Job No.

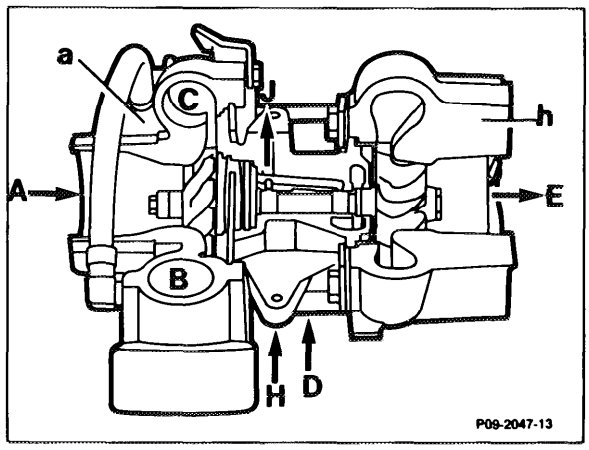
# 09-050 Function of turbocharger

**Turbocharger survey**

| Engine | Designation | Boost pressure at full load, 4000 rpm, gear lever position 3 |
|---|---|---|
| 602.96 | Garrett TB **025** 1990 or<br>T **025**<br>KKK K14 [2]) | 0.85-0.95 bar (13.75 - 14.25 psi) |
| 603.96 | Garrett TB 03 [1]) [3]) or T 03 [1]) [3])<br>KKK K24 [1]) [3]) | 0.85-0.95 bar (13.75 - 14.25 psi) |

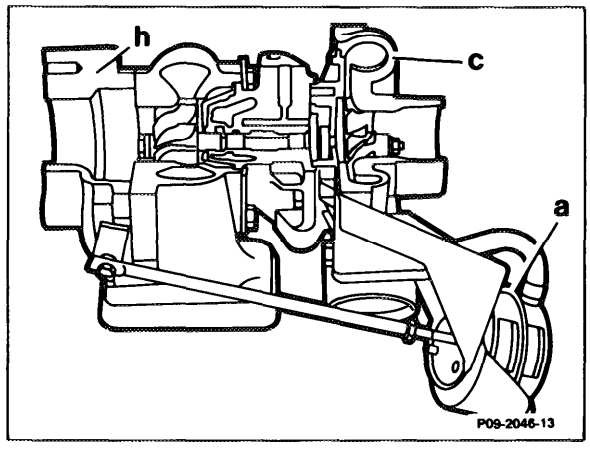
[1]) Optional
[2]) Production breakpoint at a later point in time
KKK = Kuhnle, Kopp und Kausch.
[3]) For California with air recirculation valve.

Engine 602.961, Garrett TB 025



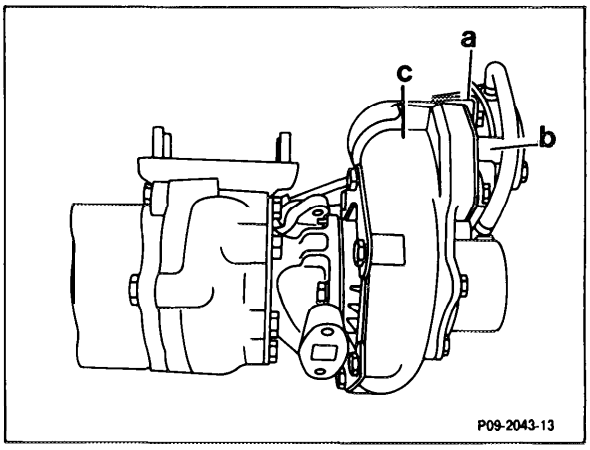

| | |
|---|---|
| a | Boost pressure control |
| h | Turbine housing valve |
| A | Fresh air inlet |
| B | Compressed air |
| C | Bypass passage |
| D | Exhaust inlet |
| E | Exhaust outlet |
| H | Oil feed |
| J | Oil discharge |

Engine 603.96, Garrett TB 03



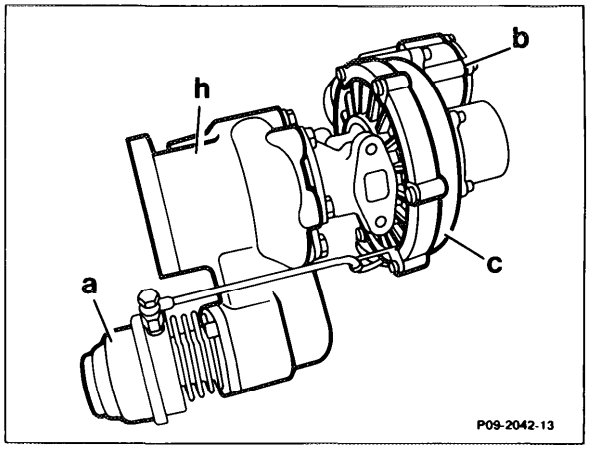

| | |
|---|---|
| a | Boost pressure control valve |
| C | Compressor housing |
| h | Turbine housing |

