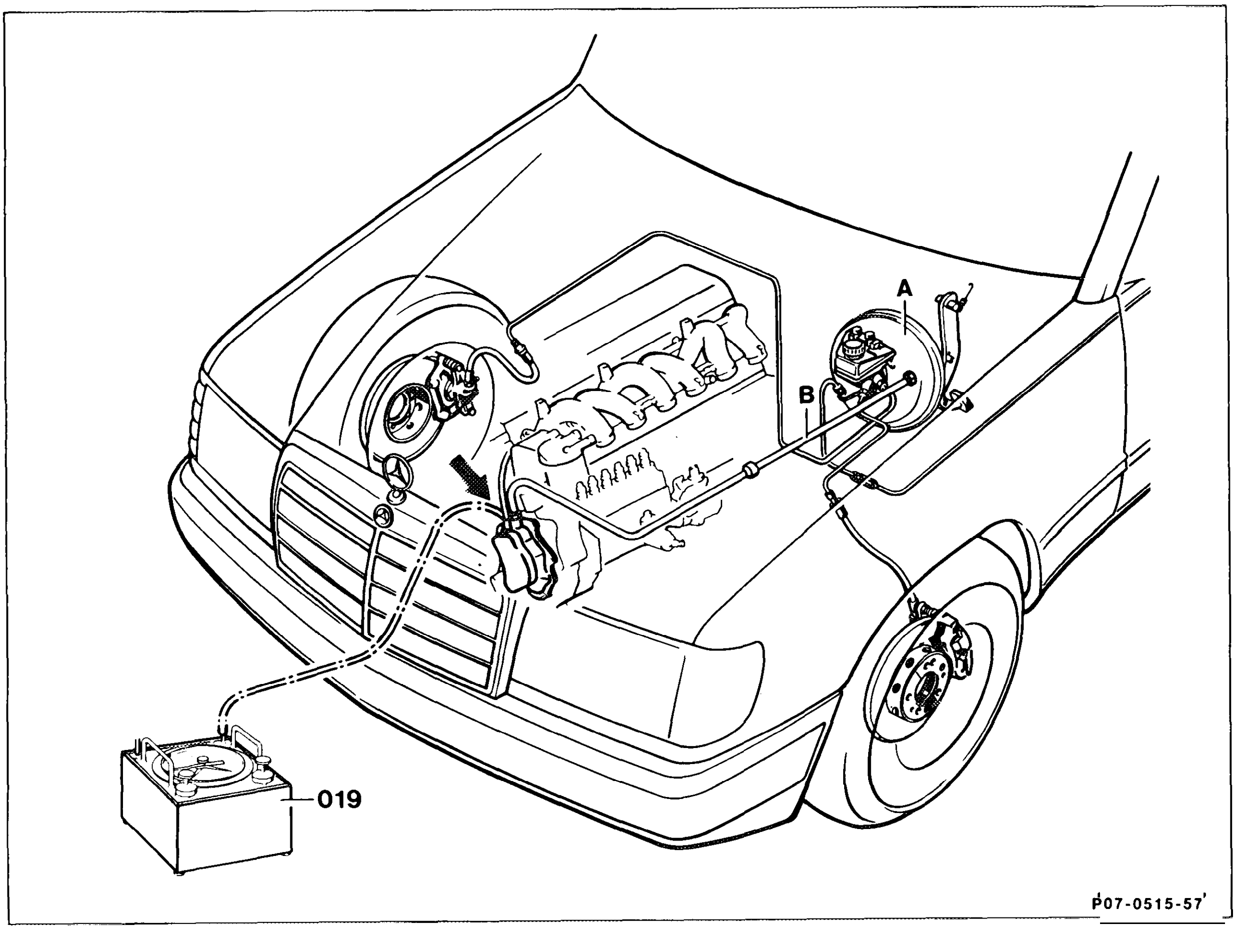
Special tool



201 589 13 21 00
00 42 80

EXIT

07.1-160 Testing vacuum pump - Turbodiesel

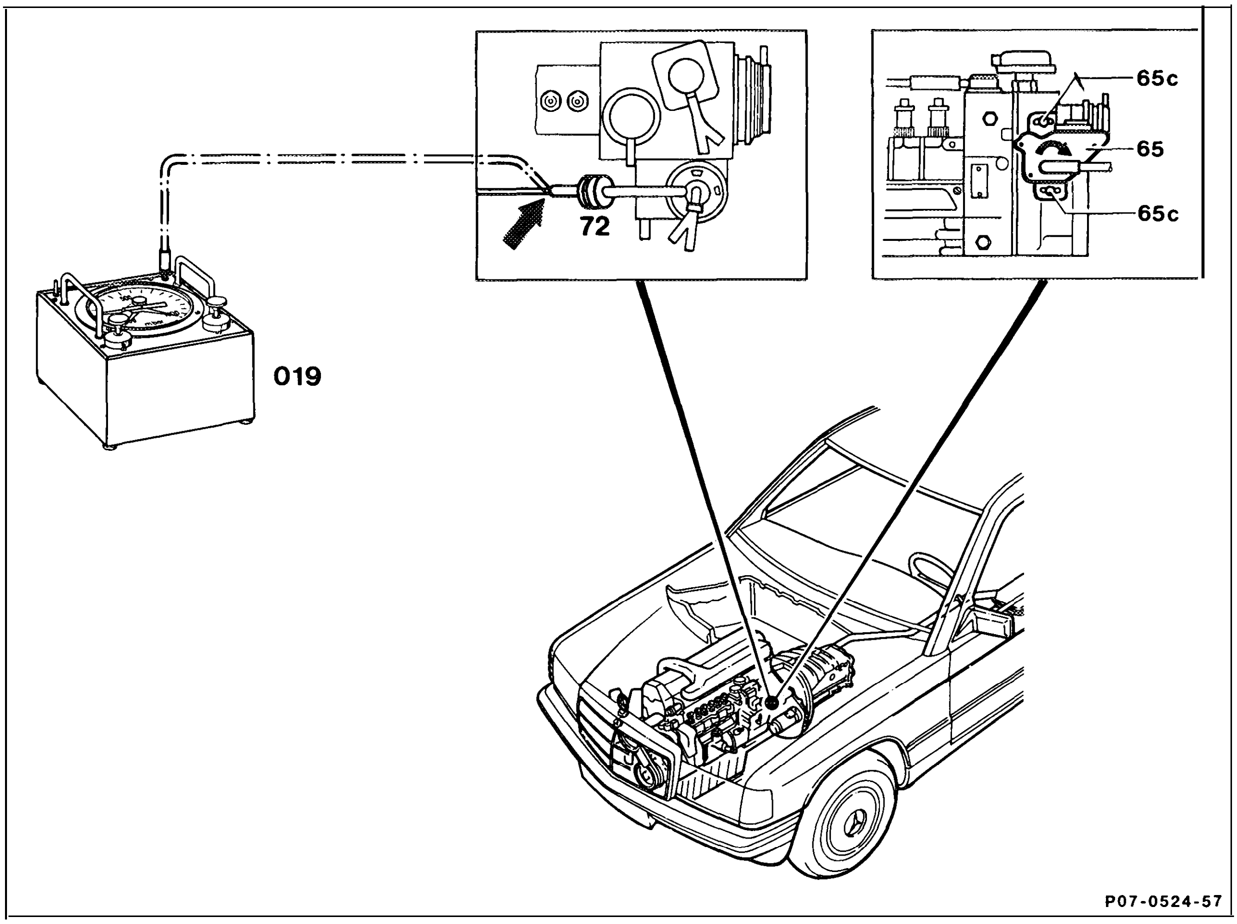


Main vacuum line (B)	disconnect at brake booster (A).
Vacuum line at ancillaries connection	detach, and use 0.8 mm gauge to check that restriction orifice is clear.
Vacuum tester (019) 201 589 13 21 00	connect to ancillaries connection and test vacuum at idle speed.

Specification: 700 mbar after 30 s.

If specified vacuum reading is not reached replace vacuum pump.

07.170 **Testing and setting vacuum control valve** for **automatic transmission - Turbodiesel**



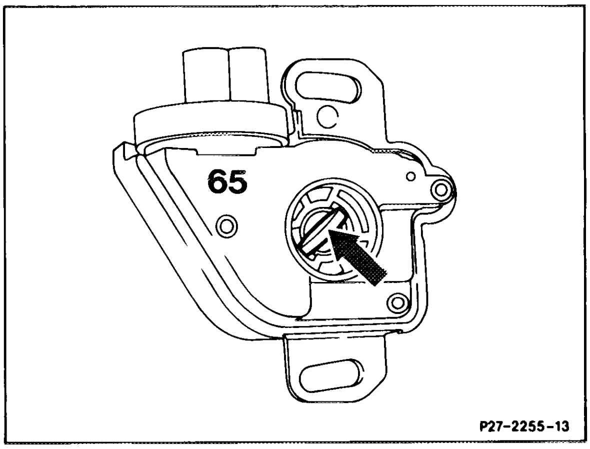
Note

Test conditions:
fun engine up to normal operating temperature
(approx. 80°C coolant temperature).
Accelerator control correctly set (30-300).

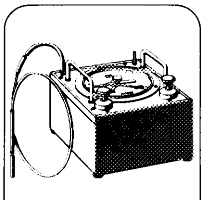
EXIT

Vacuum tester (019)	connect to damper (72) of vacuum line and take reading of vacuum at idle speed. Specification: Engine 602, 420 ± 25 mbar Engine 603, 385 ± 25 mbar With engine off, move accelerator control to full-load stop. Specification: 0 mbar, it may be necessary to set vacuum control valve. Test vacuum lines, test vacuum pump, replace vacuum control valve.
Fastening bolts (65c)	loosen, run at full throttle until control lever of injection pump is resting against full-load stop. Turn vacuum control valve (65) in direction of arrow until resistance is felt. Tighten vacuum control valve in this position.

A seal (arrow) is installed in the vacuum control valve to prevent dust and dirt getting into the valve.



Special tool



201 589 13 21 00
00 42 80

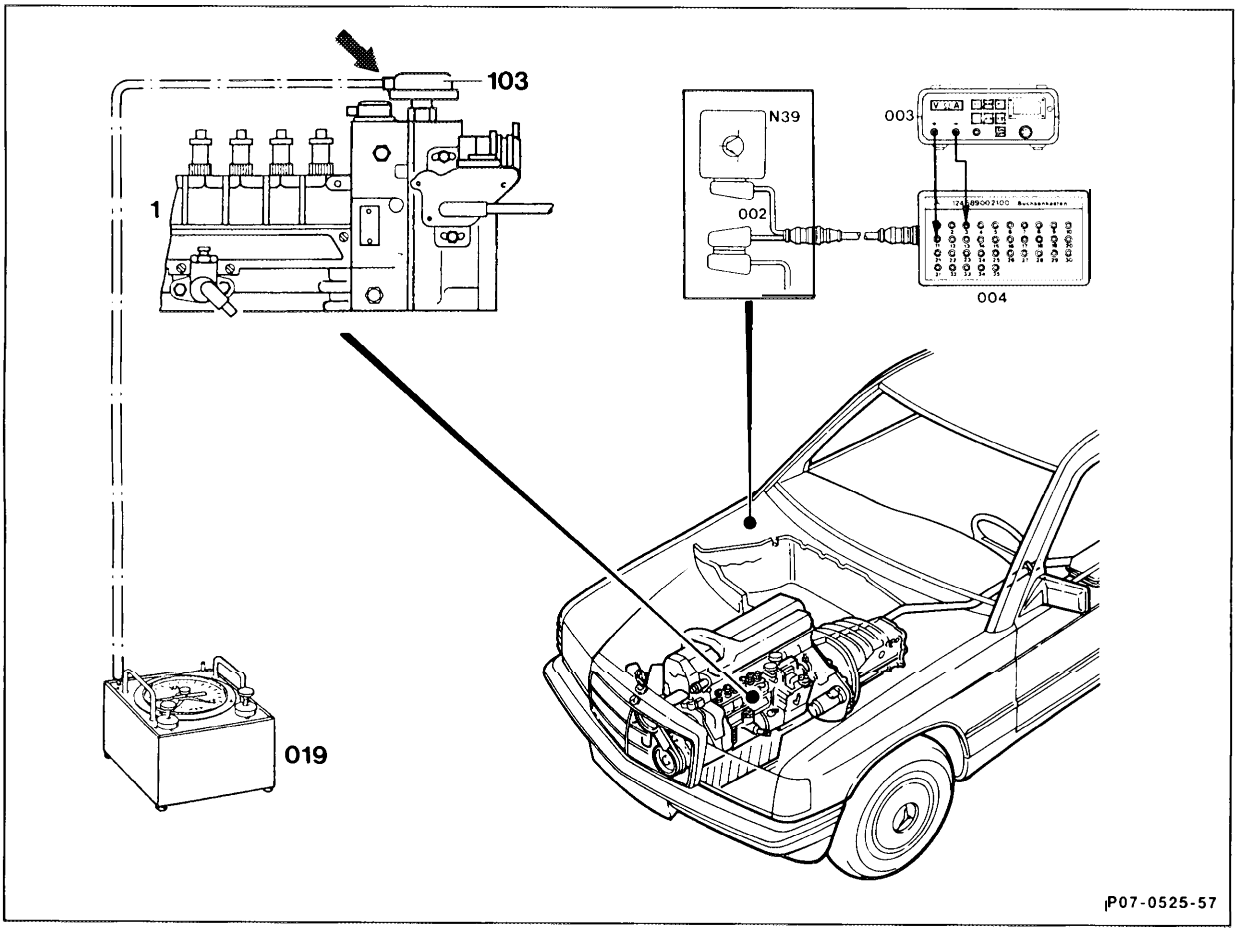
07.1-180 Testing control rod travel sensor- Turbodiesel (Model Year 1986/87 only)

Problem:

Poor performance and/or high fuel consumption.

Test conditions:

Engine coolant temperature > 80°C.
Air-conditioning system off.



Contact box (004)	connect into circuit at EDS control unit (N39) as shown in connection diagram.
Multimeter (003)	connect to jacks 3 and 11. Press button "V = ".

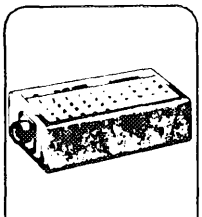
Pressure, vacuum tester (019) .... connect to ALDA unit (103) and pressurize with 1000 mbar gauge pressure. White pressure line detached.

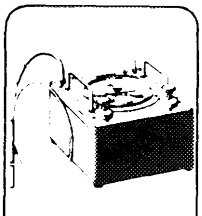
Parking brake .... apply. **Start** engine, depress service brake. Engage drive position "D", apply full throttle and take reading of voltage at 1500-2200 rpm and note.
Specification: 3.27 ± 0.08 V, at ≤ 1600 m above MSL. Pay attention to note 07.1-I 90.

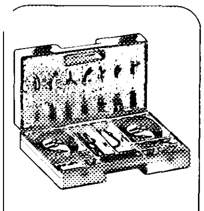
Pressure, vacuum tester .... disconnect and admit air to ALDA unit (103). Pressure line must not be connected. Stall engine as above. Take reading and note, compare with table.

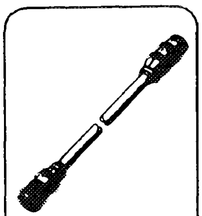
Note
A measurement or hard brake application must not last longer than 5 seconds. A pause of at least 2 minutes should occur between two hard brake applications.

Special tools


124 589 00 21 00


201 589 13 21 00


201 589 00 99 00
15 54


124 589 34 63 00

Commercial tester

Multimeter	e.g. Sun, DMM-5

Compare voltage reading or corrected voltage of control rod travel sensor with table.

Control rod travel sensor voltage

Engine speed	Pressure at ALDA	Height above MSL	Position of control lever at governor	Spec. voltage at control rod travel sensor evaluation circuit
rpm	mbar	m		U_a corr. volts
1500–2200	1000 (gauge pressure)	≤ 1600	at full-load stop	3.27 ± 0.08
1500–2200	Atmospheric pressure without tester, pressure line at ALDA disconnected	0	at full-load stop	2.45 ± 0.10
		100		2.43 ± 0.10
		200		2.42 ± 0.10
		300		2.40 ± 0.10
		400		2.39 ± 0.10
		500		2.37 ± 0.10
		600		2.35 ± 0.10
		700		2.34 ± 0.10
		800		2.32 ± 0.10
		900		2.31 ± 0.10
		1000		2.29 ± 0.12
		1100		2.28 ± 0.12
		1200		2.26 ± 0.12
		1300		2.25 ± 0.12
		1400		2.23 ± 0.12
		1500		2.22 ± 0.12
		1600		2.20 ± 0.12

Measure reference voltage at jacks 23 (red) and 3 (black). If the reference voltage (U_{ref}) is beyond 5 ± 0.1 V, the two control rod travel sensor outlet voltages ($U_{a, actual}$) measured previously, must be recalculated as follows:

$$U_{a,\ corr} = \frac{U_{a,\ actual} \times 5\ V}{U_{ref}}$$

If the control rod travel sensor voltages do not agree with the figures stated in the table above, the injection pump must be reset on an injection pump test stand.

EXIT

07.1-190 Testing electronic diesel system (EDS) - Turbodiesel

A. Engine 602.96 in Model 201 Federal Model Year 1987

B. Engine 603.96 in Models 124 and 126 Federal and California Model Year 1986/87

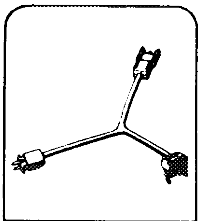
C. Engines 602.962 and 603.970, Model Year 1990

Test conditions

- Coolant temperature approx. 80°C
- Air-conditioning: **OFF**
- Shift selector lever position P
- Fuse in over-voltage protection relay in order
- Battery voltage report 12 volt at over-voltage protection between jacks 1 and 5

EXIT

Special tools



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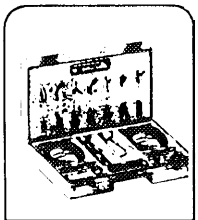

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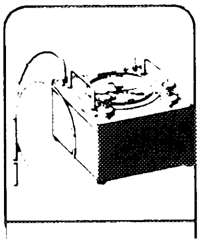
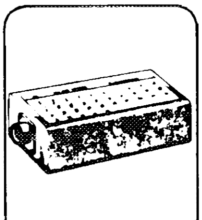
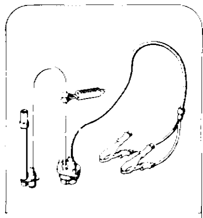


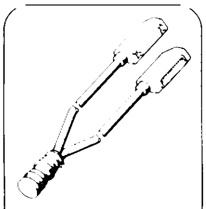
~ 1 5 8 9 1 3 2 1 0 0)



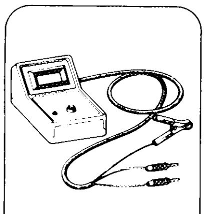
124 589 00 21 00



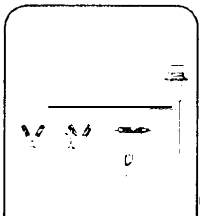
603 589 00 21 00
07



124 589 33 63 00
07 28 54



124 589 19 21 00
07 83



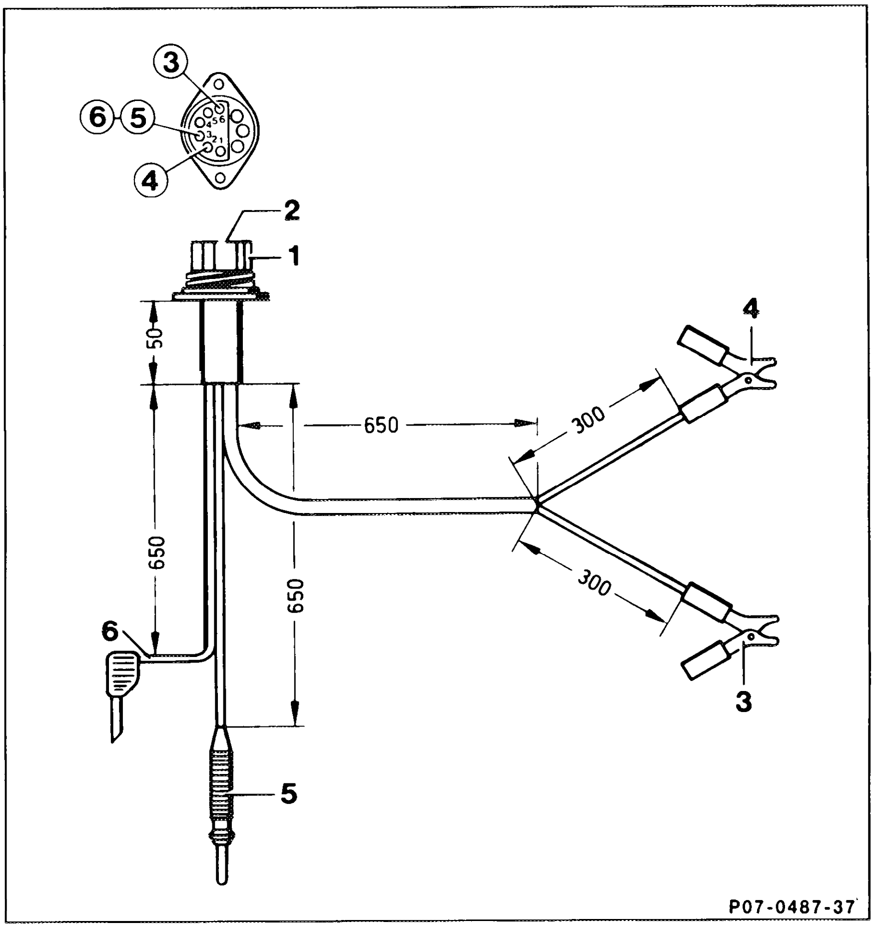
903 589 01 63 00

Commercial tools

Multimeter	e.g.	Sun, DMM-5
Digital testers	e.g.	Sun, EMT-l 01 9/Master 3 Sun, DIT 9000 All-Test, 361 O-MB Bosch, MOT 002.01
Y distributor	117078 01 45	
Lambda control tester	e.g.	Bosch KDJE-P600 Hermann L 115

Test cable shop-made

Test cable (Xl 1)



Pin assignment of test socket
Posltion 3 to jack 6
Posltion 4 to jack 2
Position 5 to jack 3
Posltion 6 to jack 3

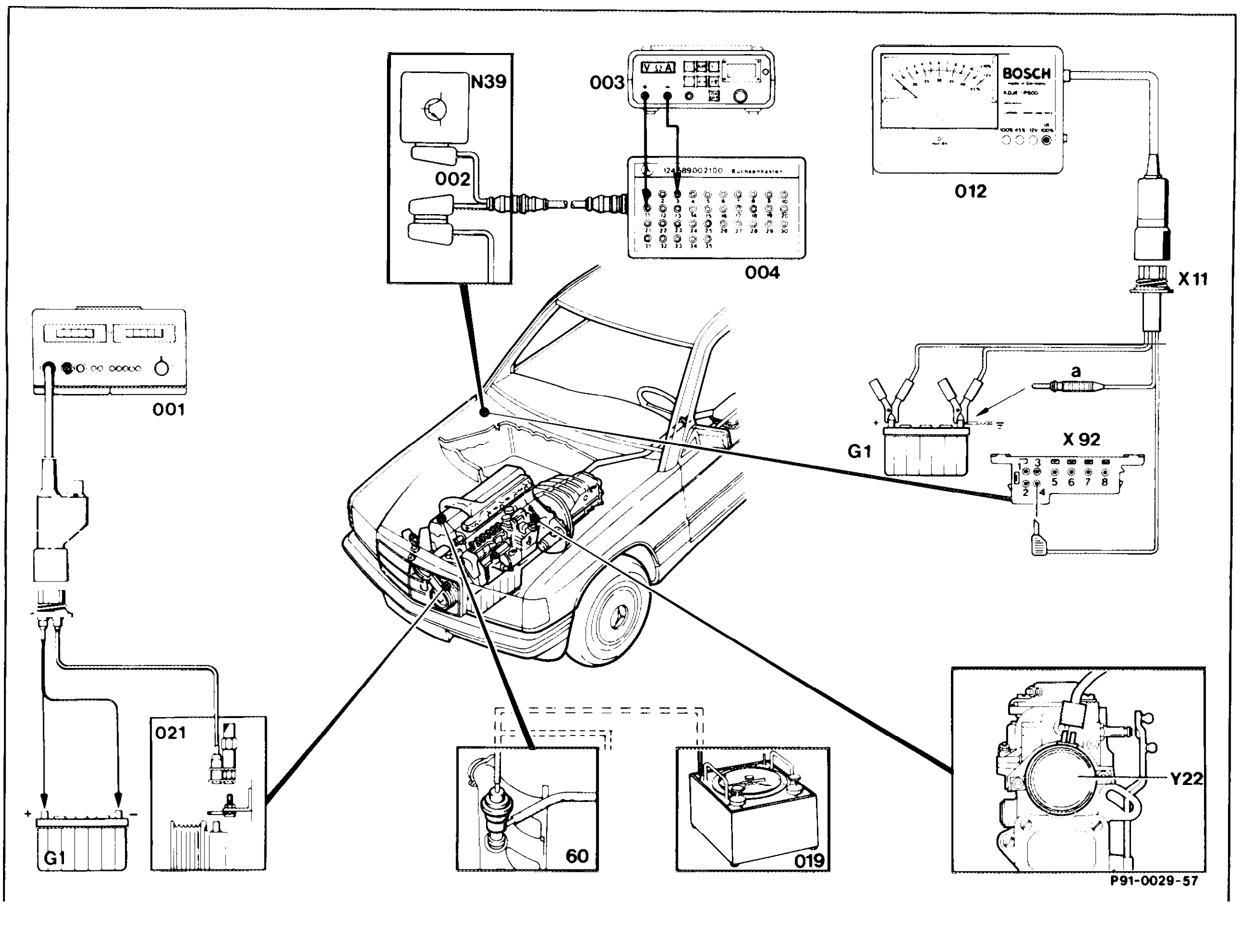
Scope of parts

Position	Designation	Part no.	Quantity/dimension
1	Test socket	123 545 00 26	1
2	Jacks	001 545 28 26	3
–	Cable	Commercial	Length as per drawing
3	Terminal, red	Commercial	1
4	Terminal, black	Commercial	1
5	Connector	Commercial	Ø 4.8 mm
6	Connector	Commercial	Ø 4 mm

A. Engine 602.96 in Model 201 Federal Model Year 1987

a) Testing
b) Testing components
c) Testing electronic idle speed control

a) Testing



Digital tester (001) and pulse counter (021) ..... connect, disconnect.

