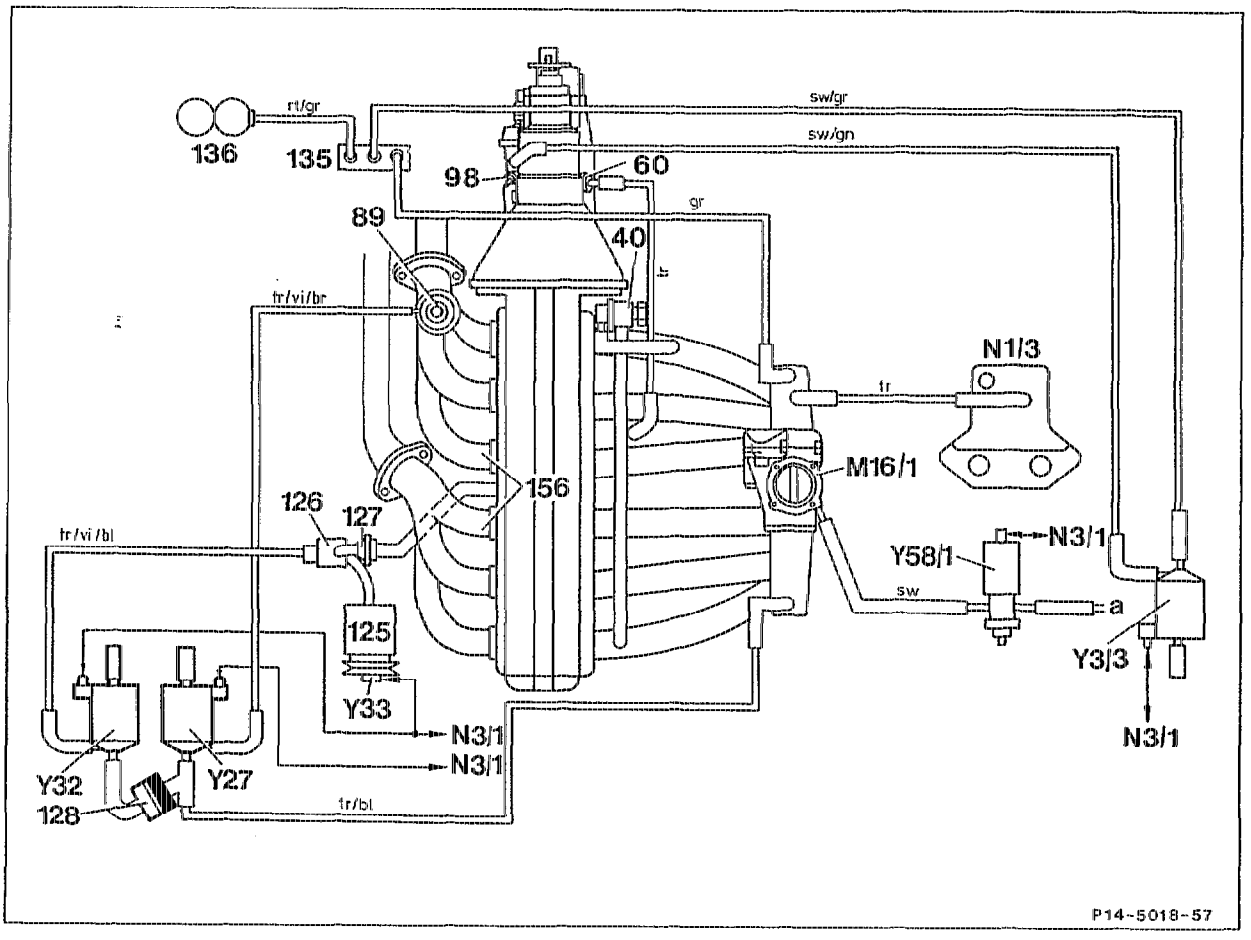
A. Function diagram of air injection and exhaust gas recirculation as well as vacuum supply