Garrett TB 03 with air recirculation valve




a Boost pressure control valve
b Air recirculation valve
c Compressor housing

KKK-K24 with air recirculation valve



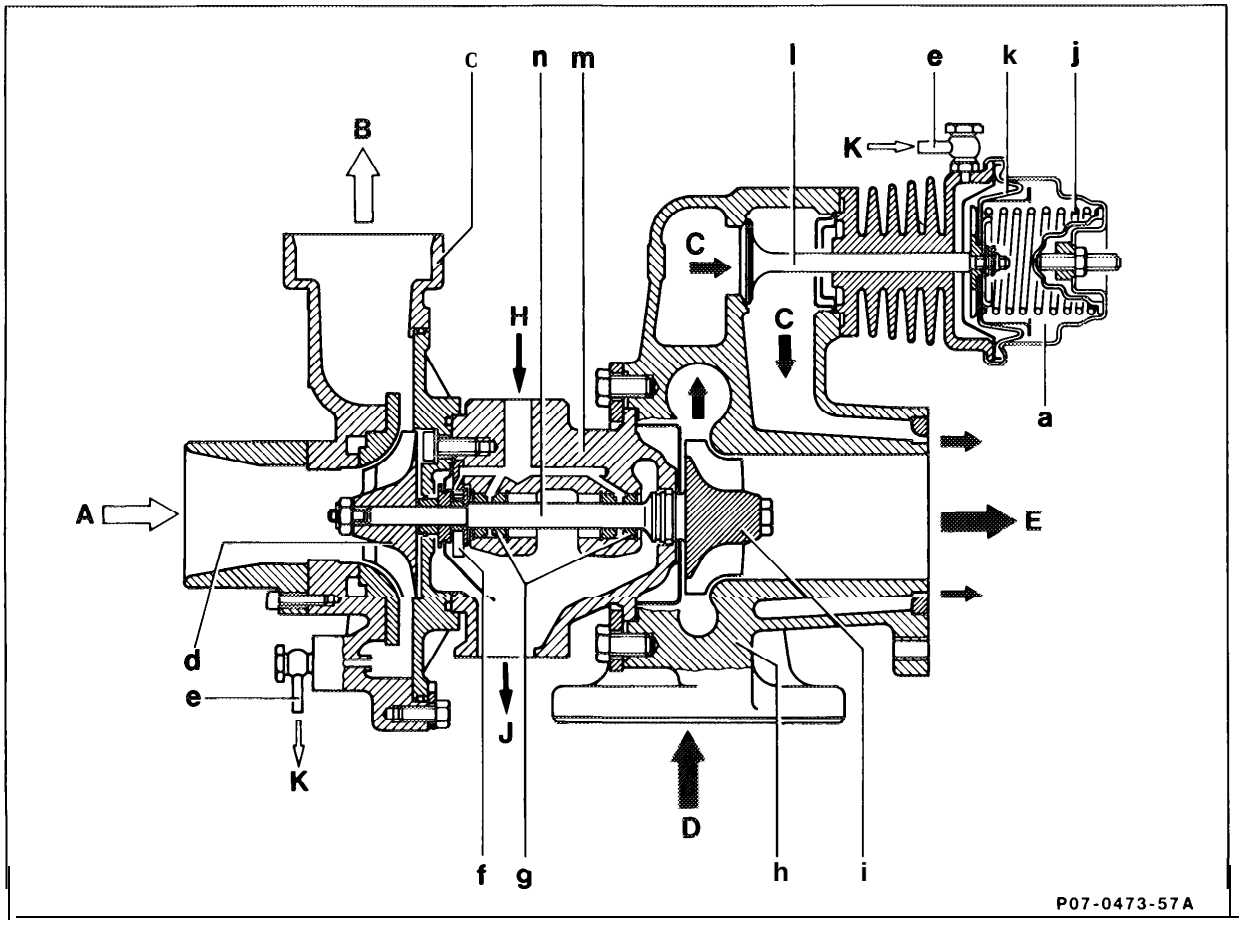

a Boost pressure control valve
b Air recirculation valve
c Compressor housing
h Turbine housing

## General

The exhaust gas turbocharger (EGT) is a flow machine. The energy of the engine exhaust gas is used for driving a turbine, which in turn drives a compressor through a shaft. The EGT is installed between the exhaust manifold and the exhaust pipe. It is connected to the engine oil circuit for lubrication and cooling.

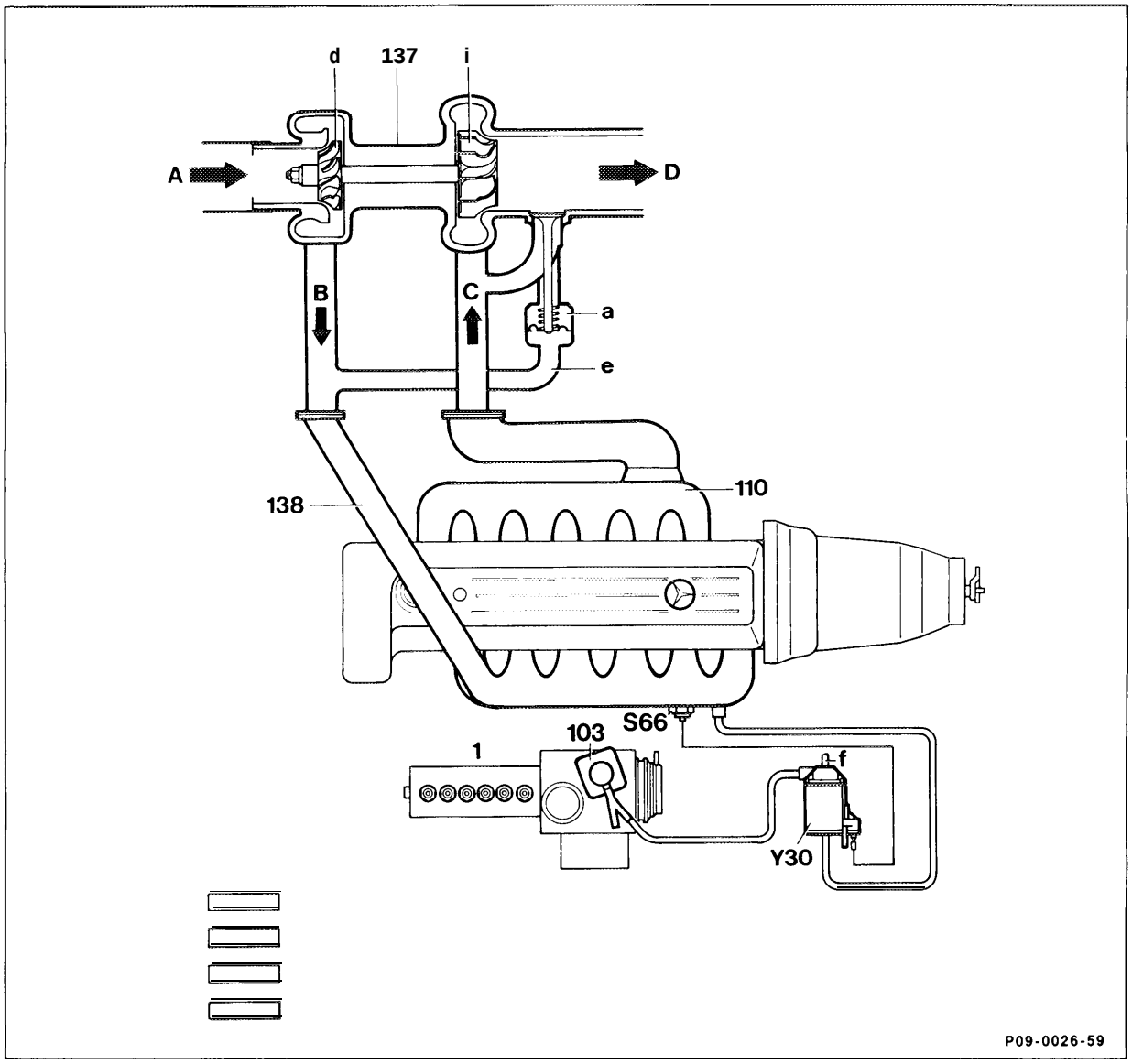
A boost pressure control valve, fitted to the turbine housing or separately, ensures that a boost pressure of 0.95 bar is not exceeded. if a problem develops in the boost pressure control valve, engine failure is prevented by means of an engine overload protection system.

The exhaust gases of the engine are passed through the exhaust manifold into the turbine housing (h) and flow onto the turbine wheel (i). The flow energy of the exhaust gases starts the turbine wheel (i) rotating. This causes the compressor wheel (d) which is connected through the shaft (n) to the turbine wheel (i) to be driven at the same speed. The maximum rotation speed is approx. 135,000 rpm. The fresh air drawn in by the compressor wheel (d) is compressed and sent to the engine.




