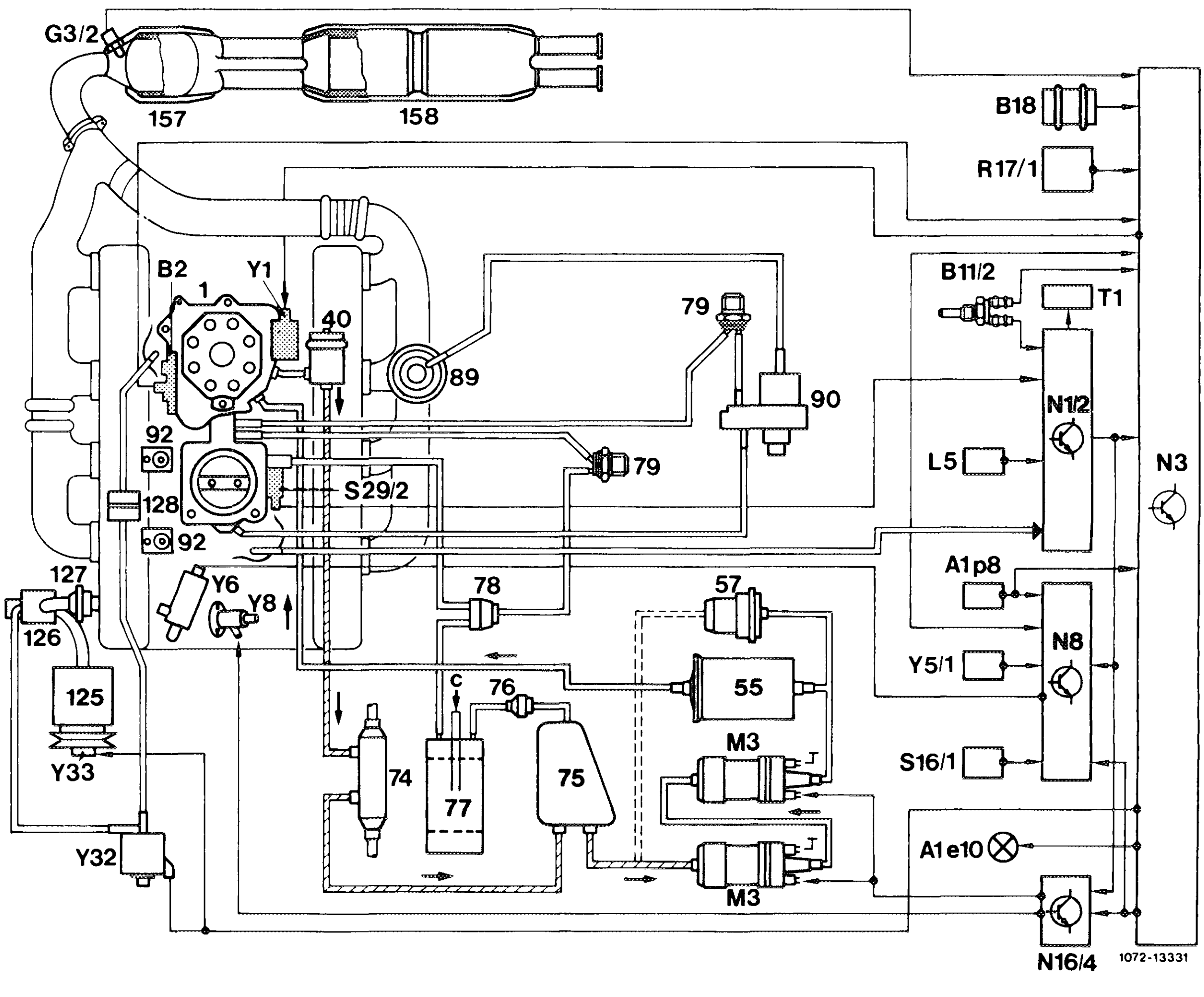
## A. General

The function of the emission control system is described in the following sections (B through H).

