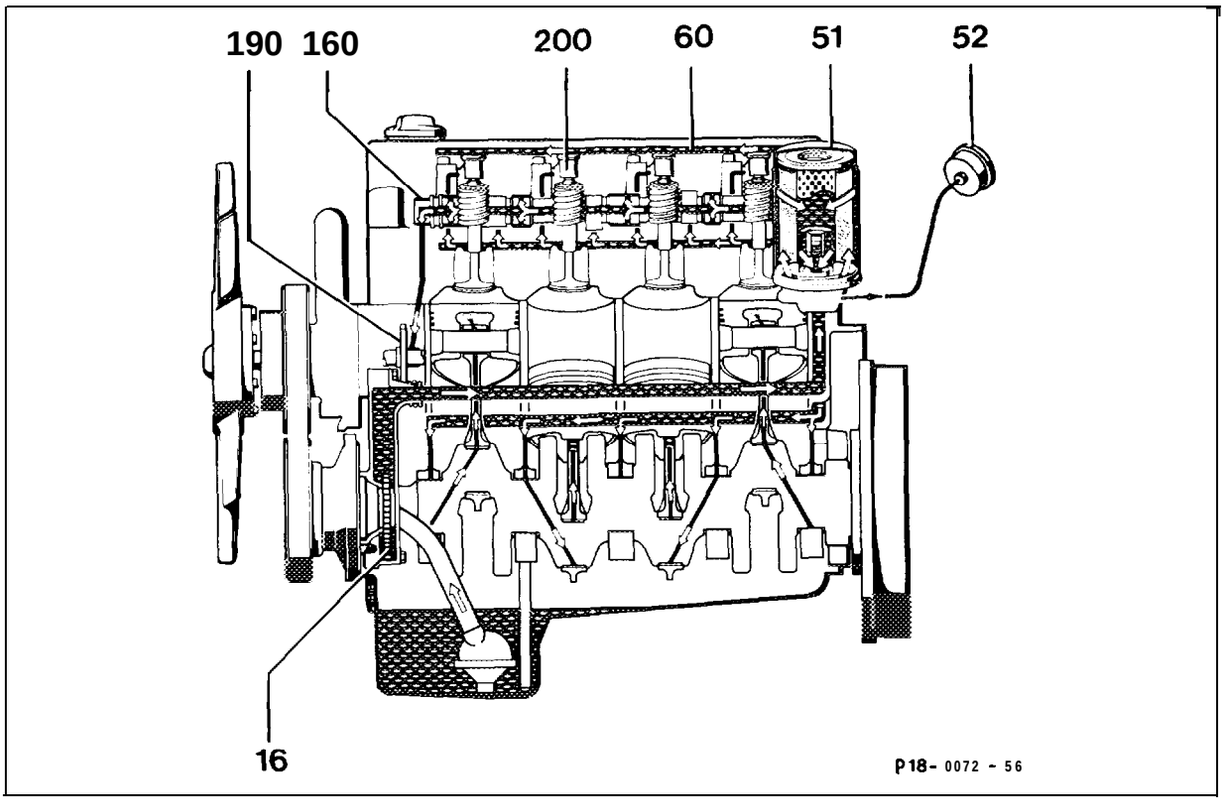
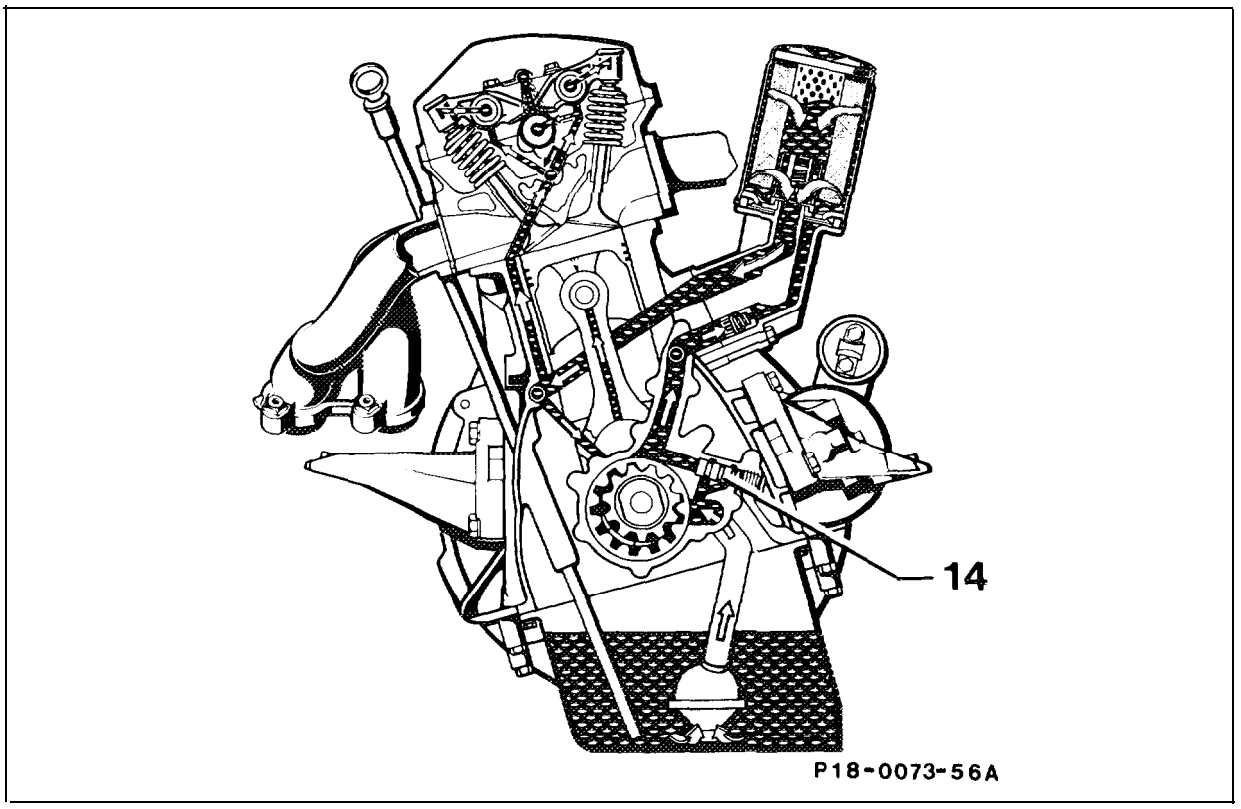
Job No.

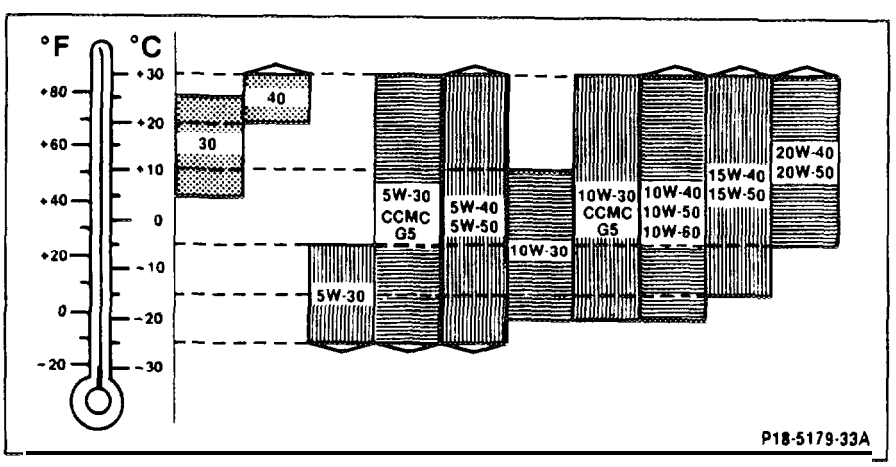
18-005 Oil circuit, oil pressure, overpressure and bypass valve, oil filter

Oil circuit





14	Oil overpressure valve	60	Oil pipe
16	Oil pump	160	Camshaft
51	Oil filter	190	Idler gear shaft
52	Oil pressure gauge		



Viscosity grades for engine oils according to SAE

Adhering to the SAE grades in accordance with ambient temperatures would result in frequent oil changes. Consequently, the temperature ranges are merely guidelines, which can be exceeded in the upper or lower limits for brief periods.

In moderate climatic zones SAE 30 may be used from the spring on for all engine models. SAE 10W-40 or SAE 10W-50 may be used as an all-seasons oil for all gasoline engines.

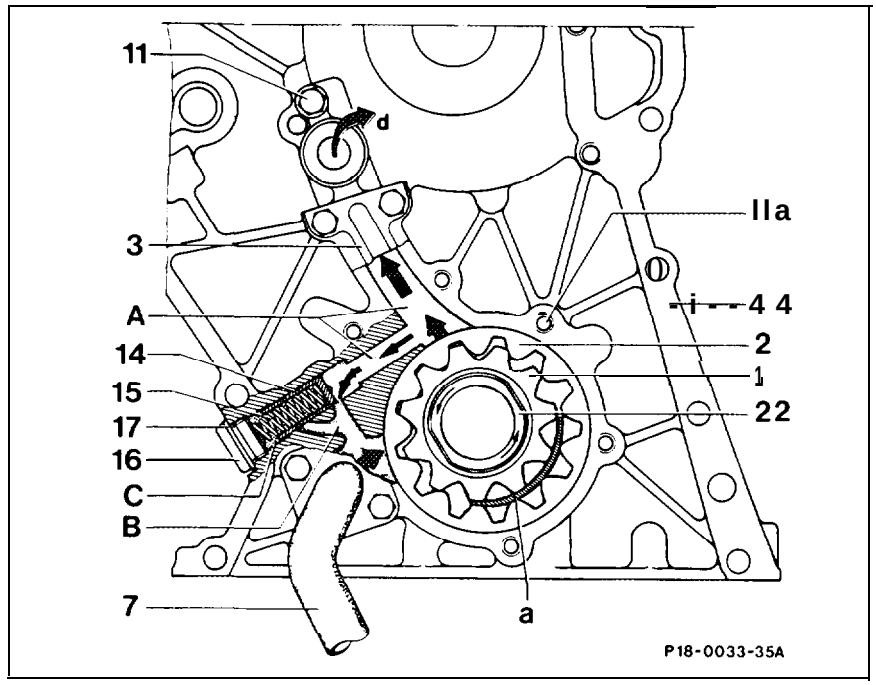
Oil capacity in liters (approved engine oils see Service Product Specifications).	
Engine (total capacity when refilling)	5,5
Engine capacity when changing oil and filter	5,0
Oil sump, max./min.	4,8/2,8

Opening pressures of oil overpressure and oil filter element bypass valve	bar gauge pressure
Oil overpressure valve in timing case cover	4,5–0,8
Oil filter element bypass valve in oil filter (difference pressure)	3,5

Function of oil circuit

The oil is drawn off at the lowest point of the oil sump through the strainer basket and the oil suction pipe (7) to the suction chamber (B) and pumped into the tooth gaps, which produce pressure chamber (A) as a result of the eccentric arrangement of the oil pump gears (1 and 2).