Functional diagram turbocharger KKK K24 (Engine 603.96)

| | | | |
|---|---|---|---|
| a | Boost pressure control valve | m | Charge housing |
| c | Compressor housing | n | Shaft |
| d | Compressor wheel | A | Fresh arr inlet |
| e | Control line | B | Compressed air (to engine) |
| f | Axial bearing | C | Bypass passage/boost pressure control valve |
| g | Bearing bushing | D | Exhaust inlet |
| h | Turbine housing | E | Exhaust outlet |
| i | Turbine wheel | H | Oil feed |
| j | Spring | J | Oil discharge |
| k | Diaphragm | K | Control pressure |
| l | Valve | | |




## Function diagram

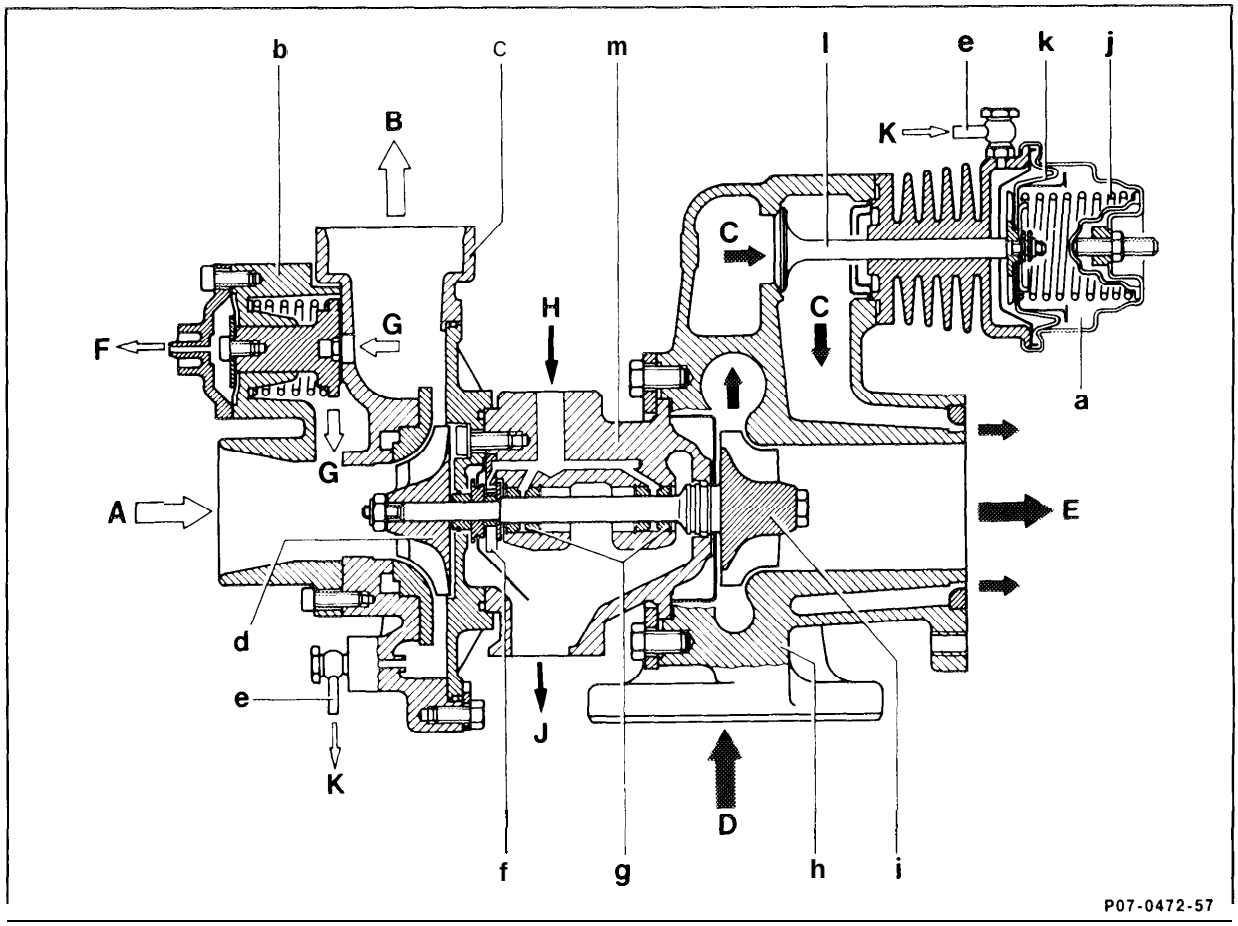
| | | | |
|---|---|---|---|
| 1 | Injection pump | a | Boost pressure control valve |
| 103 | ALDA unit | d | Compressor wheel |
| 110 | Exhaust manifold | e | Control line |
| 137 | Turbocharger | f | Air admission |
| 138 | Charge air pipe | i | Turbine wheel |
| S66 | Pressure switch, engine overload protection | A | Compressor inlet (fresh air) |
| Y30 | Switch-over valve, engine overload protection | B | Compressor outlet (compressed arr) |
| | | C | Exhaust gases to turbine wheel |
| | | D | Exhaust outlet |

**Air Recirculation Valve**

(refer also to EDS Operation No. 07.1-010)

In order to create more favorable combustion conditions for the trap oxidizer, the air recirculation valve is continuously opened or closed in accordance with the performance characteristic map.

After the closing operation, a residual vacuum of approx. 30 mbar is retained at the air circulation valve.




Function diagram turbocharger KKK with air recirculation valve California

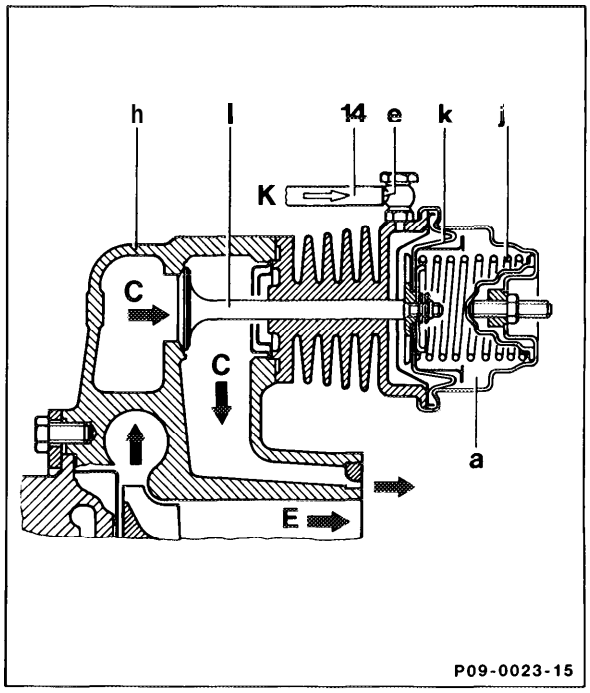
Model year 1986187

| | |
|---|---|
| a | Control valve, exhaust gas control flap |
| b | Air recirculation valve |
| c | Compressor housing |
| d | Compressor wheel |
| e | Connector hose |
| | Axial bearing |
| g | Bearing bush |
| h | Turbine housing |
| | Turbine wheel |
| | Compressron spring |
| k | Diaphragm |
| | Boost pressure control valve |
| m | Intermediate housing |

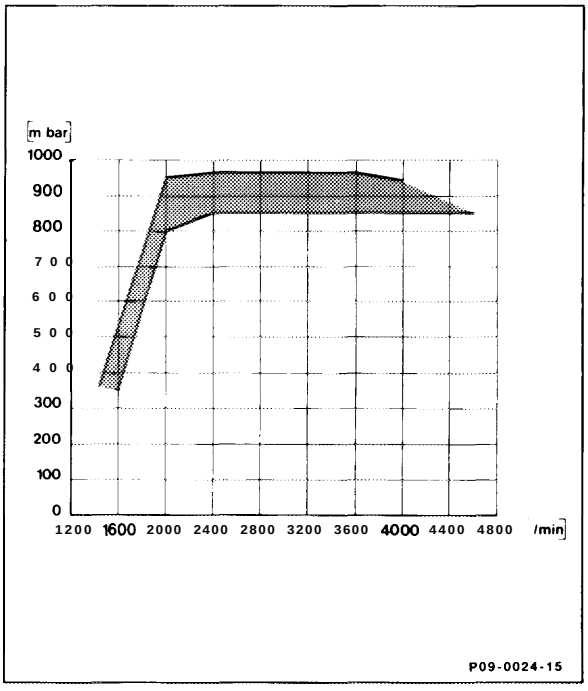
| | |
|---|---|
| A | Compressor inlet (fresh air) |
| B | Compressor outlet (compressor air) |
| C | Bypass passage, boost pressure control valve |
| D | Exhaust gas to turbine wheel |
| E | Exhaust gas outlet |
| F | Vacuum connection to vacuum transducer |
| G | Recirculated air |
| H | Lubrication oil inlet |
| | Lubrication oil outlet |
| K | Boost pressure (control valve exhaust gas control flap) |

**Boost pressure Control Valve (KKK)**

To prevent the boost pressure from rising above a certain level, a boost pressure control valve (a) is attached to the turbine housing (h). The boost pressure is taken from the compressor housing and passed through the connecting hose (14) to the boost pressure control valve. When maximum boost pressure is reached, the boost pressure control valve begins to open and allows the exhaust gas to flow along the bypass passage (c). Part of the exhaust gas flows directly into the exhaust system, resulting in a constant boost pressure level.