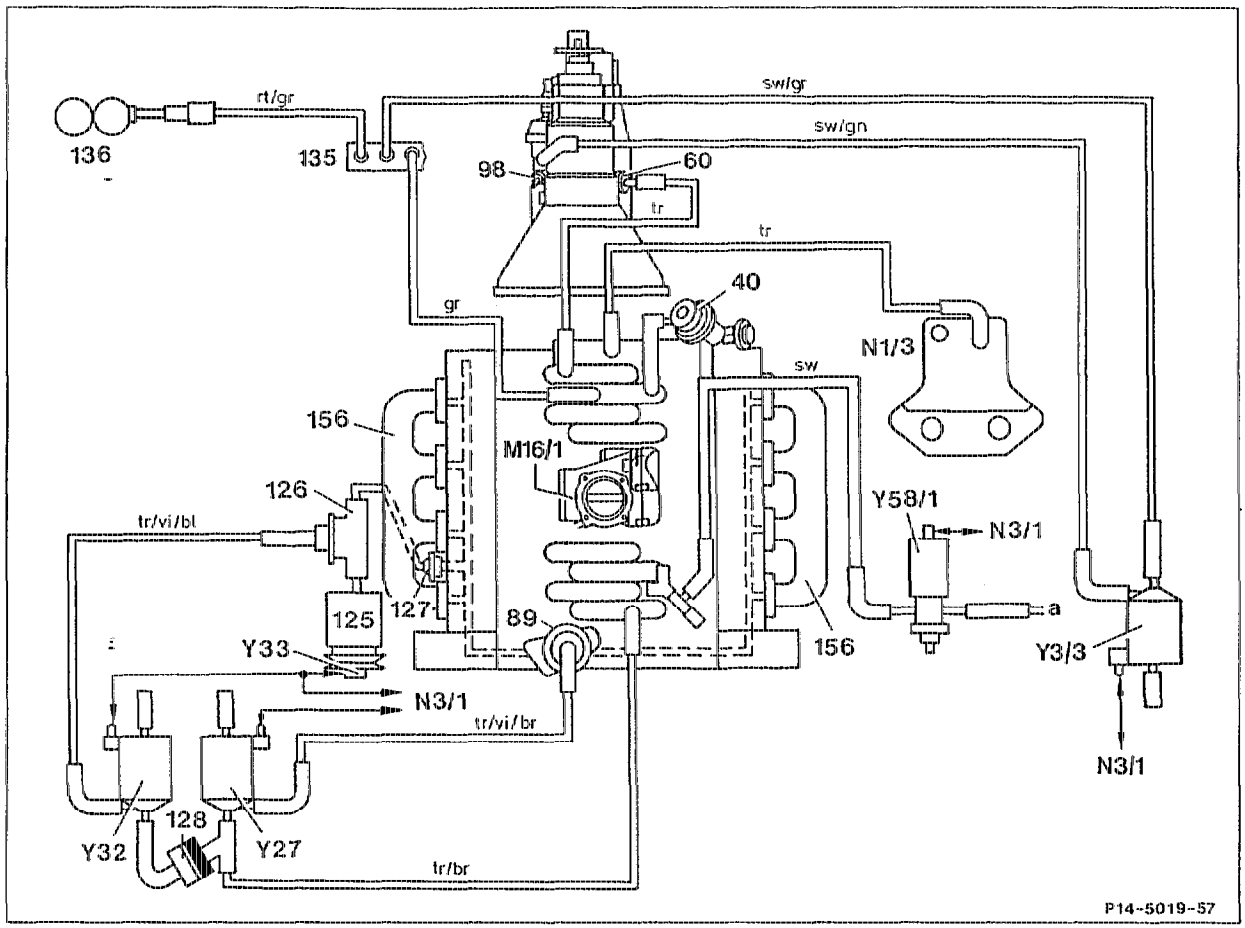
a) Engine 104



Function diagram of air injection and exhaust gas recirculation as well as vacuum supply

40	Diaphragm pressure regulator	Y27	Exhaust gas recirculation switchover valve 1)
60	Vacuum unit	Y32	Air pump switchover valve 2)
89	Exhaust gas recirculation valve 1)	Y33	Air pump electromagnetic clutch 2)
98	Shift point retard vacuum element	Y58/1	Regeneration switchover valve
125	Air pump 2)		
126	Air shutoff valve	a	Activated charcoal filter
127	Non-return valve (injected air)	bl	blue
128	Non-return valve (vacuum)	br	brown
135	Non-return valve (vacuum supply)	gr	grey
136	Vacuum reservoir	rt	red
156	Exhaust manifold	sw	black
		tr	transparent
M16/1	Electronic accelerator pedal (EFP) actuator	vi	violet
N1/3	EZL ignition control unit		
N3/1	Hot wire (LH) control unit	1)	Only (J), (USA)
Y3/3	Shift point retard switchover valve	2)	Only on vehicles with KAT