To ensure that the oil remains in the tooth gaps on its way from the suction to the pressure chamber, a sickle (a) is attached between both gears in this area.



1 Inner oil pump gear
2 Outer oil pump gear
3 Oil pump cover
7 Suction pipe
11 M6 x30 bolt (9 off)
11a Torx bolt
14 Overpressure valve
15 Compression spring
16 Screw plug
17 Seal
22 Drive sleeve
44 Timing case cover

A Pressure chamber
B Suction chamber
C Damping chamber
a Sickle
b To oil filter

The teeth mesh again at the end of the pressure chamber and force the oil out of the tooth gaps.

The oil flows from the pressure chamber (A) along the feed passage (d) in the timing case cover and crankcase to the oil filter.

Pressure chamber (A) and vacuum chamber (B) are linked by the oil overpressure valve.

From an oil overpressure of approx. 4 bar, the piston (14) of the oil overpressure valve is pushed against the force of the compression spring (15) and opens the relief cross-section, through which part of the oil flows back to the suction chamber (B), depending on oil pressure.

As the piston (14) is moved, the oil in chamber (C) is displaced and flows through the relief grooves on the outside of the piston to the suction chamber (B).

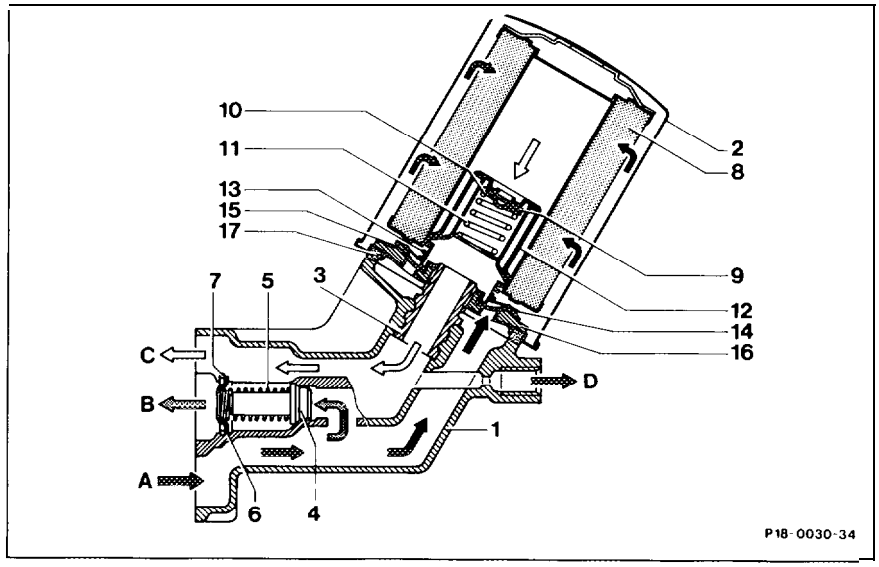
Oil filter

The oil coming from the feed passage (A) flows through the feed and discharge hose in the contact-pressure plate (16) into the replaceable cartridge.

As a result of the oil pressure, the rubber diaphragm (15) is raised and the oil flows through the filter element (8) from the outside to the inside (arrows).

On the inside, the valve plate (9) is opened as a result of the pressure of the filtered oil. The oil flows through the connection fitting (3) to the gallery (C) and on to the main oil gallery in the crankcase.

1 Oil filter bottom section
2 Replaceable cartridge
3 Connection fitting
4 Valve cone
5 Compressron spring
6 Spring plate
7 Locking ring
8 Filter element
9 Valve plate
10 Valve plate carrier
11 Compressron spring
12 Valve holder
13 Compressron spring
14 Spring plate
15 Rubber diaphragm
16 Contact-pressure plate
17 Seal
A Feed from oil pump
B Unfiltered oil to main oil gallery
C Filtered oil to main oil gallery
D Connectron for electrical oil pressure sensor



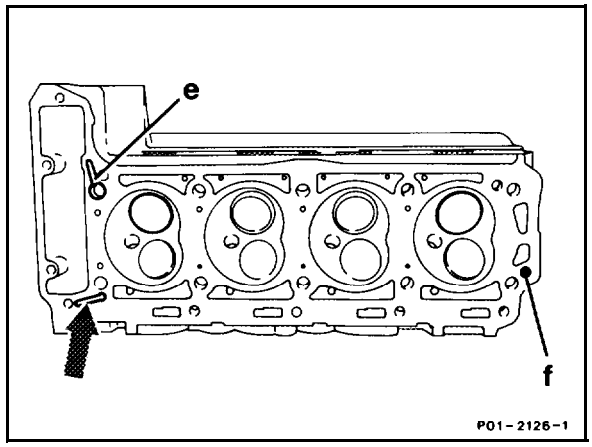
The two check valves (9-12 and 13-16) prevent the filter cartridge from running empty when the engine is switched off and when changing the filter.

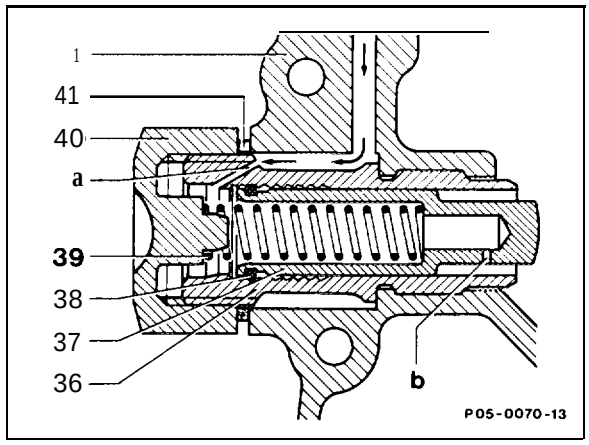
The bypass valve (4-7) opens when the difference pressure between dirty and clean oil side exceeds 3 bar. This is the case if the filter element is severely fouled. The oil then flows through the gallery (B) unfiltered to the main oil gallery.

When changing the filter, a slight quantity of oil flows out of the replaceable cartridge despite the check valves, which flows together with oil from the bottom of the oil filter along the galleries (A and C) to the engine.

Oil supply of chain tensioner

The oil flows through a passage which branches off vertically up the way at the front of the main oil gallery, to the cylinder head, flows in a cross groove (arrow) to a vertical feed passage in crankcase and on to the chain tensioner.

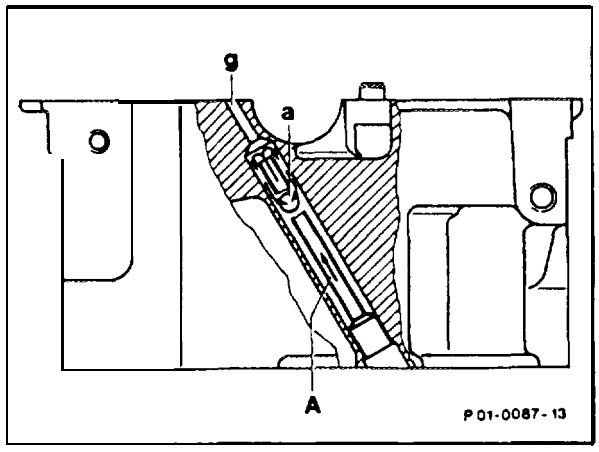




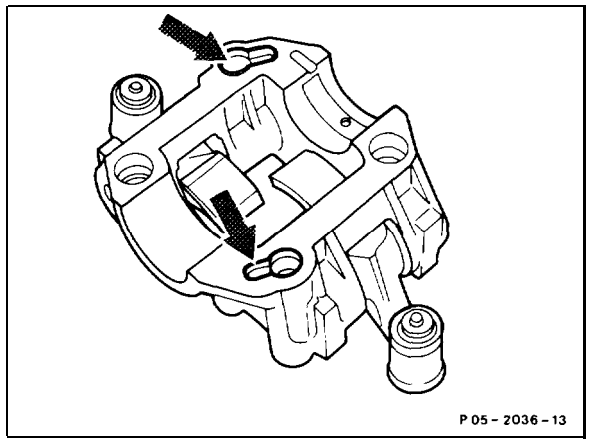
1	Crankcase
36	Chain tensioner housing
37	Thrust pin
38	Detent spnng
39	Compression spnng
40	Cap nut
41	Seal
a	Feed passage 1 .1 mm dia.
b	Restnction passage 1.2 mm dia.

Lubrication of valve timing

The oil coming from the main oil gallery in the crankcase, flows through a 4.5 mm dia. jet (A) installed in the cylinder head, and through the annular gap (arrows) direct to the longitudinal gallery (a) in the cylinder head (pressure-oriented oil feed). This oil supply system ensures that the oil pressure prevailing downstream of the oil filter depending on the operating state, always exists at the hydraulic valve clearance compensating elements. In addition, the nozzle (A) serves as an oil return flow stop which prevents the longitudinal passage (a) and the valve clearance compensating elements running dry.