14 Connecting hose
a Boost pressure control valve
e Control line
h Turbine housing
j Spring
k Diaphragm
l Valve
C Bypass passage
E Exhaust gas outlet




Boost pressure diagram - full load

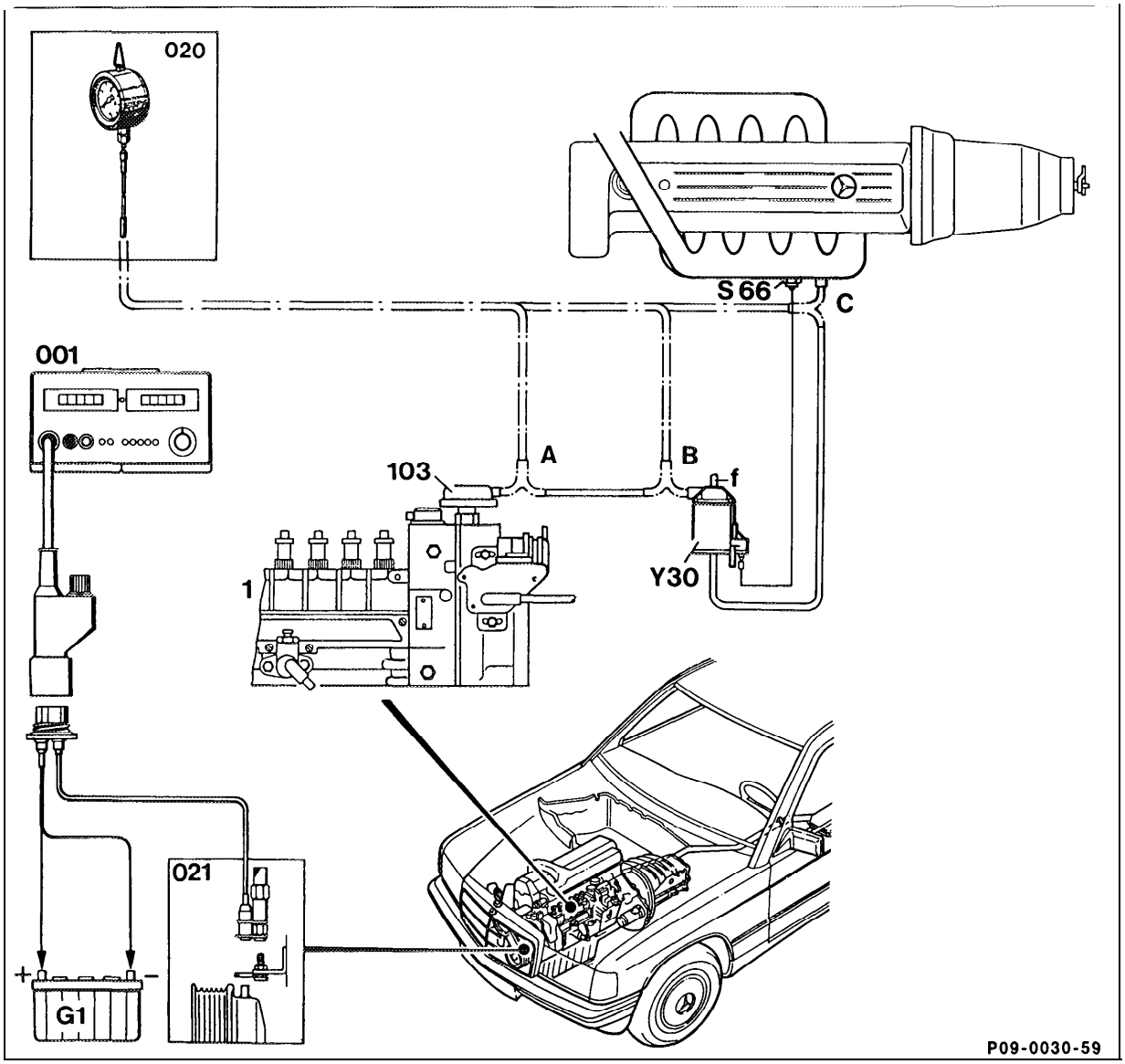
**Idle and Lower Part Load**

**No** boost pressure occurs during idling and in the lower part load range; therefore, the engine operates as a naturally aspirated engine.

**Upper Part Load and Full Load**

As the engine load and speed increase, e.g. with an increase in the exhaust gas flow, the turbine wheel (i) is accelerated producing a boost pressure up to a certain value via the compressor wheel (d). The compressed charge air is passed through the charge air pipe to the individual cylinders. The boost pressure allows an increased quantity of fuel to flow through the ALDA unit at the injection pump.

Although boost pressure exists in the deceleration mode, fuel injection is stopped as a result of the control rod position (deceleration fuel cutoff).




| | | |
|---|---|---|
| Tester | (001) ..... | connect, disconnect. |
| Pulse generator | (021) ..... | connect, disconnect. |
| Tester (020) with Y distributor | ..... | connect to measuring point “A” and test boost pressure. |
| Tester (020) with Y distributor | ..... | connect to measuring point ”B” and test boost pressure. |

Tester (020) with Y distributor . . . . . connect to measuring point "C" and test boost pressure.
Specification: 0.85-0.95 bar gauge pressure at 4000 rpm full load in drive position "3".

**Note**

This test can be conducted on the dynamometer or on the road.

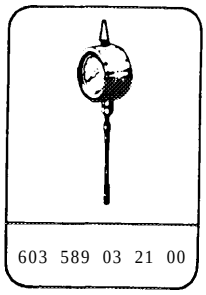
If the specified boost pressure is not reached, perform the following checks:

Connecting line from boost pressure control valve to compressor housing.
Switchover valve of engine overload protection (09-250).
White vacuum line and rubber connections.
If all components are in working order, replace turbocharger.