Lambda control tester (012) .... connect to battery **(G1)** and test connector (X92).
Connect, disconnect, press 100% IR switch.

Contact box (004)	connect, disconnect with test cable (002) to EDS control unit (N39).
Vacuum tester (019)	connect, disconnect with Y distributor at EGR valve.
Digital tester (003)	connect, disconnect to contact box (004).
Fuse at over-voltage protection (K1/1)	test.
Selector lever	move into position "P".
Air-conditioning/automatic climate control	off.
Engine	bring to operating temperature (coolant temperature to 80° C).

Note
When performing the test work, the air intake hose between the air flow sensor and exhaust gas turbocharger must be fitted, otherwise no signal will pass from the air flow sensor to the EDS control unit (N39).

Connector "a"	hold approx. 1 second to battery ground 100% readout.
Connector "a"	remove. 0% readout, no fault in system. Readout fluctuates, fault in system (refer to troubleshooting table).

Note
One pulse = 0% – 100% – 0%.

The number of pulses indicates which electrical component is faulty.

Repeat test until there are no further pulses displayed.

EXIT

Trouble-shooting table

Fault readout	Component or circuit not operating
1	Engine speed sensor (L3)
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1) electrical faults
4	Altitude sensor (B18)
5 [1])	Exhaust control circuit, electrical and mechanical faults a. Exhaust gas recirculation valve EGR (60) b. Vacuum transducer (Y31/1) c. Air flow sensor (B2/1)
8	Coolant temperature sensor (B1 1/4)
9	Intake air temperature sensor in air flow sensor (B2/1a)
10	Reference resistor (R18/2) exhaust gas recirculation (EGR)
11	Resistance trimming plug (R18/1) idle speed control (ELR)

[1]) Hold engine speed above 1200 rpm for at least 5 seconds, otherwise no readout.

Double connector of ELR solenoid Y22 . . . . Disconnect and fit on again (at least 3 seconds). Engine speed increases briefly.

Engine . . . . Run engine at approx. 1200 rpm and approx. 250 mbar. Briefly apply full throttle. Vacuum drops to 0 mbar.

Engine . . . . off.

EGR valve . . . . Pressurize EGR valve with approx. 300 mbar vacuum. EGR valve audibly closes.

EXIT

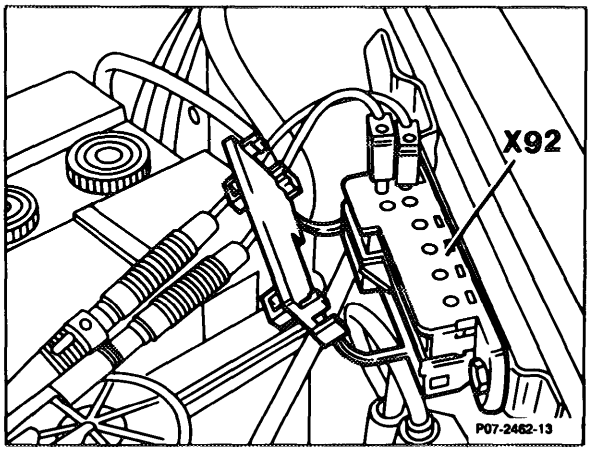
b) 'Testing components

Fault readout"1"

Testing engine speed signal
Connect multimeter to test connector (X92), jacks 1 and 2. Press button "V~". Engine at idle.

Readout: > 2.8 V-

Yes	No



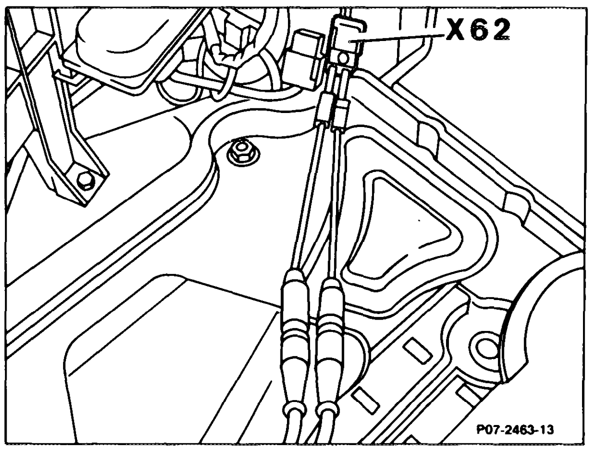
Yes → End of test

No →

Engine off. Separate plug connection (X62). Press button "Ω" and test resistance with multimeter.

Readout: 0.4–2.5 kΩ

Yes	No



No → Replace engine speed sensor (L3)

Yes → End of test

EXIT

Connection as above. Press button "V".
Engine at idle.

Readout: >4 V~
Voltage rises as engine speed rises

Yes	No

No:

Examine engine speed sensor, starter ring gear (L3) for dirt deposits and metal chips, clean if necessary.

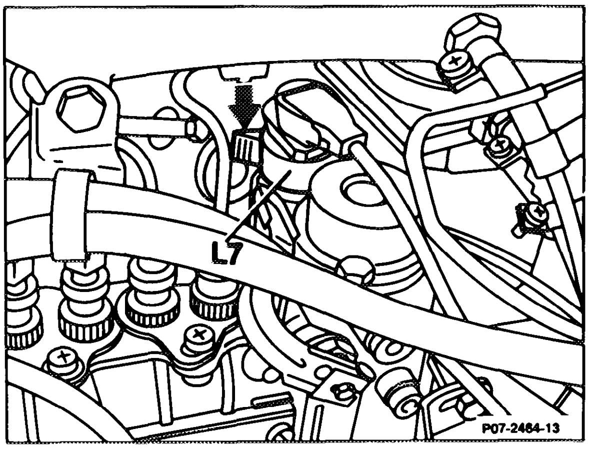
End of test

EXIT

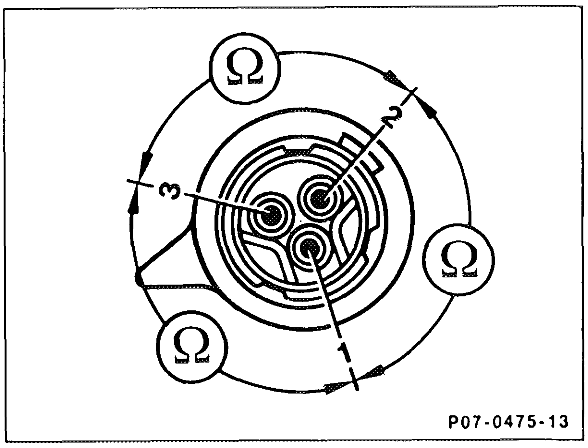
Fault readout"2"

Testing control rod travel sensor (L7) Engine off. Turn anti-twist lock (arrow) counter-clockwise and detach connector on the injection pump. Press multimeter button "Ω". Test resistance according to drawing.
Readout: Terminals 1 and 2 = approx. 25 ± 2 Ω Terminals 1 and 2 = approx. 25 ± 2 Ω Terminals 2 and 3 = approx. 50 ± 2 Ω

Yes	No



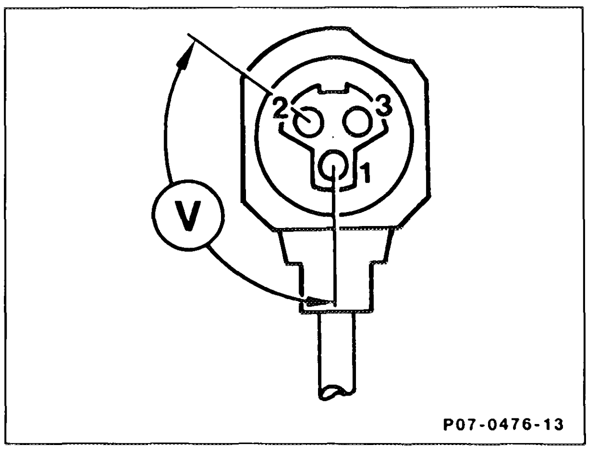
No → Replace injection pump.



Engine off. Ignition on Press multimeter button "V = ". Measure voltage between the jacks l-2.
Readout approx. 10 volts

Yes	No

No → Rectify interrupt according to wiring diagram.
Replace control unit (N39).

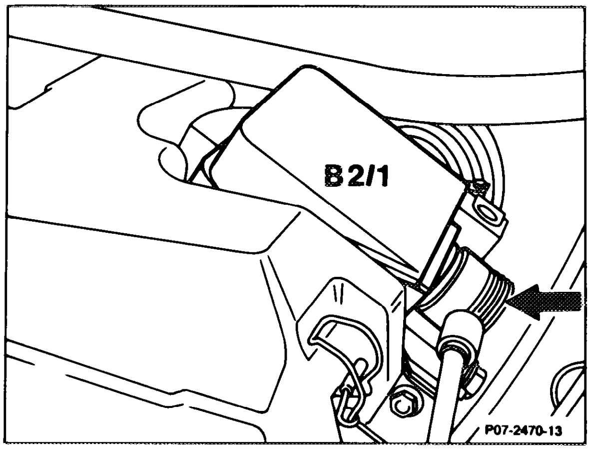


End of test

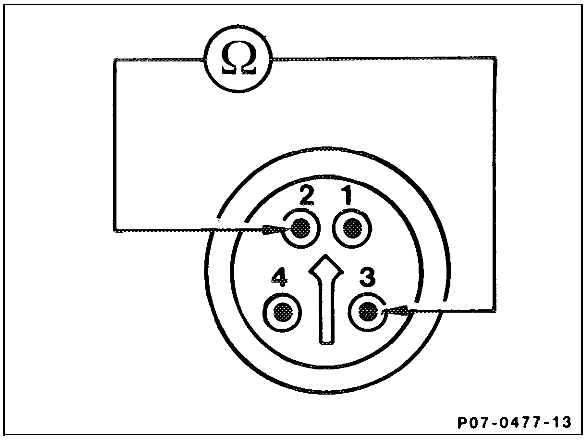
EXIT

Fault readout opening “3”

Testing airflow sensor potentiometer (B2/1) Engine off. Detach connector (arrow) from airflow sensor. Multimeter button **Ω**. Measure resistance between jacks 1 and 3 on airflow sensor.	
Readout: airflow sensor plate in idle position = approx. 50-200 Ω airflow sensor plate fully deflected = approx. 560-l 100 Ω	
Yes	No

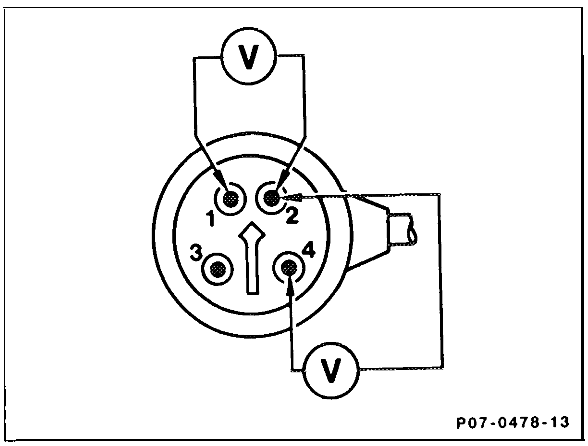


Examine airflow sensor plate for ease of movement and fouling. Replace airflow sensor if necessary.



Engine off, ignition: **ON**. Press multimeter button "V = ". Measure voltage between jacks 1 and 2 or 2 and 4, resp.	
Readout: approx. 5 volts	
Yes	No

Rectify interrupt according to wiring diagram
Replace control unit (N39).



End of test

Note
If airflow sensor removed, also perform “Testing air temperature sensor (B2/1 a)” (Fault readout 9).

EXIT

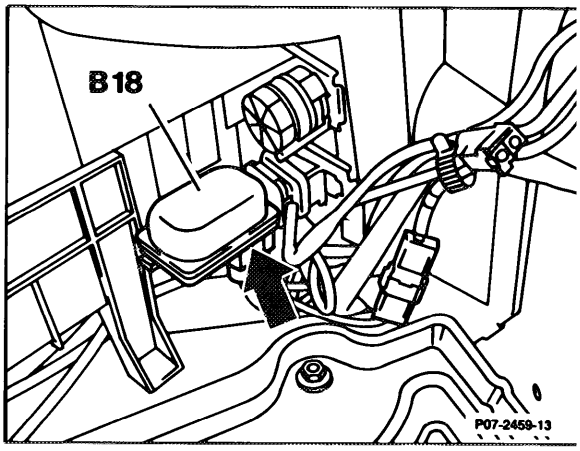
Fault readout "4"

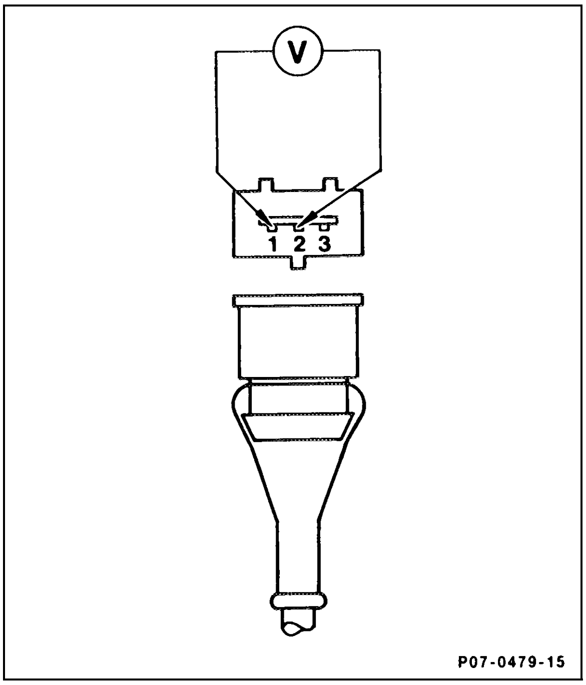
Testing altitude sensor (B18) Engine off. Ignition key in position "2". Press multimeter button "V = ". Measure voltage between jacks 1 - 2.	
Readout: approx. 5 volts	
Yes	No

No: Rectify interrupt according to wiring diagram. Replace control unit (N39) if necessary.

Yes: Replace altitude sensor.

End of test





EXIT

Fault readout "5"

Testing exhaust control circuit	
a) **Test EGR valve (60) when engine not funning** Pressurize EGR **valve** approx. 300 mbar vacuum. Detach vacuum line.	
EGR valve closes audibly and is felt to close.	
Yes	No

(No →)

Remove EGR valve and pressurize vacuum tester with approx. 520 mbar.

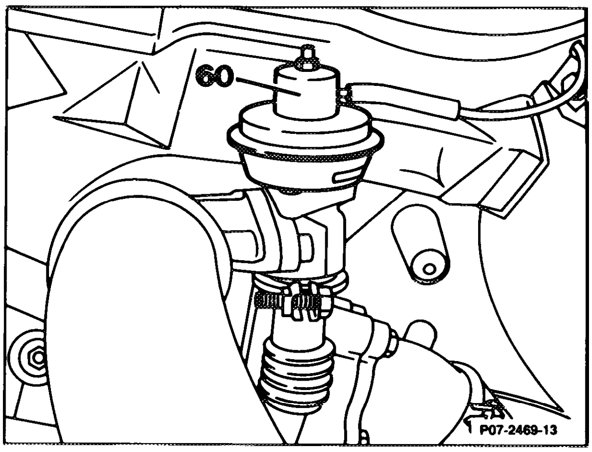
EGR valve rises approx. 5 mm off its seat (end stop).

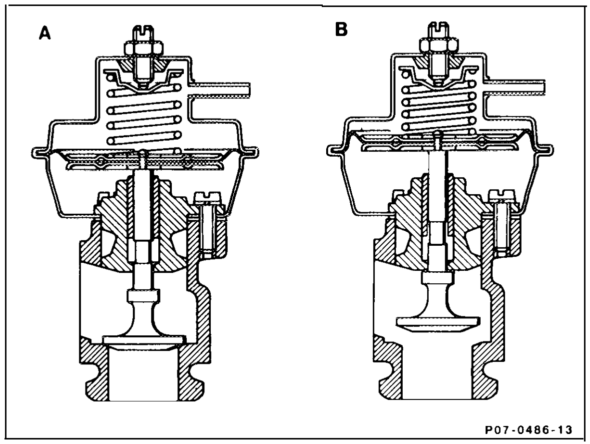
Detach vacuum line. EGR valve must be heard to close.

If one of these test steps is not successful, replace EGR valve.

(Yes →)

End of test 1

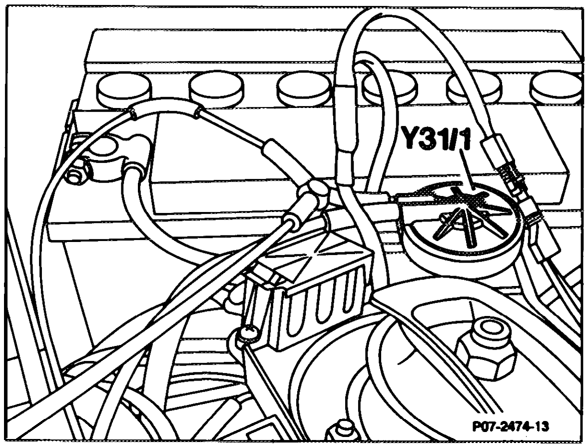




A closed
B open

b) Testing vacuum transducer (Y31/1)
Connect vacuum tester with Y distributor to vacuum transducer (Y31/1). Connect multimeter with test cable to transducer (Y31/1). Press button "A". Increase engine speed until approx. 250 mbar is reached.

Note
Ensure that connector of vacuum transducer (Y31/1) is correctly connected.



Refer to diagram for specified values.
Example: 250 mbar = 400-500 mA

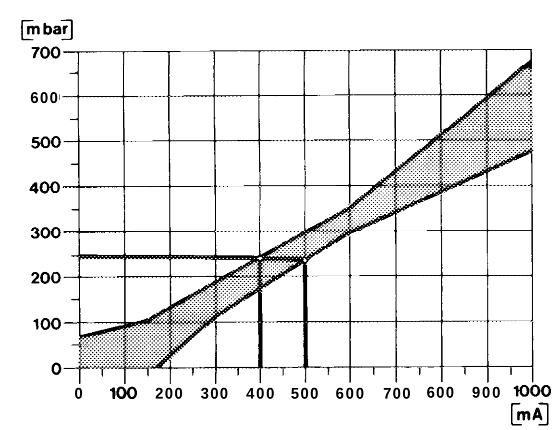
Current at vacuum transducer

0 mA	too low	too high

Check that vacuum vent (black) and filter are clear.

Check that supply line (blue) is clear. Check whether there is an interruption in vacuum line (white/purple/brown) between transducer and EGR valve. If vacuum line and vacuum are in order, replace vacuum transducer (Y31/1).

End of test



EXIT

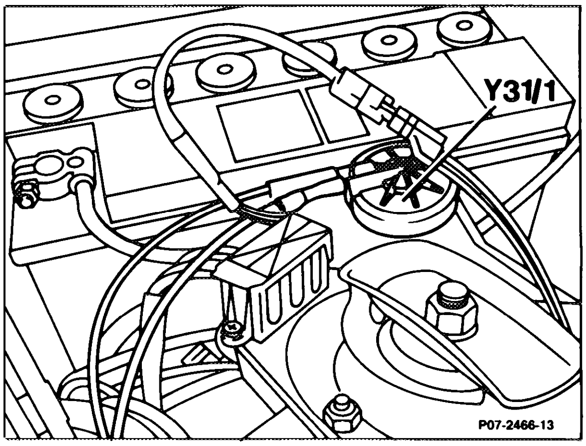
Engine off. Glow start switch in position “2”. Detach double connector on EGR vacuum transducer (Y31/1), and measure voltage with multimeter button ”V = ”.

Readout: approx. 12 volts

Yes | No

No: Rectify interrupt according to wiring diagram. Replace control unit (N39), if necessary.

End of test



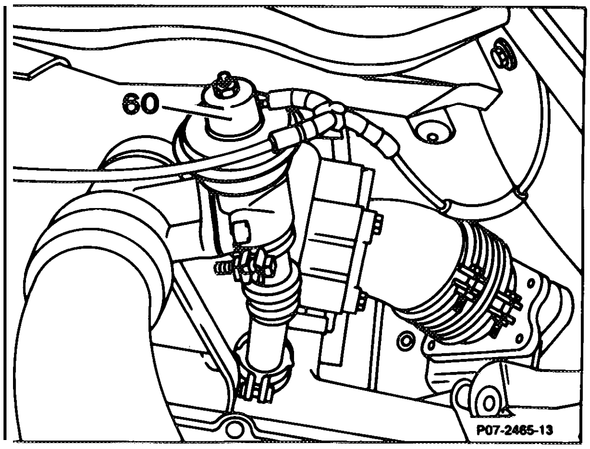
Yes:

Connect vacuum tester with Y distributor to EGR valve (60). Take reading of vacuum at 850 rpm. Accelerate briefly, vacuum drops.

Yes | No

No: Replace vacuum transducer (Y31/1). Check mechanical operation of air flow sensor (B2/1) (refer to section ”c”). If these components are in proper order, replace control unit (N39).

End of test



EXIT

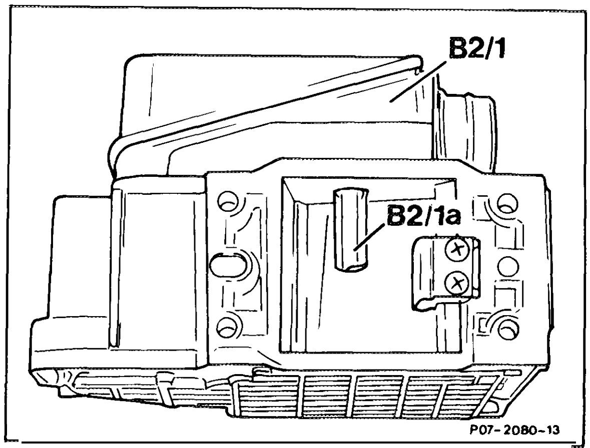
c) Check mechanical operation of air flow sensor (B2/1).