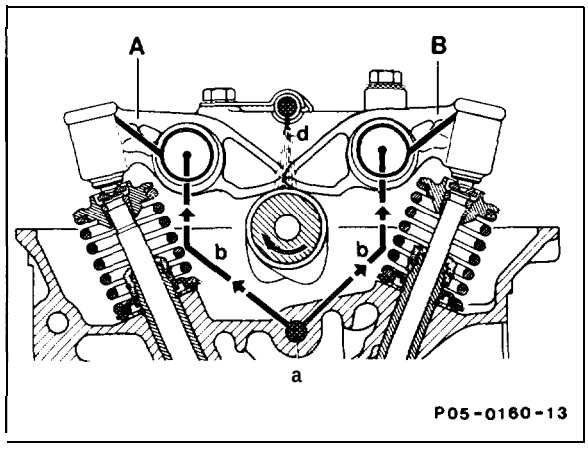


Part of the oil flows through the restriction passage (g) with dia. of 2.5 mm and the two grooves (arrows) in the rear rocker arm bearing bracket to the rear camshaft bearing and there into the hollow-drilled camshaft. The oil flows through the camshaft to the other camshaft bearings (flow-oriented oil feed).



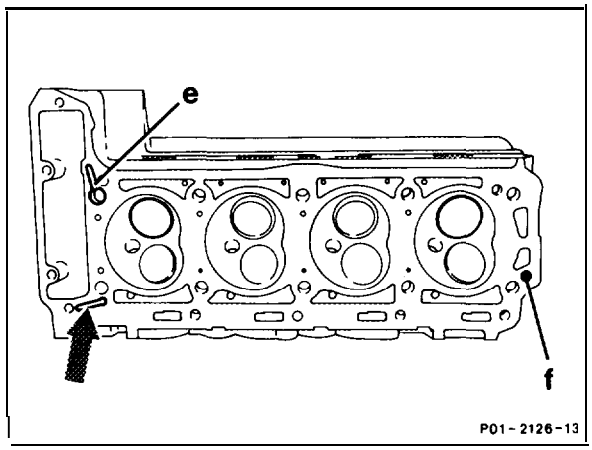
The rocker arm bearing points are lubricated from the longitudinal passage (a) in the cylinder head and the hydraulic valve clearance compensating elements supplied with oil (b) from there through a passage in the rocker arm.

The cam lubrication is provided through the oil pipe (d) bolted to the rear camshaft bearing.



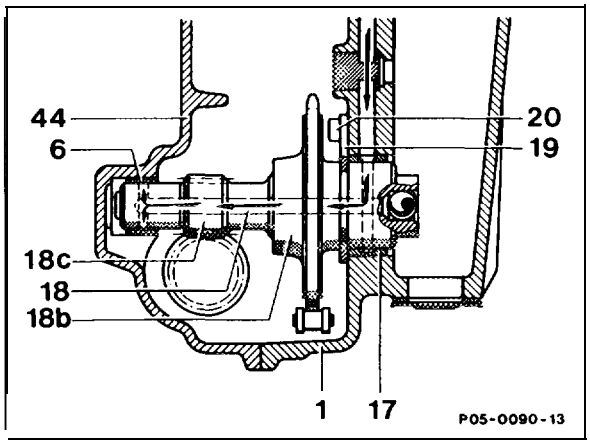
Lubrication of idler gear shaft and ignition distributor drive

The oil flows from the front camshaft bearing through a cross passage to the left front cylinder head bolt bore and from there along a cross groove (e) to the feed passage in the crankcase.

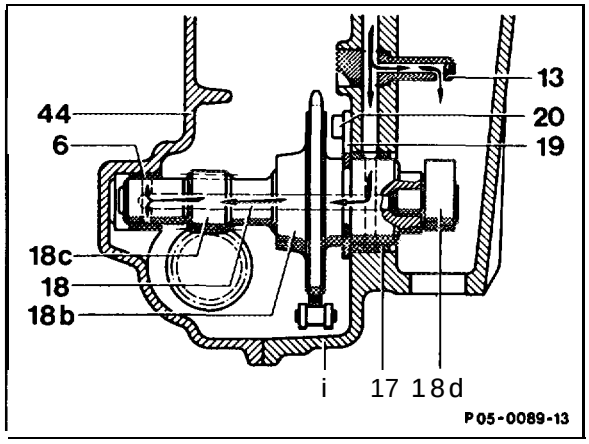


The oil flows on to the rear bearing bush (17) of the idler gear shaft and through the hollow-drilled idler gear shaft (18b) to the front bearing bush (6) in the timing case cover (44).

The ignition distributor drive (18) is lubricated by splash oil.

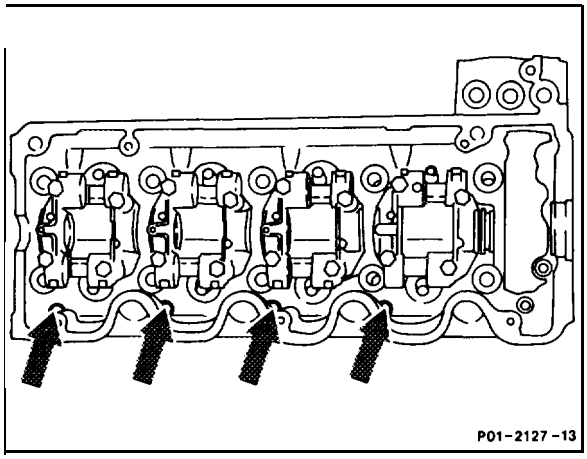


The cam (18d) which is press-fitted to the rear end of the idler shaft gear on engines 102.9221924 (non-U.S.) and drives the fuel pump, is lubricated by the oil splash jet (13).

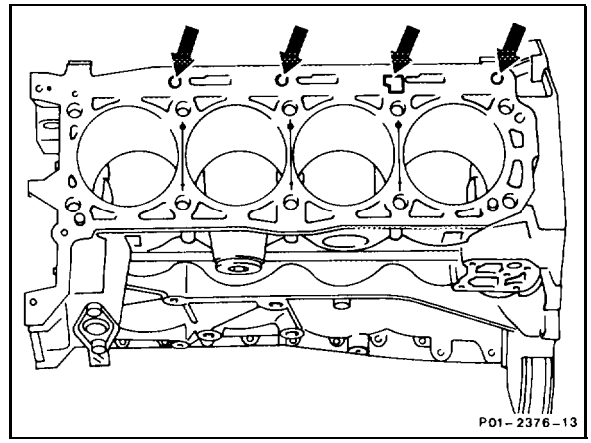


Oil return

Four return passages (arrows) are provided on the righthand side of the cylinder head (looking in direction of travel) for the oil return to the sump; part of the oil flows back through the chain box.



In the crankcase, the oil flowing back is passed along an oil collecting gallery (arrows) to the cast return passage.
From here, it flows into the oil pan.

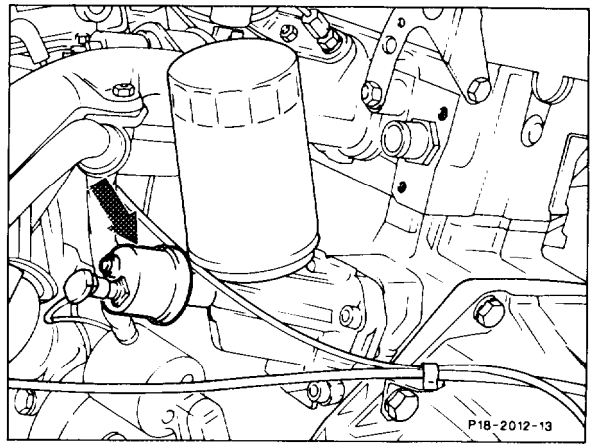


Oil pressure and oil pressure gauge

At normal operating temperature, the oil pressure at idling speed must drop to 0.3 bar gauge pressure.

When the accelerator is depressed, the oil pressure must immediately rise again and be at least 3 bar gauge pressure at 3000 rpm.

The oil pressure gauge in the instrument cluster is actuated electrically by an oil pressure sensor which is bolted onto the oil filter housing (arrow).



Function

When the ignition is switched on, the gauge in the instrument cluster is constantly energized. Ground is applied in the gauge through the pressure sensor. As the pressure increases, the ohm resistance of the pressure sensor increases and thus alters the gauge reading.

Resistances of pressure sensor as a function of oil pressure.

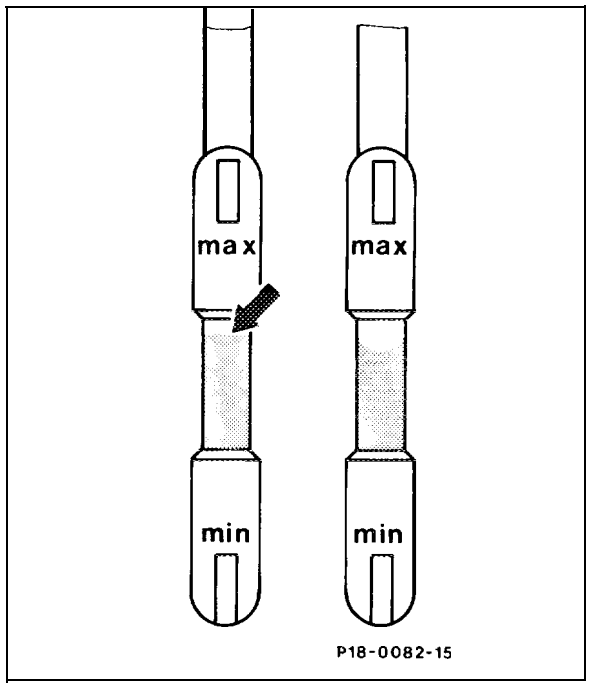
Pressure (bar)	0	1	2	3
Resistance approx. Ω	10	69	129	184

Checking oil level

The oil level depends, among other factors, on the oil temperature and on the time for the oil to flow back after the engine is switched off. For this reason, do not measure oil level until approx. 5 minutes after switching off the engine from normal operating temperature (approx. 80 °C oil temperature).

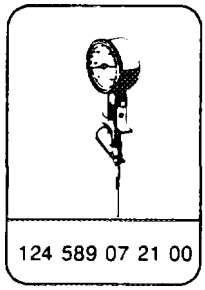
The dipstick must always be withdrawn and wiped off before checking the oil level.