## B. Function diagrams

### Engines 116, 117 with Exhaust Gas Recirculation and Air Injection



**Fault diagnosis by means of impulse period measurement**

The CIS-E control unit identifies faulty input signals and issues a fault report to the lambda measuring output. The fault report can be taken off the diagnostic socket with the lambda tester. Short circuit and wiring interruption can be identified.

A certain impulse period is allocated to each fault. The output of fault reports has priority over the output of the lambda control signal. If the lambda control is not operational (e.g. temperature oxygen sensor inadequate), the measured value display is 50% (control operation/constant display). With lambda control switched on, the display fluctuates around a mean value. If several faults occur at the same time, the fault corresponding to the smallest impulse period will always be shown. This takes place until all faults have been eliminated. An allocation of impulse period and possible cause of the fault is compiled in the testing program (07.3-121, section B).

**Plausibility circuits**
The signals input into the CIS-E control unit by the peripheral components are continuously registered.
If the composition of the signals is no longer logical, the electronics automatically form a replacement value (emergency operation characteristic) for the implausible signal.

## D. Lambda control

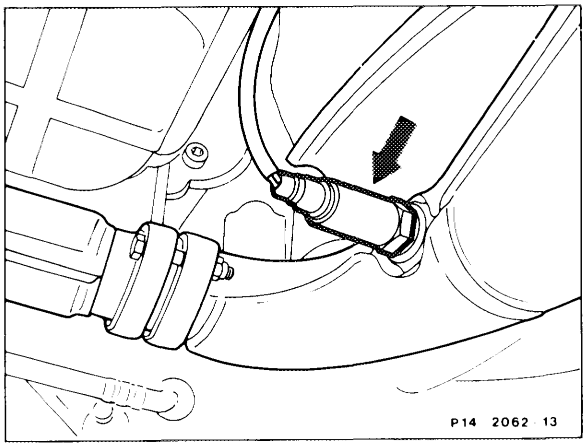
The CIS-E control unit handles oxygen sensor monitoring, signal amplification and the calculation of the output signal for the electrohydraulic adjusting element from the input signals. The current with lambda control is approx. −12.5 to +12.5 mA.

The lambda control is not operational during the following operating conditions:

- Oxygen sensor not operational or defective.
- Coasting operation with deceleration shut-off.
- Full load operation.
- Acceleration enrichment.
- During starting process below 15 °C coolant temperature to coolant temperature +70 °C.
- After start increase > 0 mA (only after starting process).

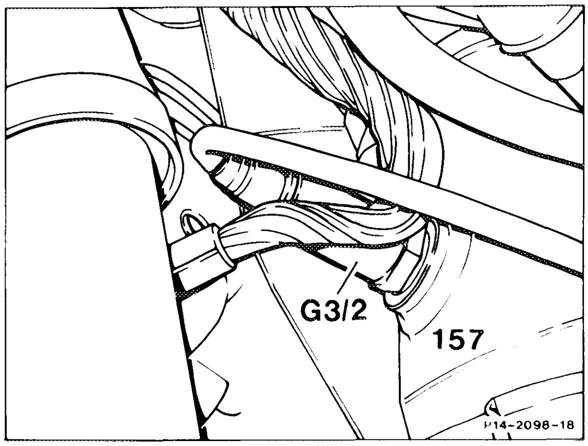
## E. Oxygen sensor

The oxygen sensor is installed in the firewall catalytic converter or in the underfloor catalytic converter.
It is heated in order to provide constant operating temperature for the oxygen sensor.
The heating element of the oxygen sensor is provided with voltage via terminal 87 of the fuel pump relay and is heated as long as the fuel pump is running.