Check ease of operation of air flow sensor flap. Air flow sensor flap must not stick.

Yes	No

No → Replace air flow sensor (B2/1).

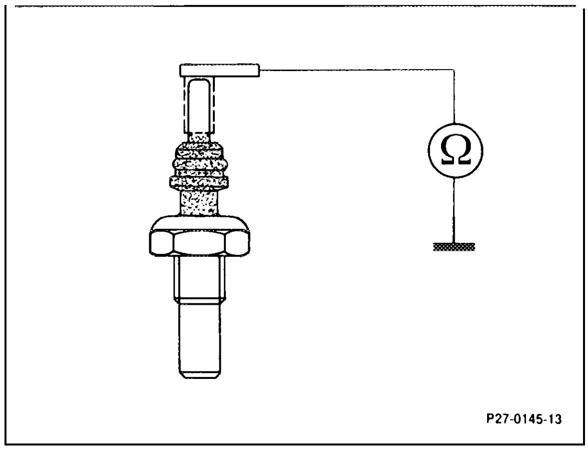
Yes → End of test



EXIT

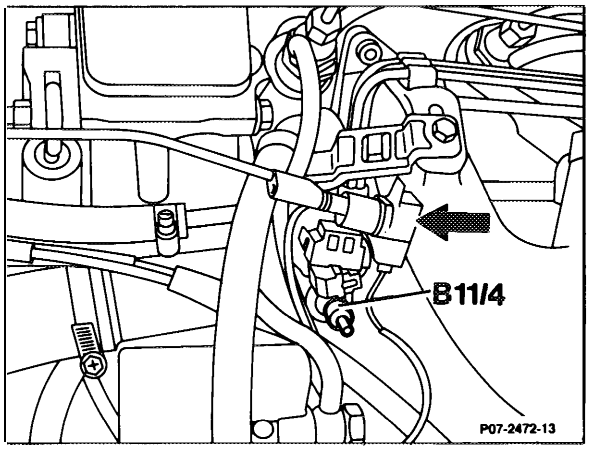
Fault readout "8"

Testing coalent temperature sensor	
Testing coolant temperature sensor (B11/4) Engine off. Detach connector at coolant temperature sensor. Test resistance to ground with multimeter position "Ω".	
Refer to diagram of "coolant temperature sensor and intake air" for specified value.	
Yes	**No**



No → Replace temperature sensor (B11/4)

Test voltage at I-pin connector (arrow) with multimeter in position "volts". Ignition: ON.	
Readout: approx. 5 volts	
Yes	No



No → Rectify interrupt according to the wiring diagram. Replace control unit (N39).

End of test

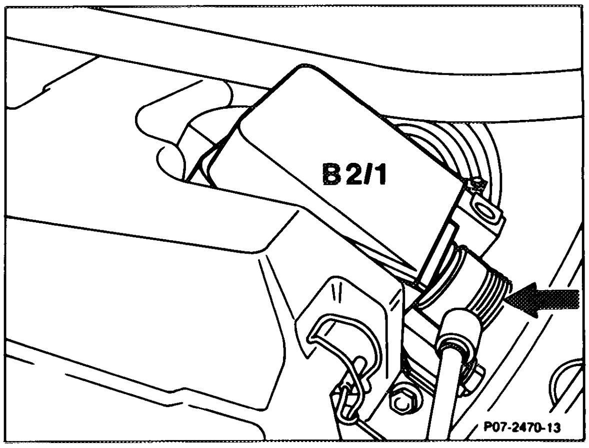
EXIT

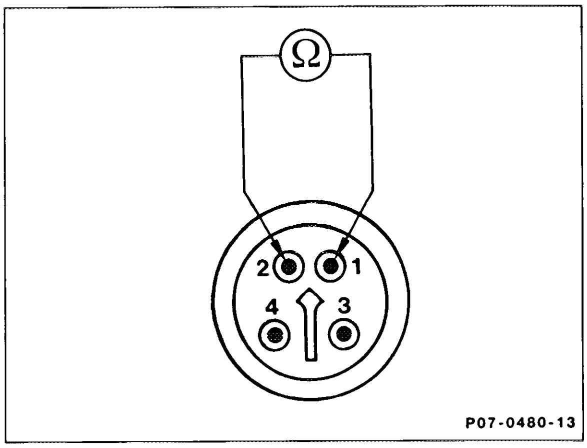
Fault readout "9"

Testing air temperature sensor (B2/1a) Engine off. Detach connector (arrow) from air flow sensor. Multimeter button "Ω". Test resistance according to table.	
Refer to diagram for specified value.	
Yes	No

No → Replace air flow sensor.

End of test



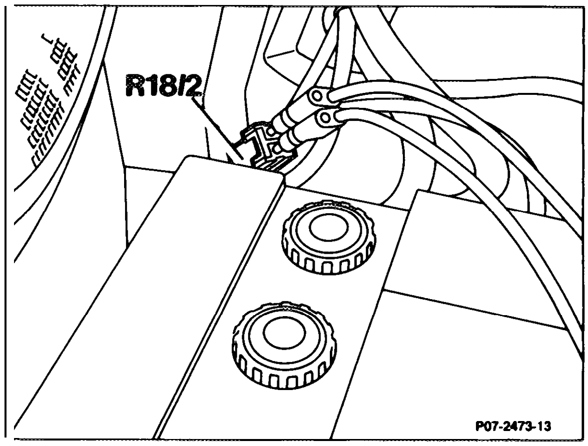


Coolant temperature sensor and intake air

Temperature in °C	Resistance ± 10%	Voltage in V ± 100%
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

EXIT

Fault readout "10"

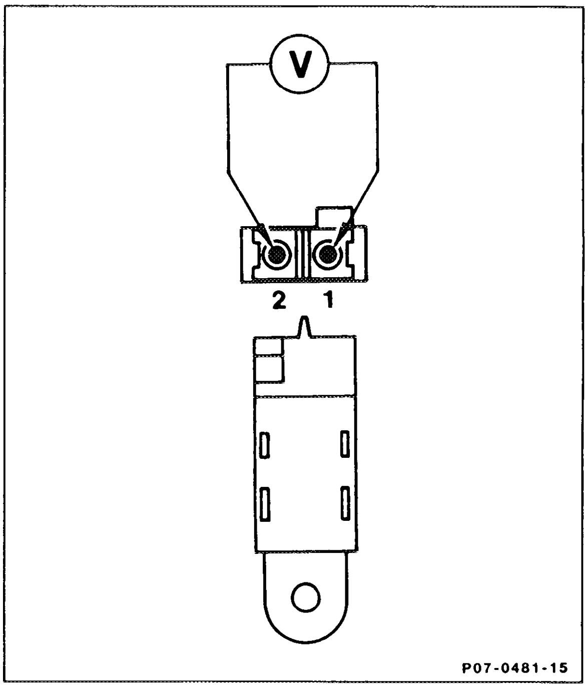


Testing reference resistor (R18/2) Detach resistance trimming plug. Turn off engine. Ignition: ON. Press multimeter button "V = ". Check voltage.	
Readout: approx. 5 volts	
Yes	No

No → Rectify interrupt according to wiring diagram.

Yes → Replace resistance trimming plug (R18/2).

End of test



Mote
When replacing the resistance trimming plug (R18/2), fit only plug with an identical part no.

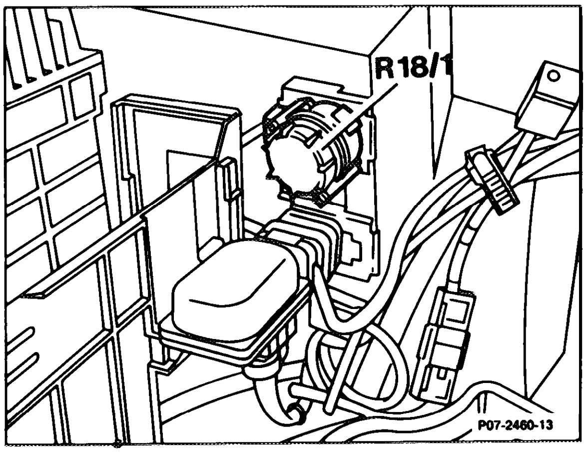
Fault readout "11"

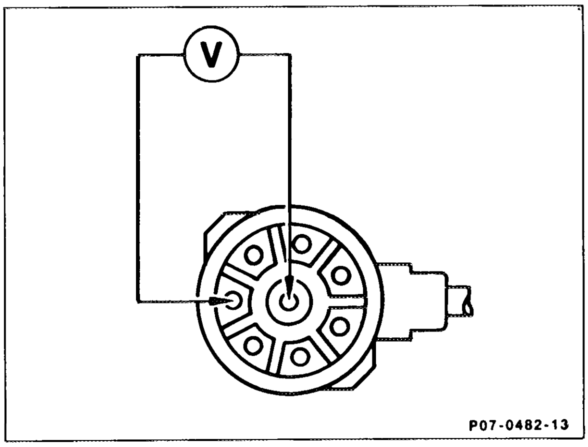
Testing ELR resistance trimming plug (R18/1) Detach resistance trimming plug. Engine off. Ignition: ON. Press multimeter button "V =". Check voltage.	
Readout: approx. 5 volts	
Yes	No

Yes → Replace ELR resistance trimming plug.

No → Rectify interrupt according to wiring diagram. Replace control unit (N39).

End of test





Note
The resistance trimming plug ELR **(R18/1)** is installed in position "4".

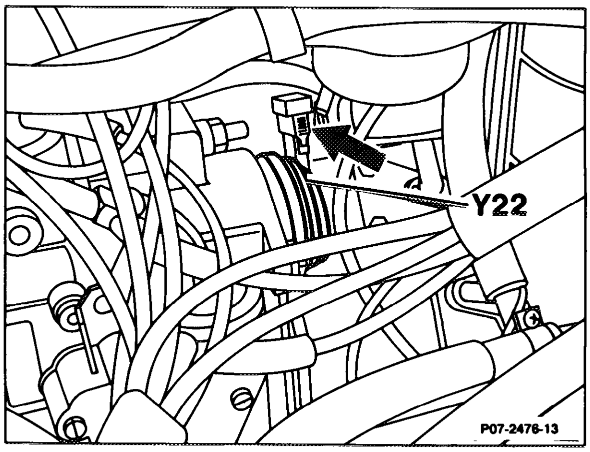
c) Testing electronic idle speed control

Testing idle speed control

Engine at idle. Detach double connector (arrow) at actuator (Y22) for at least 3 sec. and refit.

When connecting, idle speed. increases briefly.

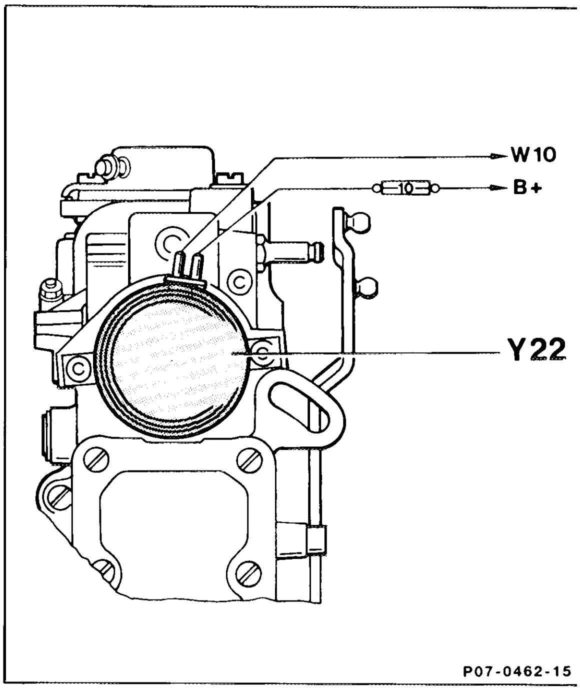
Yes	No



Briefly (max 3 sec.) apply battery voltage (approx. 12V) to actuator (Y22).

Note
Actuator (Y22) is damaged if battery voltage is applied for longer than 3 sec.
Engine speed increases.

Yes	No

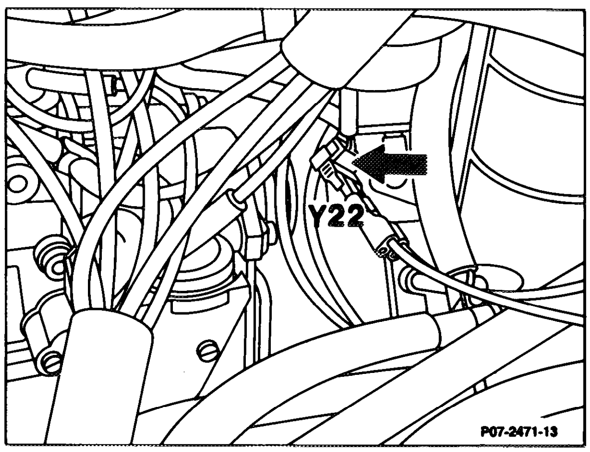


Replace actuator.

Engine at idle. Detach double connector (arrow) at actuator (Y22) and measure voltage with multimeter button "V".
Measure voltage.

Display approx. 12 volts

Yes	No

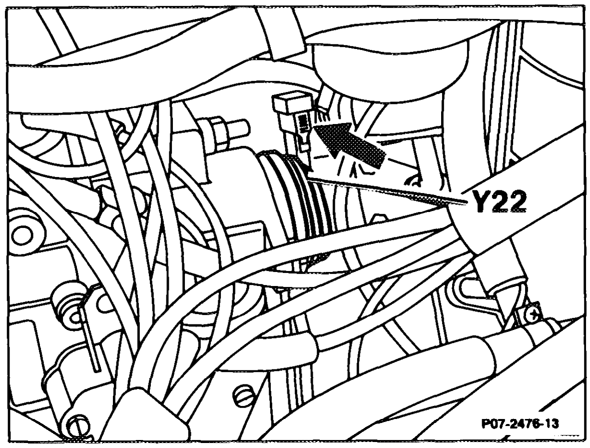


Test resistance trimming plug ELR (R18/1).
Rectify interrupt according to wiring diagram.
Replace EDS control unit (N39), if necessary.

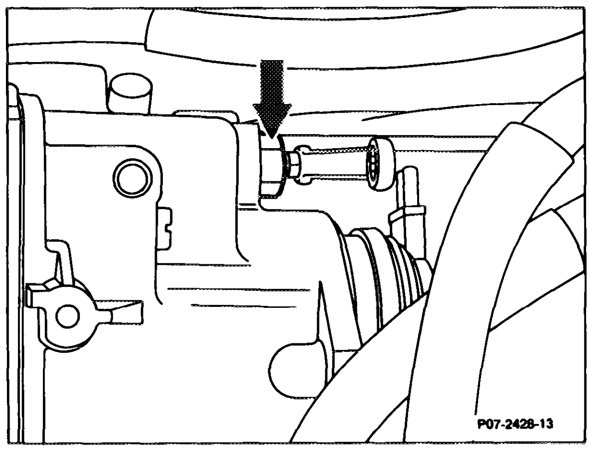
Engine at idle. Detach double connector at actuator (Y22). Test idle speed.

Specification: 620 ± 40 rpm

Yes	No
→ End of test	→ Set idle speed. Loosen locking nut (arrow) for this step. → End of test



Set idle speed. Loosen locking nut (arrow) for this step.

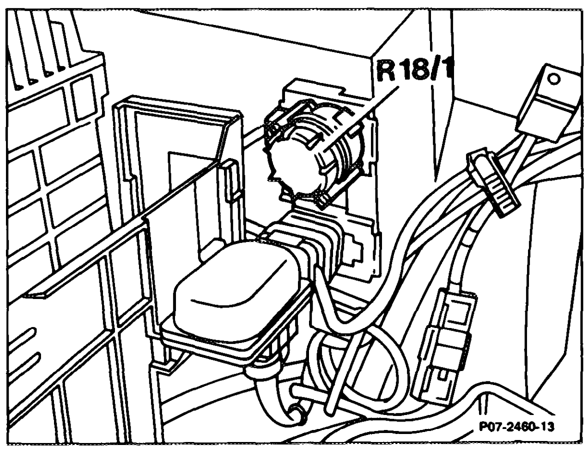


End of test

Setting idle speed by means of resistance trimming plug (R18/1)

If problems occur regarding idle, idle speed can be altered.

The positions of the resistance trimming plug are listed in the table below.



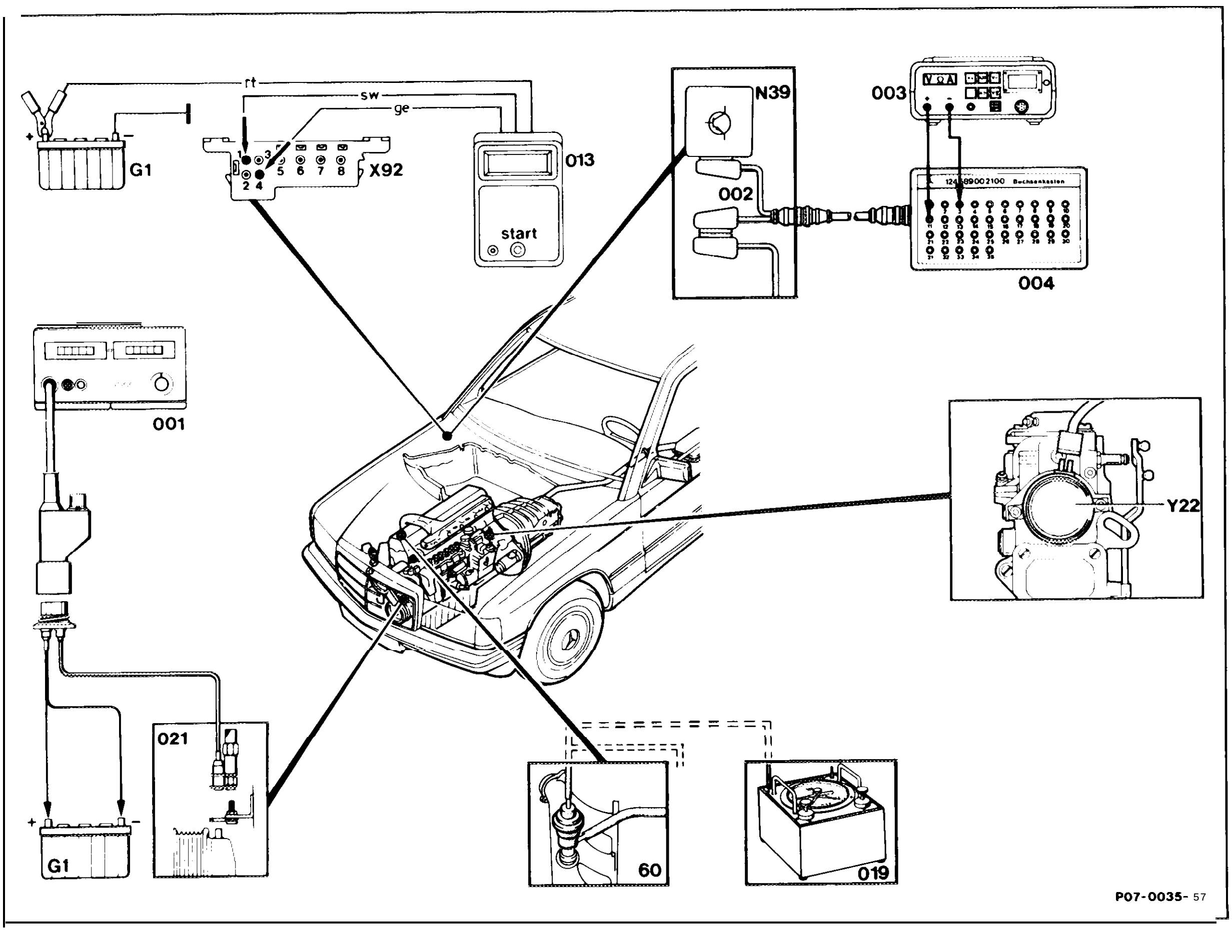
Position of resistance trimming plug	Idle speed in rpm
1	610 ± 20
2	630 ± 20
3	650 ± 20
4	680 ± 20
5	700 ± 10
6	720 ± 20
7	740 ± 20

EXIT

C. Engines 602.962 and 603.970 Model Year 1990

a) Testing
b) Testing with pulse counter
c) Trouble-shooting schedule
d) Test program with contact box
(Engine 602.962)
e) ELR, EGR function test, P2 control
f) Test program with contact box
(Engine 603.970)
g) ELR and EGW function test (Engine 603.970)

a) Testing



EXIT

Digital tester (001) and pulse counter (021)	disconnect, connect.
Pulse counter (013)	connect, disconnect to battery (G1) and with adaptor to test connector (X92 or Xl 1/4).
Contact box (004)	connect, disconnect with test cable (002) to EDS control unit (N39).
Digital multimeter (003)	connect, disconnect at contact box (004).
Vacuum tester (019)	connect, disconnect with Y distributor at EGR valve.
Fuse at over-voltage protection (K1/1)	test.
Selector lever	move into position "P".
Air-conditioning/automatic climate control	switch off.
Engine	bring to operating temperature (coolant temperature approx. 80°C).
Start button of pulse counter (013)	operate for 2-4 seconds.
Display	read off and note.
Start button	press again. If no new display appears, there is no further fault in the system.

EXIT

Engine 602.962

The number of pulses indicate whether and which component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/controlloop
1 [3])	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) atmospheric pressure sensor
5 [2])	Vacuum transducer (Y31/1) or fault in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B1 1/4)
9	Intake air temperature sensor (B2/1a)
10	Not assigned
11 [1])	ELR actuator or vacuum transducer (Y31/1)
12	Not assigned
13	EDS control unit (N39) defective (internal memory)
14	Pressure sensor (B5/1), EDS defective
15	Vacuum transducer, charge pressure control (Y31/2) pressure transducer pressure control flap (Y31/3) or faults in charge pressure control loop

[1]) Readout only in the case of short-circuit.
[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[3]) In the event of complaints perform functional test on ELR, EGR, P2 control.

Engine 603.970

The number of pulses indicates whether and which component is faulty and whether components in the control circuit are faulty.

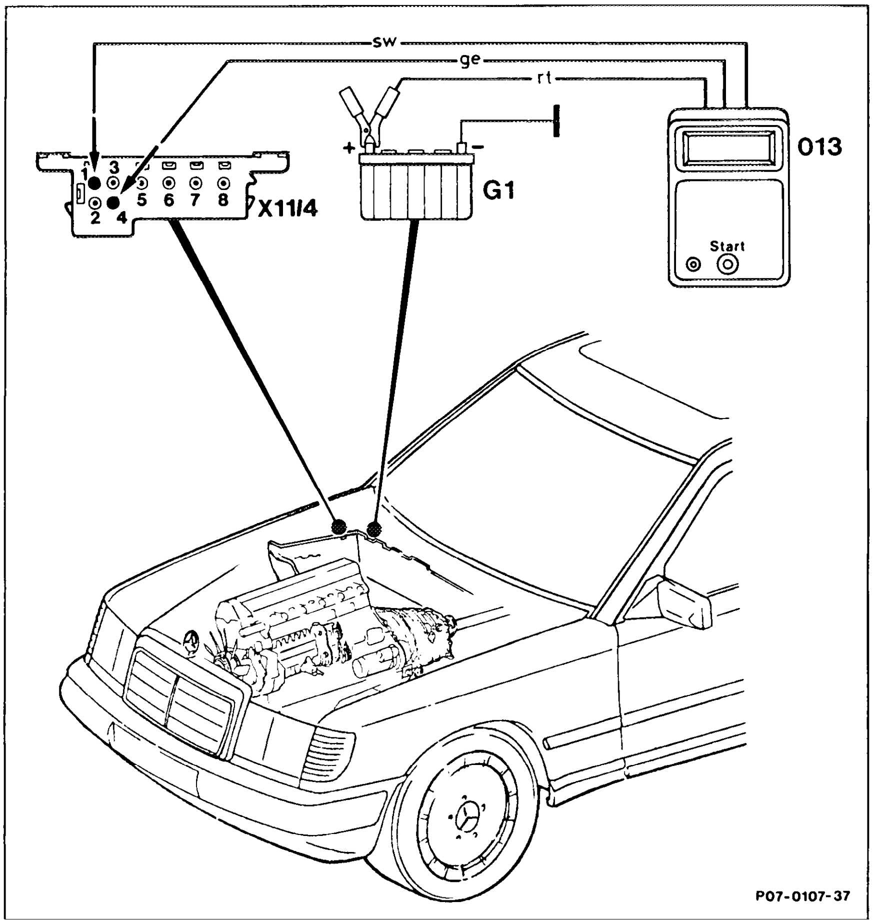
Pulse readout	Component/control loop
1 [3])	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) altitude sensor
5 [2])	Vacuum transducer (Y31 /1) or fault in exhaust control loop
6	EDS control unit (N39) Internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Power supply
11 [1])	ELR actuator or vacuum transducer (Y31/1)
12	Not assigned
13	EDS control unit (N39) defective

[1]) Readout only in case of short-circuit.
[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[3]) In the event of complaints, perform ELR and EGR function tests.