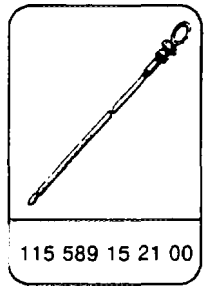
To properly assess the oil level, the dipstick must be viewed from both sides. The determining factor is always the clear horizontal indication of the dipstick (arrow).



18-025 Measuring oil consumption

Special tools



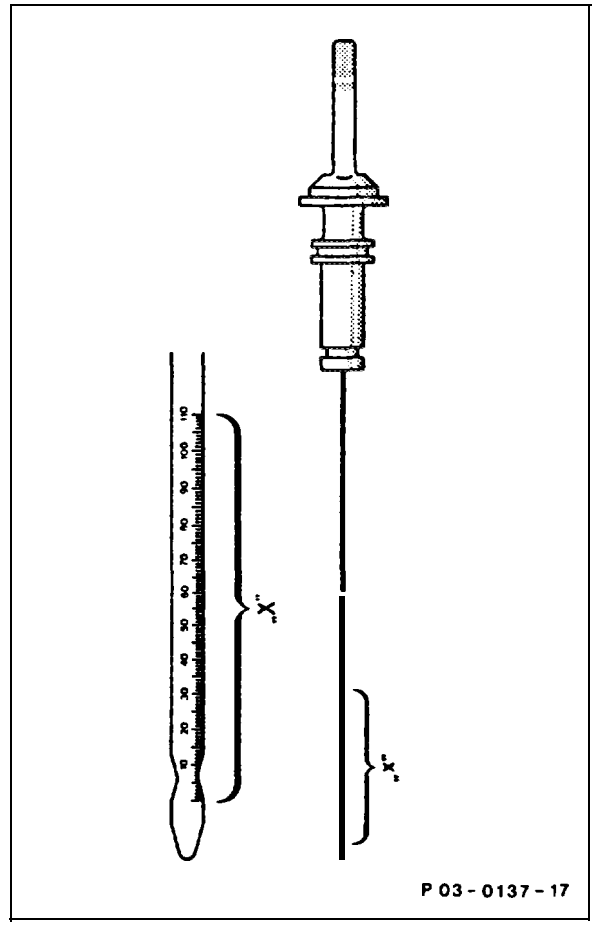


Note

Oil consumption should be calculated with the dipstick with millimeter graduations and the related test sheet. It should not exceed 1.0 li1000 km.

The procedure for measuring oil consumption is described on the front of the test sheet. It is essential to properly observe this procedure.

Oil consumption indicated in mm on the dipstick should be read off on the basis of the diagram on the rear of the test sheet in cm^3.

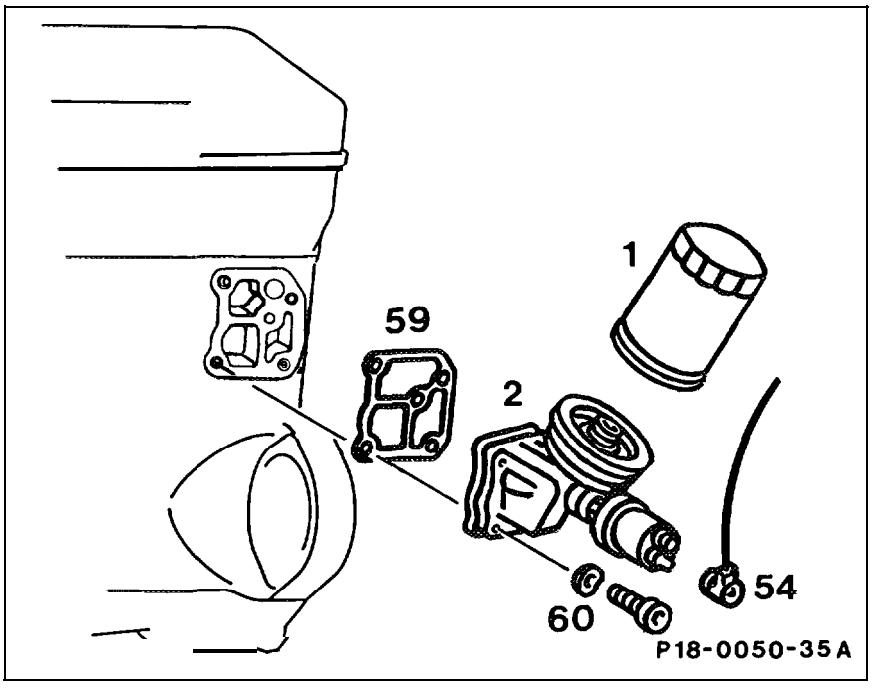


⚠Caution

To **avoid any** incorrect measurements, check whether the engine oil has been diluted with fuel before measuring oil consumption.

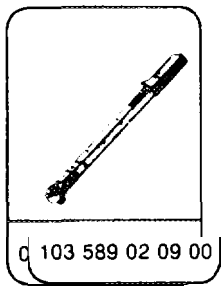
18-110 Removal and installation of oil filter

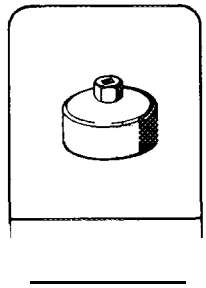
Preceding work:
Air filter removed (09-400 and 09-410).



Replaceable cartridge (1)	unbolt, bolt on, special tool 103 589 02 09 00.
	Note Tighten replaceable cartridge by hand, then tighten a further 1/4 turns (90") (step 2).
Plug (54)	for oil pressure sensor, detach, plug in.
Oil filter base (2)	unbolt, bolt on, tightening torque 25 Nm (step 4).
Gasket (59)	replace.
Sealing surfaces	clean, seal main oil gallery for this step, open (step 5).
Run engine	check for leaks.

Special tools

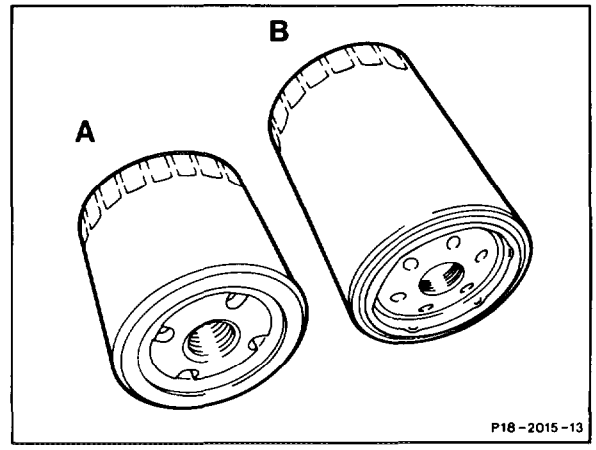




Note

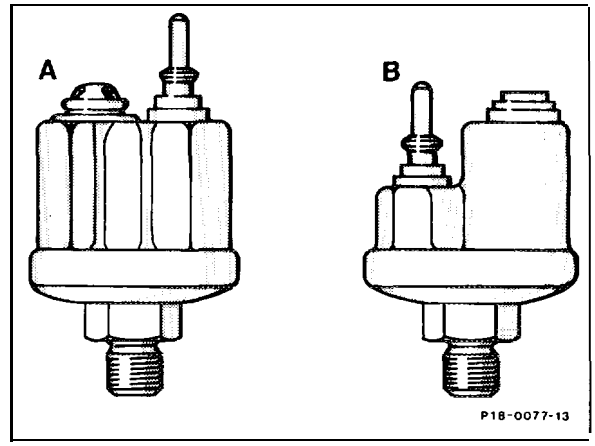
M **102** engines are equipped with an oil filter with replaceable cartridge (disposable filter).
When changing the filter, the replaceable cartridge is unscrewed and replaced with a new one.

The initial operation and continuous operation cartridges were of different sizes up to 5188.



A Initial operation replaceable cartridge
B Continuous operation replaceable cartridge

The housing of oil pressure sensor has been modified to provide adequate clearance for the speedometer shaft.



A Previous version
B Present version

Standard implementation: December 1984

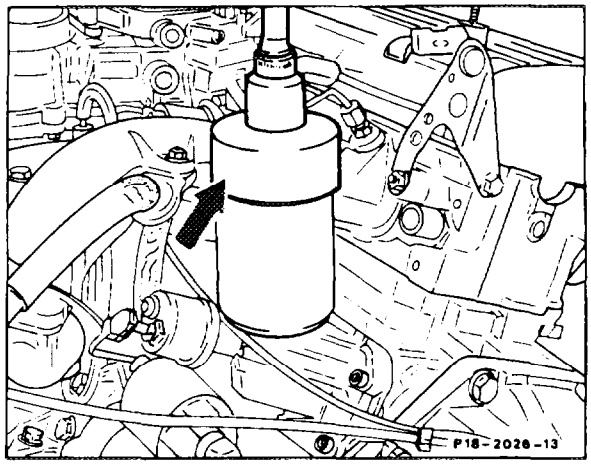
Model	Engine	Engine end No. Man. trm.	Autom. trm.	Vehicle ident end No.	
Non-U.S. version vehicles	102.924	005181	001370	A 170601	F 063039
	102.962	016655	007928		F 063008
201.024 (USA)	102.985	000782	006991		F 066585

The initial operation oil filter replaceable cartridge has been modified (same size as continuous operation filter) to achieve standardization with engine 103.

Removal and installation

1 Remove and install air filter (09-400 and 09-410).

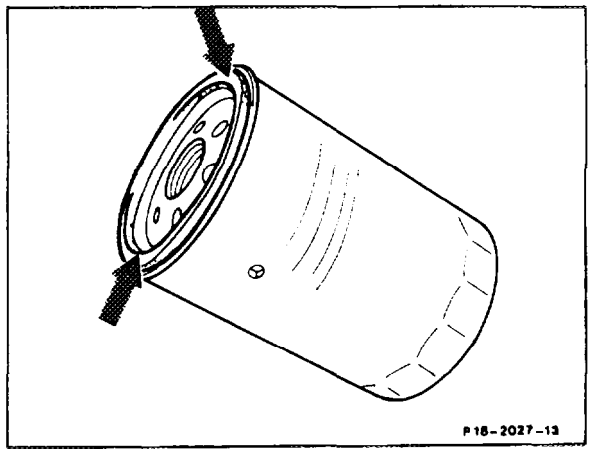
2 Remove and install oil filter replaceable cartridge, special tool 103 589 02 09 00.