**Test data**

| | |
|---|---|
| Boost pressure at full load in drive position "3" at n = 4000 rpm | 0.85-0.95 bar gauge pressure |

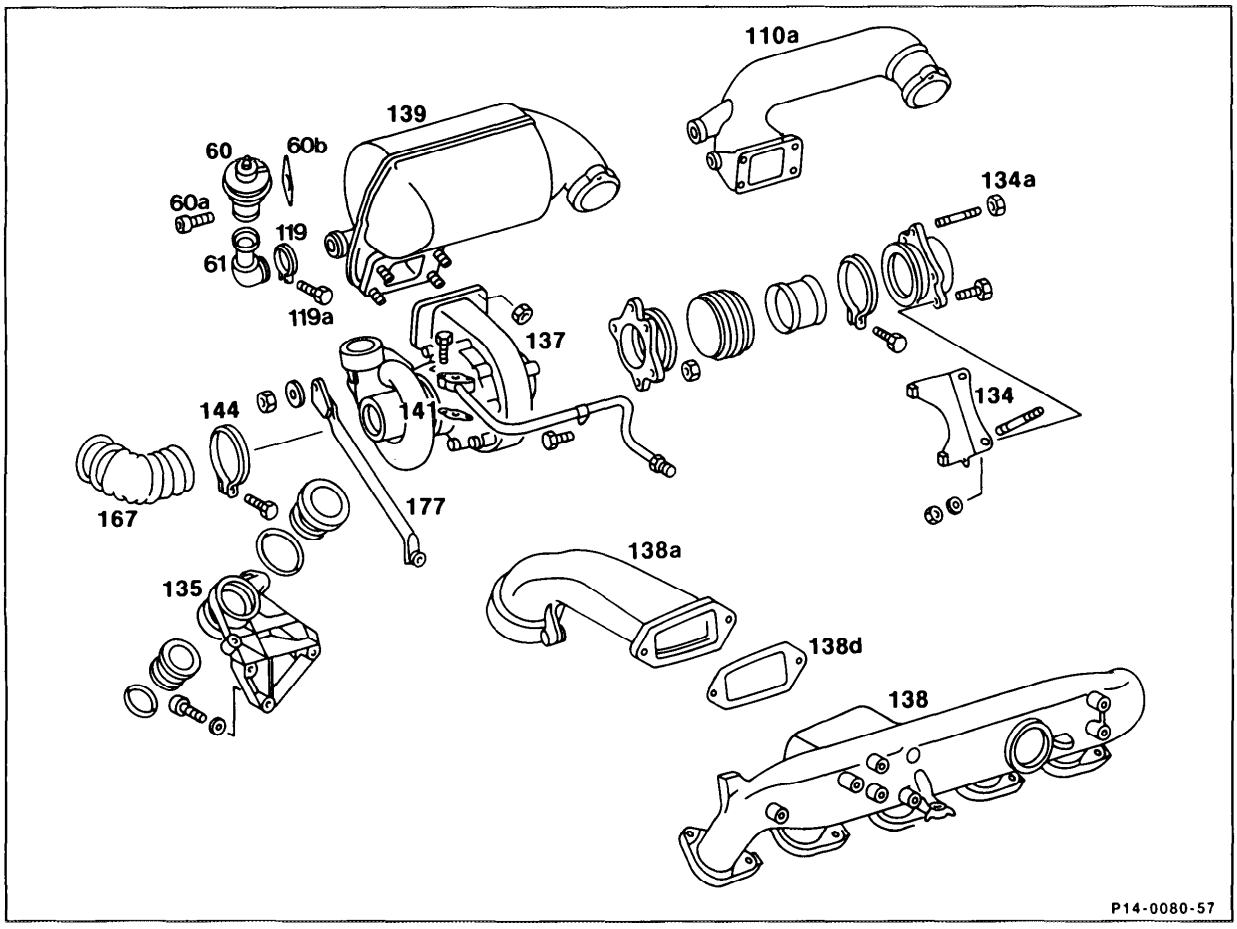
**Special tool**




**Commercial tester**

| | |
|---|---|
| Digital tester (or tachometer installed in car) | e.g. Bosch, MOT 002.01<br>Sun, DIT 9000<br>Sun, FMT-101 9/Master 3,<br>Sun, MCM-2110,<br>All-Test 361 O-MB |

## 09–150 Removal and Installation of turbocharger




| | |
|---|---|
| Vehicle | drive onto the platform or inspection pit. |
| Bottom section of noise encapsulation | detach, attach. |
| Air cleaner | remove, install (09-400). |
| Hose clip (144) | loosen and detach, attach intake hose (167). |
| Partition wall (A) between trap oxidizer and air cleaner | remove, install (9 bolts) of which 6 are accessible from above, 3 accessible from below (Figure 4). |
| Vacuum lines red/violet/brown on EGR valve (60) and red/violet/blue on air recirculation valve | detach, attach. |
| Clip (119) on corrugated pipe (61) | loosen, tighten. Tightening torque 45 Nm. |

| | |
|---|---|
| Corrugated pipe (61) | remove, install. |
| Exhaust gas recirculation valve (60) | remove, install.<br>Tightening torque 25 Nm. |
| Trap oxidizer (139) on exhaust manifold | unbolt, bolt on.<br>Tightening torque 45 Nm. |
| Supporting bracket | unbolt, bolt on and remove at the same time with trap oxidizer. |
| Charge air connecting line (138 a) | remove, install. Replace gasket (138 d). |
| Engine breather | detach, attach. |
| Mixing pipe (135) with exhaust gas recirculation valve (60) | remove, install. |
| Oil feed line (141) of turbocharger (137) | unbolt, bolt on. Replace seal. |
| Mounting bracket (134) | unscrew, screw on. |
| Nuts (134 a) (from top and bottom) | loosen, unscrew. |
| Mounting bracket (177) | remove, install. |
| Turbocharger (137) | remove, install. |

**Note**
The specified tightening torques are reference values.

## Removal, installation

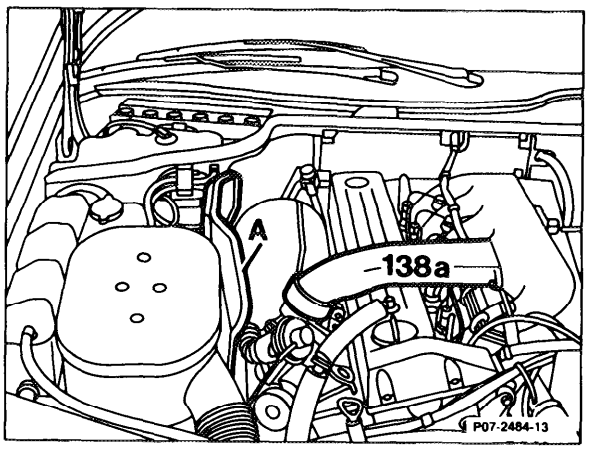
**Note**
For the conversion, the car must be driven onto an inspection pit or platform.

1 Completely remove noise encapsulation from below.

2 Remove air cleaner entirely.

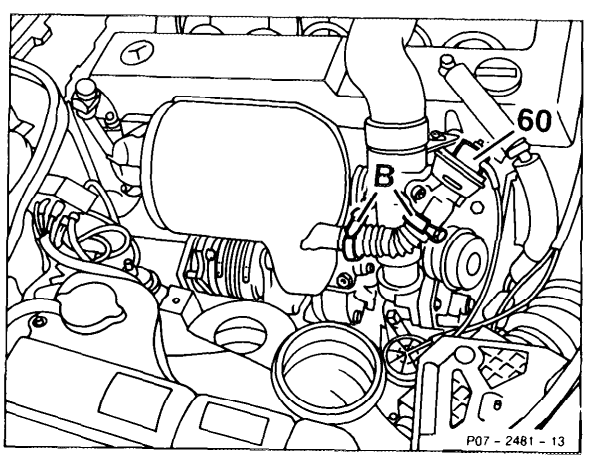
3 Loosen hose clip (144) from air flow sensor and detach intake hose (167).

4 Remove partition wall “A” (9 bolts), of which 6 (WAF10) are accessible from above, 2 (WAF8) and 1(WAF10) accessible from below.