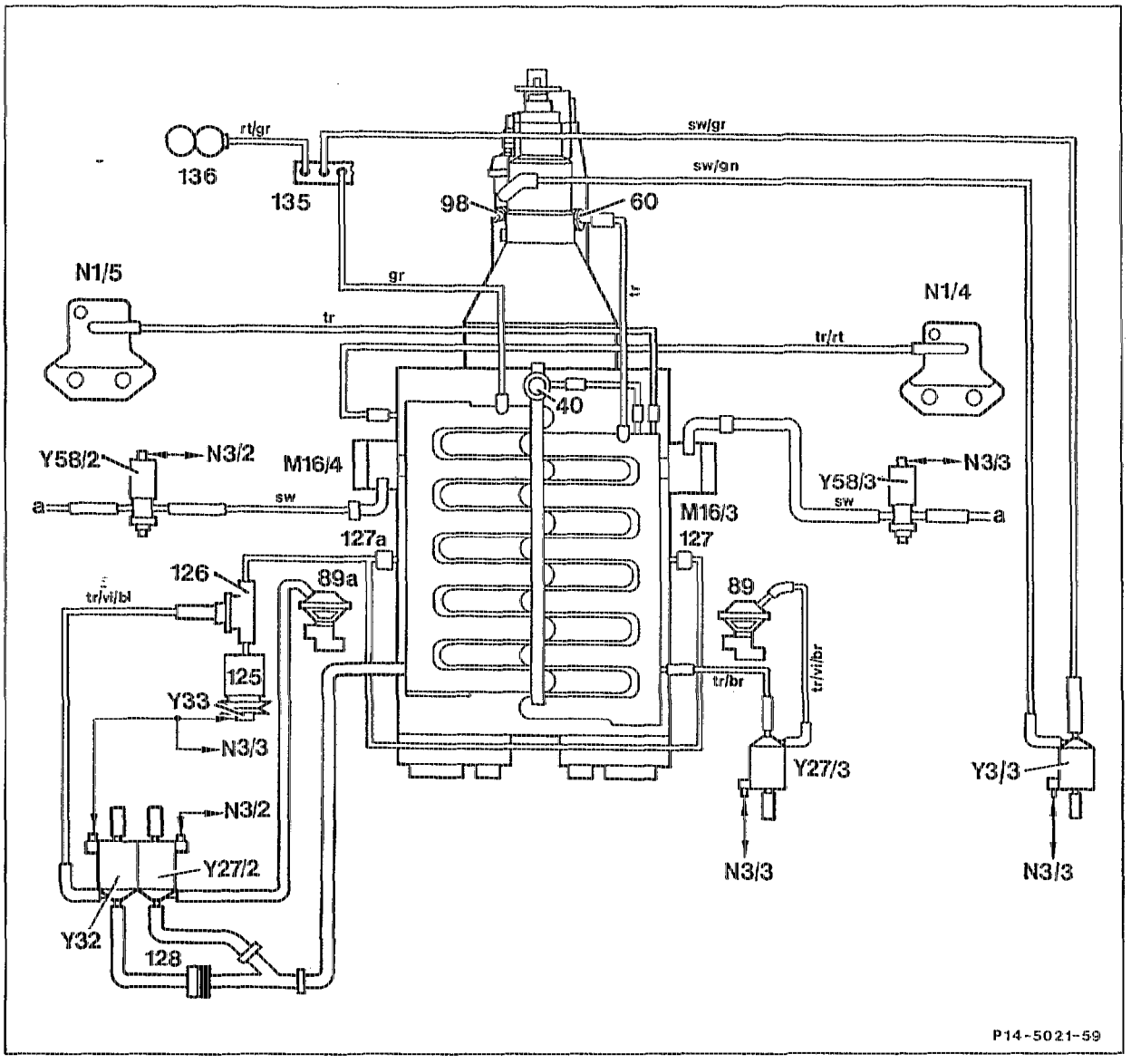
b) Engine 119



Function diagram of air injection and exhaust gas recirculation as well as vacuum supply

40	Diaphragm pressure regulator	Y32	Air pump switchover valve [1]
60	Vacuum unit	Y33	Air pump electromagnetic clutch [1]
89	Exhaust gas recirculation valve	Y58/1	Regeneration switchover valve
98	Shift point retard vacuum element [1]		
125	Air pump [1]	a	Activated charcoal filter
126	Air shutoff valve [1]		
127	Non-return valve (injected air) [1]	bl	blue
128	Non-return valve (vacuum)	br	brown
135	Non-return valve (vacuum supply)	gr	grey
156	Exhaust manifold	rt	red
		sw	black
M16/1	Tempomat cruise control/idle speed control actuator	tr	transparent
		vi	violet
N1/3	EZL ignition control unit		
N3/1	LH control unit	[1]	Only on vehicles with KAT, except (AUS)
Y3/3	Shift point retard switchover valve [1]		
Y27	Exhaust gas recirculation switchover valve		

c) Engine 120

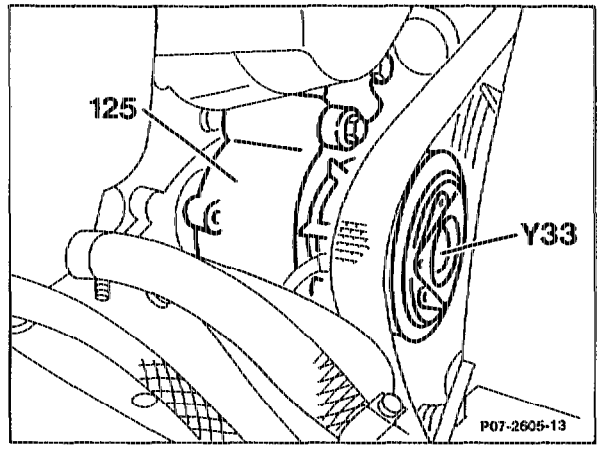


Function diagram of air injection and exhaust gas recirculation as well as vacuum supply