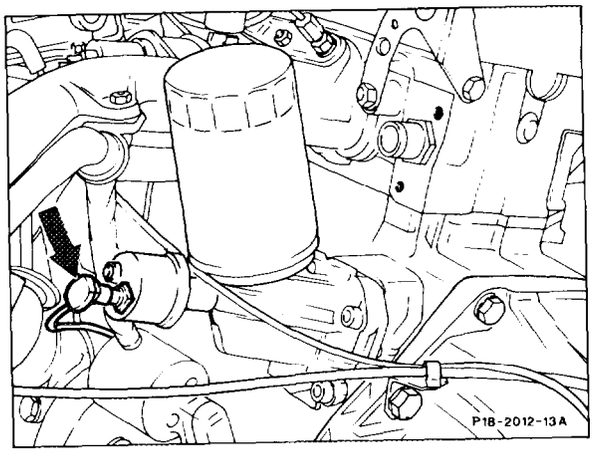
Note
Apply a light coating of oil to gasket (arrows) before installing the replaceable cartridge.

Screw on replaceable cartridge and tighten by hand.

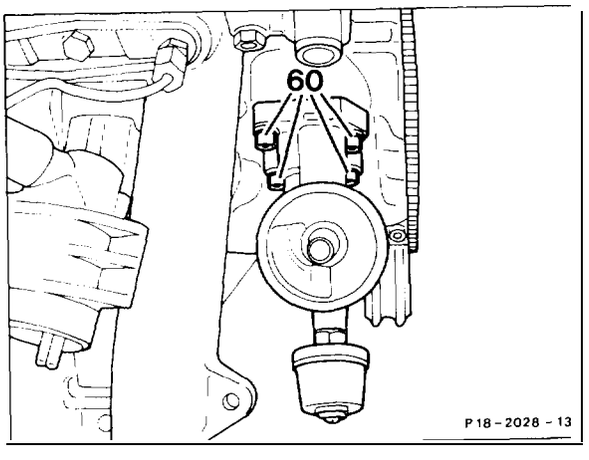
Then tighten a further 1/4 turns (90°) with the wrench socket.



3 Disconnect plug (arrow) for oil pressure sensor, plug in.



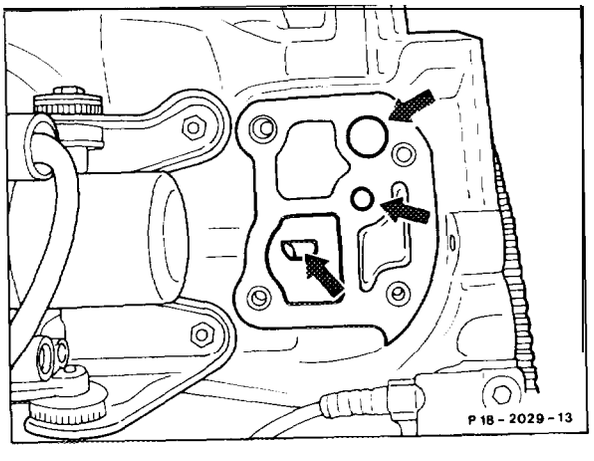
4 Unscrew oil filter base section, screw on, tightening torque 25 Nm.



5 Clean sealing surfaces on oil filter and crankcase.

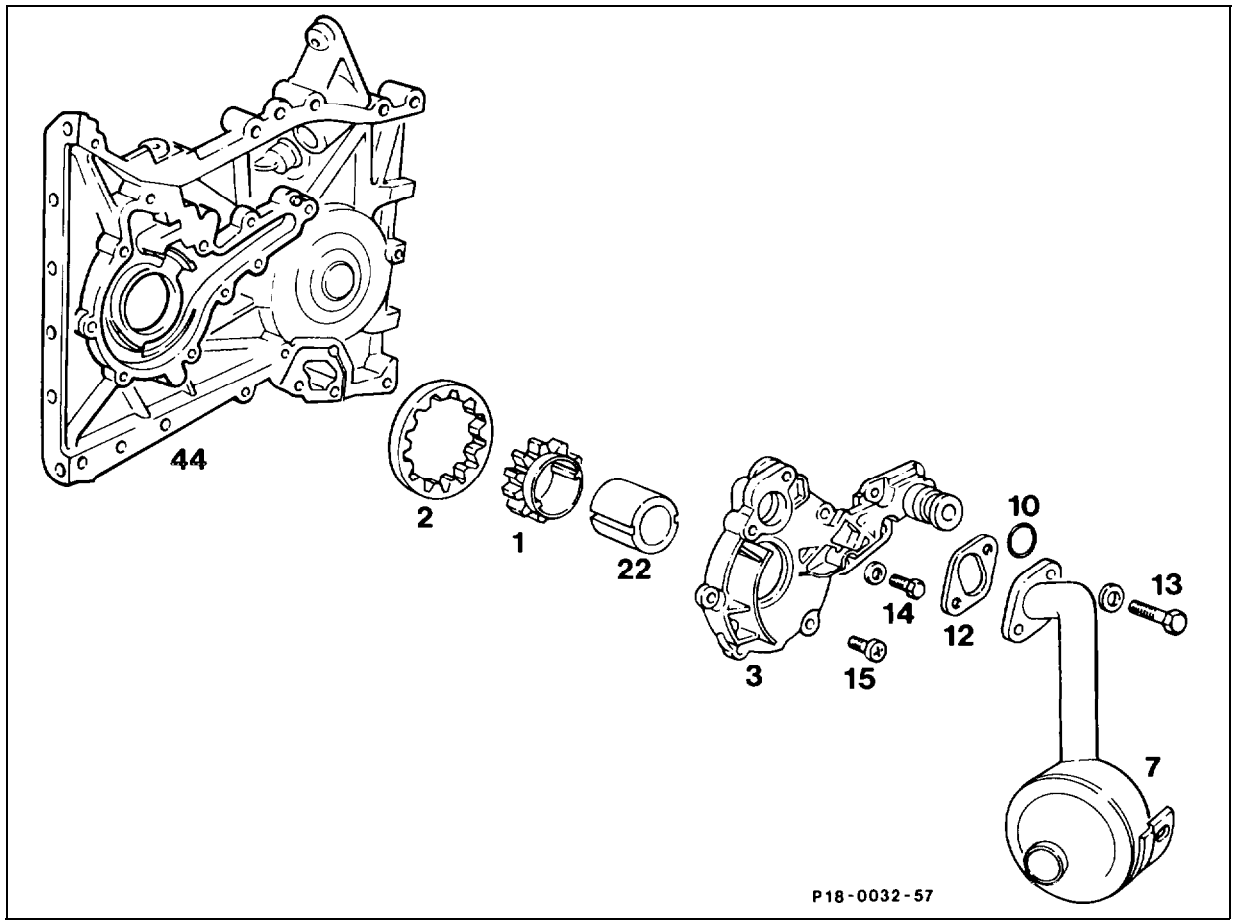
For this purpose, seal the bores on the crankcase, open (arrows).

6 Run engine, check for leaks.



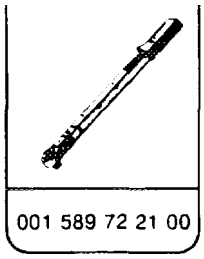
18-210 Removal and installation of oil pump

Preceding work:
Timing case cover removed (01-210).



Oil pickup (7) with strainer basket	unbolt, bolt on, tightening torque 10 Nm (step 2).
Gasket (12)	replace.
Oil pump cover (3)	unbolt, bolt on, tightening torque 10 Nm (step 3).
	Note Re-install Torx bolt at the same point (for space reasons).
O-ring (10)	replace.
Oil pump gears (1 and 2)	remove, insert, oil.
Driver sleeve (22)	if removed, install before fitting timing case cover.

Special tool



Note

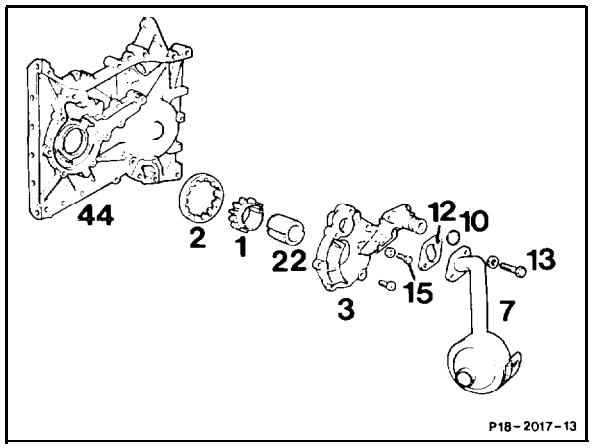
The two oil pump gears (1 and 2) are arranged eccentrically in the timing case cover (44).

The oil pump gears (1 and 2) are driven by the drive sleeve (22) which has two faces on the outer surface for this purpose and is attached by the central bolt to the crankshaft, which also holds the vibration damper or the hub with belt pulley and the crankshaft gear on the crankshaft.

The bore of the driven, externally toothed gear (1) has the identical contour as the outer surface of the drive sleeve.

The oil pump gears are supplied as **replacement parts only together (rotor set).**

The oil pump cover (3) is attached to the rear of the timing case cover (44). It is fixed in place on the timing case cover (44) with a centering sleeve.

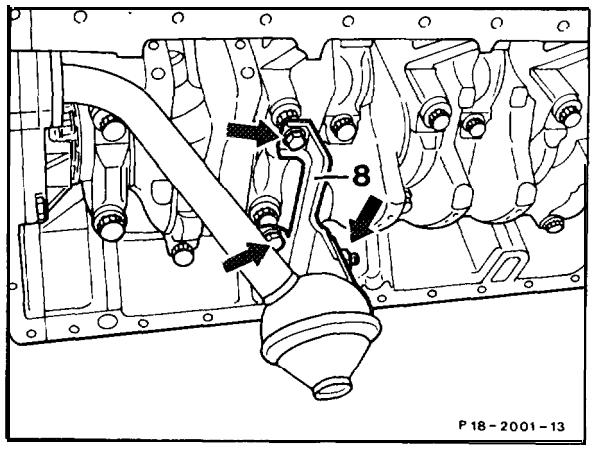


The sealing ring (12) seals the connection fitting at the oil pump cover (oil feed) to the oil passage in the crankcase.