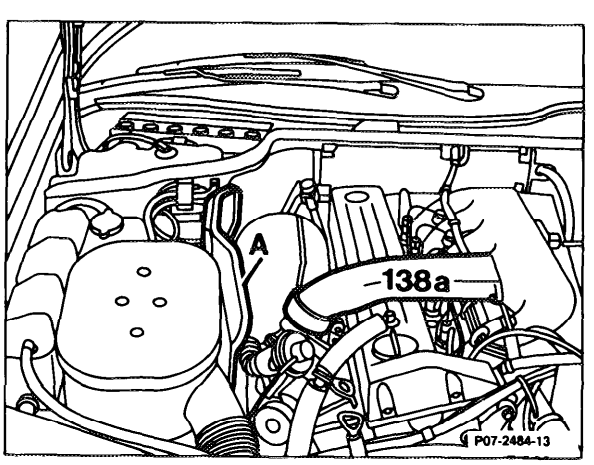

5 Detach vacuum lines red/violet/brown on EGR valve and red/violet/blue on air recirculation valve.

6 Loosen clips "B" on corrugated pipe, and remove corrugated pipe.



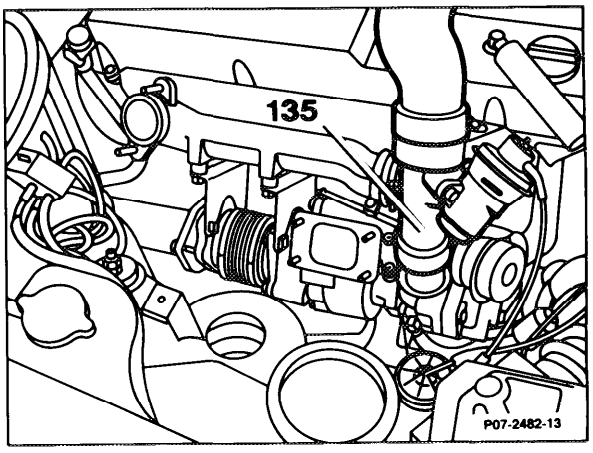

7 Unbolt trap oxidizer from exhaust manifold, remove trap oxidizer and supporting bracket at the same time.

8 Remove charge air connecting line (138 a).



9 Detach engine breather hose.

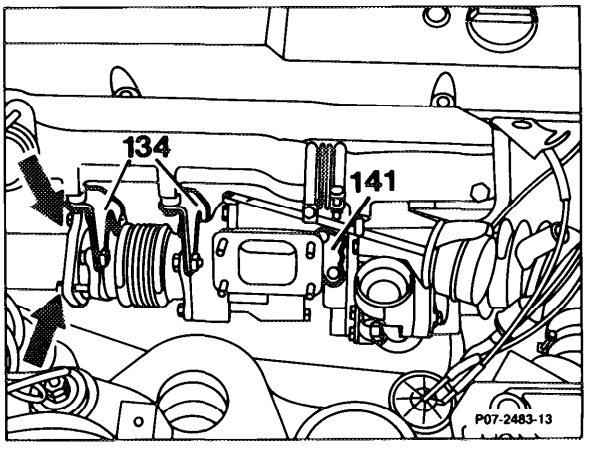
10 Detach mixing pipe (135) with exhaust gas recirculation valve from cylinder head.




11 Unbolt oil feed line (141) from turbocharger (replace seal).

12 Loosen both mounting brackets (134) on the exhaust manifold and turbocharger.

13 Loosen bolts of exhaust pipe - accessible from above (arrows).




14 Loosen bottom bolt of exhaust flange.

15 Unbolt mounting (177) from alternator flange to turbine housing on both components.

16 Remove turbocharger.

17 Install corrugated pipe with flange onto new turbocharger.

18 Clean sealing surfaces mechanically.

20 Install new trap oxidizer, insert supporting bracket at the same time and install. Tightening torque 45 Nm.

21 Install EGR valve together with corrugated pipe.

22 Install partition panel.

23 Connect vacuum line red/violet/brown to EGR valve and vacuum line red/violet/blue to air recirculation valve.

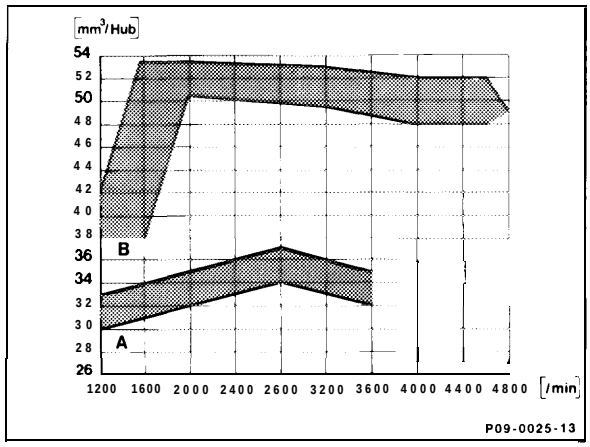
24 Connect intake hose to air flow sensor and tighten hose clip.

25 Install air cleaner complete.

26 Completely reinstall bottom section of noise encapsulation .

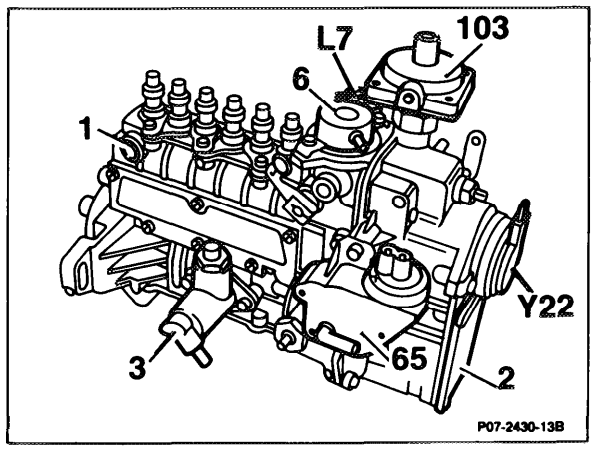
# 09–200 Function of engine overload protection - Turbodiesel

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

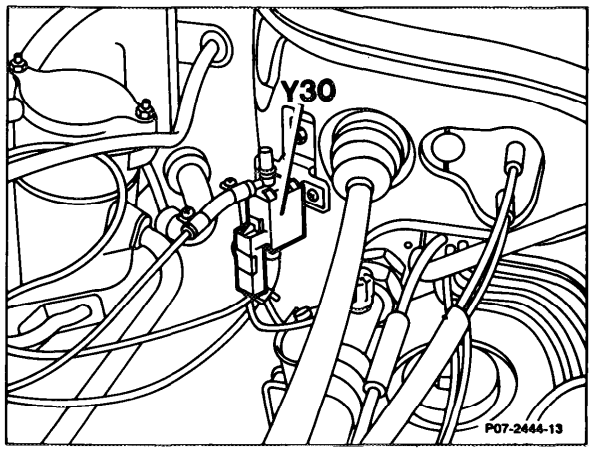



A Naturally aspirated engine quantity (P = 1050 mbar)
B Full load quantity with turbocharging