EXIT

b) Testing with pulse counter

Connection diagram



013 Pulse counter
G1 Battery
X1 1/4 Test connector for diagnostics

A Model 124
B Model 126

Assignment (XI 1/4)
1 Ground
2 TD signal
3 Pulse output
Exhaust test signal (only for production tuning)
4 Pulse readout, control unit (EDS)

Notes regarding pulse readout

If a problem occurs but no fault is indicated on the pulse readout, perform the function test, section "7.4".
The number 1 indicates no fault detected in the electronic system. All other numbers are assigned to a particular fault group.
The numbers from 1 to 11 appear on the display panel of the pulse counter.
If the LED U-Batt appears after connecting, pulse counter and power supply for pulse counter are in order.

EXIT

Testing

1 Connect pulse counter as shown in the connection diagram.

Note

LED U-Batt in display panel must light up; if not:

a) test fuse of pulse counter.

b) test jack 1 of test connector (Xl 1/4) to battery positive (1 l-l 4 V).

c) test jack 4 of test connector (Xl 1/4) to jack 1 (6-12 V).

2 Engine at idle.

3 Operate start button for between 2 and 4 seconds.

4 Take readout of pulse output and note.

Display "1" = no fault

Greater than "1" = fault in system

5 Again press start button for between 2 and 4 seconds. If no further fault exists in system, the previous readout appears once again.

6 Repeat until the first fault is diplayed again.

7 Rectify noted faults (pulse readout) according to trouble-shooting schedule.

8 Perform component test.

Erasing fault memory

After a fault has been rectified, the pulse display must be erased as follows:

9 Operate start button and readout the rectified fault, then press start button for 6-8 seconds.

Note

Each display pulse must be erased **individually.**

The fault is eliminated and erased when the fault code no longer appears on the fault display.

Display of a number larger than 1, further faults in system.

EXIT

c) Trouble-shooting schedule

Engine 602.962

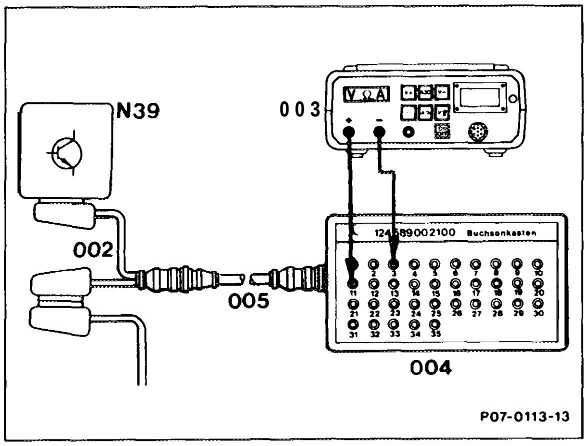
The number of pulses indicates whether and which component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/control loop
1 [3])	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) atmospheric pressure sensor
5 [2])	Vacuum transducer (Y31/1) or faults in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Engine coolant sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Not assigned
11 [1])	ELR actuator or vacuum transducer (Y31/1)
12	Not assigned
13	EDS control unit (N39) defective (internal memory)
14	Pressure sensor (B5/1), EDS defective
15	Vacuum transducer, charge pressure control (Y31/2). Vacuum transducer, pressure control flap (Y31/3) or fault in charge pressure control circuit

1) Readout only in the case of short-circuit.
2) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
3) In the event of complaints perform functional test on ELR, EGR, P2 control.

d) Test program with contact box (Engine 602.962)

Connection diagram contact box



002 25-pin test cable 124 589 33 63 00
003 Multimeter
004 35-pin contact box 124 589 00 21 00
005 Test cable 124 589 34 63 00
N39 EDS control unit

Symbols for test instruments:

Contact box
Multimeter
Jack
Pin

Voltage measurement (volt, direct voltage)
Resistance measurement (ohm)

On/off ratio readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi- cation	Possible cause/remedy
1	**1.0**	–	–	–	
2	2.0 Control rod travel sensor (L7)	N39 4 Ω 5 4 Ω 6 4 Ω 3 4 Ω 1	Ignition: **OFF** EDS control unit disconnected	50 ± 4 Ω 25 ± 2 Ω ∞ Ω ∞ Ω	Replace control rod travel sensor or injection pump Cables

On/off ratio readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi- cation	Possible cause/remedy
[2]	2.1 Control rod travel sensor (L7)	L7 2 —(Ω)— 3	Ignition: **OFF** Connector on control rod travel sensor (L7) disconnected	50 ± 4 Ω	Replace control rod travel sensor or injection pump
		L7 2 —(Ω)— 1		25 ± 2 Ω	Replace control rod travel sensor or injection pump
	2.2 Cables	N39 4 —(Ω)— L7 3	Ignition: **OFF** Connector on control rod travel sensor (L7) disconnected	< 1 Ω	Cable interrupt
		N39 5 —(Ω)— L7 2		< 1 Ω	Cable interrupt
		N39 6 —(Ω)— L7 1	Ignition: **OFF**	< 1 Ω	Cable interrupt
3	3.0 Air flow sensor potentio- meter (B2/1)	N39 3 —(V)— 24	Ignition: **ON** EDS control unit (N39) connected	5 ± 0.5 V	EDS control unit (N39)
		3 —(V)— 10		< 0.5 V	Cables Test value in order although fault was stored. Cause: Air flow sensor plate jammed briefly during starting; replace air flow sensor if necessary.
		N39 3 —(V)— 10	Engine at idle	1.7 ± 0.2 V [1]	EDS control unit (N39)

[1]) Voltage rises as speed increases.

On/off ratio readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi- cation	Possible cause/remedy
[3]	3.1 Air flow sensor potentio- meter (B2/1)	N39 3 Ω 2 4	Ignition: OFF EDS control unit (N39) disconnected	500- 1200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 Ω 1 0	Air flow sensor in off position	50- 200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 Ω 1 0	Air flow sensor plate fully deflected	560- 1100 Ω	Air flow sensor potentiometer (B2/1)
	3.2 Cables	N39 B2/1 1 0 Ω 3	Connector on air flow sensor potentiometer (B2/1) disconnected	< 1 Ω	Cable interrupt
		N39 B2/1 2 4 Ω 4		< 1 Ω	Cable interrupt
4	4.0	–	–	–	Replace EDS control unit (N39) (atmospheric pressure sensor)
5 [2])	5.0 Vacuum transducer (Y31/1) EGR valve	N39 18 V 1 Vacuum at EGR valve	Engine 900 rpm ± 50 approx. 300 mbar [4])	> 3 V [4])	Supply line black/white leaking. Air admission line (black) blocked. Air admission filter (62a) dirty. Supply line black/white or vacuum line black (rubber) blocked or leaking. Vacuum transducer (Y31/1). Cables, EDS control unit, air flow sensor potentiometer, EGR valve

[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[4]) Apply full throttle bnefly, vacuum and voltage drops. The test values are reference values.

On/off ratio readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi- cation	Possible cause/remedy
[5] 2)	5.1 Cables	N39 18 – Ω – Y31/1 1	Ignition: **OFF** Connector on vacuum transducer **(Y31/1)** detached	< 1 Ω	Cable interrupt
		N39 1 – Ω – Y31/1 E-2		< 1 Ω	Cable interrupt
6	6.0	–	.	-	Internal power supply. Replace EDS control unit
7	7.0 Engine speed sensor (L3)	N39 3 – V – 20	Engine at idle EDS control unit disconnected	> 3 V 1)	Engine speed sensor, distance, dirt, cables
	7.1 TD signal	N39 3 – V – 25	Engine at idle EDS control unit connected	> 3.5 V 6)	Cable (N39) to (XI 1/4) Short circuit or EDS control unit
	7.2 Engine speed sensor (L3)	N39 3 – Ω – 20	Ignition: OFF EDS control unit disconnected	Beru 5) 527 Ω ± 10 % VDO 5) 1900 Ω ± 10%	Engine speed sensor (L3) Cables
		L3x 1 - * - 2	Plug connector (L3x) detached	Beru 5) 527 Ω ± 10% VDO 5) 1900 Ω ± 10 %	Engine speed sensor (L3) (M27)

1) Voltage rises as speed increases.
2) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
5) Measured at 20 °C ambient temperature (for each 10 °C change in ambient temperature the reststance changes by 4%).
6) Voltage drops by approx. 0.5 V and stabilises.

EXIT

On/off ratio readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
[7]	7.3 Cables	N39 20 – Ω + L3x 2		< 1 Ω	Cable interrupt
		N39 3 – Ω + L3x 1		< 1 Ω	Cable interrupt
a	a.0 Coolant temperature sensor (B1 1/4)	N39 3 – V + 9	Ignition: ON EDS control unit connected	3)	Coolant temperature sensor, cables, EDS control unit
	8.1 Coolant temperature sensor (B11/4)	N39 14 – Ω + 9	Ignition: OFF EDS control unit connected	3)	Coolant temperature sensor
		⊥ – Ω + B11/4	Plug connector (B11/4) detached	3)	Coolant temperature sensor
	a.2 Cable	N39 9 – Ω + B11/4	Ignition: OFF EDS control unit disconnected	< 1 Ω	Cable interrupt
	9.0 Intake air temperature sensor (B2/1a)	N39 3 – V + 2 2	Ignition: ON EDS control unit connected	3)	Temperature sensor, intake air, air flow sensor, cables, EDS control unit

3) Refer to table of coolant temperature sensor and intake air.

On/off ratio readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
[9]	9.1 Intake air temperature sensor (B2/1a)	N39 3 —Ω— 22	Ignition: OFF EDS control unit disconnected	3)	Cable to intake air temperature sensor Temperature sensor
		B2/1 1 — 2	Connector on air flow sensor (B2/1) disconnected	3)	Intake air temperature sensor
	9.2 Cables	N39 B2/1 22 —Ω— 1	ignition: **OFF** EDS control unit disconnected Connector on air flow sensor potentiometer (B2/1) detached	< 1 Ω	Cable interrupt
		N39 B2/1 3 —Ω— 2		< 1 Ω	Cable interrupt
10	10.0 Power supply	N39 14 —V— 1	Engine approx. 1500 rpm	11–14 V	Alternator regulator Lima Voltage > 18 V
11 1)	11.0 ELR actuator (Y22)	N39 3 —V— 2	EDS control unit connected	11–14 V	Actuator (Y22) Cables
		N39 2 —V— 1	Ignition: **ON** Engine at idle	2.5 ± 2) 0.5 V	EDS control unit (N39)

1) Readout only in the case of short-circuit.
2) Reference value, voltage drops as speed increases.
3) Refer to table of coolant temperature sensor and intake air.

On/off ratio readout:	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
[11] [1])	11.1	N39 1 –Ω+ 2	Ignition: OFF EDS control unit disconnected	4 ± 1 Ω	Actuator (Y22) Cables
	11.2 Cables	N39 1 –Ω+ Y22 2	Ignition: OFF Detach connector at actuator (Y22)	< 1 Ω	Cable interrupt
		N39 2 –Ω+ Y22 1		< 1 Ω	Cable interrupt
13					Internal memory Replace EDS control unit (N39)
14	14.0 Pressure sensor (B5/1)	N39 3 –V+ 12	Ignition: ON EDS control unit connected	> 5 V	Pressure sensor Pressure lines Electrical cables
	14.1 Pressure sensor (B5/1)	N39 3 –V+ 17	Engine at idle	> 1.5 V 0 mbar	Pressure sensor Pressure lines Electrical cables
		Pressure tester with Y distributor on pressure sensor	Apply full throttle briefly	Voltage rises, pressure rises > 500 mbar	
	14.2 Pressure sensor (B5/1)	N39 3 –Ω+ 12	Ignition: OFF EDS control unit detached	1.4 ± 1.2 kΩ	
	14.3 Cables	N39 3 –Ω+ B5/1 3		< 1 Ω	Cable interrupt

[1]) Readout only in the case of short-circuit.

On/off ratio readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[14]	14.4 Cables	N39 1 2 –Ω+ B5/1 2	Ignition: OFF EDS control unit disconnected	< 1 Ω	Cable interrupt
	14.5 Cables	N39 1 7 –Ω+ B5/1 1	Ignition: OFF EDS control unit disconnected	< 1 Ω	Cable interrupt
15	15.0 Vacuum transducer (Y31/2)	N39 7 –V+ 1	Engine at idle EDS control unit connected	Approx. 0.4 v < 100 mbar	Vacuum transducer (Y31/2) Vacuum lines EDS control unit
	Vacuum unit, pressure control flap	Vacuum tester with Y distributor on vacuum transducer (Y31/2) Output (OUT)	Increase speed slowly to approx. 2000 rpm	Vacuum increases Voltage rises	
	15.1 Cables	N39 7 –Ω+ Y31/2 1	Ignition: OFF EDS control unit disconnected Connector on (Y31/2) detached	< 1 Ω	Cable interrupt
	15.2 Cables	N39 1 –Ω+ Y31/2 2	Connector on (Y31/2) detached	< 1 Ω	Cable interrupt
	15.3 Vacuum transducer (Y31/3)	N39 8 –V+ 1	Engine at idle EDS control unit connected	Approx. 4 v < 300 mbar	Vacuum transducer (Y31/3) Vacuum lines EDS control unit
	Vacuum unit, charge pressure control valve	Vacuum tester with Y distributor on vacuum transducer (Y31/3) Output (OUT)	Increase speed slowly to approx. 2000 rpm	Voltage drops Vacuum drops	Vacuum transducer (Y31/3) Vacuum lines EDS control unit

EXIT

On/off ratio readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
[15]	15.4 Cables	N39 1 —Ω+ Y31/3 2	Ignition: **OFF** **EDS** control unit disconnected	< 1 Ω	Cable interrupt
		N39 a —Ω+ Y31/3 1		< 1 Ω	Cable interrupt

Coolant temperature sensor and intake air

Temperature in °C	Resistance (± 10%)	Voltage in V (± 10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	la5 Ω	0.99

EXIT

e) ELR, EGR function test, P2 control

Note
This test is to be performed when in the event of complaint concerning the pulse readout, no fault is displayed.

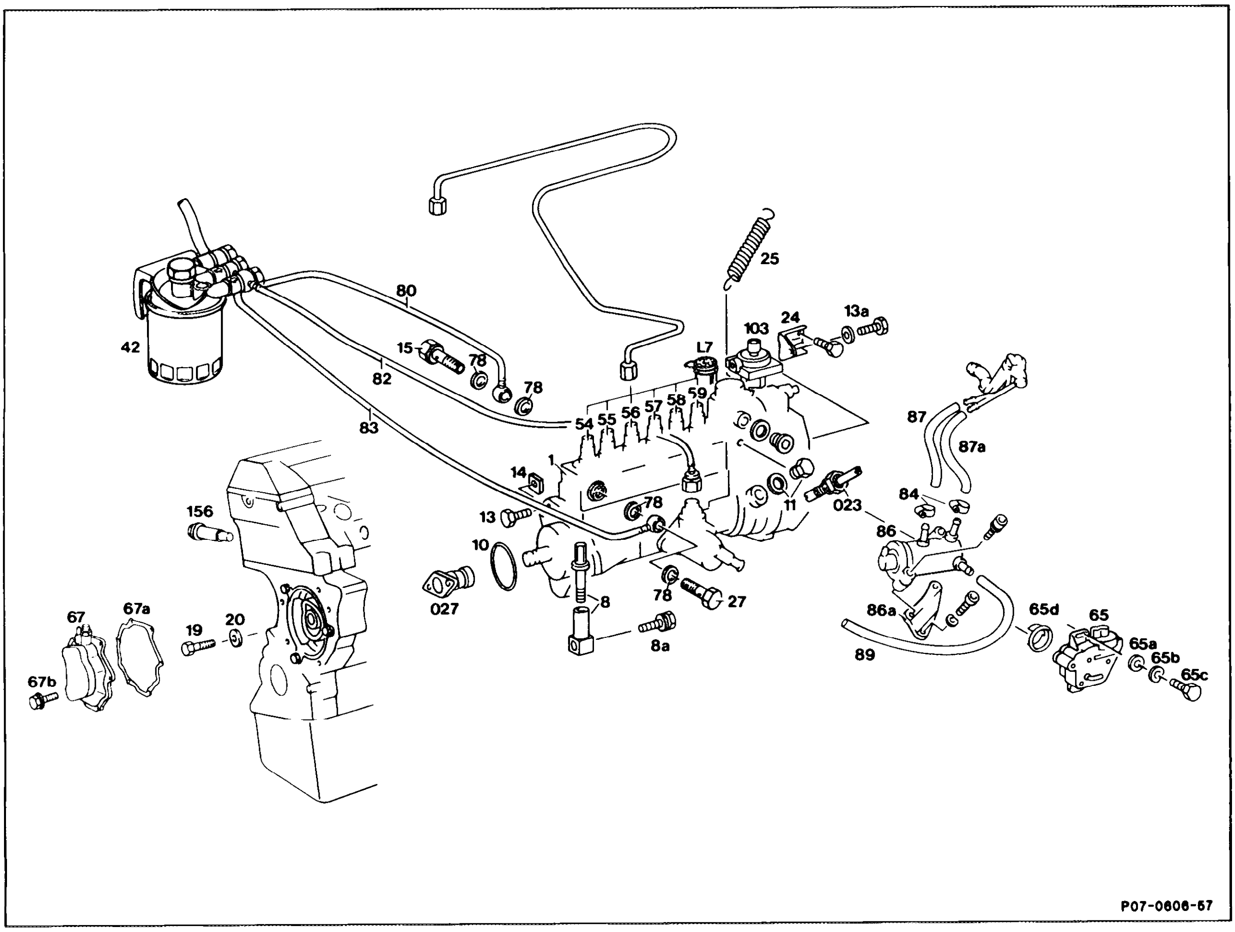
Engine 602.962 with P2 control

Test step/ test scope	Test connection/ test instrument	Operation/ requirement	Specifi- cation	Possible cause/ remedy
1.0 Idle speed control	Revolution counter with TDC generator	Engine at idle Coolant tempera- ture approx. 80°C	680 rpm ± 20	Actuator, injection pump, engine speed sensor, EDS control unit (N39), refer to test steps 7 and 11
		Plug detached from actuator	610 rpm ± 20	Set speed at injection pump. Injection pump
2.0 Exhaust control circuit	Connect vacuum tester with Y distributor to EGR valve	Engine running at 900 rpm ± 50 and approx 300 mbar. Briefly apply full throttle	Vacuum drops	Perform mechanical test on vacuum transducer (Y31 /1) and air flow sensor (B2/1). EDS control unit (N39) EGR valve
3.0 EGR valve	Connect vacuum tester directly to EGR valve.	Engine off Pressurize EGR valve with 300 mbar and disconnect again.	EGR valve audibly closes	Replace EGR valve.

Test step/ test scope	Test connection/ test equipment	Operation/ requirement	Specifi- cation	Possible cause/remedy
4.0 Charge pressure control	Connect vacuum tester (020) with Y distributor to output (OUT) from vacuum transducer (Y31/3)	Engine at idle	> 300 mbar	Vacuum supply Vacuum line Vacuum transducer (Y3 1/3) EDS control unit (N39)
Vacuum unit Charge pressure control valve		Slowly increase speed to approx 2000 rpm	Vacuum reduces	
4.1 Vacuum unit Pressure control flap (100)	Connect vacuum tester (020) with Y distributor to vacuum unit pressure control flap (100)	Engine at idle	< 100 mbar	Vacuum supply Vacuum line
		Slowly increase speed to approx. 2000 rpm	Vacuum increases	Vacuum transducer (Y3 1/2) Pressure line on pressure sensor (B5/1) EDS control unit

EXIT

07.1-200 Removal and installation of imjection pump - Turbodiesel



Bottom section of noise encapsulation	remove, fit (94-0050).
Belt tensioning device	remove, install (13-340).
Fan cowl and fan	remove, install (20-335).
Vacuum pump (67)	remove, install (43-610). Replace gasket (67).
Assembly sleeve (067)	install, remove, so that engine can be turned over easily. Special tool 601 589 05 14 00 (engines effective 09/89).
Radiator	remove, install (20-470). Model 201.128 only.
Actuator of cruise control	Remove, install (54-541), Engine 603 only.

EXIT

Central fastening bolt (19) with washer (20)	Unscrew, screw in, tightening torque 40-50 Nm. **Caution!** Left-hand thread
Crankshaft	in direction of rotation turn to **15°** ATDC of no. 1 cylinder.
Chain tensioner (156)	remove, install **(05–310).** Special tool 001 589 65 09 00.
Injection lines (54-59) at injection pump	disconnect, connect. Tightening torque **10–20** Nm. Special tool 000 589 77 03 00.
Fuel lines (80, 82, 83)	disconnect, connect, replace seals. **Caution!** Do not mix up hollow bolt (27) and overflow orifice (15).
Fuel thermostat (86) and fuel line (89)	disconnect, connect.
Pressure lines at ALDA unit (103) and vacuum lines	disconnect, connect.
Electric cables	disconnect, connect at control rod travel sensor (L7) and at actuator (Y22).
Accelerator control linkage	detach, attach. Check setting (30-300).
Injection pump (1)	Remove bolt (13 and **13a),** tightening torque 20-25 Nm. Withdraw injection pump to the rear; **hold timing device tight** when performing this step.
O-ring (10)	replace.
Start of delivery adjusting **device(8)**	remove, install; remove bolt (8a) for this step.
Spring (25)	detach, reattach.

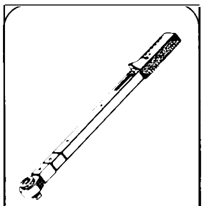
Screw plug (11) .... remove and turn removed injection pump with serrated wrench (027) until lug is visible in the governor housing hole. In this position, push in locking bolt (023) until it is felt to engage.

Caution!
Remove locking bolt (023) after installing injection pump and refit screw plug (11).

Start of delivery .... check (07.1-I **12),** set if necessary.

Vacuum control valve (65) .... remove, install, set (07.1-I 70).