The jump overlock for the timing chain is also cast onto the oil pump cover.

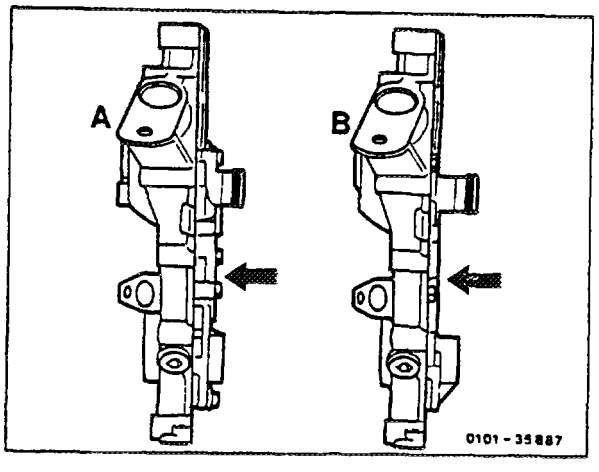
Oil suction pipe together with oil strainer basket is bolted to the oil pump cover (13) with a gasket (12).

The oil suction pipe with oil strainer basket is additionally attached by means of a bracket (8) to the main bearing cover (arrows).

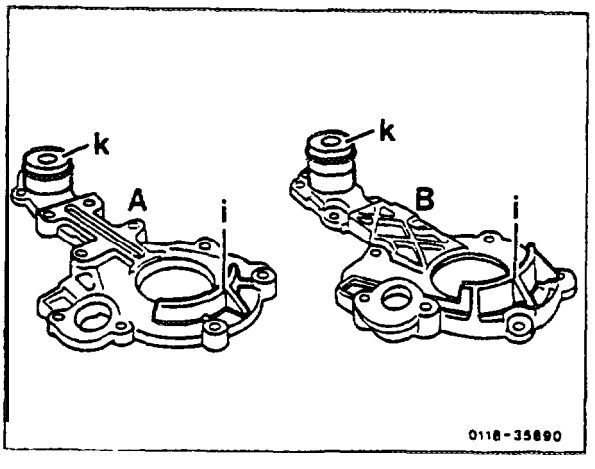


The timing case cover has been modified with the installation of the double roller timing chain (as of November 1987).
The contours on the rear have been lowered.

A Previous version
B Present version



In addition, it has a different rib pattern on the top. The jump overlock (i) is wider and the connection fitting (K) longer.



The drive sleeve for oil pump is manufactured from sintered metal, previously from steel.

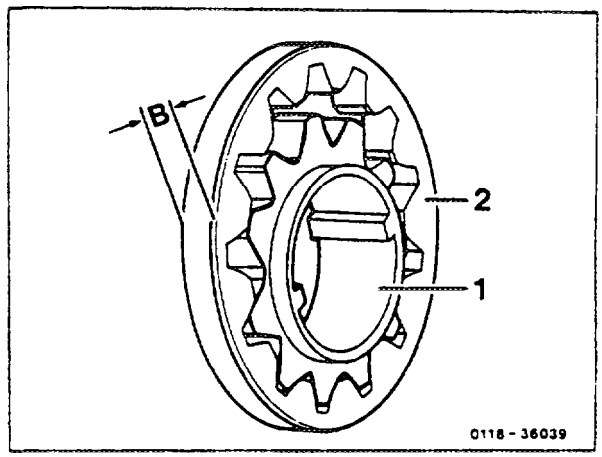
Implementation: August through December 1985

Model	Engine	Engine end Nos. Man. trm.	Engine end Nos. Vehicle ident end No. Autom. trm.
201.024 (USA)	102.985	002517-003158	002505028724 F 137963-/F 182815

* End of implementation not recorded.

2 mm wider pump gears (1, 2) are installed to improve the delivery of the oil pump.

Size "B" previously 7.5 mm
now 9.5 mm

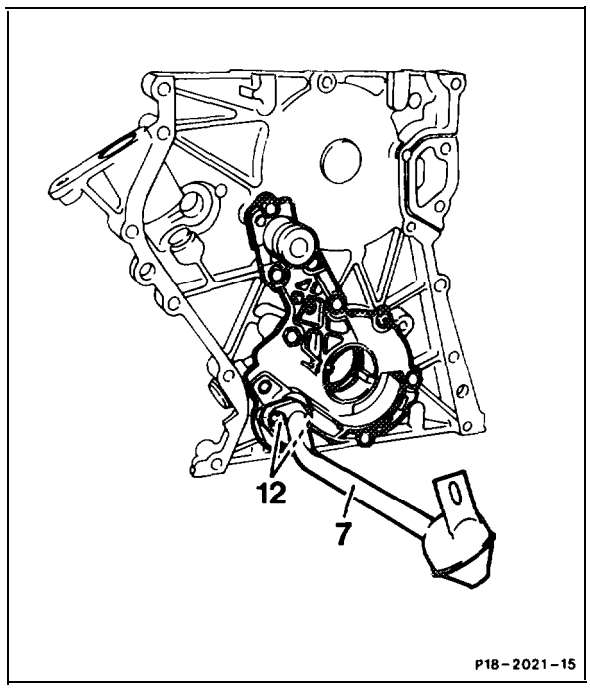


Removal and installation

1 Timing case cover removed (01-210).

2 Unbolt oil pickup together with strainer basket (7), bolt on. Replace gasket.

Tightening torque: 10 **Nm**

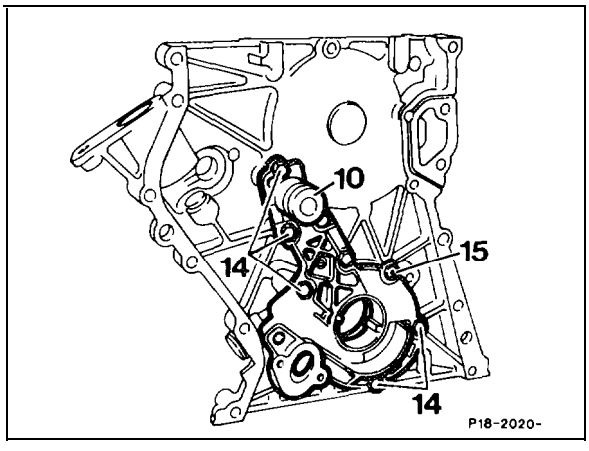


3 Unbolt oil pump cover, bolt on, replace O-ring (10).

Tightening torque: 10 Nm

Note
As of implementation of the flatter oil pump cover, a Torx bolt (15) is installed for space reasons.

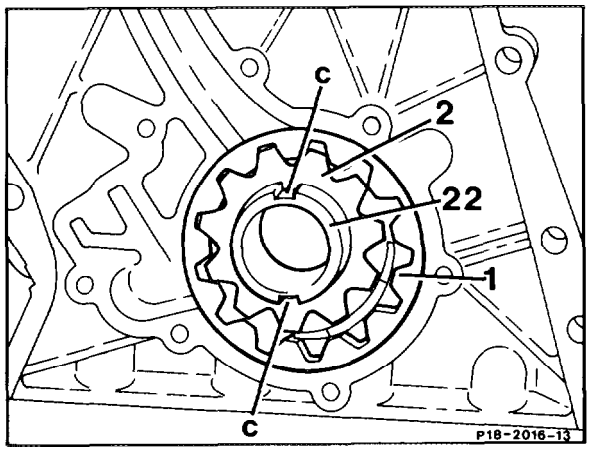
Tightening torque: 10 Nm



4 Remove oil pump gears, insert, oil with engine oil for this purpose.

Caution!
The oil pump gears may only be replaced as a pair.

If the driver sleeve (22) has been removed, this can be inserted after installing the timing case cover.