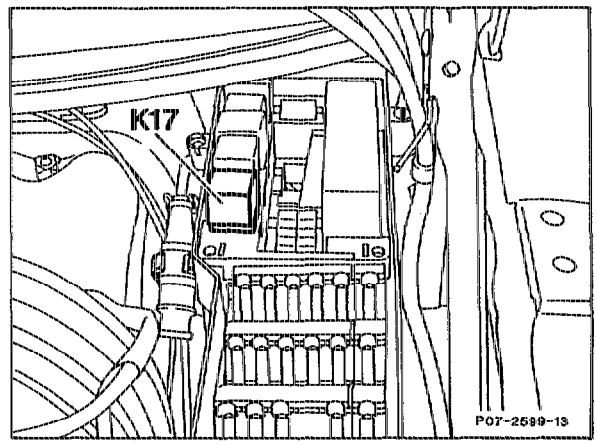
40	Diaphragm pressure regulator	Y3/3	Shift point retard switchover valve [1]
60	Vacuum unit	Y27/2	Left ARF switchover valve
89	Left exhaust gas recirculation valve	Y27/3	Right ARF switchover valve
89a	Right exhaust gas recirculation valve	Y32	Air pump switchover valve [1]
98	Shift point retard vacuum element	Y33	Air pump electromagnetic clutch [1]
125	Air pump [1]	Y58/2	Left regeneration switchover valve
126	Air shutoff valve [1]	Y58/3	Right regeneration switchover valve
127	Left non-return valve (injected air) [1]		
127a	Right non-return valve (injected air) [1]	a	Activated charcoal filter
128	Non-return valve (vacuum)		
135	Non-return valve (vacuum supply)	bl	blue
136	Vacuum reservoir	br	brown
		gr	grey
M16/3	Electronic accelerator pedal (EFP) actuator, left cylinder block	rt	red
		sw	black
M16/4	Electronic accelerator pedal (EFP) actuator, right cylinder block	tr	transparent
		vi	violet
N1/4	Left EZL ignition control unit		
N1/5	Right EZL ignition control unit	[1]	Only on vehicles with KAT, except (AUS) up to 1992
N3/2	Left LH control unit		
N3/3	Right LH control unit		

B. Air injection (only KAT version)

The catalytic converter is not operational until the temperature is in excess of approx. 300 °C. To enable the catalytic converter to reach its operating temperature more rapidly, air is supplied by an air pump (125) to the exhaust gas directly downstream of the exhaust valve. This air results in post-combustion of the incompletely oxidized exhaust elements CO and HC.
The air pump is flanged above the alternator and draws in the air through a maintenance-free dry air filter integrated in the pump housing.



The magnetic clutch of the air pump is engaged by the LH control unit via the air injection relay (K17). At the same time, the air pump switchover valve is actuated and allows the vacuum to flow to the air shutoff valve.



Air injection is performed after the engine is started at the coolant temperature stated below; a certain engine speed and inducted air quantity must not be exceeded.
The lambda control is not operational during air injection.

Engine	Coolant temperature	max. engine speed	max. injection time
104	15–45 °C	3400/min	110 s
119	10–40 °C	2500/min	110 s
120	10–44 °C	2750/min	155 s

Engine 104, 119
The quantity of air is split downstream of the air shutoff valve and is injected into the cylinder head along a line between cylinders 3 and 4.
The air is distributed to all exhaust ports via the internal port.

Engine 120
The quantity of air is split downstream of the air shutoff valve and injected into the left-hand side of the cylinder head at cylinder 10 and into the right-hand side at cylinder 3.
The air is distributed to all exhaust ports via the internal ports.

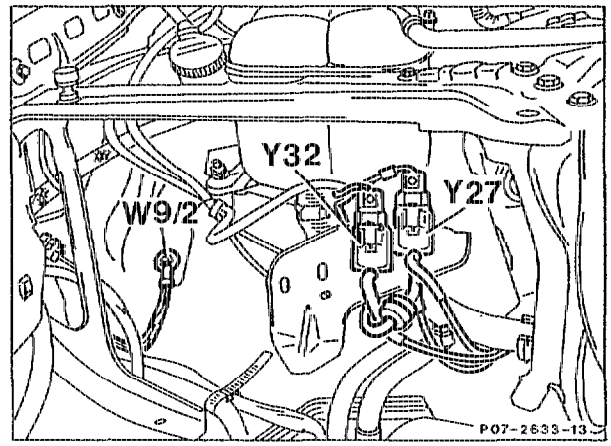
C. Exhaust gas recirculation

a) General

To reduce the oxides of nitrogen (NO_X) in the exhaust gases, part of the exhaust (approx. 10–15%) is recirculated from the exhaust manifold through an exhaust gas recirculation valve into the intake manifold. The point at which the exhaust gas is introduced into the intake manifold is located downstream of the throttle valve so that the air mass measurement is not affected.