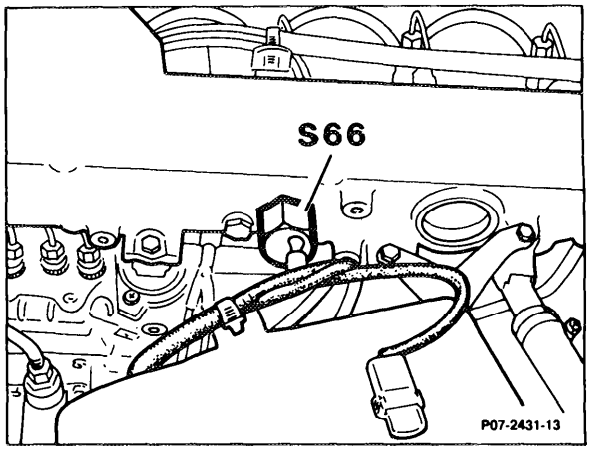
## Location of Components




1 Injection pump
2 Governor
3 Fuel pump
6 Stop unit
65 Vacuum control valve
103 ALDA unit
Y22 Actuator




Y30 Switch-over valve, engine overload protection

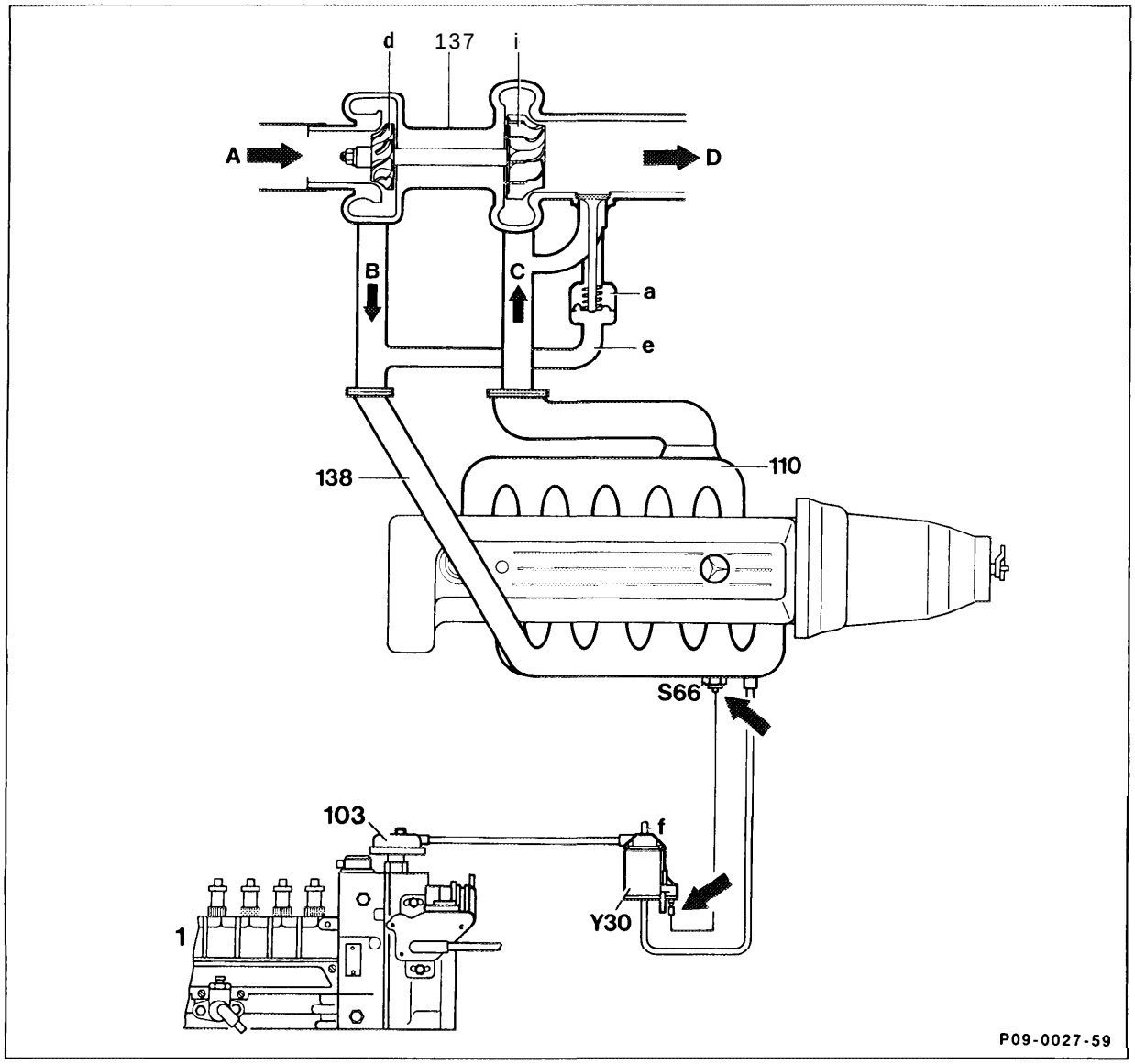



S66 Switch, engine overload protection

Pressure, vacuum diagrams (refer to 07.1-500).

Wiring diagrams (refer to 07.1-400).

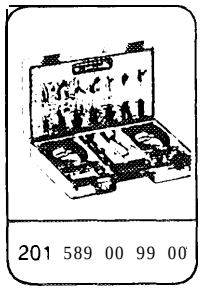
# 09–250 Testing engine overload protection - Turbodiesel




| | | | |
|---|---|---|---|
| 1 | Injection pump | a | Boost pressure control valve |
| 103 | ALDA unit | d | Compressor wheel |
| 110 | Exhaust manifold | e | Control line |
| 137 | Turbocharger | f | Air admission |
| 138 | Charge air pipe | i | Turbine wheel |
| S66 | Pressure switch, engine overload protection | A | Compressor inlet (fresh air) |
| Y30 | Switch-over valve, engine overload protection | B | Compressor outlet (precompressed air) |
| | | C | Exhaust gases to turbine wheel |
| | | D | Exhaust outlet |

| | |
|---|---|
| 2-pin connector on switchover valve (Y30) ..... | detach and briefly energize with voltage. The switchover valve must audibly actuate; replace if necessary. |
| l-pin connector on pressure switch (S66) ..... | detach and test for continuity with ohmmeter. The pressure switch (S66) is open in the off position. |
| Engine overload protection switch (S66) ..... | remove.<br>Connect pressure switch to cable of nozzle tester KDJE-P 400.<br>Connect ohmmeter to pin of pressure switch and to housing. Build up pressure of 1 .1 ± 0.15 bar at nozzle tester; the pressure switch must not have any continuity. Replace pressure switch if necessary. |