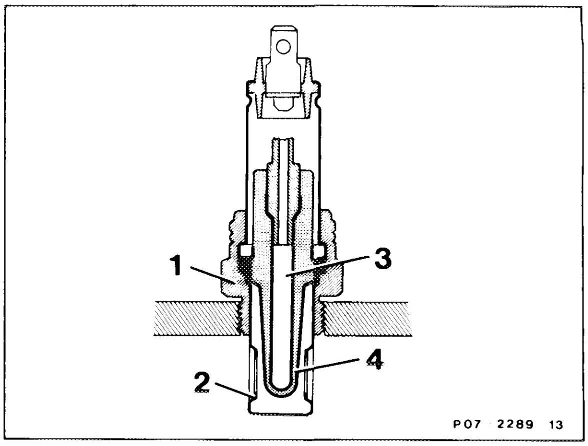

Model 107

⚠
Fuel pump relay and kickdown shut-off (N16/4) with additional plug for oxygen sensor heating.
Oxygen sensor (G3/2) is only heated from 20 °C coolant temperature (07.3-165).




Model 126
G3/2 Oxygen sensor
157 Firewall catalytic converter

The outer electrode is exposed to the exhaust emission while the inner electrode is exposed to the atmosphere. The active part of the oxygen sensor is a ceramic body mainly consisting of zirconium dioxide. Its surface is provided with a gas permeable platinum layer and with an additional protective layer on the exhaust side.

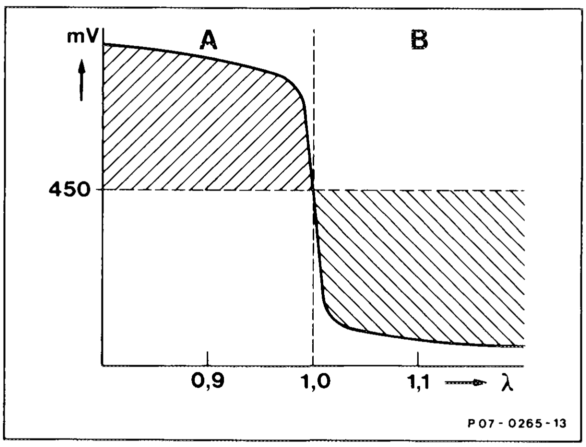



1 Sensor housing
2 Slit protective tube
3 Heater element
4 Sensor ceramic

At operating temperature the ceramic material is conductive for oxygen ions. A voltage is created in the oxygen sensor due to the different oxygen content in exhaust gas and atmosphere.

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

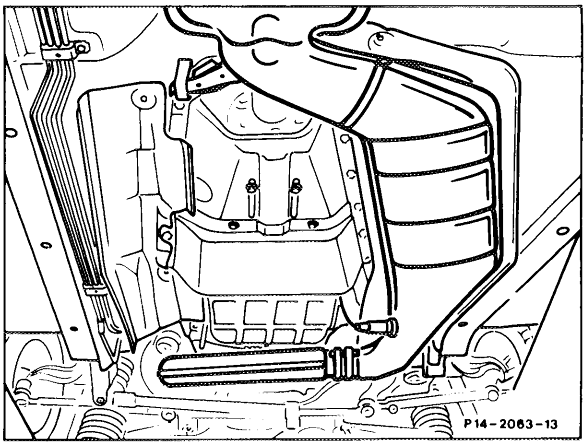
Owing to the steep voltage jump at lambda (λ) = 1 the exhaust gas composition can be rapidly registered and the air-fuel mixture corrected within a narrow control range.



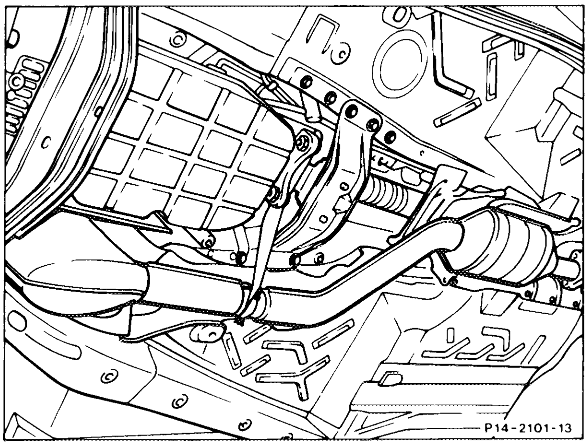

A Rich air-fuel mixture
B Lean air-fuel mixture

## F. Catalytic converters

The 3-way catalytic converters are located in the exhaust system in front of the mufflers.
The following versions are installed:
Model 107 underfloor catalytic converter
Model 126 firewall and underfloor catalytic converters.