Special tools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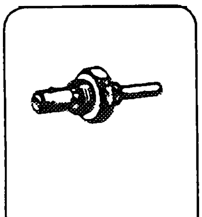
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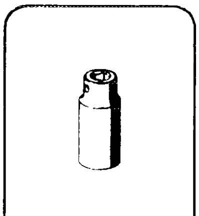
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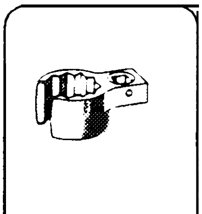
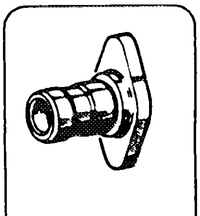
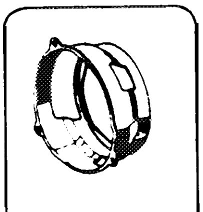

000 589 77 03 00

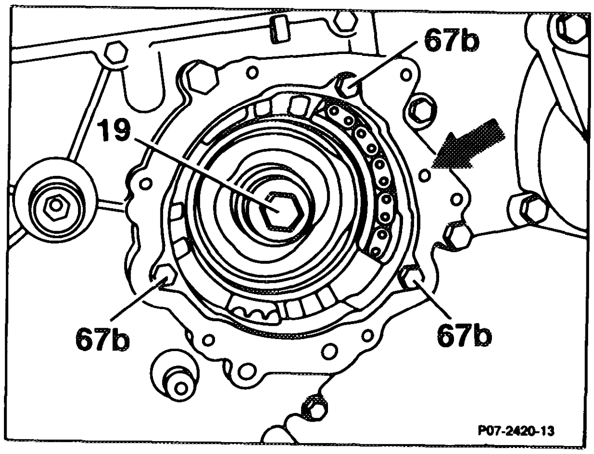

601 589000800


601 589 05 14 00

EXIT

Removal and installation

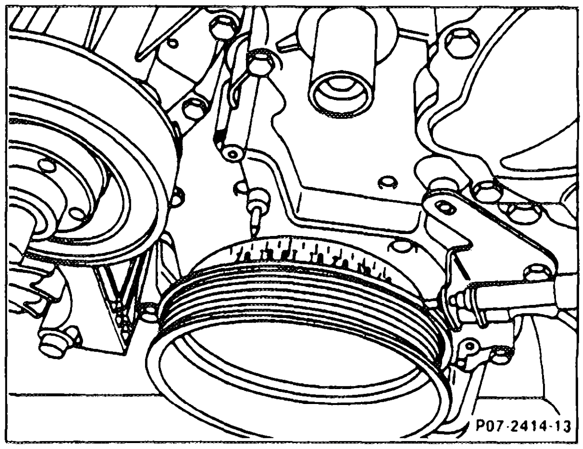
1 Loosen central fastening bolt (19), unbolt while holding crankshaft tight.



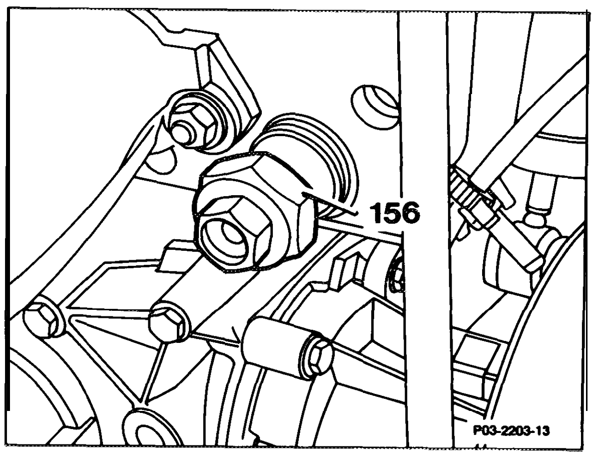
Caution!
Left-hand thread

Mount assembly basket using bolts (67b), so that the engine can be cranked easily (on engines effective 09189).

2 Turn crankshaft in direction of rotation to 15° ATDC of no.1 cylinder.

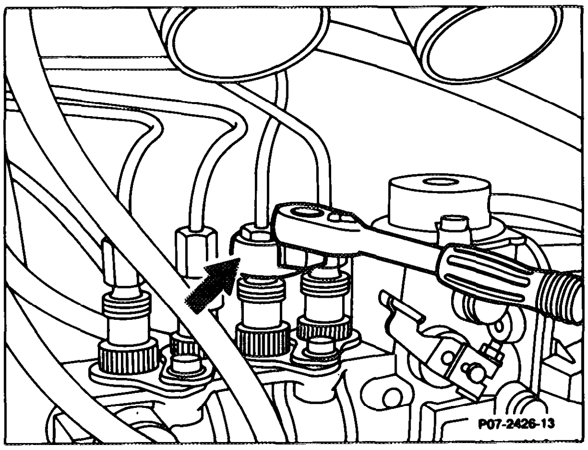


3 Remove chain tensioner (05310).



156 Wrench socket
Special tool 001 589 65 09 00

4 Detach injection and fuel lines at the injection pump.



Arrow **Box wrench socket**
Special tool 000 589 77 03 00
with 1/4" ratchet

5 Disconnect vacuum lines at vacuum unit for stop unit and vacuum control valve. Detach 2-pin connector at actuator (Y22) of electronic idle speed control.

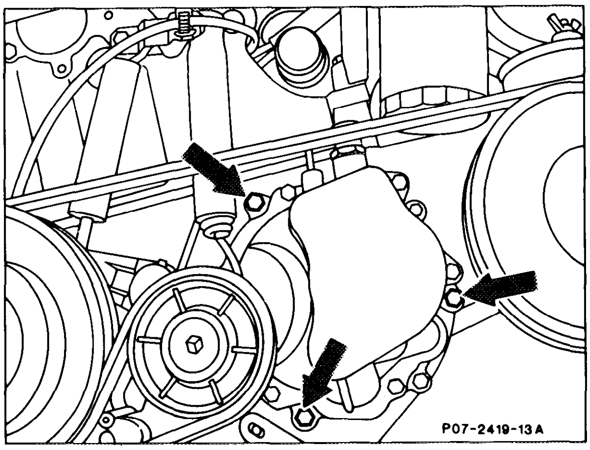
6 Disconnect electric cables at control rod travel sensor (L7) and at actuator (Y22).

7 Disconnect pressure line at ALDA unit.

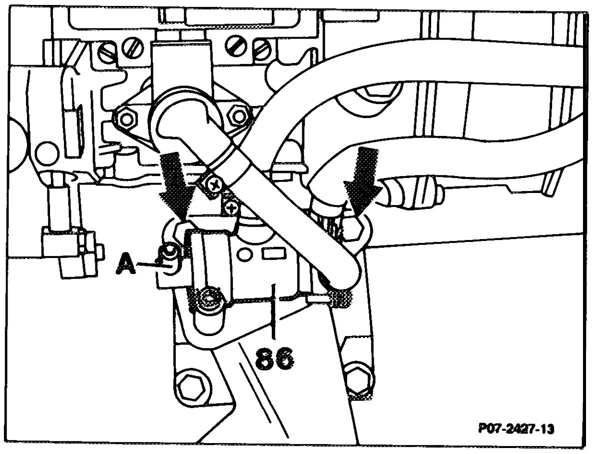
8 Detach accelerator control linkage at control lever and spring.

9 Remove vacuum control valve.

10 Remove injection pump; remove fastening bolts (arrows) and bolt on mounting bracket for this step. Withdraw injection pump to the rear, holding timing device in place.

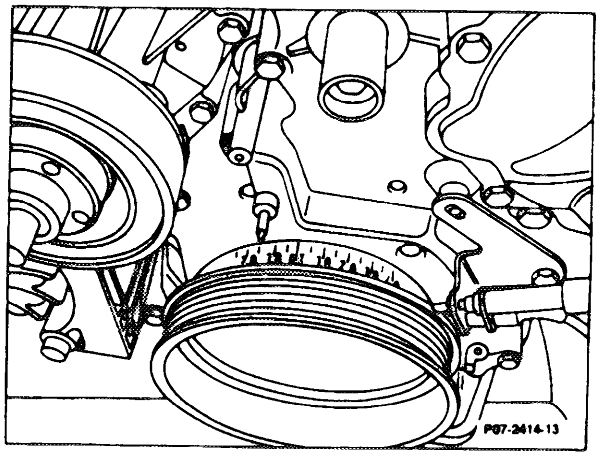


11 Remove fuel thermostat (86) complete; remove bolts (arrows) for this step.



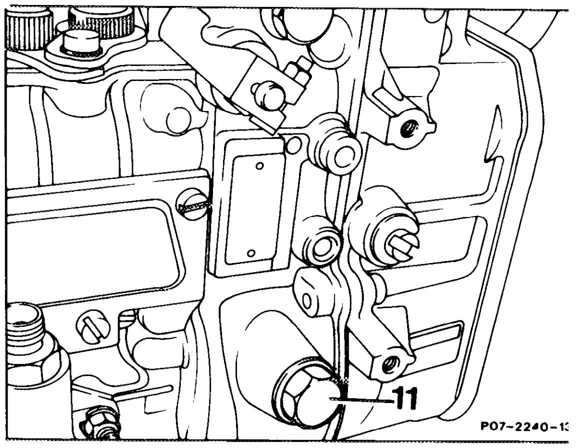
A Inlet from fuel tank

12 Check whether the engine is positioned at 15° ATDC of no. 1 cylinder; adjust if necessary.

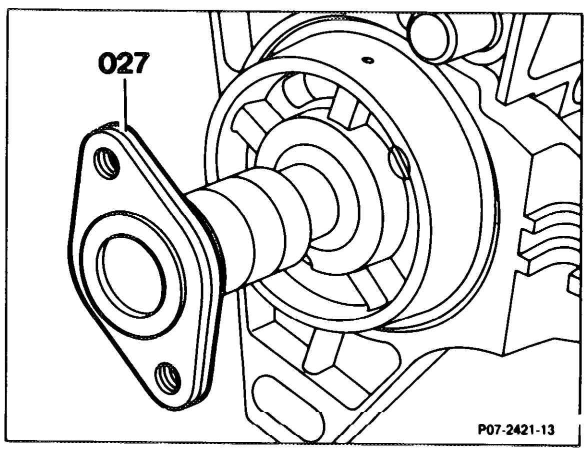


Caution !
Engine must only be cranked in direction of rotation!

13 Unscrew plug (11).



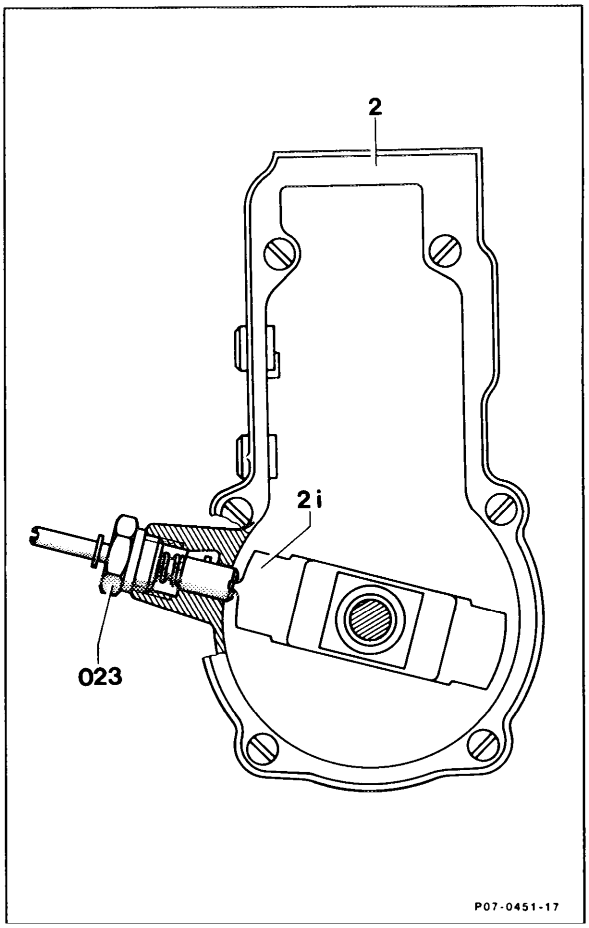
14 Use serrated wrench (027) to turn injection pump on the injection pump crankshaft until the lug of the governor is visible at the hole, i.e. push in locking bolt (023) in this position until it is felt to engage, and tighten by hand.



027 Serrated wrench
Special tool **601 589 00 08 00**

EXIT

Caution!
Remove locking bolt (023) after installing injection pump, otherwise the injection pump will be damaged when starting the engine.



023 Locking bolt
Special tool 601 589 05 21 00

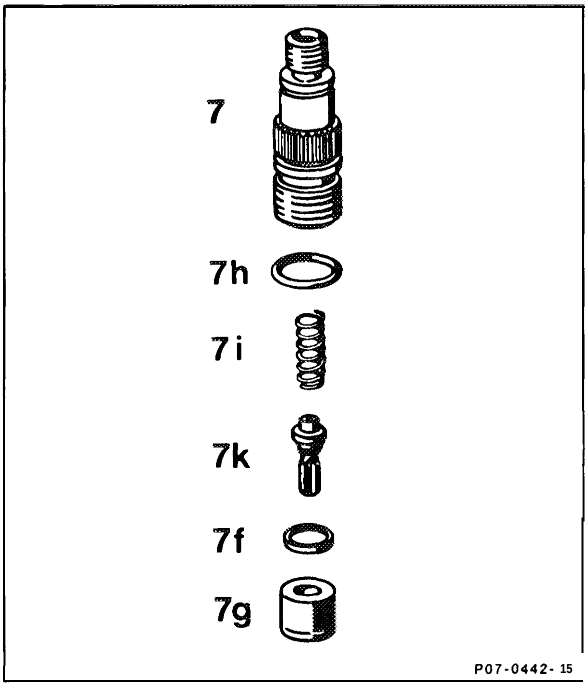
15 Install remaining parts on engine.

Note
When starting engine, the injection system is automatically bled.

16 Check start of delivery (07. l-l 12); set start injection if necessary (07. l-l 17).

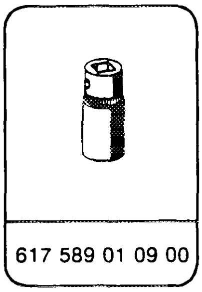
17 install vacuum control valve and set (07. l-l 70).

07.1–210 Replacing delivery valve seal - Turbodiesel



Delivery valve holder (7)	tightening torque 35 Nm, Special tool 617 589 01 09 00.
Compression spring (7i) copper seal (7f)	replace
Delivery valve (7k)	rinse in fuel before installing.
Delivery valve carrier (7g)	Make note of installed position.
O-ring (7h)	oil before assembling.

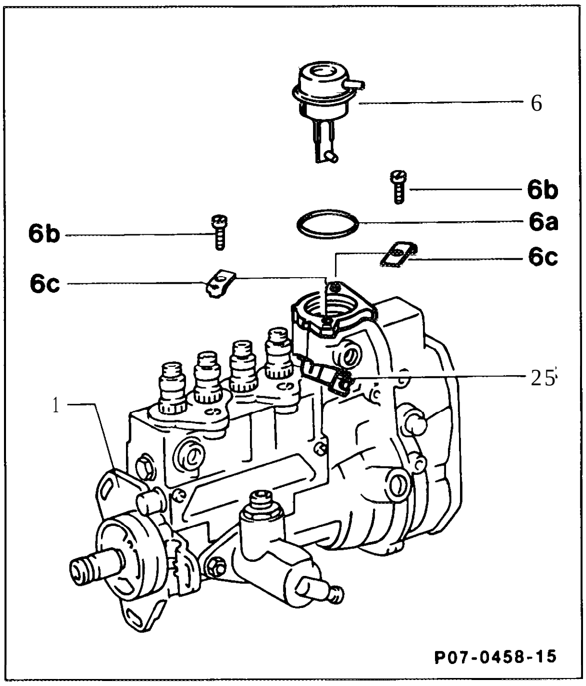
Special tool



EXIT

07.1-220 Replacing vacuum unit - Turbodiesel

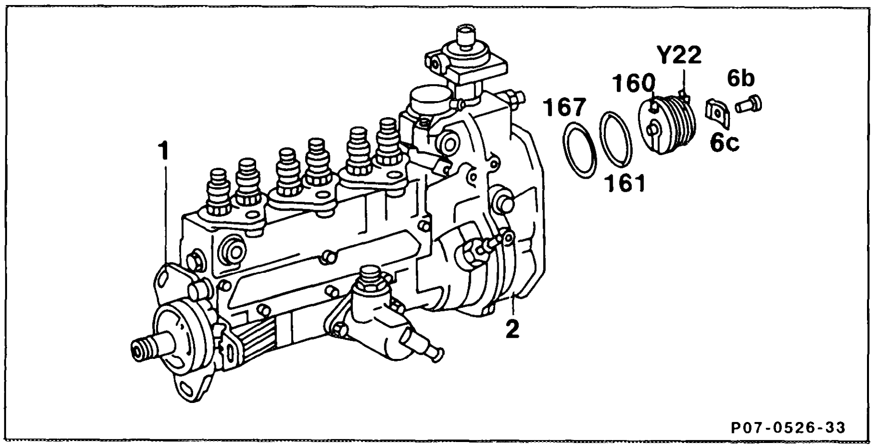
Preceding work:
Charge air pipe removed (14-180).



Screw (6b)	remove, install (use TORX-T30).
Bracket (6c)	remove, install.
Stop unit (6)	raise slightly when removing, tilt back towards engine and withdraw.
O-ring (6a)	remove, install.
Emergency stop lever (25)	press when installing and engage connecting rod of vacuum unit into the rocker of the emergency stop lever.

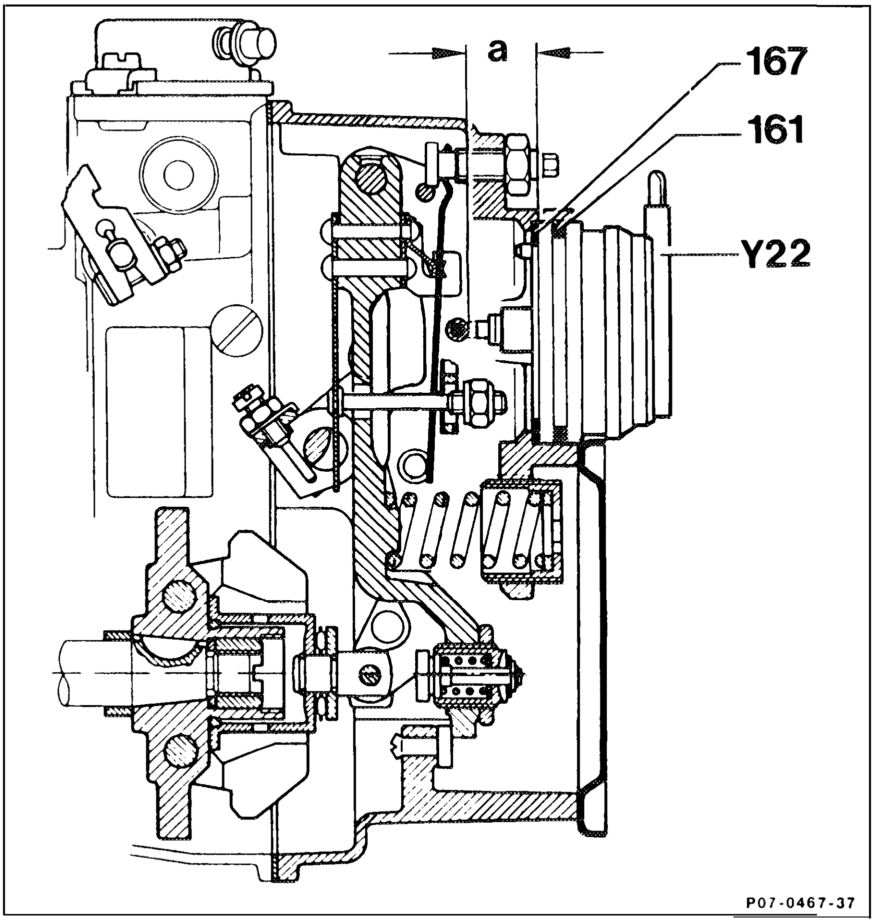
EXIT

07.1–225 Replacing actuator of electronic idle speed control (ELR) - Turbodiesel



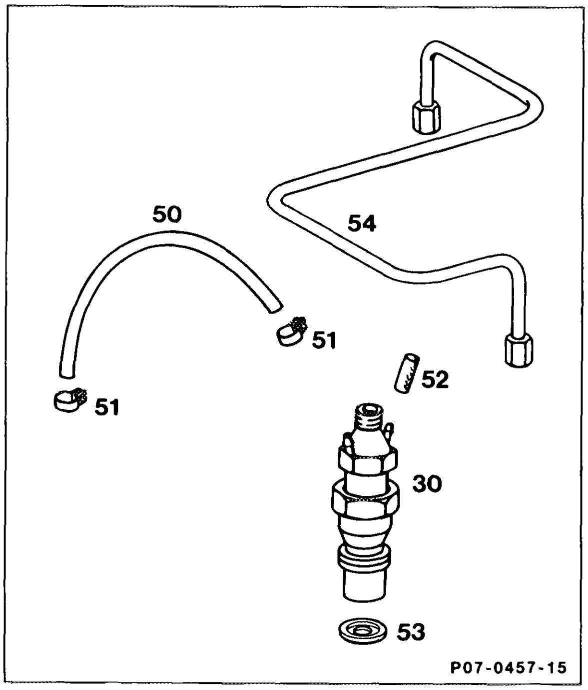
Screw (6b)	remove, install, (use TORX T30).
Bracket (6c)	remove, install.
Actuator (Y22) with intermediate plate (160)	remove, install, electrical connection must be facing upwards.
O-ring (161)	replace.
Shim (167)	for setting size "a".

EXIT



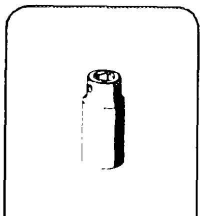
Size "a" 14.6-15.7 mm

07.1430 Removal and Installation of injectors - Turbodiesel



Bypass oil hose (50), plug (52)	remove, refit.
Injection line (54)	remove, install, tightening torque 10–20 Nm as reference value.
Injection nozzle (30)	remove, install, tightening torque 70-80 Nm, Special tool 001 589 65 09 00.
Nozzle seal (53)	replace.

Special tool

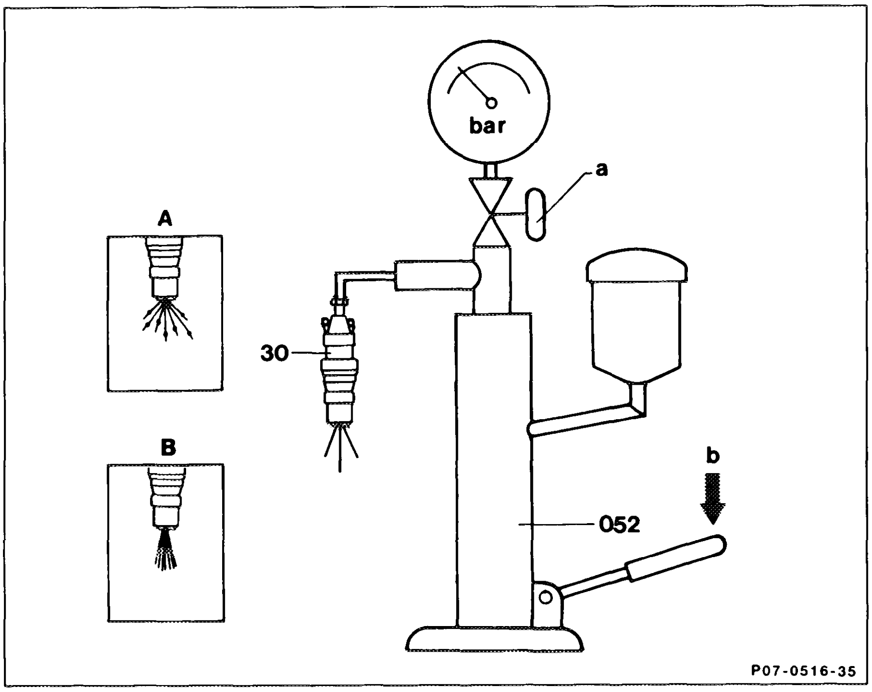


001 589 65 09 00

EXIT

07.1-231 Testing injectors - Turbodiesel

Preceding work:
Removal and installation of injectors (07-230)

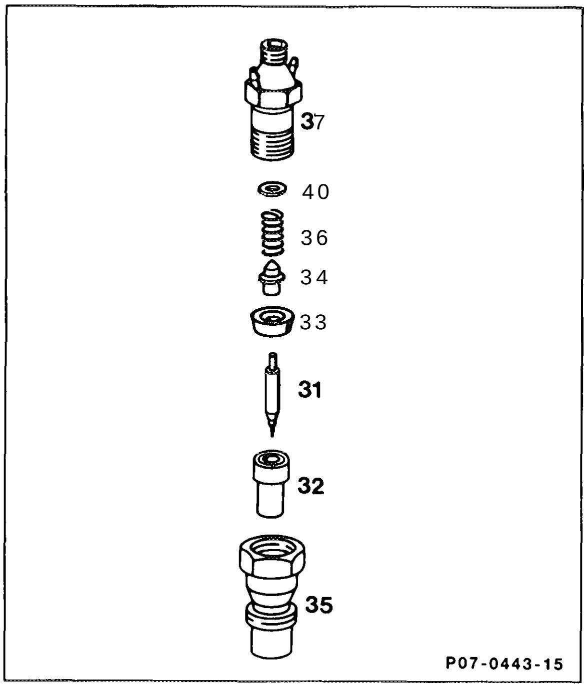


Injection nozzle (30)	pump 5 times vigorously on tester (052) 000 589 00 68 00; close valve "a" for the step.
Chatter	test; slowly operate hand lever "b" approx. 1 stroke per second for this step.
Jet	test. With short, rapid strokes, approx. 2 strokes per second, the jet must be closed and be properly formed. A – Stringy jet "poor" B – Closed jet "good"
Ejection pressure or opening pressure	test. Open valve "a" for this step and operate hand lever "b" slowly (at least 1 stroke per second). Specification: 135-145 bar for new nozzles min. 120 bar for used nozzles,

EXIT

07.1-232 Reconditioning injectors (after testing) - Turbodiesel

Preceding work:
Removal and installation of injectors (07.1-230)
Testing Injectors (07.1-231)

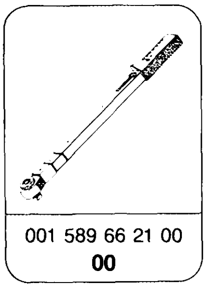


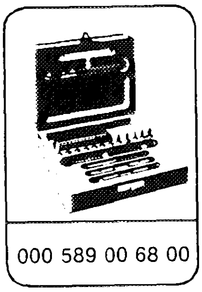
Injection nozzles	disassemble(1).
Nozzle needle (31)	remove, install, visual and sliding inspection; clean center and longitudinal bore of hole pintle nozzles; install in the same nozzle body.
Nozzle body (32)	remove combustion residues.
Intermediate disc (33)	dress on surface plate.
Pressure pin (34)	remove, install, point must be facing toward top section.
Nozzle tensioning nut (35)	unscrew, reinstall, tightening torque 70-80 Nm.
Compression spring (36)	remove, insert.
Holder (37)	to strip down and assemble the injection nozzles, clamp in protective jaws of vice.