The exhaust gas recirculation valve is controlled by the LH control unit via the exhaust gas recirculation switchover valve (Y27, engine 120 Y27/2 and Y27/3, see function diagrams).
Exhaust gas recirculation operates:

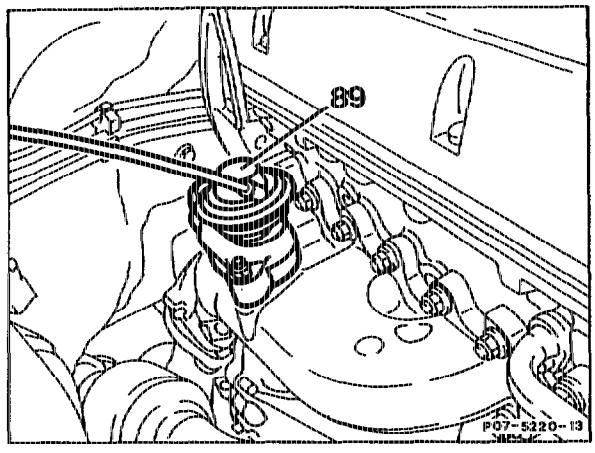
- at coolant temperatures > 65 °C,
- not at full throttle
- not at idling speed



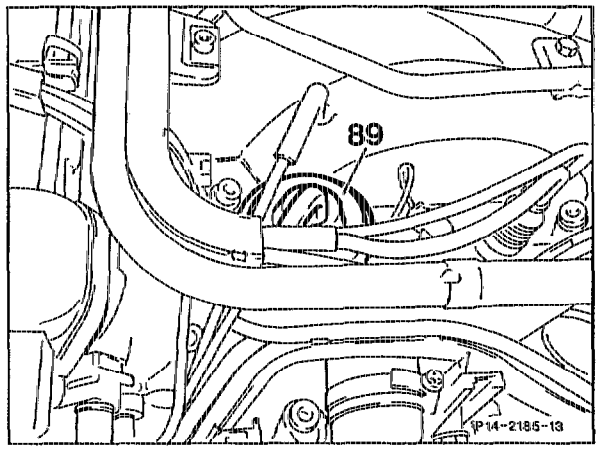
Shown on engine 119

b) Location of components

Engine 104 only (J) and (USA)
The exhaust gas recirculation valve (89) is fitted at the exhaust manifold of cylinders 4–6. The exhaust passes along a pipe to the intake manifold.

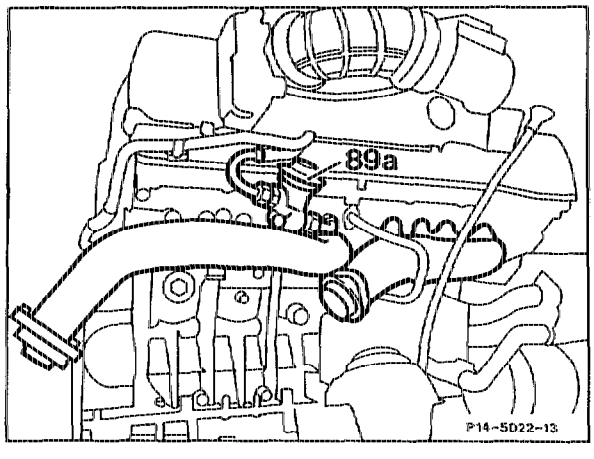


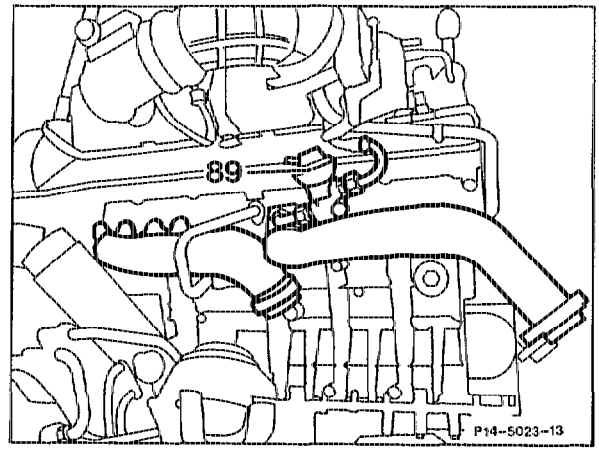
Engine 119
The exhaust gas recirculation valve (89) is mounted on the intake manifold. The exhaust extraction point is in the exhaust port of cylinder 1. The exhaust passes along a duct in the cylinder head to the exhaust gas recirculation valve from where it is fed into the intake manifold.



Engine 120
The exhaust gas recirculation valves (89, 89a) are located at the exhaust manifolds.
The exhaust flows along pipes from the exhaust manifold flanges (on left cylinder 10, on right cylinder 4) through the ARF valves into the intake manifold.