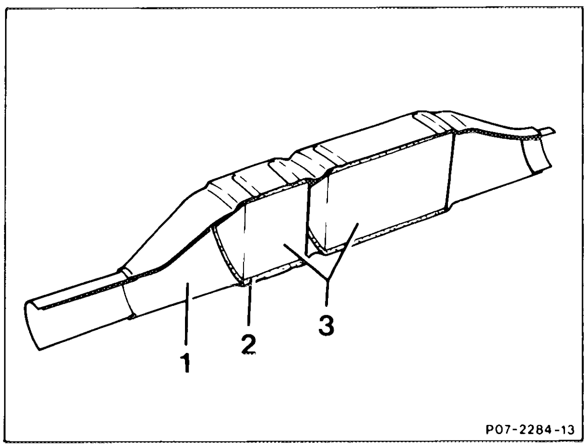



Model 107




Model 126

The catalytic converters consist of the following three main parts:
Carrier material made of high-strength ceramic or highly heat-resistant high-grade steel, also called Monolith (ceramic flexibly mounted on wire braiding).
Intermediate layer for surface enlargement.
Catalytically active layer made of platinum/rhodium.



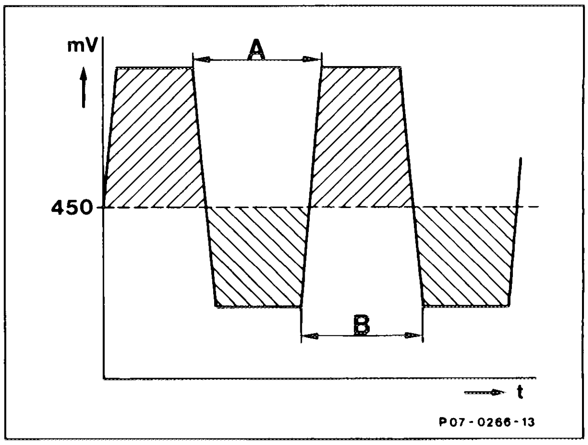

1 Braiding
2 Wire braiding
3 Monolith

**Function**

The exhaust gases flow through the catalytic converter and during this process come in contact with the precious metals. By **oxidation**, carbon monoxide (CO) is converted in carbon dioxide ($CO_2$) and hydrocarbons (HC) in water ($H_2O$), while nitric oxides ($NO_x$) are converted into nitrogen ($N_2$) by **reduction**. Decisive for this are temperature and the residual oxygen content in the exhaust gas. The catalytic process, i.e. the chemical reaction, commences from approx. 250 °C. Excessively high temperatures lead to thermal overloading.

Oxygen is required for the oxidation of CO and HC. The reduction of the nitric oxides takes place under oxygen deficiency.

The fluctuating between oxygen-deficient and oxygen-rich exhaust gas is achieved by changing the air-fuel mixture. The ratio of the air-fuel mixture is called lambda ($\lambda$). $\lambda < 1$ means rich mixture, $\lambda > 1$ means lean mixture.

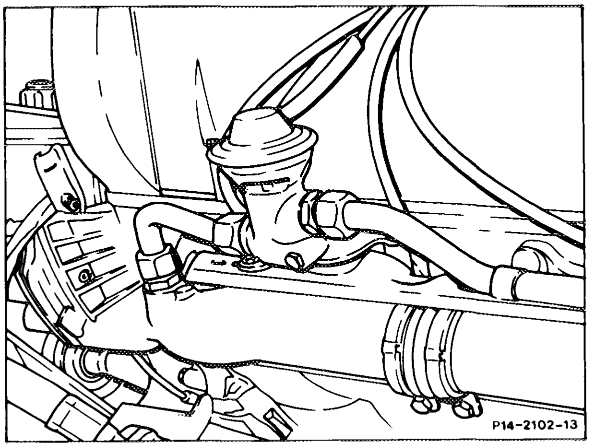



A Rich air-fuel mixture
B Lean air-fuel mixture

The fluctuation of the oxygen content in the exhaust gas in front of the oxygen sensor is controlled. It is only by means of these oxygen fluctuations that the three mentioned exhaust gas constituents can be chemically converted in the catalytic converter.