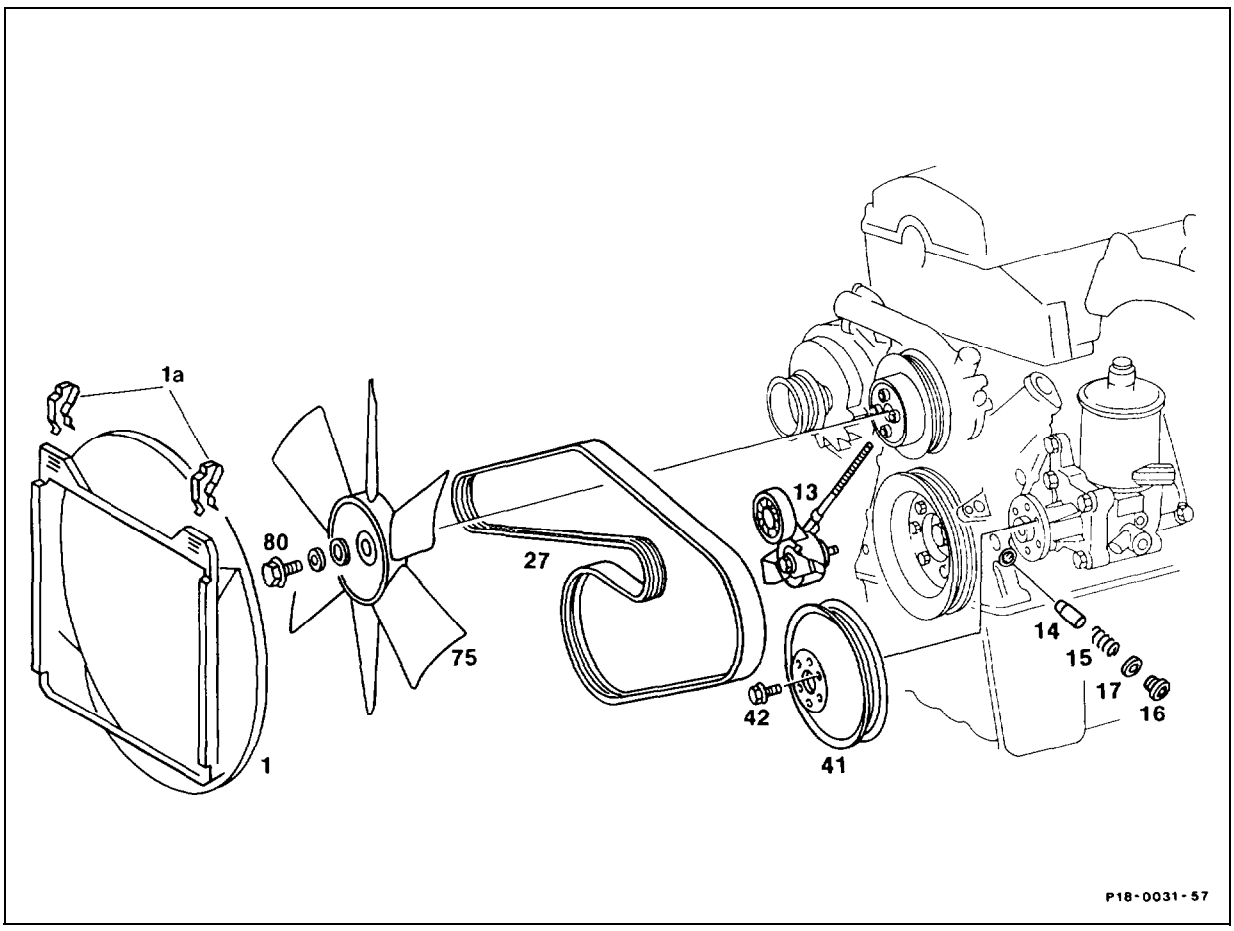


5 Check oil level, adjust to correct level if necessary.

6 Run engine, check oil pressure and oil leaks.

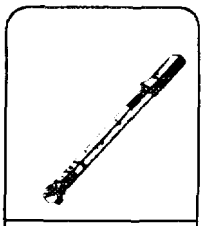
18-215 Removal and installation of oil overpressure (bypass) valve

Preceding work:
Removal and installation of V-belt (13-342).
Removal and installation of V-belt tensioning device (13-345).

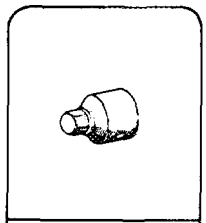


Screw plug (16)	unscrew, screw on, special tool 103 589 01 09 00. Tightening torque 30 Nm.
	Note Screw plug is pressurized by compression spring. Replace seal (17).
Oil overpressure valve (14)	remove, insert.
	Note Check that oil overpressure valve is in proper condition and moves easily in timing case cover, clean bore if necessary and replace oil overpressure valve.
With engine running	check for leaks.

Special tools



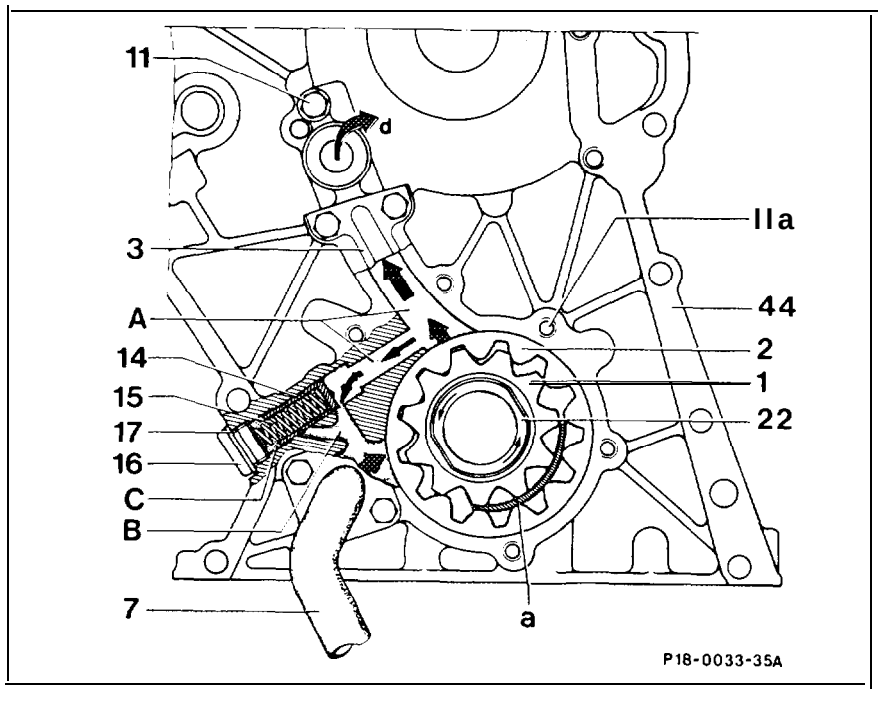
001 589 72 21 00



103 58901 0900

Note

The oil overpressure valve is installed at the side (on the left looking in direction of travel) in the timing case cover and connects pressure chamber **(A),** and suction chamber (B) of the oil pump.



14 Piston
15 Compression spring
16 Screw plug
17 **Seal**

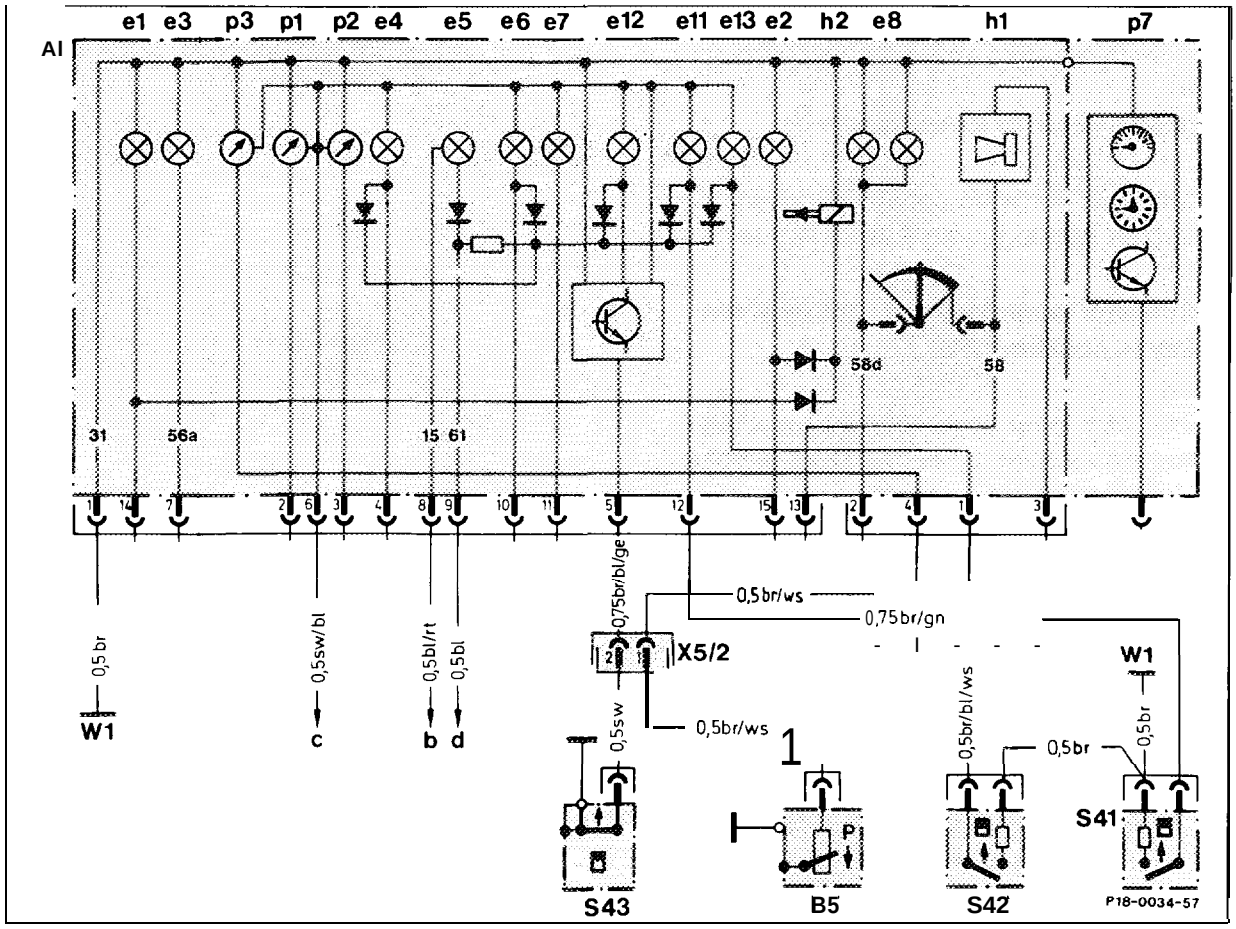
A Pressure chamber
B Suction chamber

From an oil overpressure of approx. 4 bar, the piston (14) is pushed against the force of the compression spring (15) and opens the relief cross-section along which part of the oil flows back to the suction chamber (B), depending on pressure.

When the piston (14) is moved, the oil which is on the rear of the piston in chamber (C) is displaced and flows through the relief grooves on the outside of piston likewise to the suction chamber (B).