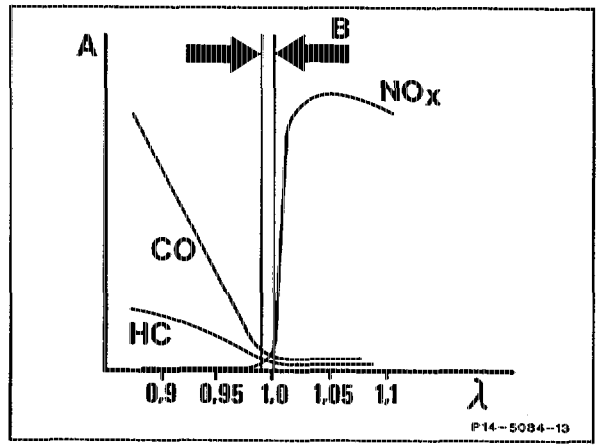
⚠
Left ARF valve (89) for right bank of cylinders.
Right ARF valve (89a) for left bank of cylinders.





D. Lambda control

If the emissions control system is to operate with a high efficiency, the mixture composition must be maintained with a high degree of accuracy. As a result of the control circuit formed with the aid of the oxygen sensor, deviations from the stochiometric fuel/air ratio ($\lambda = 1$) can be recognized and corrected. The control principle is based on measuring the residual oxygen content in the exhaust.



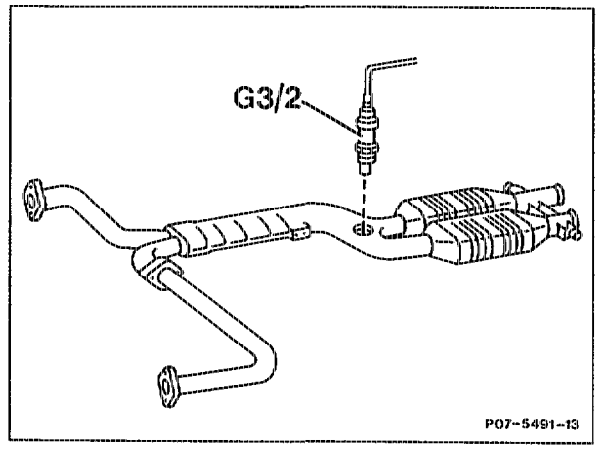
A Exhaust emissions
B Control range around $\lambda = 1$ (catalyst window)

The sensor used is the oxygen sensor which displays a voltage jump at a mixture which is exactly stochiometric ($\lambda = 1$) and thus supplies a signal which indicates whether the mixture is richer or leaner than $\lambda = 1$.
The stochiometric air/fuel ratio is the mass ratio of 14.7 kg air to 1 kg fuel which is theoretically required for complete combustion. The air number or the air ratio lambda (λ) indicates the extent to which the air/fuel mixture which actually exists differs from that theoretically required:

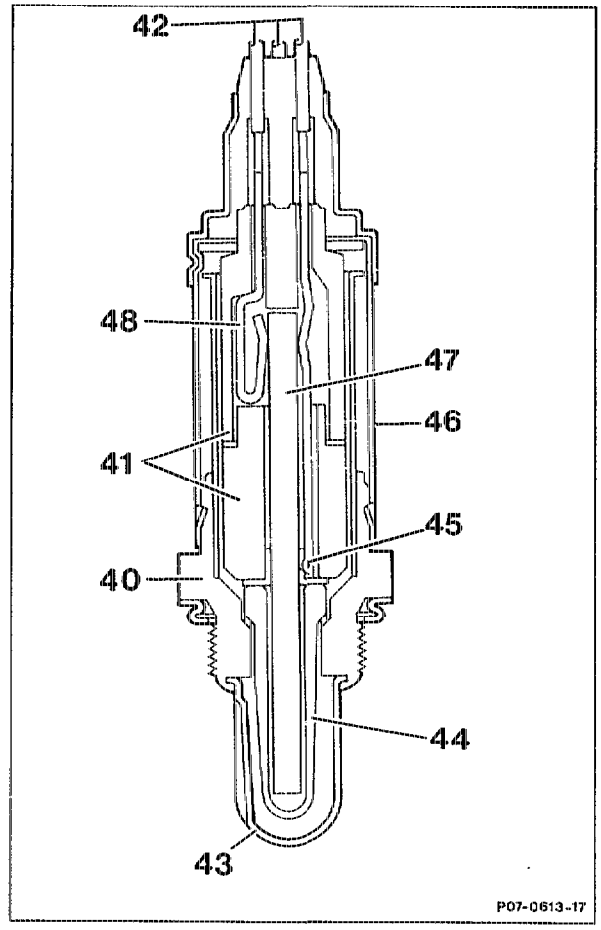
$$\lambda = \frac{\text{air mass supplied}}{\text{theoretical air demand}}$$

E. Oxygen sensor

The oxygen sensor (G3/2) is screwed into the front exhaust pipe.
It uniformly detects the exhaust flow of all the cylinders in the exhaust pipe.