Only unleaded fuel must be used in vehicles with catalytic converter and oxygen sensor. Lead additives in the fuel are deposited on the chemically reactive surface of the catalytic converter and the oxygen sensor, rendering the system ineffective.

## G. Exhaust gas recirculation (EGR)

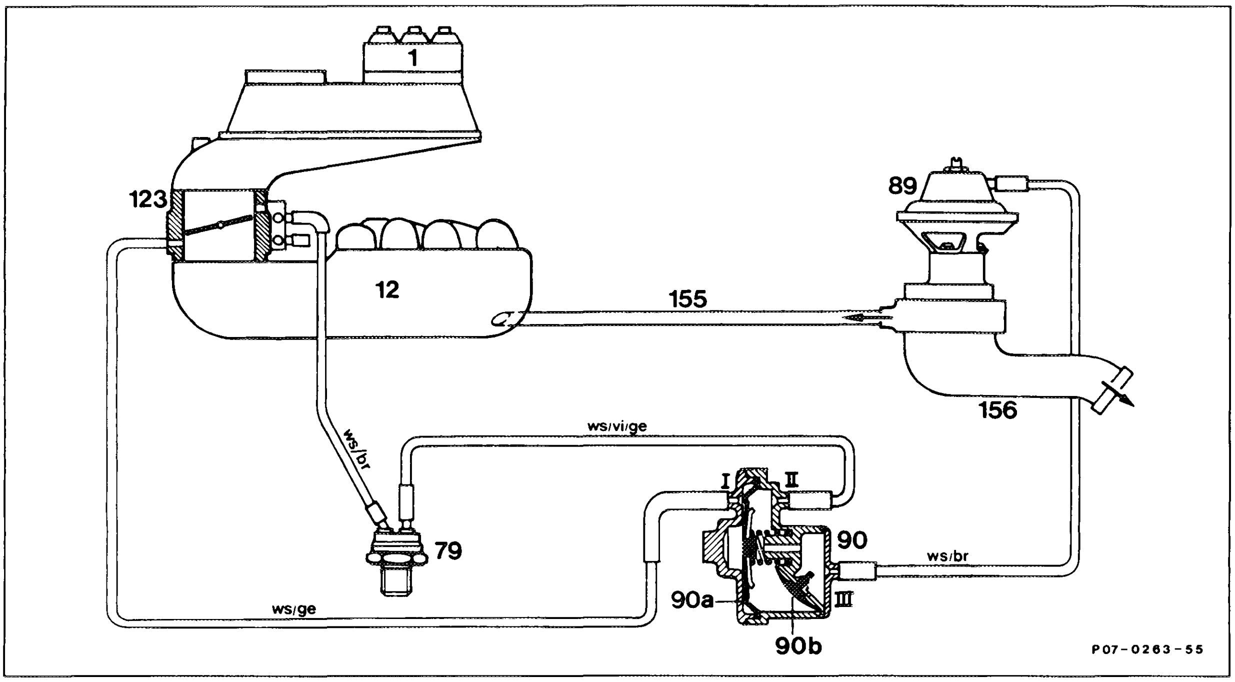



In order to reduce the nitric oxides in the exhaust gas, a part of the exhaust gases is returned into the intake manifold via the exhaust gas recirculation valve under certain operating conditions.
The oxygen-deficient exhaust gases are mixed in the intake manifold with the fresh, oxygen-rich mixture. As a consequence, the proportion of fresh mixture is lowered and correspondingly less oxygen is available for combustion. The amount of returned exhaust gases depends on the throttle valve position (vacuum at the throttle valve). The driving characteristics of the vehicle are not influenced by the exhaust gas recirculation.