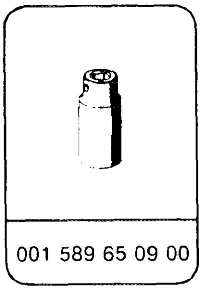
EXIT

Steel washer (40) . . . . set for ejection pressure.
Specification:
135-145 bar for new or newly set nozzle, at least 120 bar for used nozzle. Ejection pressure higher or lower depending on thickness of washer.
0.05 mm results in approx. 3 bar pressure difference.

Special tools

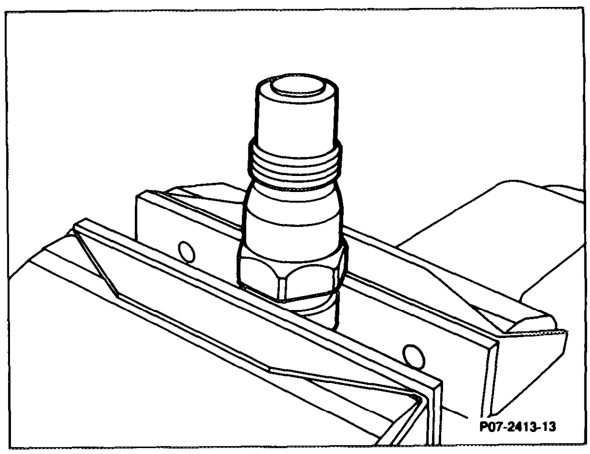




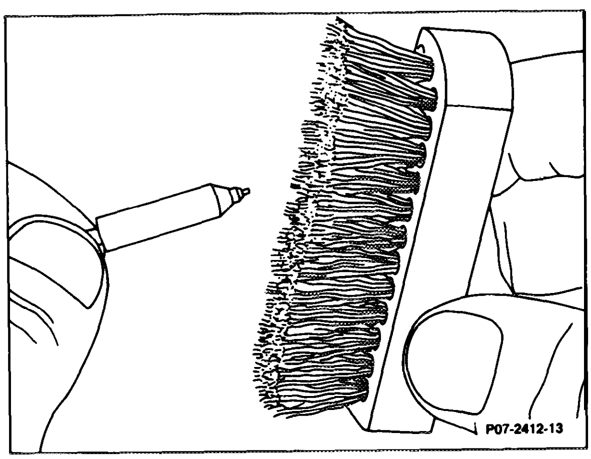


Reconditioning

1 Disassemble injection nozzle by clamping body in vice with protective jaws so that the leak oil line connections are not damaged.

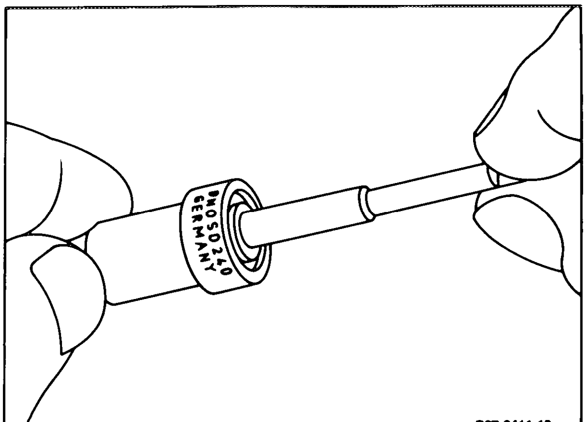


2 Clean nozzle needle and nozzle body with a brass wire brush.



EXIT

Remove combustion residues on seat of nozzle needle with a scraper.



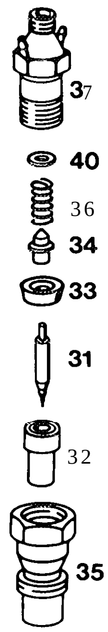
P07-2411-13

3 Visual and sliding inspection.
Dip nozzle in filtered diesel fuel. With the nozzle body held upright, the nozzle pintle must slide towards the nozzle seat by its own weight.

4 Dress intermediate disc (33) on a surface plate.

5 Assemble nozzle holder with injection nozzle. Ejection pressure is set with the steel washer (40). Ejection pressure is higher or lower depending on thickness of the washer; 0.05 mm results in approx. 3 bar pressure difference.

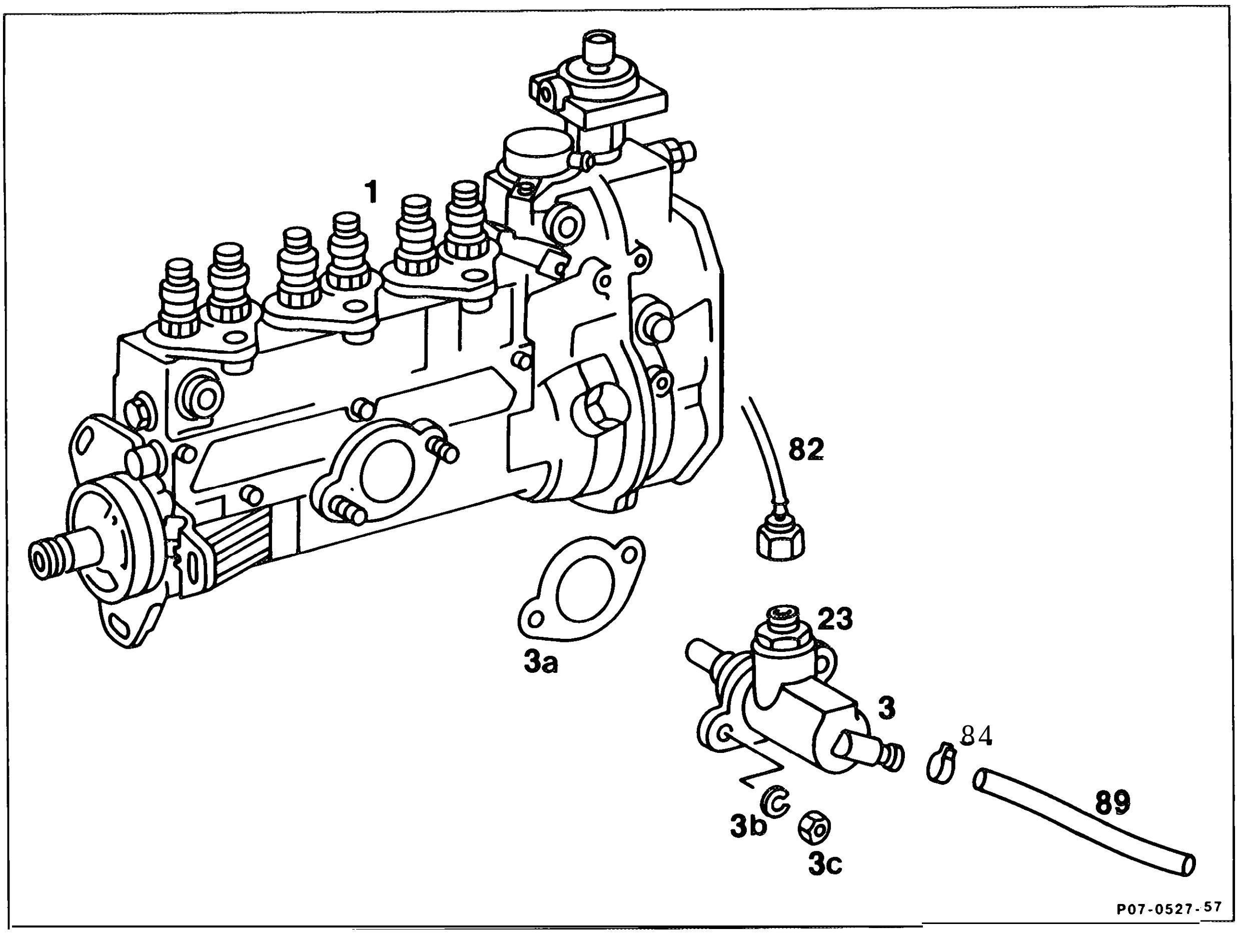
6 Test injection nozzles (07.1-231). Set if necessary.



P07-0443-15

EXIT

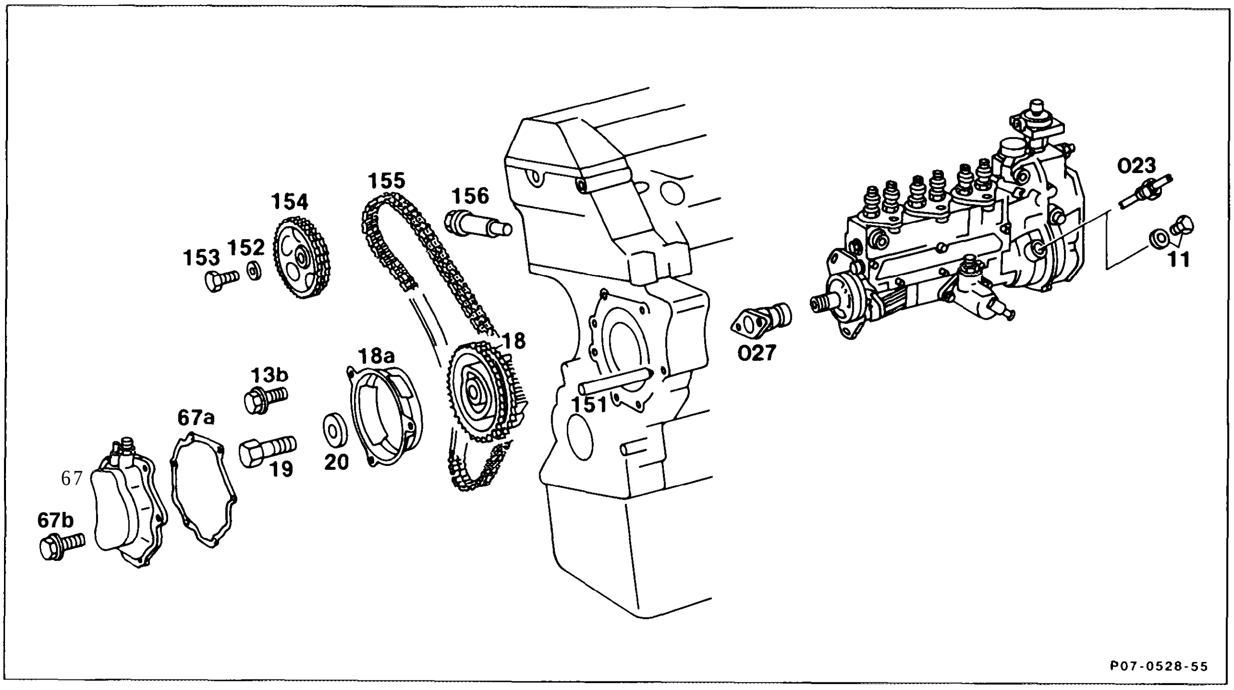
07.1–235 Removal and installation of fuel pump - Turbodiesel



Clip (84)	open, close.
Suction line (89)	detach, fit on.
Fuel filter inlet (82)	disconnect and connect.
Nuts (3c)	remove, install.
Washers (3b)	remove, install.
Fuel pump (3)	remove, install, collect engine oil flowing out during removal.
Gasket (3a)	replace.
Inlet connector (23)	remove, install when replacing the fuel pump.

07.1–240 Removal and Installation of Injection timing device - Turbodiesel

Vacuum pump removed (43-610)



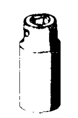
Cylinder head cover	remove, install.
Engine or crankshaft	position on 15° ATDC.
Camshaft gear (154) and timing device (18)	fix in position to timing chain with hose strap.
Chain tensioner (156)	remove, install (05-310). Tightening torque 80 Nm.
Bolt (153) for camshaft gear	unbolt, reinstall. Tightening torque 45 Nm. Note washer (152).
Camshaft gear (154)	remove, install.
Central fastening bolt (19)	unbolt, reinstall, tightening torque 40-50 Nm.

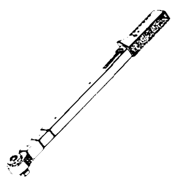
Caution!
Left-hand thread

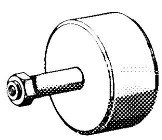
Check washer (20), replace if necessary.

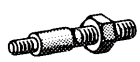
Locking pin (151)	withdraw with threaded pin (116 589 01 34 00) and impact puller (116 589 20 33 00).
Mounting basket (18a)	remove, install.
Timing chain (155)	press to the outside with metal strips (approx. 0.5 x 70 x 120) and withdraw timing device (18) with universal pliers.
Timing device (18)	remove, install.
Screw plug with seal (11)	remove from injection pump (1).
Injection pump	turn with serrated wrench (027) and lock in position with locking bolt (023). **Caution!** Remove locking bolt.
Engine or crankshaft	crank 1 revolution by hand and check TDC setting on crankshaft and camshaft.
Start of delivery	check (07.1-l 12), set if necessary (07.1-l 17).

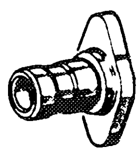
Special tools

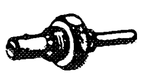

001 589 65 09 00


001 589 66 21 00 00


116589203300 05


11658901 3400 05

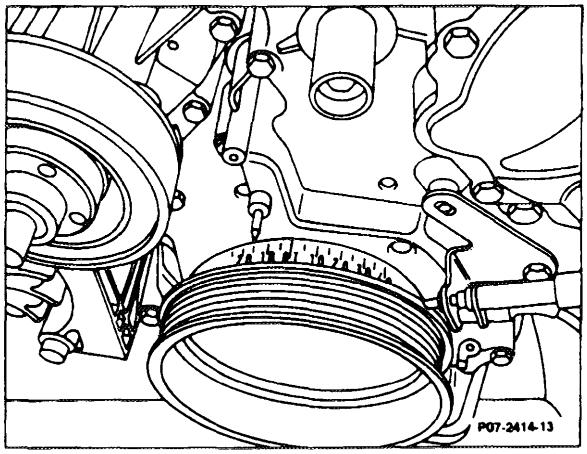

601 589 00 08 OC


601 589 05 21 00

Removal and Installation

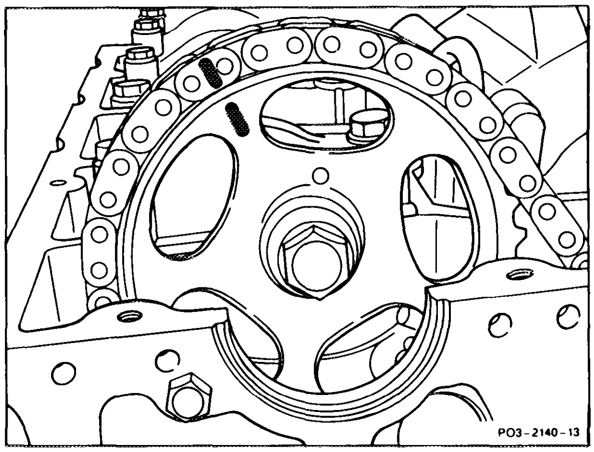
1 Remove cylinder head cover.

2 Turn engine to 15° ATDC of no.1 cylinder.

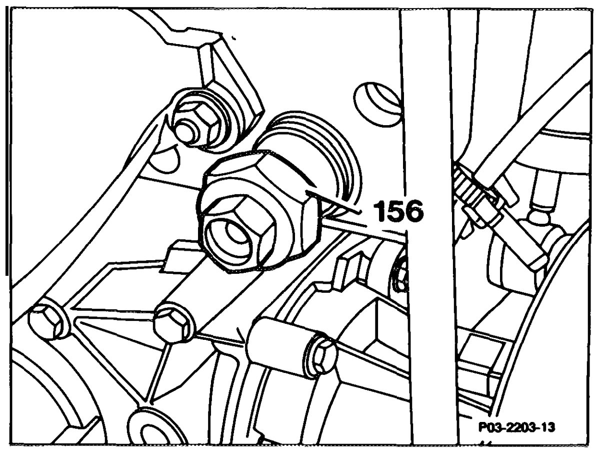


3 Fix camshaft gear and timing device in place with cable strap.

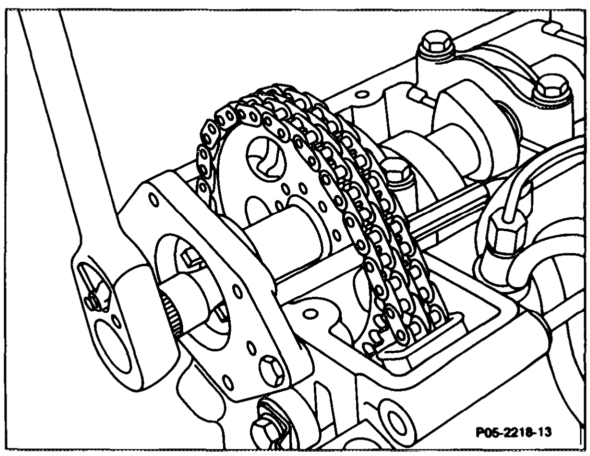
Camshaft gear



4 Remove chain tensioner (156) to relieve the load on the timing chain (05-310).



5 Remove bolt for camshaft gear on camshaft; hold crankshaft in place when performing this step.
Tightening torque 45 Nm.
Remove camshaft timing gear.



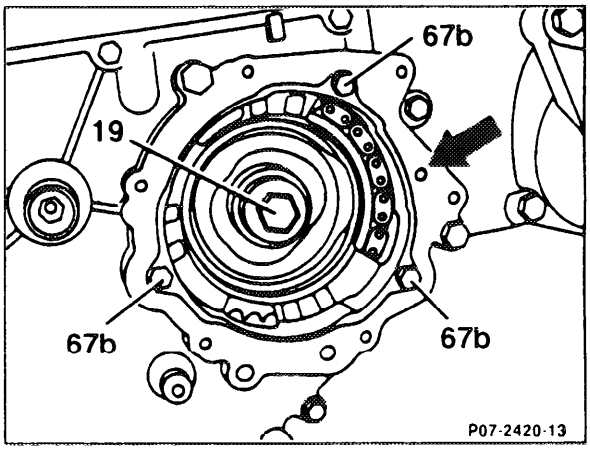
EXIT

6 Remove central fastening bolt (19); hold crankshaft in place when performing this step.

Caution!
Left-hand thread

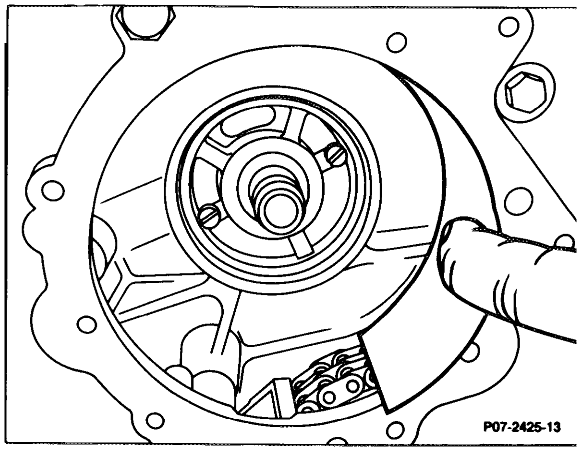
7 Withdraw locking pin (arrow) and remove mounting basket.

Impact extractor	Special tool 116 589 20 33 00
M6 threaded pin	Special tool 116 589 01 34 00

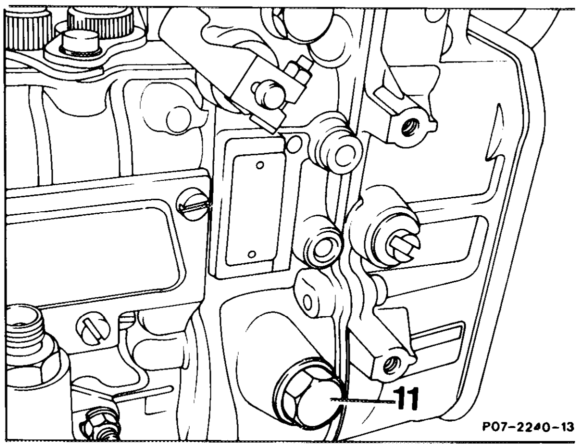


8 Press timing chain out of the way with metal strips and use universal pliers to withdraw timing device.

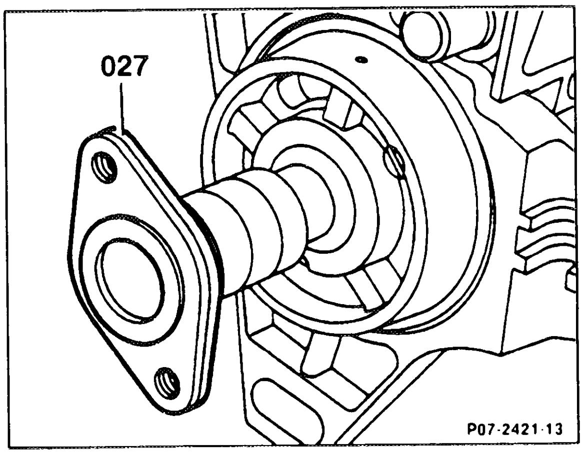
Shop-made metal strips
Thickness approx. 0.5 mm
Length approx. 140 mm
Width approx. 070 mm



9 Unscrew plug (11).



10 Use serrated wrench (027) to turn injection pump on injection pump camshaft until the lug of the governor is visible in the hole. In this position, push in locking bolt (023) until it is felt to engage and tighten union nut by hand.