18-220 Checking oil level indicator

Model 201



Wiring diagram engine oil level indicator, engine coolant level indicator, windshield washer level indicator

AI	Instrument cluster
e1	**Left** turn-signal indicator
e2	Right turn-signal indicator
e3	High beam indicator
e4	Fuel reserve warning lamp
e5	Battery charge Indicator
e6	Brake pad wear indicator lamp
e7	Brake fluid and parking brake indicator lamp
e8	Instrument lighting
e11	**Engine** coolant level indicator lamp
e12	Oil level Indicator lamp
e13	Windscreen washer indicator lamp
p1	Engine coolant temperature gauge
P2	Fuel gauge
p3	Oil pressure gauge
P7	**Electronic** clock/tachometer
B5	**Oil** pressure gauge sensor
S41	Engine coolant level Indicator lamp **switch**
S42	**Windsshield** washer level indicator lamp **switch**
S43	**Oil** level Indicator lamp **switch**
W1	Main ground (behind instrument cluster)
X5/2	Connector, interior/starter 4-pin

Test data

Resistance at max. oil level	< 1 Ω
Resistance at min. oil level	∞ Ω
Battery voltage	approx. 12 V

Commercial tool

Multimeter	e.g. Sun, DMM-5

Note

If problems occur as for example:

A. Indicator lights up constantly when engine running and oil at correct level.

B. Indicator lamp does not light up when key in position "2".

C. Indicator lamp does not light up when engine running, oil temperature > 60 °C and oil level below "min".

Test

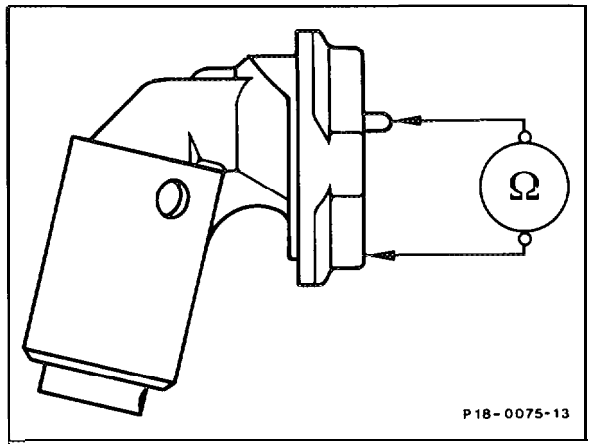
A. Indicator lamp lights up constantly when engine running and oil at correct level.

Test oil level sensor. Detach connector. Test connector to ground with multimeter.

Reading: < 1 Ω

Yes	No

Replace oil level sensor.



Test cable. Remove instrument cluster for this purpose. Test resistance with ohmmeter between contact 5 of 15-pin connector and contact of oil level sensor.

Reading: < 1 Ω

Yes	No

Replace cable harness.

Replace indicating instrument.

End of test

Modul 102 Format 1 ,0 (77x58 mm)
Bild-Motiv
Foto/Zg-Nr.
Abgabe
Korrektur
Bild-Nr. **P18-0076-13**

B. Indicator lamp does not light up when key in position "2" (check function).

Check operation of bulb.

Yes	No

Replace bulb.

Remove instrument cluster. Measure voltage with multimeter at contacts 6 and 9 of the 15-pin connector.

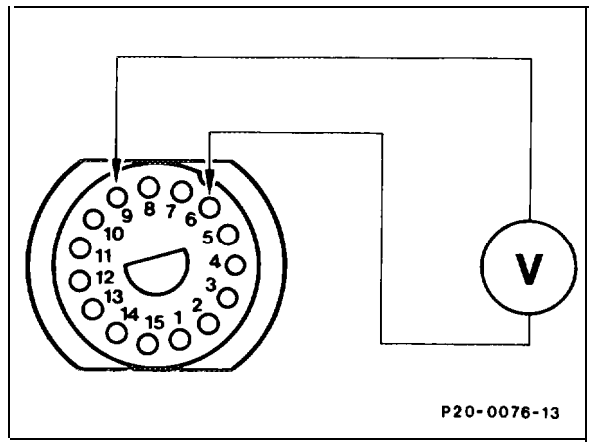
Reading: approx. 12 V

Yes	No

Replace cable harness.

Replace indicating instrument.

End of test



C. Indicator lamp does not light up when engine running, oil temperature > 60 °C and oil level below “min”, check function section "B" in order.

Test oil level sensor. Detach connector for this purpose. Test connector to ground with multimeter.

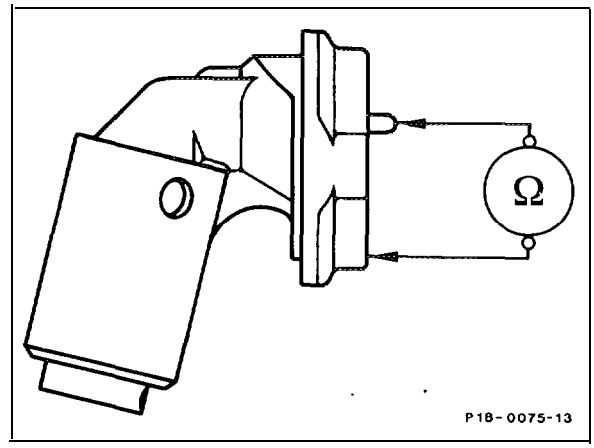
Reading: ∞ Ω

Yes	**No**

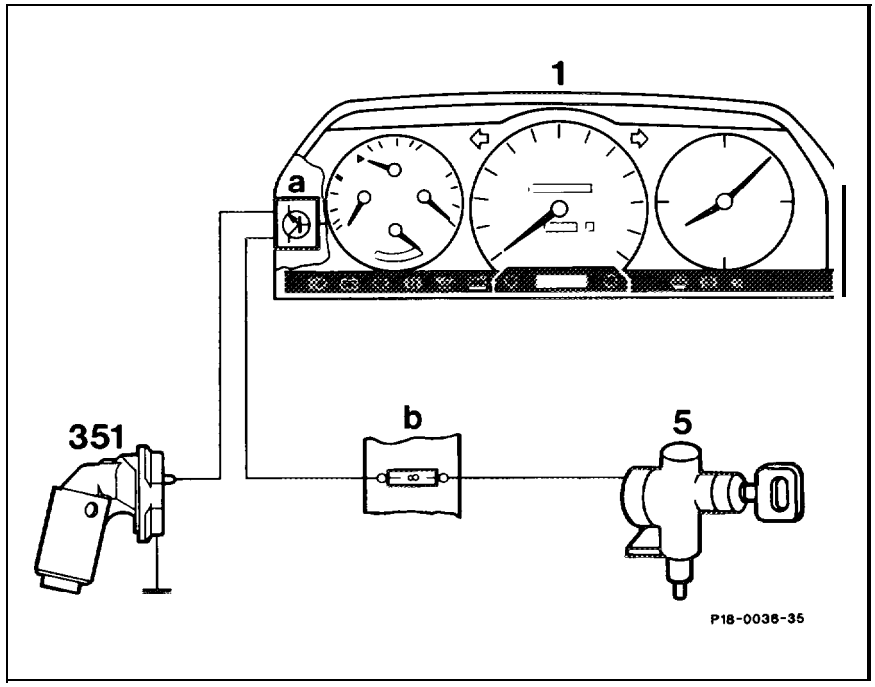
Replace oil level sensor.

Replace indicating instrument.

End of test



18-225 Function of low engine oil level indicator



1 instrument cluster
5 Ignition lock
351 Oil level sensor

a Electronics
b 8A fuse

Components

Oil level sensor in oil sump (351).

Indicator lamp in instrument cluster. Symbol: dripping oil can (1).

Electronics at instrument cluster (a).

General

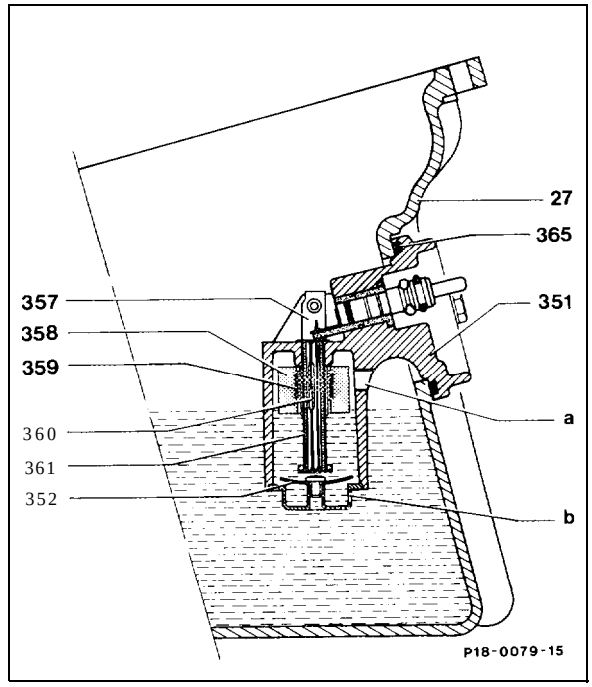
The dynamic low engine oil level indicator monitors the oil level in the sump when the engine is running and at an oil temperature above 60 °C.

No indication is given below 60 °C.

The low engine oil level indicator lights up when the ignition is switched on (check function) and goes out as soon as the engine is running.

The low engine oil level indicator shows a weak light for the check function and a bright light in the event of a fault.

The oil level in the sump is detected by a float (358) with permanent magnet (359) installed in the oil level sensor. Within the minimum range of the dipstick, the float opens the Reed contact (360) and a signal from the electronics in the instrument cluster is interrupted. The indicator lamp lights up.



27	Oil sump
351	Oil level sensor
352	Bimetal snap disk
356	Float
359	Permanent magnet
360	Reed contact
365	O-ring
a	Air admission passage 8 mm dia.
b	Discharge passage 4 mm dia.

The same also occurs in the event of a cable interruption.

When the oil level drops, the indicator lamp lights up first of all briefly and later shows a steady light, depending on the driving style.

To avoid unnecessary warnings in various driving situations, e.g. a sharp lefthand curve, the electronics is equipped with a delay circuit. It prevents the indicator lamp from lighting up until an oil shortage has been signaled for 60 seconds.

To avoid incorrect indications when the engine is cold (viscous oil flows back only slowly to the sump), the oil level sensor is equipped with a bimetal snap disk (352). This prevents the float chamber above the discharge passage (b) running empty at low temperatures.

Switching points of bimetal snap disk

Opens at approx. 60 °C oil temperature.

Closes at approx. 30 °C oil temperature.

When changing the oil, the float chamber above the air admission passage (1) is filled with oil. Any subsequent faulty indications are thus not possible.

The oil level indicator is designed so that the indicator lamp lights up just before the “min” marking on the dipstick (safety margin).

Maintenance and repair instructions

The oil level indicator does not eliminate the need for checking the oil level with the dipstick when changing the oil.

The oil level sensor (351) can be removed when the oil sump is installed. Drain approx. 2 liters of engine oil for this purpose.