The following versions are distinguished:

a) With vacuum control valve up to 08/87
b) Without vacuum control valve as of 09/87

**a) With vacuum control valve up to 08/87**




Function diagram exhaust gas recirculation with vacuum control valve up to 08/87

| | | | |
|---|---|---|---|
| 1 | Mixture control unit | 90a | Shut-off diaphragm |
| 12 | Intake manifold | 90b | Check valve |
| 79 | Thermovalve 50 °C | 123 | Throttle assembly |
| 89 | Exhaust gas recirculation valve | 155 | Exhaust gas recirculation line |
| 90 | Control valve | 156 | Exhaust manifold |

Exhaust gas recirculation takes place under the following operating conditions:

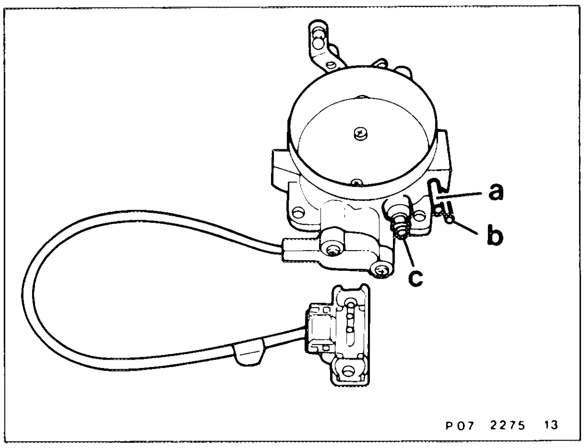
- Coolant temperature > 50 °C
- In all load conditions except idling and full load.

With the throttle valve closed, the EGR valve (89) is atmospherically ventilated via a connection on the throttle assembly (123), the thermovalve (79) and the vacuum control valve (90, connections II and III).

If the throttle valve is partly opened, vacuum reaches the EGR valve via the same way and causing it to be opened.

The control valve still maintains the exhaust gas recirculation in the high load range (not yet full load), although the exhaust gas recirculation valve would already close according to its characteristic. The bore is closed by the diaphragm and the vacuum is maintained. In the full load range the vacuum drops so that the EGR valve is closed again.

The connection (l) on the vacuum control valve serves to rapidly ventilate the EGR valve during the transition from part load range to idle speed, thus switching off the exhaust gas recirculation.



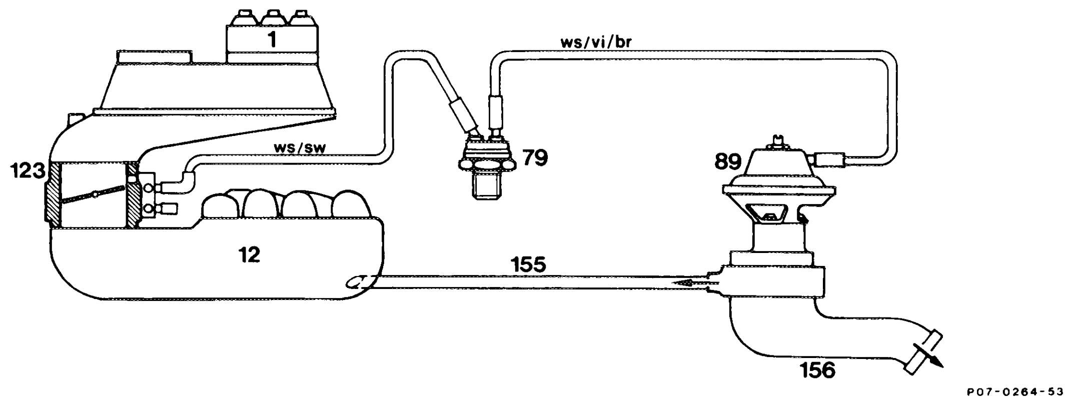

a	to thermovalve exhaust gas recirculation
b	to thermovalve fuel evaporation system
c	from purge valve
d	to vacuum control valve exhaust gas recirculation

⚠
The vacuum line ws/br of the exhaust gas recirculation was temporarily fitted to the lower connection of the throttle assembly during production start-up. The connection is okay as of the following engine number.

| Engine | Engine end No. |
|---|---|
| 116.965 | 000 395 |
| 117.968 | 000 101 |

**b) Without vacuum control valve as of 09/87**

Vacuum is directly applied to the exhaust gas recirculation valve only as a function of the thermovalve.