The active part of the oxygen sensor is a ceramic body, consisting of zirconium dioxide. It is coated on the surface with a gas permeable platinum layer and also with an additional protective coating on the exhaust side.
A metal tube with several slots protects the ceramic body from mechanical stresses.
The outside of the active sensor ceramic is exposed to the exhaust emissions, while the inside is in contact with the atmosphere.
At normal operating temperature, the ceramic material is conductive for oxygen ions of the residual oxygen. As a result of the different oxygen portion between exhaust and atmosphere a voltage is produced at the exhaust sensor.

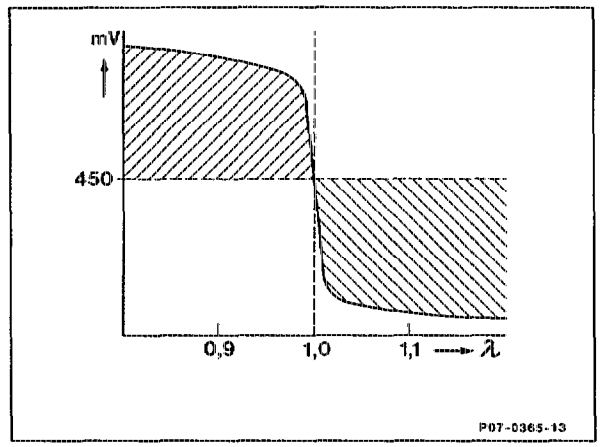


Heated oxygen sensor

40 Sensor housing
41 Ceramic supporting tube
42 Connection cable
43 Metal tube with slots
44 Active sensor ceramic
45 Contact part
46 Protective sleeve
47 Heating element
48 Terminal connections for heating element

At operating temperature (>300 °C) the oxygen sensor supplies a voltage signal to the LH control unit:
Voltage >450 mV: mixture rich.
Voltage <450 mV: mixture lean.

A voltage jump exists at the transition from the rich to lean range ($\lambda = 1$). This voltage signal is analyzed by the LH control unit which then controls the fuel/air mixture accordingly.

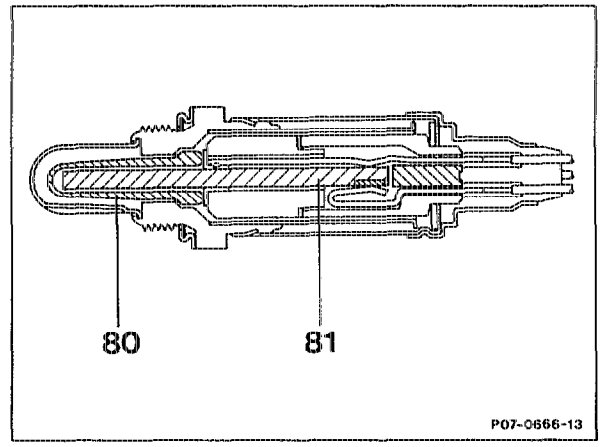


In addition to the oxygen portion in the exhaust, the temperature of the ceramic body also plays a decisive roll.
The response time for a voltage change when a change occurs in the mixture composition is a matter of seconds when the ceramic temperature is below 300 °C, and less than 50 ms at the optimal operating temperature around 600 °C.

The oxygen sensor is heated to ensure that it reaches its operating temperature as rapidly as possible and that this is maintained at a constant level.

Oxygen sensor heater

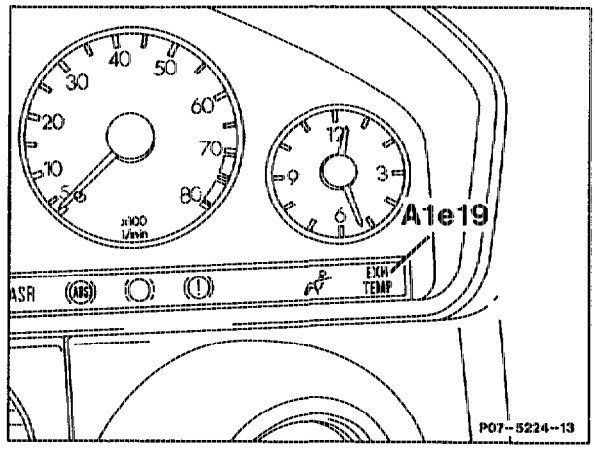
In addition to the oxygen portion in the exhaust, the temperature of the ceramic body (80) of the oxygen sensor also plays an important roll as it influences the conductivity for the residual oxygen.
The ceramic material becomes conductive from approx. 300 °C, the working temperature is approx. 600 °C. A heating element (81), which is supplied with voltage by the LH control unit at coolant temperatures above 35 °C, is integrated in the oxygen sensor. This ensures that the oxygen sensor reaches its operating temperature very rapidly. The power consumption of the oxygen sensor is 18 W.
As the oxygen heater is no longer necessary as soon as hot exhaust gases flow at higher engine speed, it is switched off at an engine speed in excess of 5500/min and switched on again below 5000/min.