027 Serrated wrench
Special tool 601 589 00 08 00

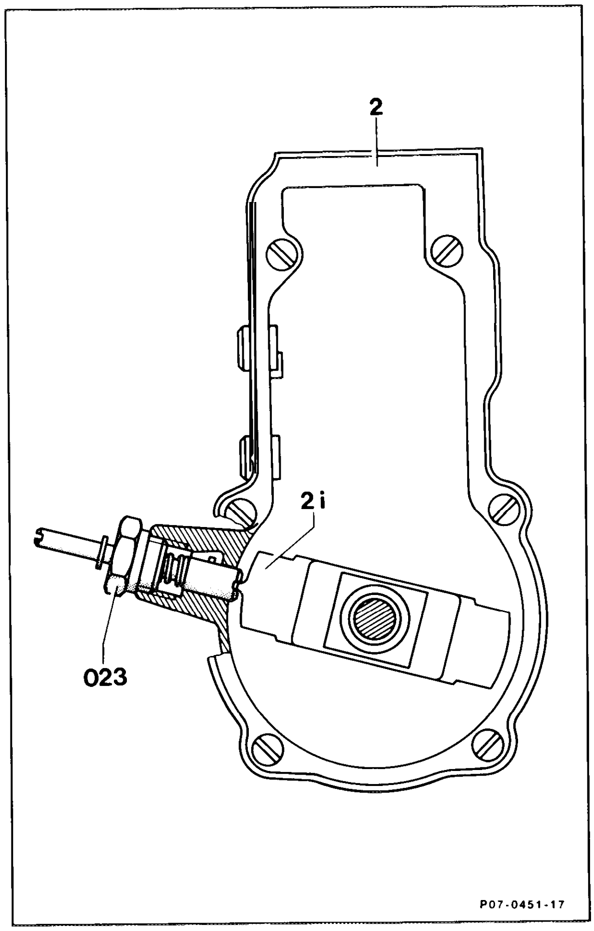
11 Install timing device. Tighten central fastening bolt to 40–50 Nm.

Caution!
Left-hand thread

12 Remove locking bolt (023) otherwise the injection pump will be damaged when engine is started.

13 Assemble engine.

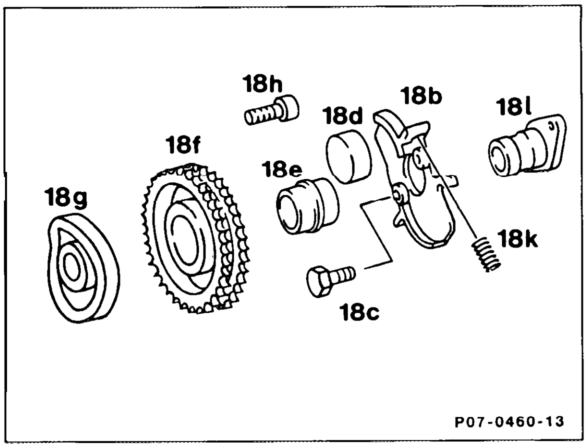
14 Test start of delivery with digital tester (07.1-l 12), set if necessary (07.1-l 17).



023 Locking bolt
Special tool 601 589 05 21 00

07.1–241 Reconditioning injection timing device - Turbodlesel

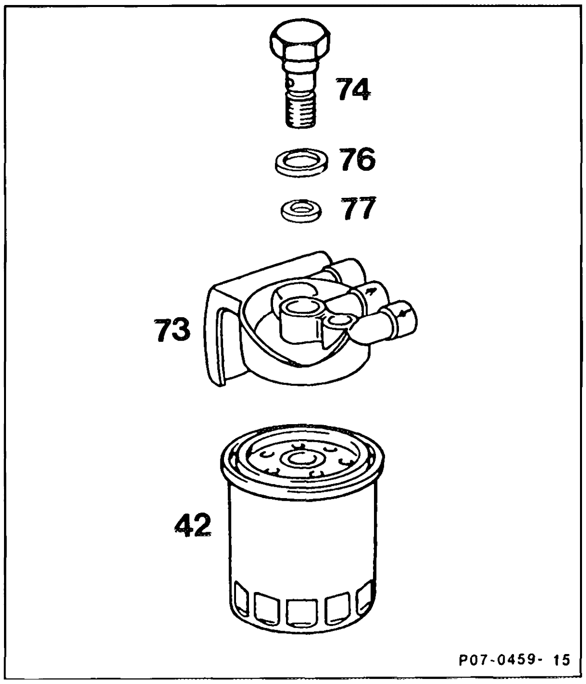
Preceding work:
Removal and installation of timing device (07.1-240)



Bolt (18h) . . . .a........	M6 x 16, remove and install. Tightening torque 15 Nm.
Drive hub (181)	remove, install.
Bolt (18c)	M8 x 16, remove and install. Tightening torque 25 Nm.
Cam (18g)	examine for signs of wear.
Sprocket wheel (18f)	examine for signs of wear.
Bush (18e)	remove, install, examine for signs of wear.
Segment flange (18e)	examine for signs of wear.
Compression spring (18k)	remove, install.
Flyweight (18d)	M8 x 16, remove, install, examine for signs of wear.

EXIT

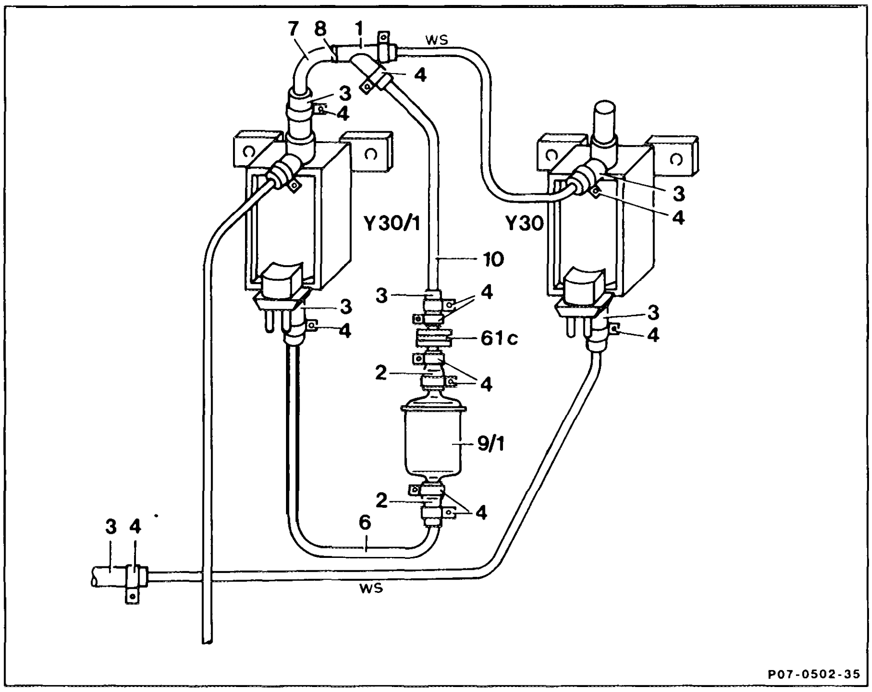
07.1–245 Replacing fuel filter - Turbodiesel



Bolt (74)	remove, install.
O-ring (76)	replace.
O-ring (77)	replace.
Filter (42)	withdraw downwards, replace.
Fuel filter top section (73)	check that restriction orifice 0.8 mm (on return line) is clear.
Leakage	check (with engine running).

Note
When the engine is started, the fuel system is bled automatically as a result of the high output of the fuel pump and the restriction orifices in the top section of the filter as well as at the injection pump.

07.1–250 Retrofitting damper with restriction orifice - Turbodiesel



Engine 603.96

A damper with restriction orifice can be retrofitted to prevent cruise control surging on hills at engine speeds between 2000 and 3000 rpm.

Parts listing

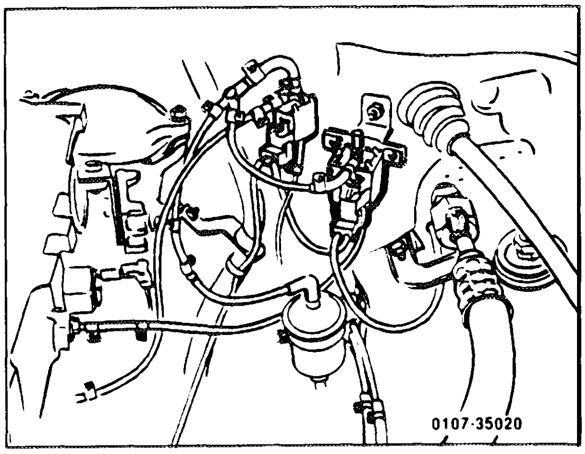
Figure Item	Quantity	Designation	Part No.
1	1	Y distributor	601 078 02 45
2	2	Reducer	117 078 03 81
3	4	Rubber hose approx. 40 mm long	117 997 09 82
4	12	Hose clip 0.8 mm	916 002 008 100
61c	1	Restriction 0.3 mm (red)	000 078 03 56
6	1	Tecalan tube (white) approx. 400 mm long	000 158 1435
Y30/1	1	3/2 solenoid switch-over valve	001 540 86 97
7	1	Bend	117 078 05 81
8	1	Connector	116 276 09 29
	2	Bushes	003 545 26 26
	2	Hose clips 11 mm	916 033 01.1 100
9	1	2-pin connector, switch-over valve	011 545 71 28
9/1	1	Accumulator	000 078 19 68
	1	Hose strap	002 997 09 90
10	1	Tecalan tube approx. 600 mm long white	000 158 14 35
	1	Cable 0.75 approx. 200 mm long	commercial
	1	Cable 0.75 approx. 900 mm long	commercial
	1	Cable 0.75 approx. 900 mm long	commercial

Scope of **work**

1 Install solenoid switchover valve (Y30/1).

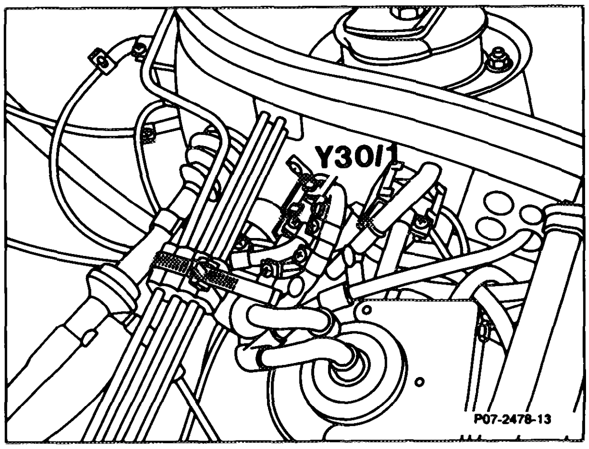
a) Model 126

Install solenoid switchover valve (Y30/1) on the intermediate panel next to the switch-over valve (Y29).

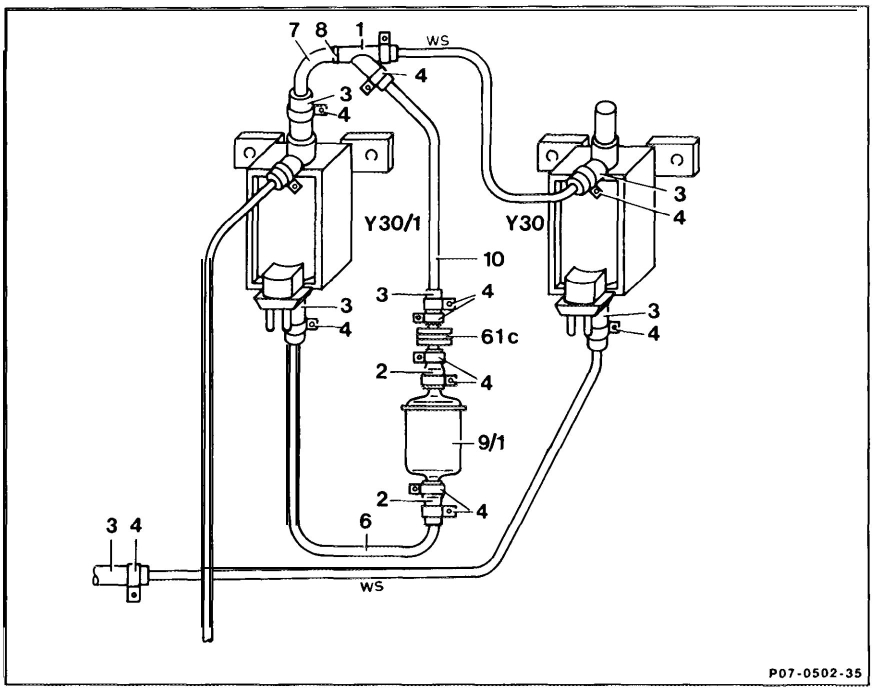


b) Model 124

On Model 124, the switchover valve (Y29) must be moved to the right.



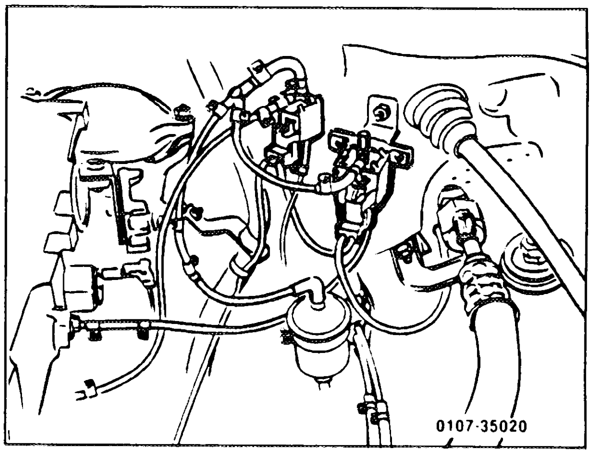
2 Fit out delivery lines as shown in the illustration opposite.



3 install delivery lines with accumulator (9/1).

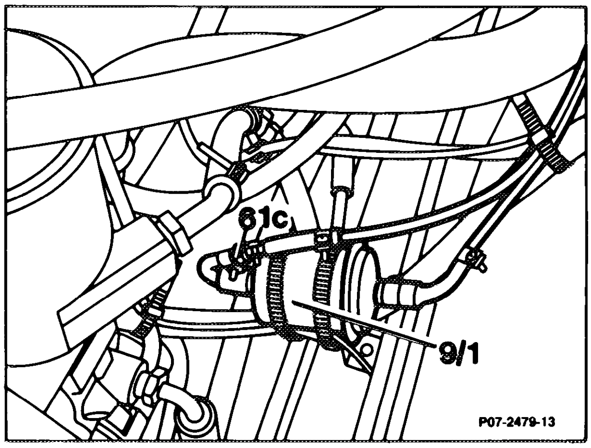
a) Model 126

Attach delivery lines with accumulator (9/1) on Model 126 to fuel line bracket with hose strap.

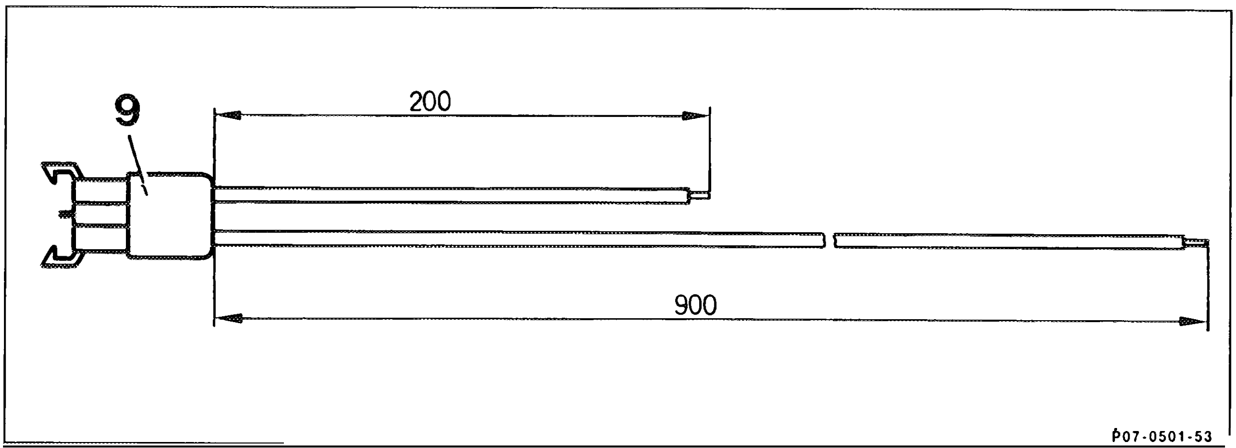


b) Model 124

Attach accumulator (9/1) to bracket of preglow cable harness with hose strap.



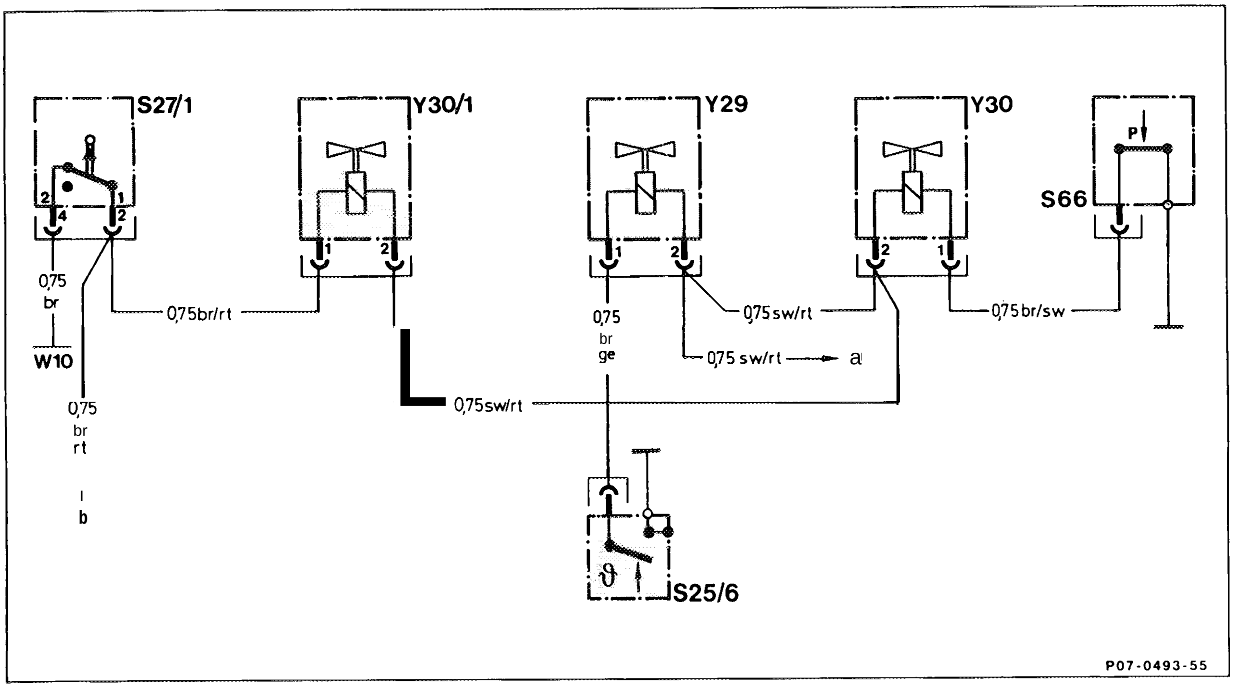
4 Make electric cable harness as shown in the drawing below.



EXIT

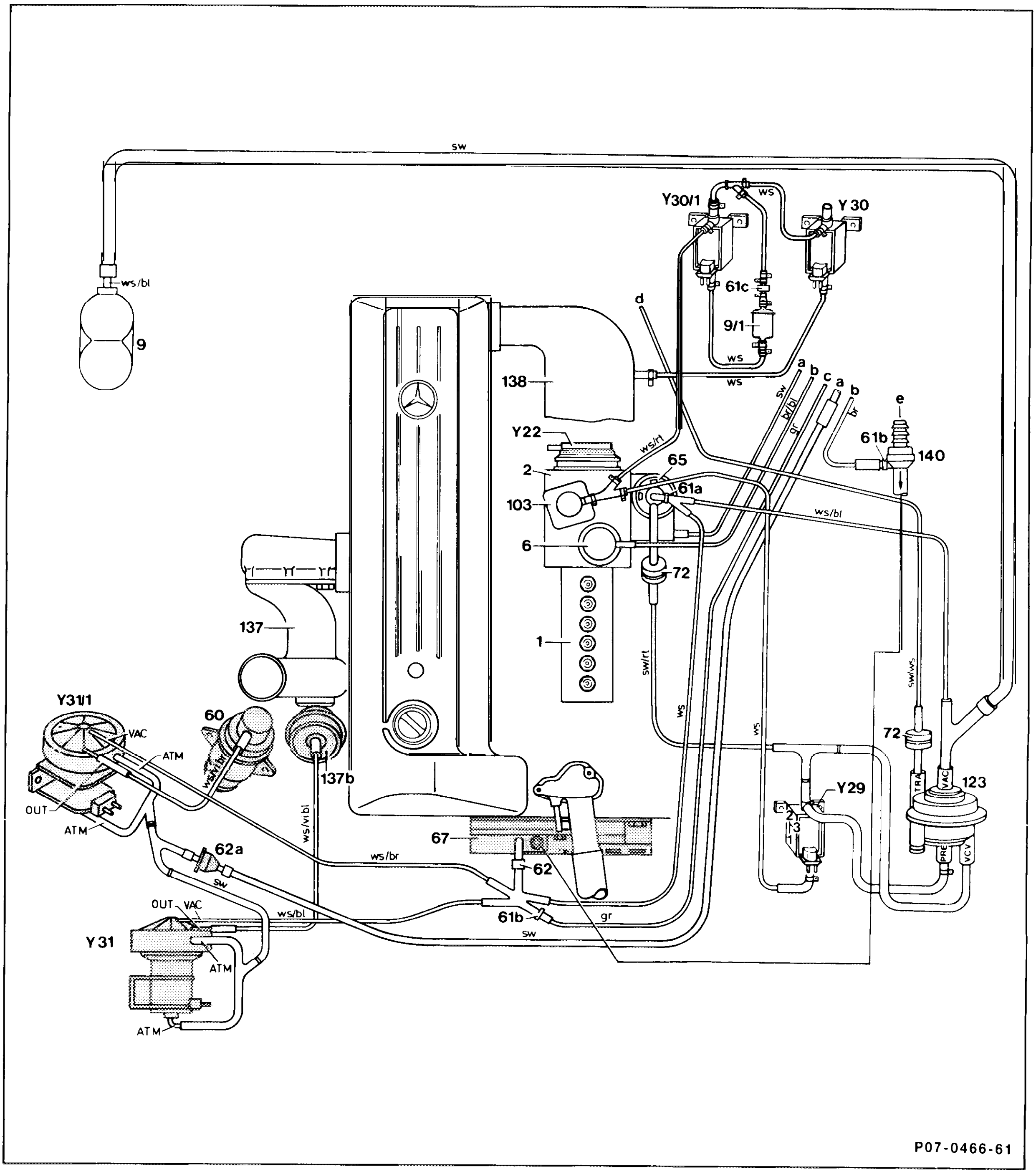
Solder on electric cables as shown in wiring diagram: short cable to contact 2 brown/red of switchover valve (Y30). Long cable to contact 1 brown/red of microswitch (S27/1).

Plug 2-pin connector onto switchover valve.