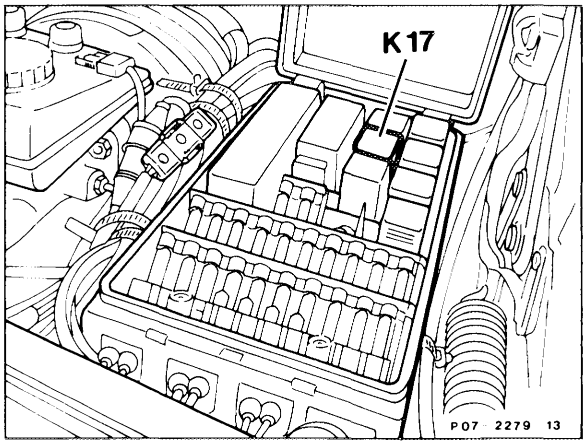



Function diagram exhaust gas recirculation as of 09/87 or model year 1988

| | | | |
|---|---|---|---|
| 1 | Mixture control unit | 123 | Throttle assembly |
| 12 | Intake manifold | 155 | Exhaust gas recirculation line |
| 79 | Thermovalve 50 °C | 156 | Exhaust manifold |
| 89 | Exhaust gas recirculation valve | | |

## H. Air injection

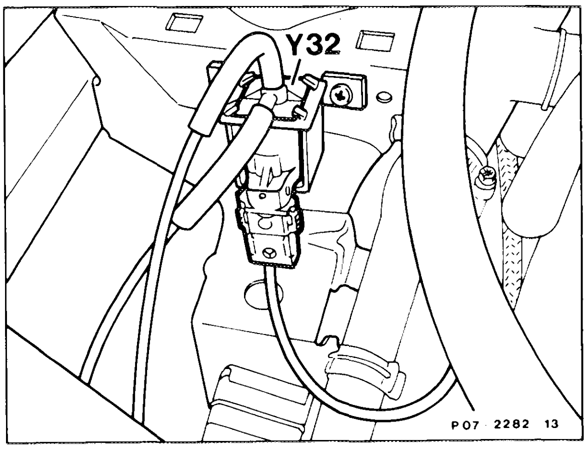
Signal processing for the switching on and switching off of the air pump via the relay (K17) is carried out by the control unit of the CIS-E injection system.




Air injection takes place if the following conditions are met:

- Coolant temperature > 17 °C < 70 °C
- Engine speed < 2500 rpm
- No full load contact
- Lambda control not switched on.

Under these conditions the electromagnetic clutch of the air pump is switched on by the control unit CIS-E (N3) via the relay (K17, see electrical wiring diagram). Via the same relay, the change-over valve (Y32) is actuated at the same time which in turn releases the vacuum to the air shut-off valve (126).




The vacuum draws the diaphragm up against the spring force, lifting the valve off its seat. The air drawn from the air cleaner is injected via the shut-off valve (126), the check valve (127) and the passages of the timing case cover and the crankcase into the exhaust ports of the cylinder heads.
The air supplied via the air pump causes a combustion of CO and $CO_2$ in the catalytic converter. The heat liberated during this process accelerates the readiness for operation of the catalytic converter.

**Note**
The bearings of the pulley shaft on the air pump were reinforced.

**Production breakpoint:** January 1986

| Model | Engine | Engine end No. |
|---|---|---|
| 126.035 | 116.965 | 008548 |
| 107.048 | 117.967 | 004085 |
| 126.039/045 | 117.968 | 003175 |