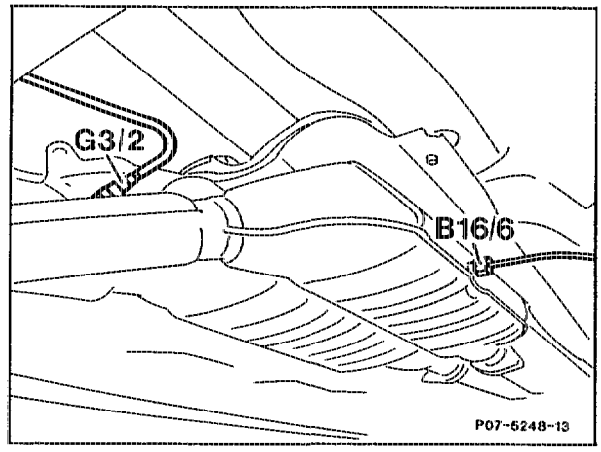
F. Catalytic temperature warning system (only (J))

a) Design

The task of this warning system is to signal an impermissibly high temperature rise in the catalytic converter to the driver by the "EXH TEMP" warning lamp (A1e19) lighting up.



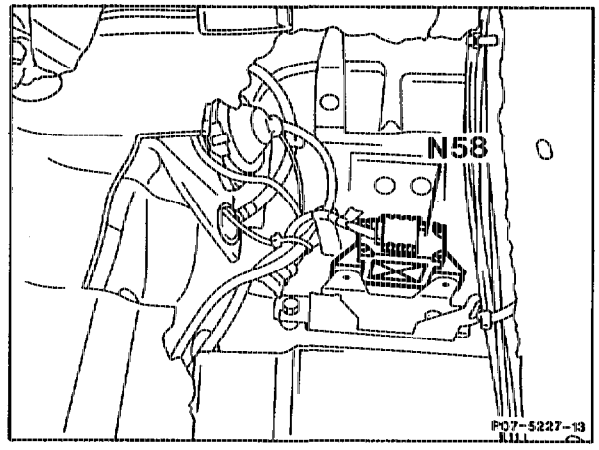
A KAT thermocouple (B16/6) is fitted to the catalytic converter which detects the exhaust temperature and passes this to the catalytic converter overheating control unit (N58).



Shown on engine 119, model 140

B16/6 KAT termocouple

A relay and a timer are provided in the catalytic converter overheating control unit (N58).



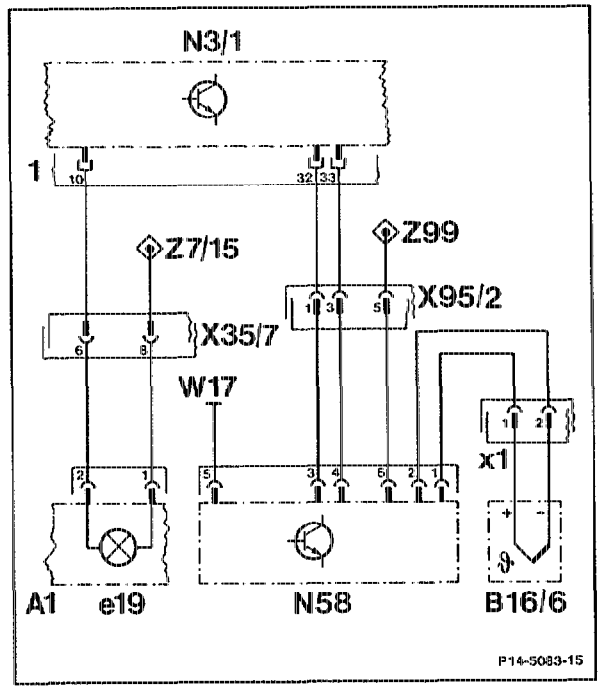
Shown on engine 119, model 140

b) Operation

The KAT thermocouple (B16/6) supplies a very low voltage (millivolts), depending on the temperature, to the electronics in the catalytic converter overheating control unit (N58).

At temperatures of approx. 900 °C the voltage is sufficiently large for the electronics in the catalytic converter overheating control unit (N58) to operate the catalytic converter overheating warning lamp (A1e19) with ground.

The warning system is operated after switching on the ignition until the engine is started as an automatic check of the warning lamp and the wiring.



Shown on engine 119, model 140

A1e19	Catalytic converter overheating warning lamp
B16/6	KAT thermocouple
B16/6x1	Plug connection, KAT thermocouple
N3/1	Hot wire (LH) control unit
N58	Catalytic converter overheating control unit
W17	Ground, right rear seat
X35/7	Separation point, cockpit/module box (18-pin)
X95/2	Plug connection, catalytic converter overheating (6-pin)
Z7/15	Connector sleeve, terminal 87 corresponding hot wire (LH)
Z99	Connector sleeve, terminal 87 SA