Wiring diagram

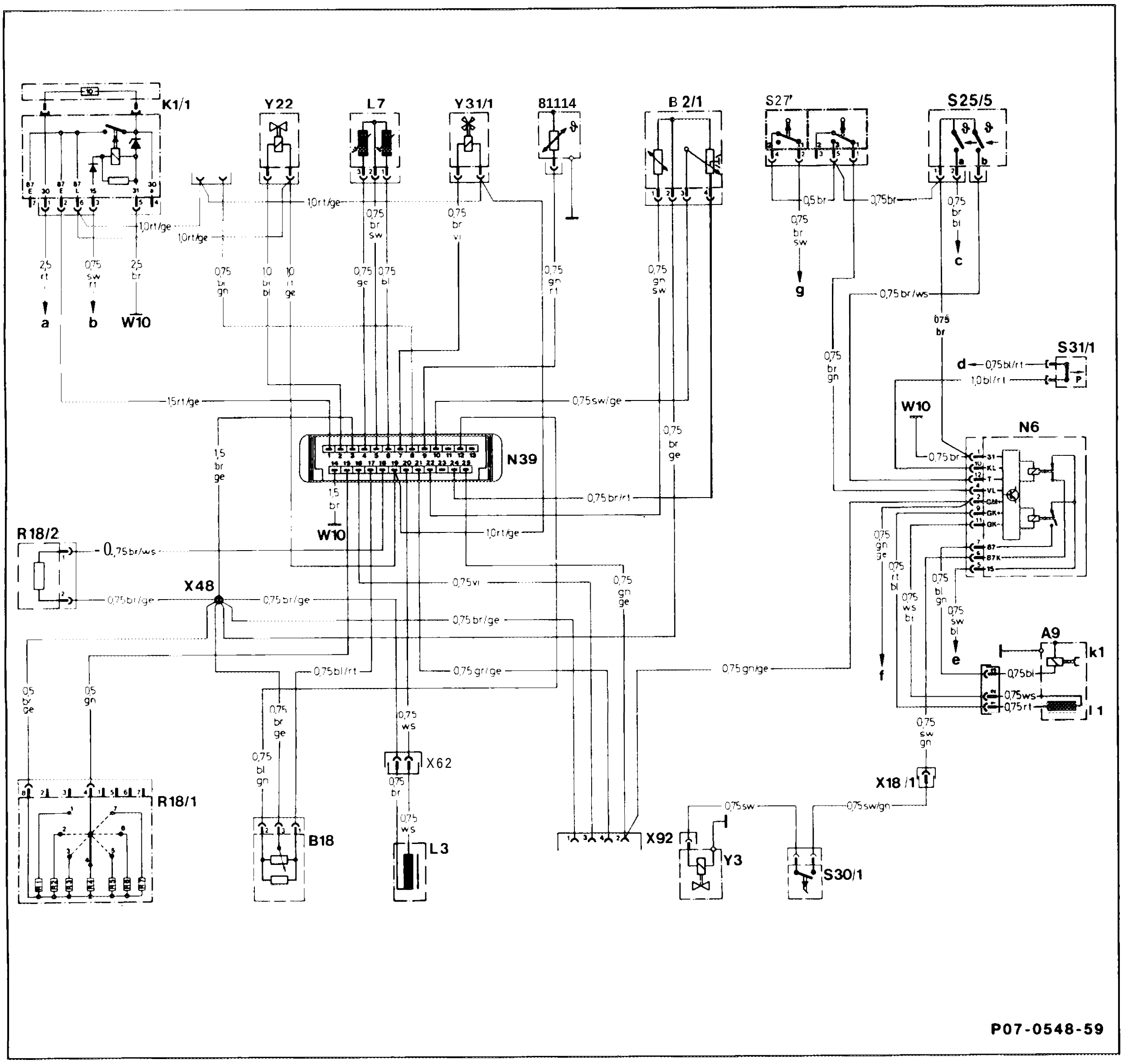
Y30	Solenoid switch-over valve, engine overload protection	Y29	Vacuum amplifier switchover valve, (diesel with automatic transmission).
Y30/1	Solenoid switchover valve	a	to control unit (N6) contact 5
S25/6	50°C temperature switch	b	to control unit (N6) contact 4
S27/1	Microswitch		
S66	Switch, engine overload protection (1.2 bar)		


sw
ws/bl
9
Y30/1
ws
Y 30
61c
9/1
ws
ws
d
138
a
b
c
a
b
sw
bl/bl
gr
br
e
61b
140
Y22
ws/rt
2
65
103
61a
ws/bl
6
72
137
1
sw/rt
sw/ws
Y31/1
VAC
ATM
60
OUT
ATM
137b
ws/vi/bl
ws/vi bl
ws
ws
72
123
TRA
VAC
Y29
2
3
1
PRE
VCV
67
62a
ws/br
62
sw
61b
gr
OUT
VAC
ws/bl
sw
Y 31
ATM
ATM
P07-0466-61

Vacuum line routing (California Engine 603.96, Models 124 and 126)

1	Injection pump
2	Governor
6	Vacuum unit
60	Exhaust gas recirculation valve
61a	Restriction blue
61b	Restriction orange
61c	Restriction
61d	Restriction
62	Filter
62a	Filter
62c	Air admission filter
65	Vacuum control valve
67	Vacuum pump
72	Damper
103	ALDA unit
123	Vacuum amplifier
137	Exhaust gas turbocharger
137b	Recirculation air valve
136	Charge air distribution pipe
140	Check valve, brake booster
Y22	ELR actuator
Y29	Switch-over valve, vacuum amplifier for automatic transmission
Y30	Switchover valve, engine overload protection
Y31	Vacuum transducer, air recirculation valve
Y31/1	Vacuum transducer (EGR)

a	Fresh air flow to car interior
b	Key operated engine stop
c	Other ancillaries
d	Vacuum unit, automatic transmission
e	Brake booster
	Pressure and vacuum connections at vacuum transducer or vacuum amplifier
PRE	Charge pressure from ALDA unit
TRA	To vacuum unit, automatic transmission
VAC	Vacuum from vacuum pump
VCV	To vacuum control valve
ATM	Fresh air supply to car interior
ARF	Exhaust gas recirculation to exhaust gas recirculation valve or air recirculation valve


K1/1
Y22
L7
Y31/1
81114
B 2/1
S27
S25/5
S31/1
W10
N6
N39
R18/2
X48
A9
k1
I 1
X18 /1
X62
R18/1
B18
L3
X92
Y3
S30/1
a
b
c
d
e
f
g
P07-0548-59

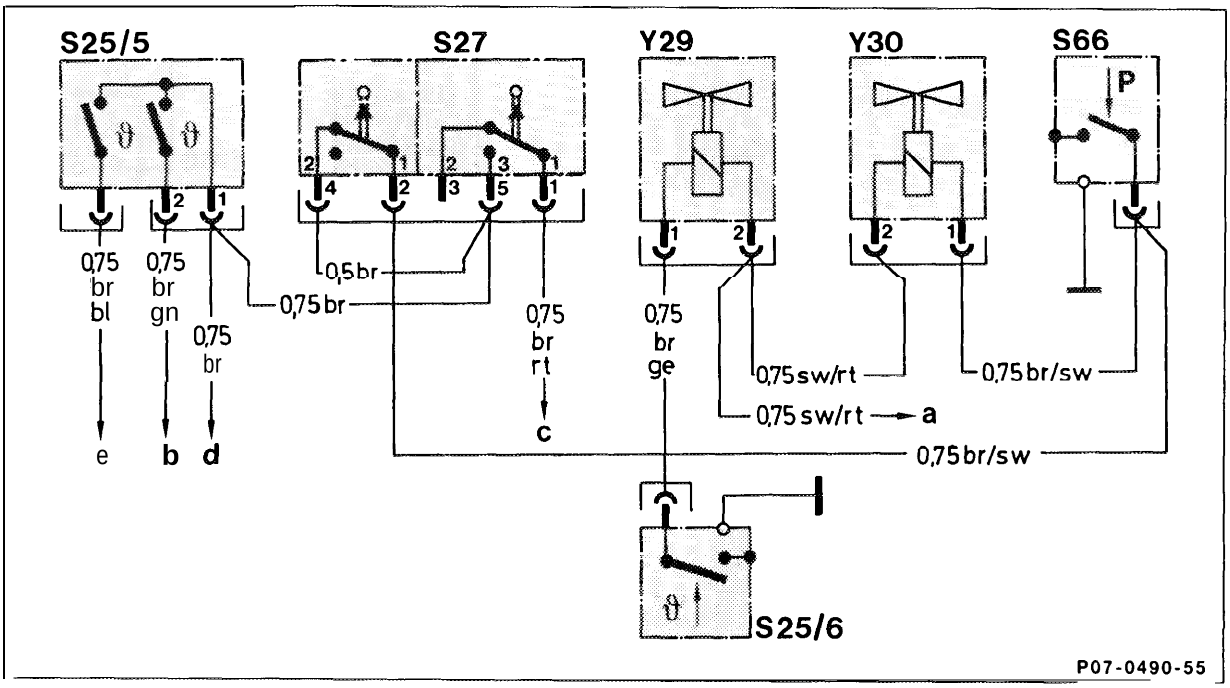
EXIT

Wiring diagram electronic diesel system Engine 602.961 Federal Model 201 Model Year 1987

A9	Refrigerant compressor
A9k1	Electromagnetic clutch
A9/1	RPM sensor
B2/1	Air flow sensor potentiometer
B11/4	Coolant temperature sensor, idle speed control
B18	Altitude sensor
K1/1	Relay, overvoltage protection
L3	Engine speed sensor, starter ring gear
L7	Control rod travel sensor
N6	Control unit, compressor shutoff
N39	Control unit (EDS)
R18/1	Resistance trimming plug (ELR)
R18/2	Reference resistor (EGR)
S25/5	Temperature switch 105/1 15°C
S27	A/C compressor/charge pressure cut-out microswitch
S30/1	Kickdown switch
S31	Pressure switch, refrigerant compressor
W10	Battery ground
X18/1	Plug connection, tail lamp wiring harness/compressor wiring harness
X48	Sleeve terminal (solder connector)
X62	Plug connection, speed sensor, starter ring gear
X92	Test connection for diagnostics (8-pin)
Y3	Kickdown valve automatic transmission
Y22	Actuator (ELR)
Y31/1	Vacuum transducer, exhaust gas recirculation
a	To terminal block X35, terminal 30/61 (battery)
b	To electrical centre connector U contact 5
c	To relay, double auxiliary fan (K8/1) contact 5
d	To electrical centre connector W contact 4
e	To relay, double auxiliary fan (K8/1) contact 4
	To tachometer (Al p7)
g	To switch, engine overload protection (S66)

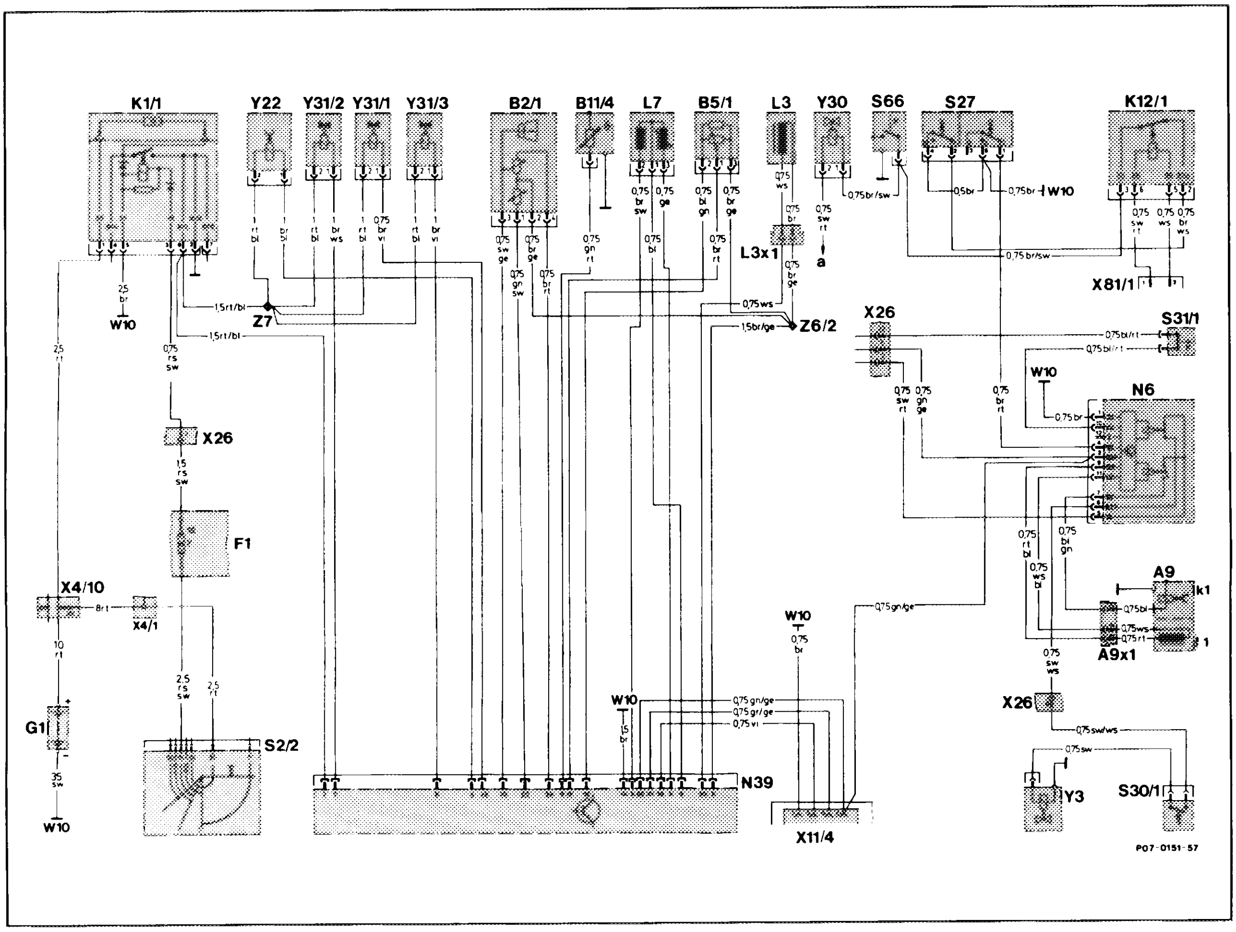
Note

Ground points not shown go to engine ground or battery ground.



Wiring diagram engine overload protection Engine 602.961 Federal Model 201.128 effective Model Year 1987

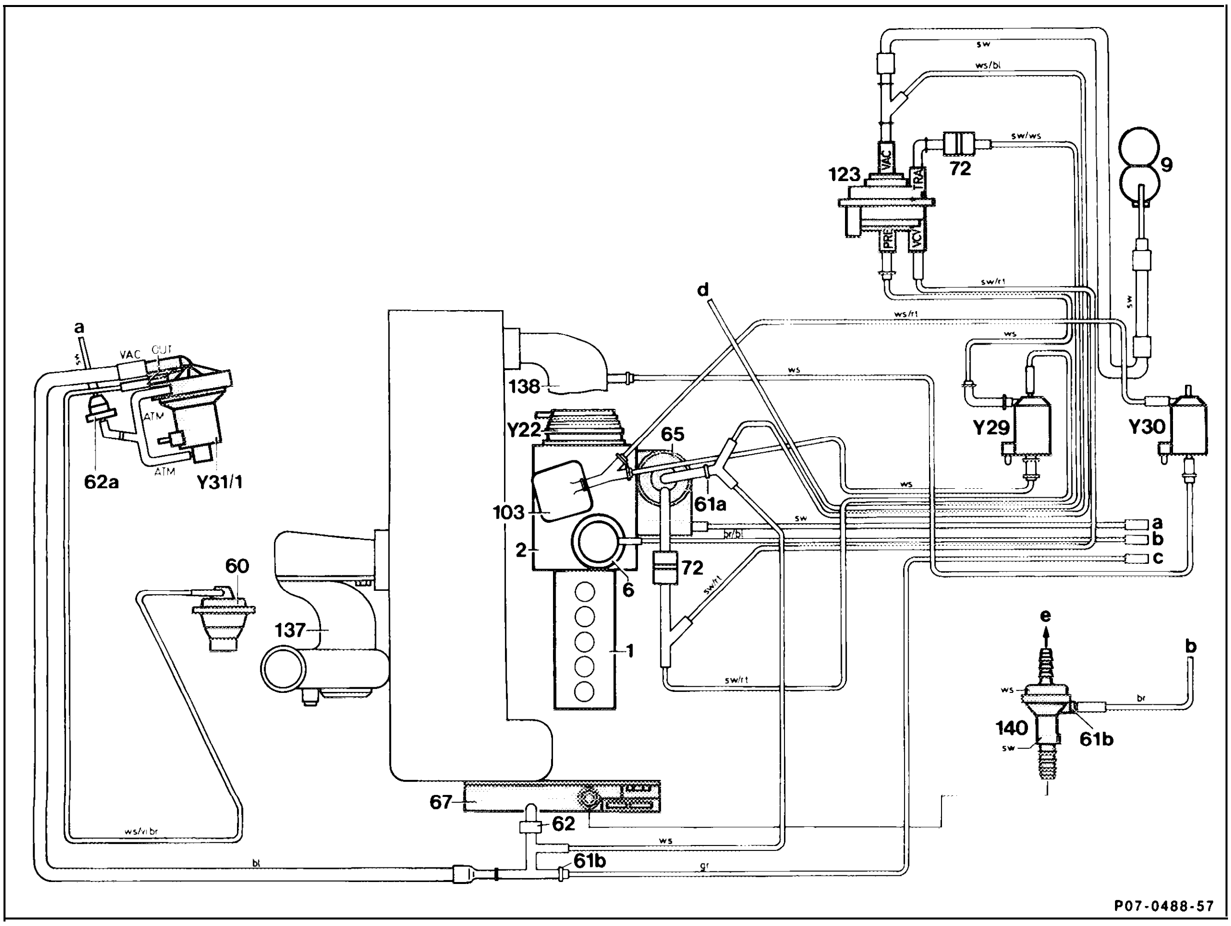
S25/5	Temperature switch 105/115 °C	a	To relay K9 auxiliary fan contact 4
S25/6	Temperature switch 50 °C	b	To relay K9 auxiliary fan contact 5
S27	A/C compressor/charge pressure cut-out microswitch	c	To control unit N6 compressor cutoff contact 4
S66	Switch, engine overload protection	d	W 10 battery ground
Y29	Switchover valve, vacuum amplifier	e	To control unit N6 compressor cutoff contact 12
Y30	Switchover valve, engine overload protection		



Wiring diagram electronic diesel control Engine 602.962, Model Year 1990 and 1991

A9	Refrigerant compressor
A9k1	Electromagnetic clutch
A9l1	Engine speed sensor
A9x1	Plug connection, refrigerant compressor
B2/1	Air flow sensor potentiometer with intake air temperature sensor (EDS)
B5/1	Pressure sensor (EDS)
B11/4	Coolant temperature sensor (EDS)
F1	Fuse and relay box
G1	Battery
K1/1	Relay over-voltage protection 87E/87L (7-pin)
K12/1	Relay, Tempomat/charge pressure cutoff
L3	Engine speed sensor, starter ring gear
L3x1	Plug connection, engine speed sensor, starter ring gear
L7	Control rod travel sensor
N6	Control unit, refrigerant compressor cutoff
N39	Control unit (EDS)
S2/2	Glow start switch
S27	A/C compressor/charge pressure cut-out microswitch
S30/1	Kick-down switch
S31/1	Pressure switch, refrigerant compressor, OFF 2.0/30/ON 2.6/22
S66	Switch, engine overload protection
W10	Battery ground
X4/1	Cable connector, terminal 30/interior, 2-pin
X4/10	Cable connector, terminal 30/terminal 61 battery
X11/4	Test connection for diagnostics, 8-pin (pulse readout)
X26	Plug connection, interior/engine
X81/1	Plug connection, engine cable harness/Tempomat/1-pin
Y3	Kick-down valve, automatic transmission
Y22	Actuator (ELR)
Y30	Switchover valve, engine overload protection
Y31/1	Vacuum transducer (EGR)
Y31/2	Vacuum transducer, pressure control flap
Y31/3	Vacuum transducer, charge pressure control
Z6/2	Sleeve connector (solder connection on clutch housing)
Z7	Sleeve connector, terminal 87 (solder connection in cable harness)
a	K9 relay, additional contact 4, terminal 15

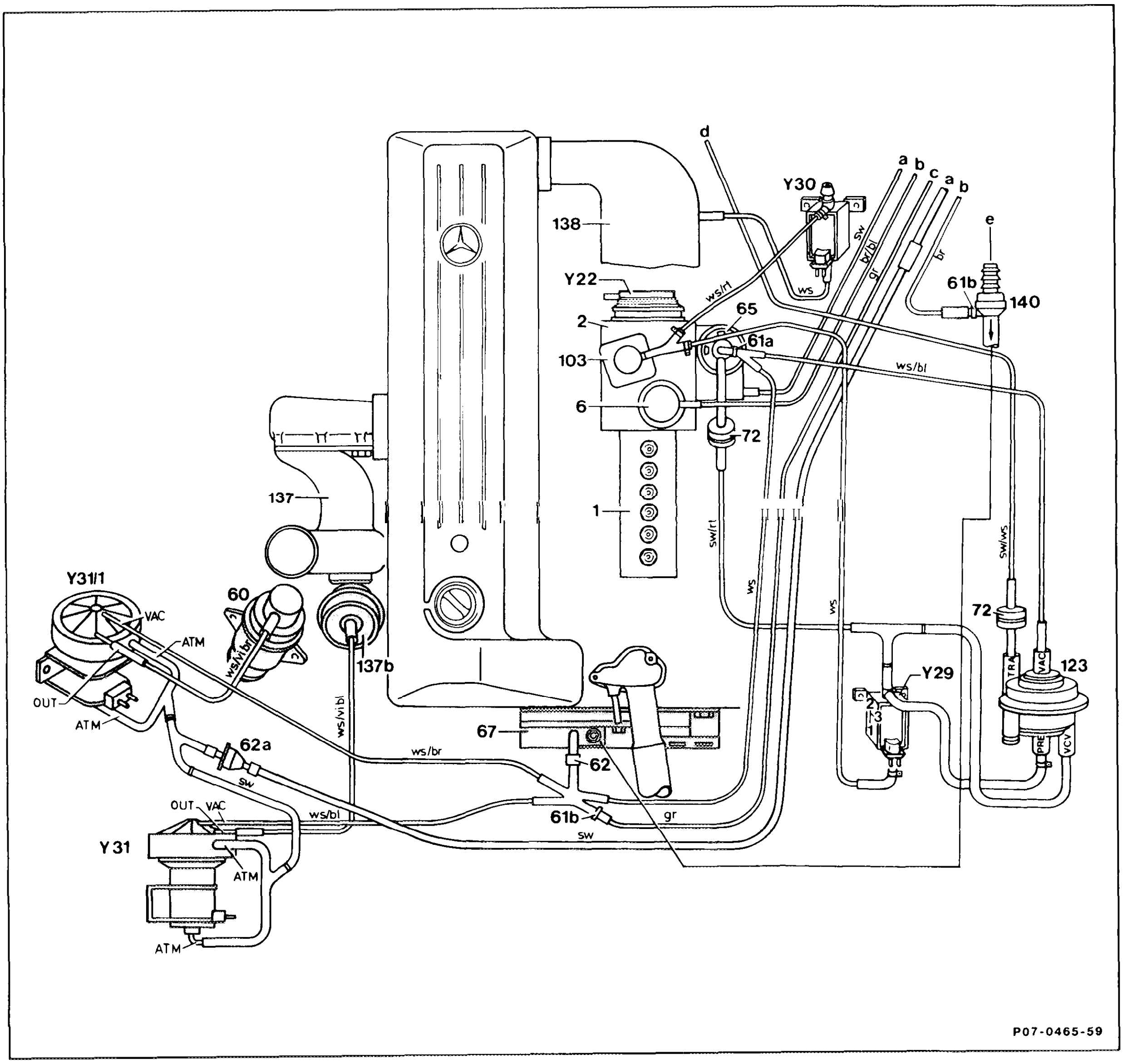
07.1-500 Vacuum Circuit Diagrams- Turbodiesel



Vacuum Line Routing Electronic Diesel System Engine 602.961 Federal Model 201
Model Year 1987

1	Injection pump
2	Governor
6	Vacuum unit stop
9	Vacuum reservoir
60	Exhaust gas recirculation valve
61a	Restriction
61b	Restriction
62	Filter
62a	Filter
65	Vacuum control valve
67	Vacuum pump
72	Damper
103	ALDA unit
123	Vacuum amplifier
137	Exhaust gas turbocharger
138	Charge air distribution pipe
140	Non-return valve - brake booster
Y22	ELR actuator
Y29	Vacuum amplifier switch-over valve, automatic transmission
Y30	Switch-over valve, engine overload protection

Y31/1	Vacuum transducer, exhaust gas recirculation valve
a	Ventilation to passenger compartment
b	Key shut-off
c	Other ancillaries
d	Vacuum unit, automatic transmission
e	Brake booster
	Pressure and vacuum connections to vacuum transducer or vacuum amplifier
PRE	Charge pressure from ALDA unit
TRA	To vacuum unit, automatic transmission
VAC	Vacuum from vacuum pump
VCV	To vacuum control valve
ATM	Ventilation to passenger compartment
OUT	Exhaust gas recirculation to exhaust gas recirculation valve
sw	black
bl	blue
br	brown
gr	grey
vi	violet
rt	red
ws	white



d
a
b
c
a
b
Y30
138
e
Y22
61b
140
65
2
61a
103
6
72
137
1
Y31/1
60
72
VAC
ATM
137b
123
Y29
OUT
ATM
67
62a
62
OUT
VAC
61b
Y31
ATM
ATM
P07-0465-59