**Special tools**

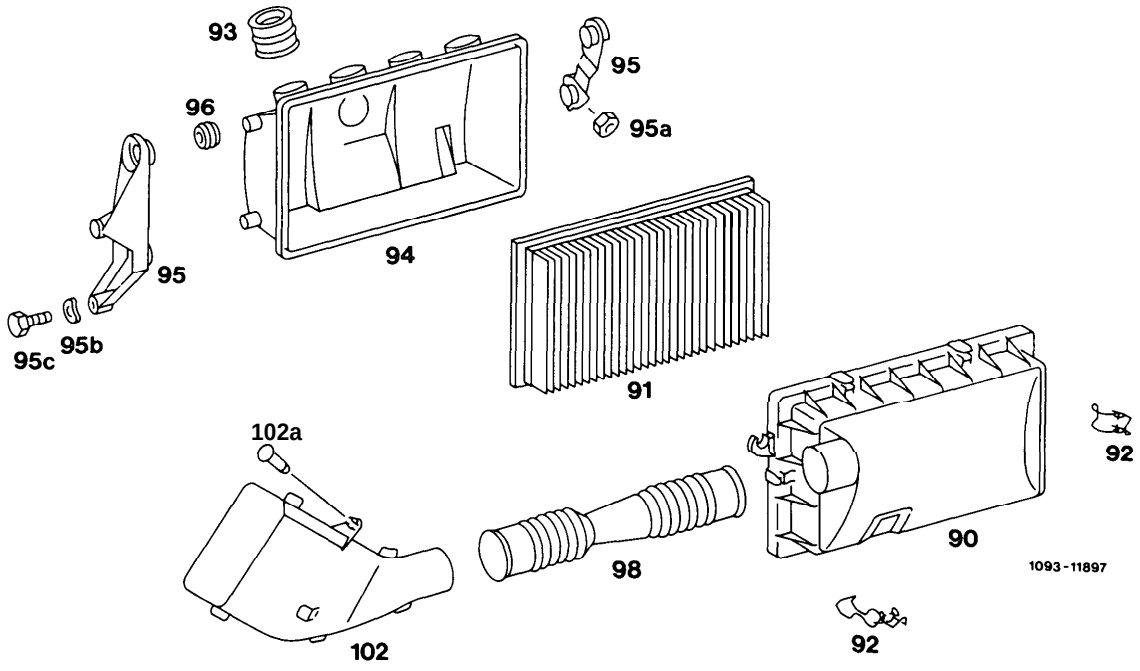



Commercial tester

| | |
|---|---|
| Digital multimeter | e.g.Sun, DMM 5 |
| Valve tester | e.g. Bosch, KDJE-P 400<br>(Bosch Order Designation) |
| Optionally O-6 bar pressure gauge | e.g. Bosch No. 1687 231 000 |
| Optionally nozzle tester EFEP 60H | e.g.Bosch No. 0684 200 700 |

# 09-400 Removal and installation of air cleaner

## A. Standard version and Federal as of 1984




| | |
|---|---|
| Suction line (98) | installation position. |
| Closing catch, 6 off (92) | open, close. |
| Air cleaner cover (90) | remove, reinstall. |
| Air cleaner filter element (91) | remove, reinstall. |
| Nut (95a) | remove, reinstall. |
| Washer (95b) | remove, reinstall. |
| Bolt (95c) | remove, reinstall. |
| Bracket, 2 off (95) | remove, reinstall. |
| Air guide housing (94) | remove, reinstall. |
| Sealing boot (93) | remove, reinstall, ensure proper seating. |
| Rubber, 4 off (96) | replace according to condition. |
| Intake scoop (102) | remove, reinstall. |
| Pin (102a) | replace according to condition. |

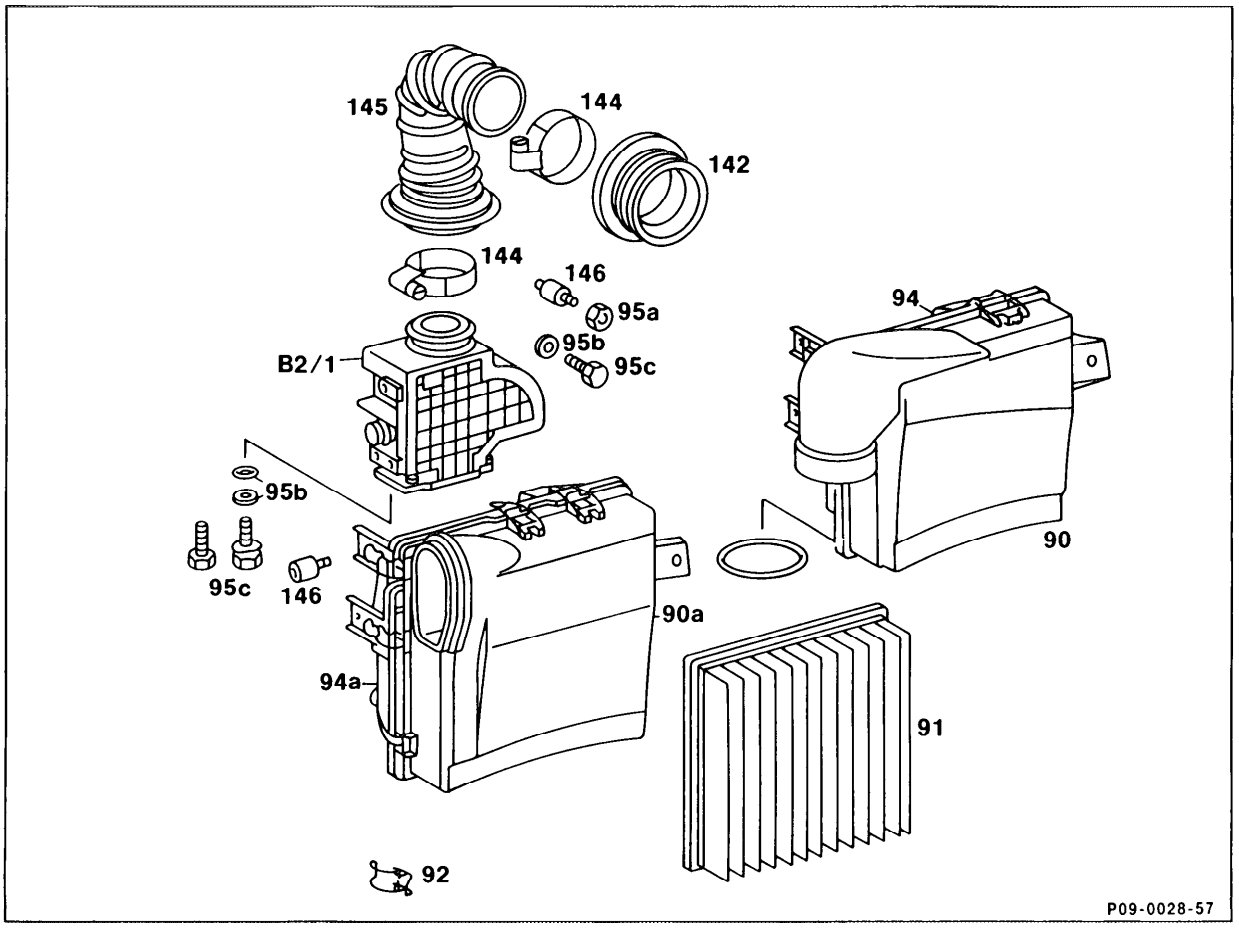
**Engine 602.91**

Air cleaner cover (90) and filter element (91) of revised material.

**Production breakpoint:** December 1989

| Model | Engine | Engine end no. Manual transmission | Engine end no. Automatic transmission |
|---|---|---|---|
| 201.126 | 602.911 | 086698 | 016956 |

## B. Model 201




| | |
|---|---|
| Air cleaner element (91) | remove, install. Ensure correct position during installation. |
| Air cleaner cover (90) | remove, install. |
| Air guide housing (94) | remove, install. |
| Air guide housing (94 a) | remove, install. |
| Cup seal (142) | remove, install. |
| Hose strap (144) | slacken, tighten, remove, install. |
| Intake pipe air line (145) | remove, install. |
| Stopper (146) | renew according to condition. |
| Nut (95 a) | bolt on, unbolt. |
| Air flow sensor (B2/1) | remove, install. |
| Wire clip (92) | unclip, clip in place. |
| Air cleaner cover (90 a) | remove, install. |
| Washer (95 b) | remove, install. |
| Bolt (95 c) | remove, install. |

**Repair Instruction**

When the engine is running, the fender cover (right) must be removed, otherwise the fresh air intake (arrow) is blocked.